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THE RELATIONSHIP OF AFFECT
TO TREATMENT AND OUTCOME
IN CHRONIC LOW BACK PAIN

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THE RELATIONSHIP OF AFFECT TO TREATMENT AND OUTCOME IN CHRONIC LOW BACK PAIN

By

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ABSTRACT

THE RELATIONSHIP OF AFFECT TO TREATMENT AND OUTCOME
IN CHRONIC LOW BACK PAIN

By

Paul W. Delmar

This two-part study of patients with chronic low back pain examined the relationship between measured affect and rehabilitation outcomes. The first part reviewed medical records of subjects who completed a multidisciplinary pain program at Mary Free Bed Hospital and Rehabilitation Center (MFB). The second part consisted of a follow-up of the current status of these past patients.

Medical records provided demographic and testing information concerning the patients. Scores on the Affective dimension of the McGill Pain Questionnaire (MPQ) were obtained at intake and at weekly intervals during treatment from 75 chronic low back pain patients. Follow-up information was obtained through the use of MFB's 6- and 12-month follow-up questionnaire. An additional request was made for the client to complete the Productivity of Life Questionnaire voluntarily.

The purpose was to determine the existence and nature of any relationship between scores on the MPQ's Affective dimension and outcome results of a multidisciplinary pain clinic (MPC) treatment

program. Second, the researcher attempted to determine whether different populations existed within the sample and, if so, how the various populations' levels on the MPQ Affective dimension differed.

The outcome data did not substantiate the hypothesis that chronic pain patients' scores on the MPQ's Affective dimension would correlate positively with successful outcome. Correlation and regression analyses were used to evaluate these issues.

To evaluate affect over time, two procedures were used. The analysis of variance (ANOVA) demonstrated a significant quadratic effect and a significant cubic effect. The hierarchical linear method was used to evaluate the level of affect at intake, 4 weeks, 8 weeks, and 12 weeks. The variabilities in both the slope and intercept were significant at all four time points, indicating that the slope and intercept differed significantly among subjects. The variables that were significant in this analysis were reviewed and discussed.

The chi-square test of association was not significant in assessing the relationship between membership in the worker's compensation, auto no-fault, or noninsurance subsample group and outcome. An ANOVA was done to determine whether group differences existed on the productivity variable. No differences were found by group membership.

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CHAPTER I

THE PROBLEM

Introduction

Persistent complaints of pain inflict significant economic loss on society. Bonica (1980) estimated that the cost of acute and chronic pain to the United States economy is more than $90 billion annually. Casey (1979) estimated that five million people in the United States are at least partially disabled by persistent low back pain and that 93 million workdays are lost each year due to this affliction. For as many as 78% of the individuals who are severely disabled by chronic low back pain, no pathophysiological basis can be found for their complaint (Loeser, 1980).

Traditional medical care often has failed to relieve chronic pain because such treatment is based on an acute-care model. The acute-care model assumes there is objective evidence of a pain generator. Acute care involves evaluating the symptoms and attempting to treat the immediate cause. Because chronic pain patients' complaints do not respond to acute-care treatment, these individuals often become problems in the health care system. Patients with chronic pain have become recognized as a specific treatment population. To reduce the effects of pain, behavioral treatments have been developed over the past 20 years. The multidisciplinary pain

clinic (MPC) was developed to meet the challenge presented
patients with persistent complaints of low back pain.

Research conducted during the past 20 years has provid
considerable support for the efficacy of behavioral techniques f
reducing pain perception and pain-related behaviors. Outco
studies have documented positive results of such techniques
increasing levels of productivity and a return to normalcy
chronic pain patients (Linton, 1982, 1986). Outcome and follow-
studies have demonstrated that substantially and statistical
significant improvements in reducing pain-related behavior can
made through the use of MPCs. Initially, MPCs emphasized in-patie
treatment programs. Fordyce, Fowler, Lehman, and de Lateur's (196
pioneering effort was an in-patient-based, operant program that l
the way for others to follow (Cairns & Pasino, 1977; Cairns, Thoma
Mooney, & Pace, 1976; Fowler, 1975; Greenhoot & Sternbach, 197
Sternbach, 1974; Swanson, Maruta, & Swenson, 1979; Swanson, Swenso
Maruta, & McPhee, 1976). After MPCs' results were documented,
movement toward out-patient programs became apparent (Arkawa, 198
Chapman, Brena, & Bradford, 1981; Herman & Baptiste, 1981; Wan
Illstrup, Nauss, Nelson, & Wilson, 1980). The shift to out-patie
programs has substantially reduced the cost of these program
making them more accessible to chronic pain patients (Linton, 198
1988).

Several researchers have attempted to identify variables
predict the treatment outcome of patients in MPCs (Block, Kremer,
Gaylor, 1980; Dworkin, Richlin, Handlin, & Brand, 1984; Keef

Block, Williams, & Surwit, 1981; Kleinke & Spangler, 1988; Maruta, Swanson, & Swenson, 1979). Prediction studies traditionally have avoided including recipients of worker's compensation because of the implications of "compensation neurosis." The prevailing view has been that patients on compensation or awaiting litigation are neurotics or malingerers--people trying to live off the efforts of others by feigning their pain (Melzack, 1985).

Researchers have reported that patients receiving compensation had a significantly poorer outcome than those who were not receiving compensation (Block et al., 1980; Finneson, 1977; Hammonds, Brena, & Unikel, 1978; Herman & Baptiste, 1958). In other pain-clinic outcome studies, no relationship was found between compensation and treatment response (Arnoff & Evans, 1982; Brena, Chapman, & Bradford, 1980; Brena, Chapman, & Decker, 1981; Chapman & Brena, 1982; Maruta et al., 1979; Painter, Seres, & Newman, 1980; Rosomoff, Greene, Silbert, & Steele, 1981; Seres, Painter, & Newman, 1981; Swanson, Swenson, Maruta, & Floreen, 1978).

Further study is needed to be able to predict which individuals are best served by MPCs. Measuring the level of affective distress is one way of determining differences among groups of patients with chronic pain. It is also a way of determining which individuals' suffering is greater than that of others.

Identification of the Problem

Scientific measurement procedures have focused on pain as an individual sensory quality that varies only in intensity. Although

intensity is a noteworthy dimension of pain, to describe pain solely in terms of intensity is like describing the visual world only in terms of light, failing to consider color, pattern, texture, and other dimensions of the visual experience.

Pain is a complex perception, rather than a simple sensation. This complexity extends beyond the multiple dimensions of sensation; affective and motivational aspects must be recognized. Failure to consider the motivational-affective dimension of pain has seriously limited the total picture of the pain experience. The motivational dimension is crucial to the concept of pain as a perception. The motivational dimension comprises an individual's perception of past experience, attention to the perceived stimuli, sensory stimuli, and intensity of the experience. If researchers consider only the sensory features of pain, they are ignoring the most important aspect of pain--its motivational and affective properties (Melzack & Wall, 1983).

In an effort to develop an instrument to measure the sensory, intensity, and motivational-affective properties of pain, Melzack and Torgerson (1971) constructed the McGill Pain Questionnaire (MPQ), a verbal pain questionnaire that would allow for the quantification of the concept of pain. A verbal questionnaire was chosen because of the importance of the use of language. Individuals suffering from pain use language as a medium to relate the perception of pain to significant others in their lives.

The MPQ is a paper-and-pencil instrument designed to quantify the dimensions of the pain experience. The dimensions are sensory, affective, evaluative, and miscellaneous. Subjects are shown 20 sets of word descriptors and asked to select those words that are relevant. The most appropriate word in each word set is circled. Each set contains up to six words. Ten word sets describe sensory qualities, five are affective descriptor sets, a single set describes the evaluative dimension, and the rest are classified as miscellaneous. The researcher scores the total number of words that apply to the pain. The words within each word set have been assigned rank orders, so one is able to compute the total rank of the words chosen.

Researchers have found that elevated scores on the Depression and Hysteria scales of the Minnesota Multiphasic Personality Inventory (MMPI) were associated with higher scores on the Affective dimension of the MPQ (Aronoff & Evans, 1982; McCreary, 1981). In addition, elevated scores on the Depression and Hysteria scales of the MMPI have been associated with positive outcome in studies of multidisciplinary clinics for the treatment of chronic low back pain (Kleinke & Spangler, 1988l Painter, Seres, & Newman, 1980). Thus, there might be a relationship between elevated scores on the Affective dimension of the MPQ and positive outcome for patients receiving treatment from an MPC. However, the nature of that relationship has not yet been explored. This research was undertaken to address that problem. The researcher also determined how to better understand the characteristics of individuals

receiving treatment through an MPC and to assess the outcome using the affective dimension of the MPQ.

Purpose of the Study

The purpose of this study was to determine the existence and nature of the relationship between patients' scores on the Affective dimension on the MPQ and the outcome of an MPC treatment program for chronic pain. The researcher also attempted to determine whether the three treatment groups within the study population (patients receiving worker's compensation, patients covered by no-fault automobile insurance, and those receiving no financial support) differed significantly in their scores on the Affective dimension of the MPQ over the course of treatment: at intake, upon completion of the program, through follow-up.

Importance of the Study

This study is important for many reasons. The researcher sought to determine whether a relationship exists between patients' scores on the Affective dimension of the MPQ and the results of an MPC treatment program for chronic low back pain, and to measure the extent of that relationship. This information will help distinguish between individuals with greater potential for success in treatment programs and those with less potential for success. Such knowledge will allow practitioners to use resources more effectively in determining the appropriateness of client selection for particular treatment programs. It also will allow clinicians to use their time

more efficiently to investigate barriers to success in individua clients.

This study is the first to use a Hierarchical Linear Mode (HLM) to analyze the chronic pain population. Previous research o individual change has been plagued by conceptualization and desig inadequacies (Bryk & Raudenbush, 1988). Pretest and posttes designs are generally inadequate for the study of individual chang (Bryk & Weisberg, 1977; Rogosa, Brand, & Zimowski, 1982). Thi means pretest and posttest designs are inadequate for studyin effects on learning because learning is a process of individua change involving the acquisition of knowledge, in this study th knowledge of pain-reducing techniques, and the skill of employin these techniques over time. Bryk and Raudenbush believed "researc on learning requires multi-time point data and a statistical mode that permits an explicit representation of individual growth" (p 67).

The results of this study will include statistics derived usin new advances in analyzing multilevel data by employing the HL procedure. This will allow for the enhancement of scientifi understanding of the MPQ by using an appropriate form of statistica analysis. This means that the researcher evaluated the Affectiv dimension of the MPQ in a manner that has not been used to date More important, the researcher used an advanced and more appropriat method of statistical analysis to analyze the data.

As a consequence, the results of the study will be mor statistically sound, lending themselves to a greater understandin

of the relationship of the affective dimension of the MPQ, historical and demographic variables, and outcome results following treatment in an MPC. The study should answer whether or not a relationship exists between the level of affect of the MPQ and outcome. If there is a relationship, does it exist for the various groups involved? The individual patterns of affect over time were analyzed to determine whether patterns of growth exist.

Generalizability

Kleinke and Spangler (1988) addressed methodological issues in their overview of research involving MPCs. They found five methodological issues inherent in previous research investigating variables relating to treatment outcomes. These issues are as follows. First was the need for a unified definition of successful treatment outcome. Kleinke and Spangler objected to indices of treatment outcome based on combinations of patient and therapist ratings. The second issue was that most previous studies predicting outcome used univariate statistics subject to Type I error. The third objection was based on the fact that variables used for prediction of outcome were often intercorrelated. The fourth objection related to whether studies predicting outcome should look at patients' discharge scores or whether they should look at intake scores. The fifth issue stemmed from the need to define the kinds of pain patients for whom the researchers were trying to predict outcomes.

The present researcher addressed all of the above-mentioned objections in an effort to enhance replicability and to facilitate the generalizability to other patients with chronic low back pain. First, two measures of outcome were included in this study. One was continuous, whereas the other was dichotomous. These both presented a unified definition of successful treatment outcome. Second, appropriate multivariate statistics were used, minimizing Type I error. Multiple regression and HLM were used to investigate systematically the relationship between the predictor variables and outcome, as well as individual growth. Fourth, this researcher used the affective dimension of the MPQ at intake, through treatment, and through follow-up. The fifth issue was addressed by confining the study to those individuals suffering from chronic low back pain.

Research Questions

The researcher's primary purpose in this study was to explore the nature and extent of the relationship between patients' scores on the Affective dimension of the MPQ and the outcome of an MPC treatment program. A secondary purpose was to determine what combinations of MPQ Affective score, demographic variables (age, educational level, spouse's employment, marital status, employment status at intake, involvement in litigation, involvement in rehabilitation, and sources of income), and historical variables (length of chronicity, number of hospitalizations, number of surgeries, and number of past employers) best predict the outcome of treatment.

A successful outcome was defined as the individual's returni to work, participating in a vocational rehabilitation program, achieving a high level of productivity on the Productivity of Li Questionnaire. An unsuccessful outcome was defined as the patient not being employed, not being involved in a vocationa rehabilitation program, or maintaining a low level of productivi on the Productivity of Life Questionnaire.

The following research questions were posed to guide t collection of data with which to achieve the purposes of t research.

1. Will subjects' scores on the Affective dimension of the M correlate positively with successful outcome following treatment an MPC?

Individuals who acknowledge psychological distress a dissatisfied with their present situation or are distressed becau of prolonged chronic pain. Thus, these individuals may have great motivation to succeed in an MPC.

2. Will the MPQ Affective dimension scores of subjects in t worker's compensation group, the group covered by no-fau automobile insurance, and the group receiving no financial suppo differ over the course of treatment: at intake, upon completion the program, through follow-up?

The researcher examined the pattern of patients' scores on t Affective dimension of the MPQ from intake, through the course treatment, and at follow-up. The typical level of affect for t three treatment groups was then determined.

3. Is there a difference in the treatment-success rates of t three groups (those receiving worker's compensation, those cover by no-fault automobile insurance, and those receiving no financi support)?

Research Hypotheses

The following hypotheses were formulated to guide the analys of data gathered in this study:

Hypothesis 1: Chronic pain patients' scores on the Affecti dimension of the MPQ at intake will correlate positively wi successful outcome following treatment in an MPC.

Hypothesis 2: Subjects with high scores on the Affecti dimension of the MPQ at intake will have a nonlinear pattern Affective dimension scores over the course of treatment, up completion of the program, and at follow-up.

Hypothesis 3: There will be no difference in the treatmen success rates of the three study groups: those receivi worker's compensation, those covered by no-fault automobi insurance, and those receiving no financial support.

Assumptions

1. The researcher assumed that both the administration and t scoring of the MPQ were consistent with standardized procedures.

2. It was assumed that the subjects responded truthfully the research instruments.

Definition of Terms

The following terms are defined in the context in which th are used in this dissertation.

Chronic pain: Pain that is perceived beyond the expect period of healing of an injury (in the absence of any observab

physical abnormality) or that extends for a lengthy period in association with a chronic condition (e.g., arthritic degenerative changes in the spine).

Chronic pain syndrome: A condition characterized by deterioration in physical, social, and psychological functioning in people experiencing prolonged pain.

Disability: In the context of health experience, any restriction or lack of ability (resulting from an impairment) to perform an activity in the manner or within the range considered normal for a human being.

Handicap: In the context of health experience, a disadvantage resulting from an impairment or a disability that limits or prevents a person's fulfillment of a role that is normal (depending on age, gender, and social and cultural factors) for that individual.

Impairment: In the context of health experience, any loss of or abnormality in psychological, physiological, or anatomical structure or function.

Malingering: Conscious and willful feigning and/or willful exaggeration of a disease or injury that is the basis for reports of alleged pain in pursuit of a goal that is usually socioeconomic.

Medical rehabilitation: Restoration of an individual to optimal physical and mental functioning in light of his/her impairment.

Muscular relaxation: A type of therapy in which patients use instructional tapes or techniques to relax the skeletal muscles. Training may be facilitated by electromyographic biofeedback.

Pain behavior: Verbal or nonverbal actions understood
observers to indicate that an individual might be experiencing pa
and suffering. The actions include audible complaints, faci
expressions, abnormal posture and gait, use of prosthetic device
avoidance of activities, medication-seeking behavior, and seeking
medical assistance.

Residual functioning capacity. The ability to perform specif
social and work-related physical and mental activities followi
medical rehabilitation related to an impairment or when
condition(s) has reached a point of maximum improvement
Limitations imposed by an impairment are included in assessment
residual functioning capacity.

Work-capacity evaluation: An objective assessment of a pe
son's relevant social and functional capacities in order to ma
reasonable predictions about his/her ability to learn and perfo
discrete job-related duties.

Work-hardening programs: Programs designed to help a patie
develop enough physical endurance and self-confidence to carry out
regular workday (either full time or part time) with acceptab
levels of discomfort and pain, taking into account limitations bas
on the assessment of residual functioning capacity.

Overview

Chapter I contained an introduction to the study; an identif
cation of the problem, purpose, and importance of the study; a
generalizability of the findings. The research question

hypotheses, and assumptions were stated, and definitions of key terms were given.

Chapter II is a review of literature on topics related to the study. Writings and research on the following subjects are included: the physiology of chronic pain, how pain signals are transmitted, theories regarding pain, the results of multidisciplinary treatment programs for low back pain, prediction of treatment outcomes of MPCs, and the Affective dimension of the MPQ and the relationship of affect to receipt of worker's compensation.

The design and methodology of the study are explained in Chapter III.

The results of the statistical analyses performed in the study are presented in Chapter IV.

Chapter V contains a summary of the findings, conclusions drawn from those findings, implications for research and practice, and the researcher's reflections.

CHAPTER II

LITERATURE REVIEW

Introduction

This chapter contains a review of literature and research related to the physiology of chronic pain, how pain signals are transmitted, and theories regarding pain. Also discussed are the results of multidisciplinary treatment programs for low back pain, prediction of treatment outcomes of multidisciplinary pain clinics (MPCs), An overview of pain measurement with an in-depth review of the McGill Pain Questionnaire is provided, followed by a section on the Affective dimension of the McGill Pain Questionnaire (MPQ) and the relationship of affect to receipt of worker's compensation.

Overview of the Concept of Pain

This section lays a foundation for understanding the concept of pain. Pain is classified in four categories from the medical perspective. The first category is acute. Acute pain is pain that lasts less than 4 weeks. There is objective evidence of nociception or a pain generator.

Recurrent pain is the second category. Recurrent pain is less than 4 weeks' duration; thus, it is acute in nature, but this acute condition returns at least every 6 months. The interlude is pain free and lasts fewer than 6 months.

Potentially chronic is the third category. Pain in this category lasts more than 4 weeks and less than 6 months.

The fourth category of pain is chronic pain. This pain is of at least 6 months' duration. There are three types of chronic pain. The first is from a known cause. There is objective evidence to serve as the basis for the pain sensation. A cure is not possible. The second type is from an unknown cause. The diagnosis may be inadequate and/or the treatment is inadequate. If the physician has objective evidence for the basis of the pain, it is curable if diagnosed and treated properly. The third type of chronic pain is where no objective evidence for the basis of pain exists.

The next section contains a description of how pain signals are processed. This section is included to describe the physiology of pain.

The Physiology of Chronic Pain

The physiology of the transmission of pain signals is discussed in this section. The way in which pain is induced, how pain is received, and how pain signals are transmitted to the brain are examined.

Tissue Damage

Tissue damage is one cause of pain. A person generally begins to feel pain at an average critical temperature of 42.5 degrees Centigrade; 45.5 degrees Centigrade is the temperature at which tissue begins to be damaged if it is exposed to radiant heat. If the temperature remains at this level indefinitely, the tissues are

eventually destroyed. Pain resulting from heat is closely correlated with tissue damage. In a study of soldiers who had been severely wounded during battle, Beecher (1956) found that most of them felt little or no pain except a short time after sustaining the wound. This was a function of stress. Pain was felt later.

Pain Receptors

Pain receptors in the skin and other tissues are all free nerve endings; they are widespread in the superficial layers of the skin. Pain receptors also are found in certain internal tissues, such as the periosteum, the arterial walls, and the joint surfaces. Most of the deep tissues are not extensively supplied with nerve endings. However, any widespread tissue damage will cause the aching type of pain found in these areas. This is discussed later in the section entitled "The Pattern Theory of Pain."

In contrast to most other sensory receptors in the body, pain receptors adapt either slowly or not at all (Guyton, 1971). Under some conditions, the threshold for excitation of the pain fibers becomes progressively lower as the pain stimulus continues, causing the receptors to become more activated with time. This increased sensitivity of pain receptors is called hyperalgesia. One can readily understand the importance of the failure of pain receptors to adapt in chronic pain syndromes. These receptors continue to keep the patient apprised of possible damaging stimuli long after that information has served a biologically useful purpose.

Individuals with chronic pain do not become accustomed to it Instead, they become more "sensitive" and suffer more as time passe (Bonica, 1973). This sensitivity to pain eventually is reflected a anxiety, before gradually giving way to various degrees o depression as patients evaluate their pain and related medica problems. As patients focus more attention on their medica problems, the reasons for them, and possible treatments, they begi to think and talk more about the pain and become mor hypochondriacal on examination. The constant attention to an selected sensitivity of the painful area eventually lead to hyperalertness to all symptomatic cues (somatization).

The Transmission of Pain Signals

A series of complex electrical and chemical events occur between the stimulus of tissue injury and the subjective experienc of pain. The anterolateral system is a major ascending system fro the spinal cord to the brain that transmits pain impulses. Th anterolateral system contains three major pathways. The pathway are named for their site of termination: the spinothalamic (o neospinothalamic) tract, the spinoreticular (or paleospinothalamic tract, and the spinotectal tract.

Within the anterolateral system, two pathways carry pai impulses within the central nervous system (Haugen, 1956). Keat and Lane (1963) stated that pain impulses are transmitted over tw sets of nerve fibers, both of which are present in all peripher nerves. One system, known as type-C fibers, is small an

unmyelinated. The other system is A-Delta fibers, which are larger and thinly myelinated. They are discussed in greater detail below.

A-Delta Pain Fibers

A-Delta pain fibers are nociceptive neurons with small, thinly myelinated axons. Pain signals are transmitted by large A-Delta fibers at velocities of 5 to 30 meters per second. They are activated most efficiently by strong mechanical pressure and extreme heat. Activation of these nociceptors is associated with the sensation of sharp, pricking pain. When A-Delta fibers are blocked by moderate compression of the nerve trunk, the pricking quality of pain disappears. The pricking-pain pathway terminates in the caudal portion of the ventral-basal complex, an area that is the human analog of the posterior nuclear group in lower animals. From this point, signals are transmitted into other areas of the thalamus and to the somatosensory cortex. Most of the fibers from this area go to somatic sensory area II, which is concerned with pain localization.

Type-C Pain Fibers

The terminal regions of C-fiber axons are unmyelinated and are smaller than A-Delta pain fibers. Type-C fibers transmit pain signals at velocities of .5 to 2 meters per second. When type-C fibers are blocked by low concentrations of local anesthetic, the burning and aching quality of pain disappears (Guyton, 1971). C-fibers are believed to be activated by a chemical released into the extracellular fluid as a result of tissue damage (Kelly, 1985).

The nerve endings are activated by high-intensity mechanical, chem
cal, and thermal (greater than 45 degrees Centigrade) stimulatio
Type-C fibers are called polymodal nociceptors. They are wide
distributed in deep tissues as well as skin. The burning/achi
pain fibers terminate in the reticular area of the brain stem and
the interlaminer nuclei of the thalamus, the entire cortex, limb
system, the frontal lobes, and the hypothalamus. Both the reticul
area of the brain stem and the interlaminer nuclei are part of t
reticular activating system, whose function is to transmit activi
signals to all parts of the brain.

Double Pain Signals

The sudden onset of a pain stimulus gives a "double" pa
sensation--a physiological acute pain sensation followed a second
so later by a physiological chronic pain sensation. The prickin
pain rapidly alerts the person to the possibility of tissue damag
and facilitates the person's reaction to withdraw from the harmfu
stimulus. The burning/aching sensation tends to become increasingl
distressful over time. It is the slowly rising C-fiber stimulation
combined with the patient's affective and evaluative responses, tha
gives rise to chronic pain.

In addition to local tissue reactions, reactions at th
segmental levels of integration are manifested by a spasm
skeletal and smooth muscles and by glandular hyperactivity (Bonica
1974). Reactions at the suprasegmental levels are manifested b
more highly integrated, but still automatic, protective and adaptiv

patterns involving primarily respiration and circulation Ultimately, reactions at the highest integrative levels involve th cerebral cortex. These slowly rising pain patterns are susceptibl to central control (Melzack & Wall, 1970).

Specific Pain Pathways

Two types of second-order neurons transmit information abou pain in the spinal cord. One type is called the relay cell, whic projects to the brain stem or thalamus. The other is called th interneuron, which transfers information about pain to othe interneurons or to relay cells (see Figure 2.1). The second-orde neurons receive A-Delta and C-fiber inputs from interneurons in th substantia gelatinosa (lamina II).

Relay cells for pain are located in two regions of the dorsa horn. Their axons ascend in the anterolateral quadrant of the whit matter. The axons of relay cells in Rexed's lamina I and II projec to the neospinothalamic tract.

The pain-projection pathways ascend in the anterolatera portion of the lateral column; hence, they are collectively calle the anterolateral system. The anterolateral system is primaril crossed in humans; this is especially true for the neospinothalami component. A small but significant ipsilateral component exists These uncrossed fibers may be the reason pain returns in som patients despite an initially successful surgical section o anterolateral fibers (Kelly, 1985).

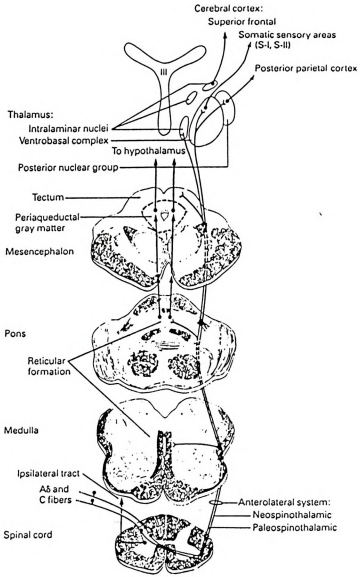


Figure 2.1: The anterolateral system of spinothalamic, spinoreticular, and spinotectal fibers conveys information about pain to several regions of the brain stem and diencephalon. (From Kandel & Schwartz, 1985.)

There are two general populations of spinal cord nociceptive neurons (See Figure 2.2). They are neurons in lamina I and II and neurons in lamina V.

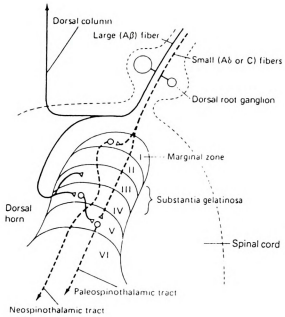


Figure 2.2: Schematic drawing of the dorsal horn of the spinal cord, illustrating that the nociceptive neurons, whose axons form the ascending anterolateral system, are found in lamina I and lamina V of the dorsal horn. (From Kandel & Schwartz, 1985.)

Neurons in lamina I are selectively activated by pain afferents. This group is made up of ascending dorsal horn nociceptive neurons. Their axons form the neospinothalamic component of the anterolateral system. This group may be responsible for the localization of sharp or acute pain on the body surface (Kelly,

1985). This type of pain is most often studied in the laboratory but does not normally prompt patients to seek medical attention.

Neurons in lamina V receive input from mechanoreceptors, thermoreceptors, and pain receptors. The second group of ascending dorsal horn nociceptive neurons are located primarily in lamina V. These large cells respond to both nonnoxious and noxious stimuli. They are called multireceptive or wide-dynamic-range nociceptors.

The responses to each of the fiber groups differ. Threshold touch stimuli produce a brief burst of firing in lamina V cells, followed by a brief inhibition. When large-fiber touch input is suppressed, there is a build-up in the activity of the same cell following C-fiber stimulation, leading to prolonged afterdischarges and facilitation. The cell axons contribute to the paleospinothalamic and spinoreticular components of the anterolateral system. This seems to promote the more diffuse, chronic types of pain that are of primary importance in the practice of medicine (Kelly, 1985).

In summary, pain receptors are free nerve endings and are stimulated while tissue damage is occurring. Pain receptors adapt very slowly, and hypersensitivity to pain develops. Slow-moving C-fibers transmit chronic pain to essentially all areas of the cerebral cortex and reticular activating system. This causes a general activation of the entire nervous system, which leads to fatigue, anxiety, and hyperactivity of the skeletal muscles.

Theories of Pain

The physiology of the transmission of pain signals was reviewed in the preceding section. This section contains a review of theories on pain and how they have changed over the years. This progress will demonstrate how theorists went from a traditional theory of pain to the more recent and accepted behavioral and cognitive-behavioral perspective of pain perception. It is important to recognize the foundation on which current research on pain perception is based.

The specificity theory of pain and the pattern theory of pain are discussed and evaluated in this section. The gate control theory of pain by Melzack and Wall also is considered. Fordyce's respondent and operant pain model, a behavioral method for treating chronic pain, is reviewed, as well.

The Specificity Theory of Pain

Specificity theory is the traditional theory of pain and was widely accepted during the first half of the twentieth century. Specificity theory originated in a classical description by Descartes in 1664 (Melzack, 1982). He conceived the pain system as a straight-through channel from the skin to the brain. Descartes suggested that the system is like the bell-ringing mechanism in a church: Someone pulls a rope at the bottom of the tower, and the bell rings in the belfry. He proposed that if a person's foot came too close to a fire, the sensation would be transmitted up the leg and back, into the head, where presumably something like an alarm

would be set off. The person would feel pain and respond to it. Descartes' concept of the specificity theory proposed that the brain is aware of the outside world only through messages conveyed to it by sensory nerves.

In 1842, Johannes Muller contributed to an understanding of the sensory process, theorizing that the brain receives information about external objects only through the sensory nerves (Melzack, 1982). Activities in nerves represent coded or symbolic data concerning the stimulus object. Muller's theory led to the search for a terminal center in the brain for each of the sensory nerves. Muller conceived a straight-through system from the sensory organ to the brain center responsible for sensation. He believed that the cortex was at the "top" of the nervous system, and a search was undertaken for the cordal centers. Visual and auditory projections to the cortex were found very early. Muller assumed that these cortical areas were the seat of sight and hearing.

Between 1894 and 1895, Max von Frey published a series of articles in which he presented a theory of cutaneous senses (Melzack, 1982). His theory was expanded during the next 50 years, forming the basis of modern-day specificity theory. Von Frey's theory designated free nerve endings as pain receptors. He combined three kinds of information to form this theory. The first was Muller's doctrine of specific nerve energy. Von Frey believed that Muller's notion of a single sense of touch or feeling was inadequate, so he expanded this concept to include four major cutaneous modalities: touch, warmth, cold, and pain. Each

presumably was projected through its own special system to a brain center responsible for the appropriate sensation.

The second kind of information von Frey used was the distribution of sensitivity to warmth and cold at the skin. He believed the skin comprised a mosaic of four types of sensory spots: touch, cold, warmth, and pain.

A third kind of information von Frey used pertained to the fine structure of body tissues. In the nineteenth century, anatomists used particular chemicals to stain thin slices of tissue from various parts of the body and then observed the tissues through a microscope. They found two types of specialized structures: (a) the free nerve endings that branch out into the upper layers of the skin and (b) nerve fibers wrapped around hair follicles.

Von Frey reasoned that, because the free nerve endings are most commonly found and the pain spots are found almost everywhere, free nerve endings are pain receptors. Meissner corpuscles are found in the fingers and palm of the hand, where touch spots are most abundant and most sensitive. These and the fibers surrounding hair follicles are touch receptors. Von Frey noted that the conjunctivum of the eye and the tip of the penis are both sensitive to cold, but the conjunctivum is not sensitive to warmth and the penis is not sensitive to pressure. Because Kraus end-bulbs are found in both places, Von Frey concluded that Kraus end-bulbs are cold receptors. Hence, the major sensation--warmth--and one major receptor, Ruffini

end-organs--were left over. Thus, von Frey concluded that Ruffini end-organs were warmth receptors.

Von Frey's theory dealt only with receptors. Later researchers considered specific fibers from the receptors to the spinal cord and then specific pathways in the spinal cord itself. Bishop (1946), Rose and Mountcastle (1959), and Sinclair (1967) demonstrated that there is a one-to-one relationship among receptor type, fiber size, and quality of experience. The fiber-diameter groups are held to be modality specific. The theory indicates "specific nerve energy" on the basis of fiber size, so specificity theorists speak of A-Delta fiber pain and C-fiber pain or touch fibers and cold fibers as though each fiber group had a straight-through transmission path to a specific brain center. The location of the pain center has been a source of debate among specificity theorists. Head (1920) proposed that it is located in the thalamus because cortical lesions or excisions rarely abolish pain. Therefore, theorists believed that the thalamus contained the pain center and that the cortex exerted inhibitory control over it.

Today, specificity theory defines pain as a primary sensation with special peripheral receptors, neuronal transmitters, and receivers in the central nervous system. The pain pathway is seen as an uninterrupted transmission system. The intensity of pain a person perceives is in direct proportion to the intensity of the stimulus that is applied. Peripheral pain receptors are believed to be specific receptors that are distinct from the other main group of

sensory receptors--mechanoreceptors and thermoreceptors. Specific
ity theory maintains that free nerve endings are the pain receptors
These nerve endings generate impulses carried by specific nerv
fibers (pain fibers), A-Delta and C-fibers, in peripheral nerves
These fibers carry the impulse of pain primarily to the latera
spinal thalamic track in the anterolateral part of the spinal cord
The spinal thalamic track transmits the impulses to the pain cente
in the thalamus.

Specificity theory does not account for the discrepancy tha
exists between the intensity of noxious stimuli and the subjectiv
perception of pain. Some researchers have believed that th
receptors excited by intense, noxious stimulation are specialized t
respond to those particular kinds of stimuli. It is questionabl
whether stimulation of the receptor must always elicit only th
sensation of pain (Melzack & Wall, 1970). Possibly, a fe
specialized fibers respond only to intense stimulation. This doe
not mean they exist solely to produce pain when stimulated. Certai
spinal cord tracks and central nervous system pathways carry mos
impulses related to pain. It does not follow that they wil
constitute a specific pain system. Melzack and Wall (1965) place
the specificity theory in the following perspective:

> Physiologic specialization is a fact that can be recognize
> without acceptance of the psychologic assumption that pain i
> determined entirely by impulses in a straight-throug
> transmission system from the skin to a pain center in th
> brain. (p. 972)

Pattern Theory

Pattern theory is a general heading for the theories that were proposed as a reaction to specificity theory. Goldschneider, once a strong supporter of von Frey's theory, proposed in 1894 that stimulus intensity and central summation are the critical determinants of pain (Melzack, 1983).

Studies of pathological pain influenced Goldschneider in developing his pattern, or summation, theory of pain. Goldschneider believed that mechanisms of central summation, most likely in the dorsal horns of the spinal column, were essential to consider in understanding pain mechanisms. He proposed that particular patterns of nerve impulses that evoke pain are produced by the summation of the skin's sensory input at dorsal horn cells. Pain results when the total output of cells exceeds a critical level. This occurs as a result of the excessive stimulation of receptors of pathological conditions that enhance the summation of impulses produced by normally nonnoxious stimuli. Goldschneider assumed that a spinal summation path transmits pain signals to the brain. This path consists of slowly conducting, multisynaptic fiber chains. He presumed that the large fibers projecting up the dorsal column pathways carry specific information about the tactile discriminant properties of cutaneous sensation.

Three theories emerged from Goldschneider's concept. The peripheral pattern theory deals primarily with peripheral as opposed to central patterning. Pain results from excessive peripheral

stimulation, which produces a pattern of impulses interpreted as pain.

Waddell (1955) and Sinclair (1955) proposed a pattern theory suggesting that cutaneous qualities emanate from spatial and temporal patterns of nerve impulses as opposed to separate modalities' specific transmission. The peripheral pattern theory proposes that all fiber endings are alike, so the pattern for pain is produced by intense stimulation of nonspecific receptors. Whereas this pattern ignores the possibility of physiological specialization, it does reveal a high degree of receptor-fiber specialization.

The central summation theory proposed by Livingston (1943) suggests that a specific central neural mechanism accounts for the summation phenomena in phantom limb pain, causalgia, and neuralgias. Livingston proposed that pathological stimulation of sensory nerves initiates activity in closed, self-exciting loops of neurons in the gray matter of the spinal cord. Normally nonnoxious inputs trigger this activity to generate volleys of nerve impulses interpreted as pain.

Livingston's theory is useful in explaining phantom limb pain. He suggested that the trauma associated with removal of a limb initiates abnormal firing patterns in reverberatory circuits in the dorsal horns of the spinal cord. This action sends volleys of nerve impulses to the brain, causing pain. Livingston proposed that the reverberatory activity may spread to adjacent neurons in the lateral and ventral horns to produce autonomic and muscular manifestations

in the limb. These actions then produce further sensory inp creating a vicious circle between the central and periphe processes to maintain abnormal spinal cord activity. Mi irritations near the site of the trauma then feed into active po of neurons to maintain an abnormal disturbed state. Impu patterns normally interpreted as touch are then perceived to trig neuron pools into a significantly higher level of activity, wh sends volleys or impulses to the brain to produce pain. Br activity registering emotional disturbance feeds into the abnorm neuron pool by evoking neural activity.

Gerard (1951) proposed that a peripheral neuron lesion m bring about temporary loss of sensory control of firing in t spinal cord neurons, which may fire in synchrony due to the spre of electrical fields. This combined firing of neuron pools cou recruit additional units and move along in the gray matter. T firing is maintained by impulses different from and of le intensity than those needed to initiate it. The firing of t neurons discharges excessive and abnormally patterned volleys to t higher central cord activity.

Livingston's and Gerard's concepts are powerful in explaini phantom limb pain. However, they fail to account for the fact th surgical lesions of the spinal cord do not always abolish pain.

The sensory interaction theory proposes that a specializ input-controlling system normally prevents summation from occurrin The destruction of this system allows pathological pain states

develop. According to this theory, there is a rapidly conducti fiber system that inhibits synaptic transmission in a more slow conducting system that carries the signals for pain. The t systems are described as myelinated and unmyelinated fiber system Noordenbos (1959) proposed that the small fibers carry nerve-impul patterns that produce pain, whereas large fibers (A-Beta) inhib the transmission of pain. A proportional increase in the number small fibers in relation to large fibers could increase neur transmission summation and pathological pain. There are diffus extensive connections within the ascending multisynaptic system, contrast to the idea of a straight-through system.

A change in the fibers in favor of the small fibers consistent with the observed relative loss of large fibers aft peripheral nerve injury. This may explain delays, temporal a spatial summation, and other properties of pathological pain.

Pattern theories of pain were developed in response to t deficits of the specificity theory. Pattern theories claim th large cutaneous fibers comprise a specific touch system. T smaller fibers converge on dorsal horn cells, which summate the input and transmit a pattern to the brain, where it is perceived pain. Pattern theories suggest that intense noxious stimuli at t periphery set up a vicious circle that maintains abnormal spin cord activity to generate abnormal volleys of stimulati consciously interpreted as pain. A specialized input-controlli system normally prevents stimulus summation from occurrin Destruction of this system leads to chronic pain states.

Pattern theories propose the existence of a rapidly conducting fiber system that inhibits synaptic transmission in the more slowly conducting system carrying the signal for pain (Zotterman, 1939). The two systems of pain transmission have been identified as epicritic and protopathic (Head, 1920), fast and slow (Lewis, 1942), and myelinated and unmyelinated (Noordenbos, 1959) fiber systems. Proponents of the pattern theories believe that, under pathological conditions, the slow system establishes dominance over the fast; the result is diffuse, burning, chronic pain.

The various pattern theories have failed to provide a satisfactory general theory of pain. They lack unity and have not been integrated into a single theory using the various theoretical mechanisms.

Summary of the Specificity and Pattern Theories of Pain

The specificity and pattern theories of pain both include valuable concepts that supplement one another. The first concept is recognition of receptor specialization for the transmission of particular kinds and ranges of cutaneous stimulation. The information generated by peripheral receptors is coded in the form of patterns of nerve impulses. The specific physiological assumption that attributes the painful experience to activity of one type of receptor, fiber or spinal pathway, is the basis for both theories.

There is evidence that a higher central nervous system activity or cognitive function influences pain. Anticipation of pain, anxiety and attention (Hill, 1952), cultural background (Chapman, Finesinger, Jones, & Cobb, 1947), early experience (Melzack, 1973), and prior conditioning (Pavlov, 1927) all have a profound effect on pain experience and response. The previous assumption that pain was a primary sensation relegated affective and evaluative processes to the role of "reactions to pain" and made them secondary considerations in the whole pain process.

Both the specificity and pattern theories assume that the affective and cognitive process must follow the primary noxious sensation. However, this assumption fails to account for basic data. Beecher's (1946, 1959) observation that American soldiers wounded during World War II "either denied pain from their extensive wounds, or had so little that they did not want any medication to relieve it" implies that central control of painful stimuli can be elicited.

The previous traditional views of the pain mechanism failed to account for two psychophysiological processes that result in pain. They were exploring the physiological basis for pain. The first is a sensory discriminative process, in which stimuli are localized in space and time along an intensity continuum. The second is the cognitive affective component, which motivates the organism to stop the pain as quickly as possible. Sherrington (1906) noted that pain comprises both sensory and affective dimensions. He proposed that the "mind rarely, probably never, perceives any object with absolute

indifference, that is, without 'feelings.' . . . Affective tone is an attribute of all sensation, and among the attribute tones of skin sensation is skin pain."

The Gate Control Theory

The gate control theory of pain proposed by Melzack and Wall (1965) provides the basis for considering the cognitive and affective dimensions of pain, in addition to the more obvious sensory dimensions described by the specificity and pattern theories. In 1965, Ronald Melzack, a psychologist, and Patrick Wall, a physiologist, propounded a theory incorporating substantial portions of the specificity theory and the pattern theory of pain in an attempt to account more fully for evidence regarding pain mechanisms. The researchers attempted to integrate what they believed were the requirements of accountability into a comprehensive theory of pain.

The differences between Melzack and Wall's (1965) theory and previous theories were significant. They proposed that there is an explicit mechanism for the inhibition of the slowly conducting nociceptive system by the fast-conducting one. They also proposed that the descending controls from the brain could moderate the passage of nociceptive signals. In 1982, Melzack and Wall revised their theory to address the explicit mechanism on physiological grounds. The theory may be an oversimplification regarding the physiological mechanism (Britton & Skevington, 1989), but it provides the most useful starting point to date.

According to the gate control theory, the perception of or reaction to a pain-producing stimulus applied to the skin is the result of an interplay among three systems within the spinal cord: (a) cells of the substantia gelatinosa (SG) (lamina II) in the dorsal horn of the spinal cord, (b) central transmission cells (T cells) in the dorsal horn, and (c) afferent fibers in the dorsal column of the cord.

The hypothesis of the neural mechanisms (Melzack & Wall, 1965) underlying pain sensation states that the interaction between myelinated and unmyelinated inputs to the spinal cord occurs at two sites. These sites are the inhibitory interneurons in the SG (lamina II) cells and dorsal horn pain-transmission neurons. Both myelinated and unmyelinated primary afferents were proposed to have a direct excitatory action on the T cells. The SG neurons inhibit transmitter release from both classes of primary afferents, in this way presynaptically inhibiting all afferent input to the pain-transmission cells. The myelinated afferents excite the inhibitory SG neuron, reducing input to the T cell and thus inhibiting pain. Fields (1987) supported this hypothesis by making the clinical observation that selective stimulation of large-diameter myelinated fibers produces analgesia.

Melzack and Wall also proposed that activity in unmyelinated nociceptors inhibits the inhibitory SG cells, resulting in the enhancement of transmission from primary afferents to the T cells, consequently increasing pain intensity. This allows the

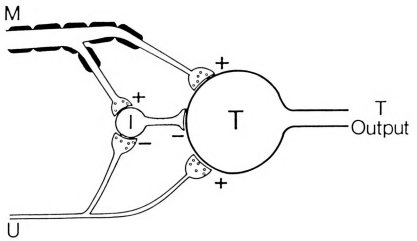
unmyelinated afferents to have two distinct excitatory effects on dorsal horn pain-transmission cells: first, a direct synaptic excitation and second, an indirect excitation resulting from the inhibition of the inhibitory SG cell.

The gate control theory emphasizes that the perceived intensity of pain is the result of a balance of input from myelinated and unmyelinated fibers. Normally, stimuli activate both types of afferents, and the sensation produced by brief noxious stimuli is of rapid onset and short duration. Here, both the intensity and duration of the pain are reduced by the inhibitory input from the myelinated afferents.

Myelinated afferents have a direct excitatory and an indirect inhibitory effect on the pain-transmission cell (see Figure 2.3). Myelinated afferents have the potential either to produce or to inhibit pain. Activity in non-nociceptive myelinated afferents produces pain when the inhibitory SG neuron is maximally inhibited by activity in unmyelinated nociceptors. The indirect inhibitory effect of the myelinated fibers is blocked, and their direct excitatory action on the T cells would predominate.

These three categories of activity are believed to interact with one another to provide perceptual and cognitive information regarding the pain and the motivational tendency toward the pain. The afferent fibers in the dorsal column of the spinal cord are involved in a system of interplay within the spinal cord. Signals from the pain-producing stimuli reaching the spinal cord apparently are transmitted to both the SG cells and the afferent fibers. Pain

signals reaching these afferent fibers bypass the gating mechanism (the SG cells) and are transmitted directly to the central controls. Here they activate selective brain processes, resulting in the transmission of descending signals to the spinal gate (the SG cells). These return impulses influence the modulating properties of the spinal gate (SG cells). They may have either an excitatory or an inhibitory effect. These descending messages account for the influence of numerous variables affecting the pain experience. These variables are attention, memory, conditioning, the meaning of pain, and anxiety.



Afferent Input	I Cell Effect	T Cell Effect	T-Cell Output (T-I)
M	+	+	0
U	−	+	+ +
M + U	0	+	+

Figure 2.3: Effects of myelinated afferents on the pain-transmission cell. (From Fields, 1987.)

The gate control theory accounts for the effect of cognitiv and affective factors in the reaction to pain by incorporating the into the sensory perception of pain. Melzack and Casey (1968 developed a conceptual model of the sensory, motivational, an central control determinants of pain. They proposed that the outpu of the T cells of the gate control system projects to the sensory discriminate system and the motivational-affective system. Th central control trigger is represented by a large-fiber system t the central control processes and then back to the gate contro system, as well as to the sensory-discriminate and motivationa affective system. This way, all three systems would interact wit each other, as well as project to the motor system (see Figure 2.4)

The motivational-affective dimension is based on th phylogenetically older spino-reticular and paleo-spino-thalami components of the anterolateral somatosensory pathway, sendin projections to the brain stem reticular formation and the limbi system. These tracts respond to stimuli, fear and anxiety.

The cognitive-evaluative dimension of pain depends on th cortical process. There is a central control system that act rapidly in identifying, evaluating, and selectively modifying th sensory input. This accounts for the influence of past experience sex, attention, and evaluation of the input as threatening or not o the sensory-discriminate and motivational-affective systems. Thi rapidly works to allow analysis of the input, comparing it wit other input in memory, and bringing it into action-respons strategies.

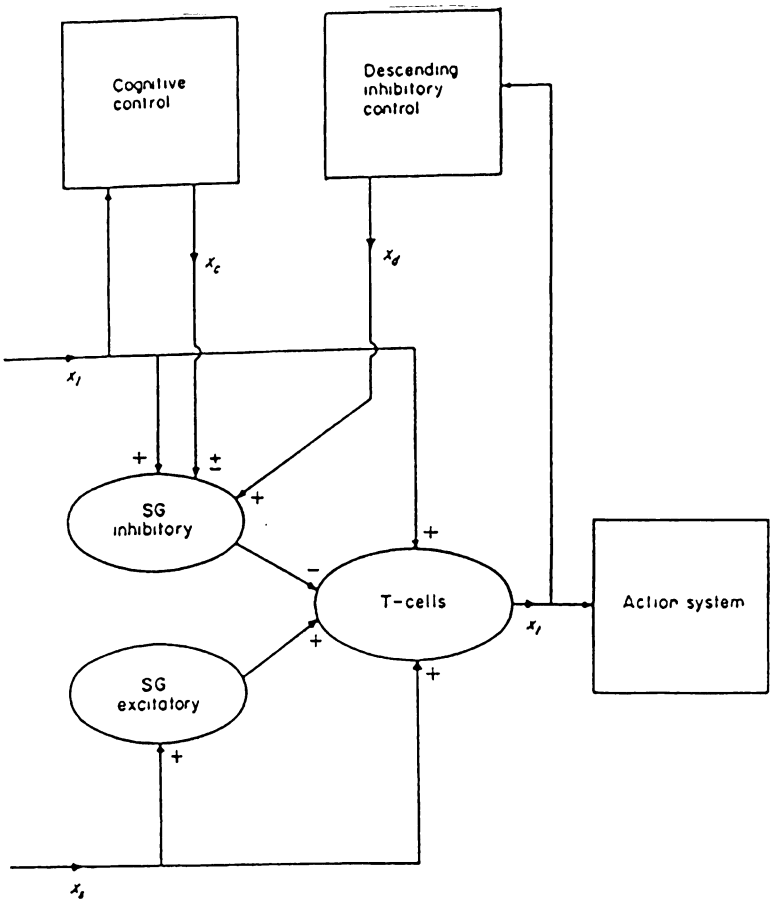


Figure 2.4: The gate control theory of pain. (Adapted from Melzack & Wall, 1982.)

Melzack (1973) theorized that the cognitive-evaluative system is served by the dorsal column and the dorsal-lateral pathways. This system has an inhibitory influence on the dorsal horn cells in the spinal cord. It is believed to have the capacity to modulate sensory input before it is transmitted to the sensory-discriminative and motivational-affective systems. This component of the gate control theory is important. The cognitive-evaluative system directly influences the motivational-affective system, whereby the frontal cortex plays an important role, interacting with both the cortical area and the reticular and limbic structures. Cognitive, affective, and evaluative input can alter pain perceptions.

Stimulation of the brain activates descending afferent fibers to influence afferent conduction at the earliest synaptic levels of the somethetic system. It is possible for conscious central nervous system activity such as attention and distraction, anxiety and conditioning, to exert control over sensory input. These central influences are thought to be mediated through the gate control system (Wall, 1967). It is important to recognize the role of higher central nervous system activity, such as attention, distraction, anxiety, and conditioning, in the pain process. The degree of conscious control of pain is determined by the extent and duration of the input pattern. Some of the most unbearable pain rises so rapidly in intensity that the patient is unable to achieve any control over it. Conversely, more slowly rising chronic pain is susceptible to central control; thus, the patient may be able to keep his/her pain under control.

Melzack and Casey (1968) pointed out that it might be appropriate to direct treatment efforts toward the neglected contribution of affective and cognitive processes as opposed to surgical remedies for pain. They believed that pain can be treated, not only by trying to cut down on sensory input by anesthetic block or surgical intervention, but also by influencing the affective and cognitive dimensional factors.

The strength of the gate control theory is that it offers an explanation for puzzling and paradoxical clinical findings (Fields, 1987). Britton and Skevington (1989) used a mathematical model of the gate control theory of pain to account for acute pain in humans. They developed three possible explanations for chronic pain, based on an evaluation of the gate control theory. It might be that chronic pain is associated with plastic changes in the nervous system. It might also be that psychological factors result in cognitive control being more excitatory (or less inhibitory) than would otherwise be the case. Finally, one input into the control system--one value for the firing frequencies in each of the large and small fibers--could result in more than one possible output from the T cells, depending on the history of the injury (Britton & Skevington, 1989).

Behavioral Methods for Treating Chronic Pain

Fordyce played a pioneering role in investigating the psychology of chronic pain. He helped identify the importance of behavioral factors in patients with chronic pain. He then developed

strategies for diagnosing and treating chronic pain. Fordyce (1968) described the use of behavior-management techniques for problems associated with treating chronic pain. Following the publication of his papers (Fordyce, Fowler, & de Lateur, 1968; Fordyce, Fowler, Lehmann, & de Lateur, 1968b), the use of behavioral methods to treat chronic pain increased rapidly. Fordyce and his colleagues (Fordyce, 1976; Fordyce, Fowler, & de Lateur, 1968; Fordyce, Fowler, Lehmann, & de Lateur, 1968a, 1968b; Fordyce & Steter, 1978) refined behavioral learning theory (operant and classical conditioning) for the chronic pain population. Behavioral methods, broadly defined, are now used in virtually every legitimate treatment program in the United States.

Traditional medical care responds to the perception of chronic pain mainly from an acute-care model. This model, however, fails to address special characteristics of chronic pain. A discipline known as behavioral medicine has developed over the past 15 to 20 years, during which time there has been a significant increase in psychologically or behaviorally based treatment of pain.

Loeser (1982) categorized the phenomena of pain in the human being into four domains: nociception, pain, suffering, and pain behavior) (see Figure 2.5).

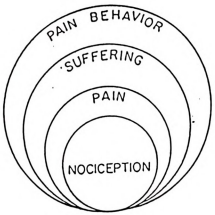


Figure 2.5: Schematic diagram for the components of pain (only pain behavior is measurable and observable). (From Loeser, 1982.)

The first three domains--nociception, pain, and suffering--are personal, private, internal conditions that can only be inferred to exist. They are unmeasurable in a clinical setting. Nociception connects pain with thermal, mechanical, or chemical stimuli that damage or threaten tissue. Nociception is a common symptom of disease, warning the individual that something is wrong and signaling the need for protection. Nociception is the detection of tissue damage by transducers in skin (Loeser & Egan, 1989); deeper structures receive this information by means of A-Delta and C-fibers in the peripheral nerves. Pain is the recognition of nociceptive stimulation by the central nervous system.

Suffering is the negative affective response to pain or other emotionally latent events, such as fear, anxiety, isolation, and depression. Pain behavior is what a person does or does not do or

say that leads the observer to believe the individual is suffering from noxious stimuli. All pain behaviors are measurable and observable.

Excessive disability-related behavior may characterize chronic pain--pain that has been in existence for 6 months or more. Fordyce recognized that there is a difference between chronic and acute pain. In many instances of chronic pain, the noxious stimulus is not observed or known. Previous medical examinations may have implied, without direct confirmation, that there was an organic basis for the complaints. Chronic pain also exists when the individual has little basis for estimating when the pain and associated disruption of life will cease. Chronicity exists when learning or conditioning effects become established and add to the complication of understanding the problem. In this circumstance, chronic pain represents a number of problems involving a complex interaction of organic/physical, environmental, and psychological factors, principally those of learning or conditioning.

Fordyce described pain problems by making a functional distinction between respondent pain and operant pain. Respondents are actions of an organism that are reactive in nature (Fordyce, 1981). In the presence of an adequate stimulus, the response will automatically follow. Antecedent stimuli control respondents and involve the body's glandular or smooth-muscle functions. Operants are responses that are under voluntary control; they also may be elicited by antecedent stimuli but are influenced by the consequences of the response. In this manner, operants come under

the control of those consequences. Operants involve primarily striated or voluntary muscles controlling such functions as speech, bodily movements, and facial expressions.

Fordyce distinguished between problems of respondent pain and operant pain in determining the appropriate approach to the problem of chronic pain. The expression of pain is influenced or controlled to a significant degree by environmental consequences; therefore, it should be viewed as operant pain. The role of these environmental consequences must be considered when seeking a solution to the problem. In contrast, expressions of pain that are influenced or controlled by an antecedent environmental stimulus reflect respondent pain.

The behaviorist can classify a patient's pain as primarily respondent or primarily operant in nature. This classification is made only after carefully assessing information relating to body damage and the environmental consequences of the patient's expression of pain. Fordyce's use of the terms "respondent pain" and "operant pain" does not address the issue of real or imaginary pain. From this perspective, the proper question is not whether the pain is real, but rather what factors influence it. The pain is perceived as real.

The Respondent Pain Model

Chronic pain traditionally has been viewed from the perspective of a disease or medical model. In the diagnostic process, it has been assumed that the indications of pain occur as a result of

underlying body damage. The medical model also assumes that, if body-damage factors were eliminated, the pain would cease. This conceptual model works quite effectively with most problems of acute pain, but its efficacy diminishes as time passes and the pain becomes more chronic.

Chronic pain frequently is described as a deep, dull aching that persists for hours, days, weeks, or even months and increases with activity. Treatment from a respondent-pain perspective has limited options.

Treatment of chronic pain with the medical/disease model often fails. This is especially true when plastic changes in the central nervous system take place. The physician who is committed to the medical/disease model has few options. Traditionally, most physicians begin treatment with a course of conservative management techniques, which may include heat, massage, traction, or a variation of these modalities. Further diagnostic work may be the next step for patients who do not obtain relief. If the diagnostic evaluations demonstrate positive results, surgical intervention may be the next step. If the low back pain continues, repeated diagnostic procedures may be the next step. If the diagnostic evaluations demonstrate positive results, surgical intervention may be repeated. If the low back pain continues, further treatment from a conservative perspective may occur. If the patient continues to complain of pain, the treating physician may refer him or her to another physician, who is likely to apply the same conceptual model.

Unless the original physician erred or the second one has special skills or methods unknown to the first, it is unlikely the referral will lead to a cure. The second physician may follow the course of treatment begun by the original treating physician.

After other therapies have proven unsuccessful, the physician's next option is to tell the patient the pain is not real. Physicians often respond to the implication that the pain is "all in the patient's mind" by labeling the pain psychogenic. This implies that a personality problem is responsible for the pain symptoms. At this point, the patient typically rejects the referral for psychotherapy or reluctantly accepts it. Even if psychotherapy is accepted and the patient participates fully, such therapy rarely is successful in resolving the pain problem (Fordyce, 1981).

The most common response by physicians who perceive chronic pain from the medical/disease model and whose traditional treatment methods have failed is to tell the patient that nothing more can be done. The chronic pain patient then is given a renewable prescription for medication, told his or her physical limitations, given recommendations for rest and exercise, and finally advised to learn to live with the pain. Although the treating physicians' intention is to curtail patients' endless pursuit of further diagnostic and treatment interventions, this response often has the opposite effect. The patient thinks the authenticity of his or her pain has been challenged. To prove that the pain is real, the patient may actually increase rather than decrease involvement with health care providers.

The traditional or respondent approach to chronic pain occurs as a result of physicians' inability to recommend alternatives. Another way to deal with chronic pain is to address pain behaviors rather than simply treating the underlying pain. This approach has been called the operant pain model, in contrast to the respondent pain model that traditionally has been used.

The Operant Pain Model

Operant behaviors are similar to respondent behaviors in that specific stimuli can produce them. However, operant behaviors are different because they are sensitive to the influence of conditioning. Conditioning relates to factors occurring during as well as after presentation of the stimulus. Operant behaviors are sensitive to their consequences. Accordingly, operants will increase or decrease in relationship to the likelihood of recurrence when followed by a reward or punishment.

Operant pain may increase in frequency and magnitude following positive consequences or a reduction in neutral or negative consequences. Respondent pain may quickly develop into operant pain if the pain behaviors consistently occur in an environment that promotes conditioning effects. The use of respondent pain avoids the issue of whether a patient's pain is "real" or "imaginary" (Fordyce, 1981). Society perceives this pain-related behavior as pain. This operant pain, or the pain-related behavior, allows a previously healthy person to adopt the image of infirmity (Fey & Fordyce, 1983; Fordyce, 1981). Pain signifies distress and

suffering, and "sick" individuals frequently receive sympathy and attention. Because they are sick, these individuals are not expected to carry out the duties they normally would be required to perform. Being insulated from stress and important decisions is one of the benefits sick people receive. The person with chronic pain is not expected to attempt to reverse the sickness or illness by pursuing some form of health care.

Fordyce (1981, 1983) used the marital situation as an example of how pain behavior can bring about subtle yet powerful changes in the partner's actions. The chronic pain patient receives special sympathetic deference, and uncomfortable discussions or arguments may be discouraged. The chronically ill person may avoid unpleasant tasks and use his or her pain to influence how the couple will spend their time or money or plan for the future.

In most respondent pain problems, the above-mentioned conditions or reinforcers are not present long enough or strongly enough to distract the person from a normal life. However, in some cases the nature and extent of the injury, combined with the psychological atmosphere, are such that repeated pain behavior is consistently reinforced while "well" behaviors are ignored or extinguished.

Pain behaviors slowly become operant in nature (Fey & Fordyce, 1983); they may increase or decrease in response to the positive and negative consequences to which they lead. The pain behaviors may become increasingly independent of the nociceptive stimuli that are

present. Early medical-management strategies, social contingencies, or psychological problems may allow the conditioning process to occur. This conditioning allows the chronic pain patient to be sick, reinforcing the insulation it provides from responsibilities.

Pain behaviors may appear to occur independently of physiological stimuli and may be under the control of environmental stimuli. Treatment for this type of pain problem involves examination and modification of the environmental contingencies. Continued medical-model-oriented treatment on the underlying pathology will fail to interrupt the pain behavior or halt the pattern of chronicity; in fact, it may systematically intensify the problem.

The most obvious and, at times, potent reinforcer of pain behavior is direct positive reinforcement (Fey & Fordyce, 1983). This reinforcement may be in the form of attention, solicitousness, affection, and comforting behavior from a spouse or significant other, as well as prescribed medications or rest that is contingent on the pain. The spouse's pain-contingent behaviors are in response to overt displays of pain and are evident only when pain behavior is present.

Direct reinforcement also may come from the health care system itself. In treating the chronic pain patient, a physician may demonstrate professional concern, which may serve to reinforce the pain behavior, especially in patients who have few outlets for their pain complaints.

Chronic pain patients may have multiple physical and emotional complaints and often receive a wide variety of medications from sympathetic physicians. Although some patients medicate themselves with alcohol, most problems arise through the use of prescribed medications that are self-administered on a pain-contingency basis. Patients may dose themselves repeatedly during a 24-hour period, increasing their dosage as the narcotic or barbiturate habituation and tolerance increase.

Notwithstanding the obvious problems of drug dependency, addiction serves as a potent reinforcer of pain behavior. The addiction interferes with work, family, and social activities. In addition, addiction to prescription medications may exacerbate the patient's preoccupation with his or her pain.

Monetary compensation is another source of direct reinforcement for pain behavior and disability. Insurance benefits in the form of disability payments frequently equal or exceed what a person was earning while he or she was employed. These payments provide a significant disincentive for reducing sick or pain-related behaviors. Those pain patients with the least interesting jobs, the fewest employment options, and the fewest personal and occupational skills are most likely to resist returning to work and to continue demonstrating pain behaviors. A disabled pain patient becomes trapped in a vicious circle, dealing with the potential termination of benefits or being forced to return to work. The chronic pain patient continually must prove that the pain problem is real by

demonstrating appropriate pain behavior or reinstituting diagnostic workups and/or medical treatment.

Rest is another direct positive reinforcement for continued pain behavior. Patients with low back pain and acute respondent pain may find that movement produces increased levels of pain and that rest reduces pain. Although rest frequently is prescribed in the acute phase of any injury, as pain persists in chronicity, rest may become a potent contingent reinforcer of pain, serving to promote the disability.

Indirect reinforcement for pain may be subtle. Avoidance conditioning plays a role in the evolution of the problem of operant pain and is particularly resistant to extinction. Pain serves to remove the person from a stressful or difficult situation. An individual faced with an aversive or noxious event may act to avoid it if at all possible. Pain behavior is a convenient way to avoid other direct, effective solutions for burdensome or physically demanding employment situations, jobs with low pay, or marriages that are psychologically stressful. Chronic pain patients learn that temporary solutions based on pain behaviors are easier to achieve than the difficult long-range solutions to many of the problems they face.

Avoidance responses are seen in chronic pain patients as compensatory body positions or devices such as crutches or braces. In the acute phase of the injury, walking or moving about produces pain and encourages the patient to favor the affected limb by limping. At times, the immediate reduction in sharp pain strongly

reinforces the limp or use of the device. The avoidance response becomes a habit that is not easily broken. Because he or she anticipates the pain elicited by the stimuli, the patient may continue to limp or use the device.

Bandura (1969) showed that modeling is a strong influence in learning complex behaviors and attitudes. Such learning is accomplished by observing the actions of others. Pain behavior may be learned through modeling or imitation. Children growing up with a chronic pain patient in the home will learn to imitate the pain responses they observe. When the children see these pain responses reinforced at home or at school, they quickly learn to display similar behavior when they are ill or injured.

The purpose of treating chronic pain with the operant method in behavioral-medicine programs is to change the patient's treatment and home environment, so as to develop and sustain alternative responses that are incompatible with sick behavior. The operant method is based on the assumption that pain behaviors persisting past the predicted or anticipated healing time are under the control of conditioning effects. Minimizing social reinforcement encourages the extinction of pain behaviors. The role of the treatment staff with whom the chronic pain patient comes into contact is to minimize the reinforcement of pain behaviors. Treatment staff and family encourage "well" behavior and systematically reinforce it.

The operant pain treatment program must address the individual needs of the chronic pain patient. Core aspects of a program

usually include medication reduction, physical reactivation through physical and occupational therapy, family counseling, treatment for depression, and vocational counseling. Any additional problems that limit functioning are addressed individually.

After 17 years of achieving positive results through a behaviorally oriented treatment program for chronic pain, Fordyce (1985) reconfirmed the goals of behavioral treatment. He believed that his critics have confused the hypothesis that pain behaviors can be learned and unlearned with the notion that pain itself can be learned and unlearned. Behaviorally oriented treatment programs for chronic pain reduce the disability associated with chronic pain problems. Although decreased pain is not a primary goal of rehabilitation programs using behavioral treatment, many patients have reported a lessening of pain following application of behavioral methods.

Fordyce conceptualized behavioral treatment as therapy for excess disability instead of treatment for pain. His concept of excess disability highlights the major problem of people with chronic pain. Those people who are more functionally disabled than necessary pose the problem. An operant pain treatment program is appropriate for patients who are capable of functioning at higher levels with less disability, discomfort, and distress.

The chronic pain patient's potential for increased functioning may be overlooked or underestimated when the physician sees him or her only for the presumed problem, which might be hysteria, poor motivation, degenerative disc disease, spinal stenosis, or pain of

unknown origin. If the behavioral-medicine practitioner attends to what the patient does or does not do, learning technology can be used to increase, decrease, or maintain selected behaviors to bring about improvements in functioning. These improvements in functioning may occur without changes in the underlying medical or psychological problem (Fordyce, 1985). The reduction of excess disability is the primary purpose of behavioral pain-management programs. Although most patients increase their functioning and quality of life without reporting a decrease in pain, this is not a shortcoming of the treatment approach.

The behavioral approach to the management of chronic pain recognizes psychological factors that are not derived from psychopathology, but instead come from learning theory. Learning theory hypothesizes that pain behaviors can result from several things, one of which is the contingent reinforcement of pain behavior by factors in the environment. The issue of whether the pain is organic or psychogenic is not relevant. The behavioral approach assumes that pain behaviors may occur as a result of nociception, the adverse effects of disuse and/or overguarding of involved body parts, and contingent reinforcement from the environment. It is further assumed that pain behaviors are modifiable; they may diminish and activity level increase without directly and specifically dealing with the source of nociception.

Viewing pain in behavioral terms is a radical shift in perspective. In an answer to the critics of the behavioral management of chronic pain, Fordyce (1985) stated:

> There is perhaps no more difficult intellectual task than to learn and assimilate that what we know to be true is not. The traditional concept of pain as a kind of sensory system and sensory experience linked to nociception is probably essentially valid in acute, but not necessarily in chronic, pain. We must recognize that "pain" is an open system. Once pain behaviors begin to occur, for whatever reason, they are subject to influence by factors outside the person. In the extreme case, those pain behaviors may come under virtual total control of environmental factors and thereby persist in the absence of nociception. (p. 123)

Cognitive-Behavioral Therapy

Cognitive-behavioral therapies reflect a recent development in the field of pain management. In recent years, cognitive-behavioral theory and techniques have been applied more frequently to the treatment and management of pain in both acute and chronic nonmalignant pain problems (Goldfried, 1977; Meichenbaum & Turk, 1976; Tan, 1982). This approach is an outgrowth of Melzack and Wall's (1965) gate control theory of pain and the growing interest among psychologists in the application of cognitive and cognitive-behavioral therapy to health-related problems. Ellis (1962) and Beck (1976) pioneered the use of "cognitive restructuring" techniques, which are used in identifying and modifying cognitions associated with negative emotions and maladaptive behavior.

The cognitive-behavioral approach is based on the assumption that the beliefs, expectations, and attitudes people maintain in certain situations determine their emotional and behavioral reactions to the situation. Cognitive variables such as distraction and the meaning of the pain for the individual, as well as such emotional variables as anxiety and depression, influence the

experience of pain. Logically, the modification of cognitions can be used to alter the pain experience. The cognitive-behavioral approach does not ignore the subjective experience of pain; rather, it views suffering as one of several aspects of a complex pain problem.

The goal of cognitive-behavioral therapy is to correct faulty cognitions underlying emotional and behavioral disturbance. When this concept is applied to pain problems, the approach may be considered "psychoeducational" (Turner & Romano, 1989). Interventions consist of cognitive restructuring, coping statements, relaxation, visual imagery, and assertiveness and communication training. These interventions increase the patient's awareness of events that reduce pain. The patient may effectively avoid or adaptively cope with pain-increasing events by using pain-relieving actions. Awareness and knowledge give the chronic pain patient a sense of control over pain, replacing feelings of anxiety and helplessness. Individual adaptive coping plans consist of two components: (a) ways to prepare for pain flare-ups and (b) coping strategies to use at times of increased pain.

Advance preparation involves continued practice in stress-management, communication, relaxation, exercise, and stretching skills. If these skills have not been practiced, they are unlikely to work effectively in a crisis. These coping strategies allow the patient control over pain perception. The more the strategies are practiced, the more effective they become.

These interventions are valuable components of an interdisciplinary treatment program for pain. Although cognitive-behavioral methods for pain control appear promising, the evidence from controlled studies is still limited (Tan, 1982).

Review of Treatment-Outcome and Follow-Up Studies of the Multidisciplinary Treatment of Low Back Pain

Introduction

Traditional medical treatment aims at removing or relieving the pathogenic process, but such treatment is not possible or effective for many patients with chronic benign low back pain. Chronic low back pain presents a major challenge to traditional medical science. Casey (1979) estimated that five million people in the United States are at least partially disabled by persistent low back pain, and 93 million workdays are lost each year due to this complaint. Yet for as many as 78% of the individuals who are severely disabled by chronic low back pain, no pathophysiological basis can be found to support their pain complaints (Loeser, 1980).

Various statistics have been cited about the vast economic loss chronic pain inflicts on society. Bonica (1980) estimated that acute and chronic pain costs the United States economy more than $90 billion annually.

Chronic pain is a problem of considerable proportions. Traditional medical management often has failed to relieve the pain. Chronic pain patients usually become "problems" in the health care system and are recognized as a specific treatment population. To

meet the demand for relief from pain, several behavioral treatments for chronic pain have been developed in the past 20 years.

Chronic pain usually refers to the persistent complaint of pain for at least 6 months. The multidisciplinary pain clinic (MPC) constitutes a major response to the challenge presented by patients with protracted complaints of low back pain. Patients for whom traditional medical management has proved inadequate, as well as those with no identifiable pathophysiology, are treated at MPCs.

Criteria for admission to MPCs include the provision that patients have pain problems of a minimum duration--usually 6 months, although most patients have suffered much longer. The highest mean duration of chronic low back pain--8.7 years--was reported for a treatment group at Rancho Los Amigos (Cairns, Thomas, Mooney, & Pace, 1976). MPC patients share a history of failed surgical interventions (a mean of 2.5 reported surgeries), accompanied by multiple previous hospitalizations (an average of about six) (Fordyce et al., 1973; Swanson, Swenson, Maruta, & McPhee, 1976). The ensuing review of MPCs describes their response to the challenge presented by patients with protracted complaints of low back pain.

The studies reviewed in this section were categorized according to four general types of behavioral treatment for pain: operant, relaxation, cognitive, and multimodal. The treatment focus in each report was used in categorizing the study. Studies encompassing two or more treatment methods were included in the section on the multimodal approach, but research that focused on one technique and

used another secondary treatment were classified according to the primary treatment approach.

The Operant Approach

According to proponents of the operant viewpoint, pain behavior is a set of overt responses (i.e., medication taking, limping, pain reports), which can be controlled by reinforcers (i.e., attention, medications, and so on) if the reinforcers are given contingent on the pain behaviors. Fordyce and his associates (Fordyce et al., 1973) developed a treatment program based on operant principles. This program concentrated on decreasing medication use, pain levels, and pain behaviors. Fordyce (1976) focused instead on increasing activity and other constructive behaviors.

In Fordyce's treatment program, activity levels were increased gradually by systematically reinforcing each increase with social praise and the chance to rest. Medications were systematically decreased as the patient was provided with progressively smaller doses in a "pain cocktail," which was given on a fixed-time rather than pain basis. Trained not to reinforce pain behaviors, family and staff avoided providing sympathy or a reduction of work responsibilities contingent on pain. The experience of pain was dealt with only in the sense that pain behavior was ignored and well behavior reinforced.

Of the 15 studies conducted from 1968 to 1982, most used a one-group pre/posttest design. Cook and Campbell (1979) pointed out that there are several problems (i.e., controlling the history,

maturation, regression, and reactivity) to measurement with this type of design, which makes causal inference difficult. In this type of research, factors extraneous to actual treatment such as placebo, attention, and demand characteristics may not be accounted for in the one-group pre/posttest design. It is difficult to attribute significant change to the treatment unless there is convincing control over the entire experiment.

In these studies, subjective pain complaints ordinarily decreased, but only by a moderate amount. In all studies that employed inferential statistics, statistical significance was obtained, but clinically the reductions in subjective pain complaints were not impressive. Swanson et al. (1976) reported a 14% decrease in pain ratings. However, in none of the studies was pain reduced below a rating of 4 on a 0 to 10 scale. Although subjective pain ratings were reduced significantly, patients still complained of having considerable pain. In all studies except that of Ignelzi, Sternbach, and Timmermans (1977), reported reductions were maintained. The operant program resulted in clinically significant increases in activity levels and reduction in analgesic intake. The researchers usually reported modest reductions in subjective pain ratings. The follow-up studies indicated maintenance of treatment gains.

Although a high percentage of subjects completing the program improved, only a minority of the original pain patient population completed the program. It was difficult to organize, administer,

and gain control over important reinforcers in the operant treatment programs (Vinic, 1981; White & Donovan, 1980).

The results from these studies support the usefulness of the operant approach. There is no longer a question about whether the operant program is beneficial in increasing activity levels and decreasing the use of medication. The question is no longer whether it works, but how well it works, for whom, and why. Experiments dealing with the specific components of the program need to isolate and improve on the effective ingredients. Defining which patients are likely to respond to the program is also important. In comparative studies, the cost effectiveness of the operant program needs to be determined.

Table 2.1 contains summary information on outcome studies using the operant approach.

The Relaxation Approach

The basis of the relaxation approach to pain is the assumption that organic processes are relevant and are influenced by learning. The basic idea in treating chronic pain is to break the vicious pain cycle that exists. Whenever injury occurs, typically causing pain, the tendency is to tense the muscles in the affected body area, thereby immobilizing the site to further trauma. In acute pain, this response has obvious value. However, when the muscles are chronically tensed, the tension produces more pain, which in turn causes more tensing; thus, a pain-tension cycle begins. Eventually, other problems such as lack of sleep, depression, overuse of

Table 2.1.--Outcome studies using the operant approach.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Fordyce, Fowler, Lehmann, & de Lateur (1968)	3--low back	In-patient operant program with systematic activity increases and medication decreases	Single subject AB	Increased walking and activity levels, decreased medication use.	None
Fordyce, Fowler, Lehmann, de Lateur, Sand, & Treischman (1973)	36--majority low back	Same as Fordyce et al. (1968)	1 group pre/post	Increased activity, decreased medications and pain. At follow-up, activity and pain gains maintained.	22 months
Greenhoot & Sternbach (1974)	54--diverse	In-patient program similar to Fordyce et al. (1968)	1 group pre/post	Increased activity, decreased pain.	None
Sternbach (1974)	75--diverse, mostly low back	Similar to Fordyce et al. (1968); 25 patients also received surgery	1 group pre/post	Increased activity, decreased medications and pain. Gains maintained at follow-up.	6 months
Fowler (1975)	36--low back	As in Fordyce et al. (1973)	1 group pre/post	Medication intake decreased, increased activity.	Not stated
Cairns, Thomas, Mooney, & Pace (1976)	36--low back	As in Fordyce et al. (1973)	1 group pre/post	At follow-up, 58% of the patients had decreased medication levels, and 70% had decreased pain or increased activity.	10 months
Swanson, Swenson, Maruta, & McPhee (1976)	50--72% back	Similar to Fordyce et al. (1973)	1 group pre/post	At discharge, activity increased 16%, pain decreased 14%, and 79% of the patients decreased their medication use. At follow-up, 50% were deemed to have moderate or better improvement.	6 months

Table 2.1.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Anderson, Cole, Gullickson, Hudgens, & Roberts (1977)	34--79% back	Similar to Fordyce et al. (1973)	1 group pre/post	Of original patients, 54% rejected, 38% refused, and 8% dropped out of treatment; 78% of those completing the program had normal levels of drug use and activity.	6 months
Cairns & Pasino (1977)	9--back	In-patient activity training; (a) no special training, (b) verbal reinforcement, (c) verbal reinforcement + graphic feedback	3 group pre/post	c = b > a for specified activities in physical therapy.	None
Ignelzi, Sternbach, & Timmermans (1977)	54--diverse	Follow-up of Greenhoot & Sternbach (1974)	1 group follow-up	Increased activity, decreased medication, decreased pain; but for those not receiving surgery, pain decrease was not significant.	36 months
Hammonds, Brena, & Unikel (1978)	61--70% low back	Analgesic nerve blocks contingent on successful increase in weekly activity level	1 group pre/post	About 30% dropped out. Of those completing, activity levels doubled. Maintained at follow-up.	4 weeks
Swanson, Maruta, & Swenson (1979)	200--back, neck	In-patient program like Swanson et al. (1976)	1 group pre/post	18% dropout rate. At discharge, activity increased; 59% of patients improved medication level, decreased pain. At follow-up, pain decrease was maintained, 20% working, 29% adhered to drug program.	12 months
Roberts & Reinhardt (1980)	58--diverse	(a) similar to Fordyce et al. (1973); (b) patients rejected for treatment, (c) patients refusing treatment	3 group pre/post	77% of operant patients functioning normally at follow-up. a > b, c up-time, work, drug use, and pain.	1-8 years

Table 2.1.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Varni, Bessman, Russo, & Cataldo (1980)	1--chronic pain (burn)	Reinforced "well" behavior and systematic activity increases	Multiple baseline across settings, reversals	Observed pain behavior decreased contingent on reinforcement of "well" behaviors, and activity increased only when treatment present.	None
Cinciripini & Floreen (1982)	171--chronic low back pain, neck, face	Medication reduction, physical therapy, biofeedback and relaxation, behavior group therapy, contract goals, self-monitoring, family training	1 group pre/post	90% of patients medication free, 83% decrease in pain talk, 65% decrease in nonverbal pain behaviors, 23% decrease in complaints, 22% increase in assertion, 52% decrease in self-report of pain, 83% increase in pedometer, increase in physical exercise	None
Miller & LeLieuvre (1982)	Single-subject	(a) Social reinforcement/ext. to increase activity on ward and physical therapy and to decrease pain behavior; (b) "a" plus quotas during physical therapy	Single subject ABAB	Medication: good control, mean decrease = 55%; pain behaviors: control, 2/4 decrease to 0 during treatment; ward activity: 3/4 increase during first treatment, but not maintained during second; exercise: difficult to increase; pain: decrease of 37% in MPQ pain intensity and 26% in word ranks.	None

Table 2.1.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Sanders (1983)	4--chronic low back pain	(a) Functional pain-behavior analysis, (b) progressive relaxation, (c) assertion training, (d) social reinforcement for activity increase	Nonconcurrent multiple baseline across Ss with control for order	(b) contributed most to overall improvement, followed by (d). (a) and (c) had minimal effect. No order effect.	None
Linton & Gotestam (1985)	15--chronic low back pain	(a) Waiting-list control; (b) applied relaxation as out-patients; (c) applied relaxation + operant day-ward program for medications, pain, activity	3 group pre/post + single subject	Expectancy nonsignificant. Pain b > a; exercise c > a; activities of daily living b & c > a; downtime nonsignificant; depression b & c > a; anxiety and mood nonsignificant; goals b > c.	None
Linton, Melin, & Stjernlof (1984)	28--chronic low back pain	(a) Waiting-list control; (b) regular clinic treatment; (c) "b" as needed + behavior therapy: applied relaxation, operant activity	3 group pre/post	Pain c > b & a; MPQ nonsignificant; activities of daily living c > a; activities only c improvement; medication c > b & a; sleep c > b & a; Beck nonsignificant.	None

analgesics, and lowered activity exacerbate this cycle. Treatment through the relaxation approach focuses on reducing muscle tension and psychological stress to control the pain.

Table 2.2 contains summary information on studies in which electromylograpyhic (EMG) biofeedback or other relaxation techniques like progressive muscle relaxation were used to break the vicious pain cycle. EMG and pain levels are the principal measures reviewed here because many researchers did not employ other measures.

Most of the studies on relaxation treatment conducted between 1977 and 1981 used a one-group pre/posttest design. The limitations of this type of design were discussed in the previous section. Another limitation of these studies is that they lacked a broad range of objective outcome measures. The typical investigation included EMG and pain ratings, but few researchers reported on other pain-related behaviors. Follow-up periods also were quite short.

Overall, the data from these studies suggest that many patients may benefit from relaxation treatment. A lack of data from well-controlled studies makes this conclusion somewhat tentative. There was a general indication that chronic pain patients can significantly lower their EMG levels and experience a decrease in pain. It is not clear from these studies how much pain levels decreased, whether other pain behaviors were affected, or why the pain decreased.

One advantage of relaxation therapies is that they are inexpensive and easy to administer. The use of relaxation as a part of the coping-skills approach to pain appears prudent.

Table 2.2.--Outcome studies using the relaxation approach.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Gentry & Bernal (1977)	2--back	Frontalis EMG biofeedback	Uncontrolled case studies	Both patients had reduced EMG levels; it was implied that they had pain decreases. Pain improvements were maintained at follow-up.	6 weeks
Grzesiak (1977)	4--spine	Progressive relaxation and focusing	Uncontrolled case studies	All patients had decreased pain and improved mood at discharge. Three of the 4 maintained gains at follow-up.	1-2 years
Hendler, Derogatis, Avella, & Long (1977)	13--diverse	Frontalis EMG biofeedback	Uncontrolled case studies	At follow-up, 6 of the 13 patients had some relief.	1 month
Peck & Kraft (1977)	14--8 back, 6 TMJ	EMG biofeedback (back/masseter)	1 group pre/post	Back patients had slight EMG reductions and 1 of 8 had a pain reduction, while TMJ patients had EMG reductions and 2 of 6 had pain reductions. These gains maintained at follow-up.	3 months
Belar & Cohen (1979)	1--back	Back-muscle EMG biofeedback	Single subject AB	Decreased EMG and pain frequency plus increased activity at discharge. Pain reduction and activity gains maintained.	6 months
Nouwen & Solinger (1979)	26--back	(a) Back-muscle EMG biofeedback, (b) waiting-list control	2 group pre/post	a > b EMG and pain reductions. At follow-up, EMG returned to pretreatment levels for Group a, but pain reductions were maintained.	3 months

Table 2.2.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Freeman, Calsyn, Paige, & Halar (1980)	8--low back	EMG biofeedback	1 group pre/post	At follow-up, 5 of 8 patients approached a 50% reduction in EMG levels, 4 of 8 had less pain, and 5 of 8 had improved MMPI.	3 months
Jones & Wolf (1980)	1--back	Back-muscle EMG biofeedback	Uncontrolled case study	At follow-up, decreased EMG, pain, and drug-intake levels.	5 weeks
Nigl & Fisher (1980)	4--back	Back-muscle EMG biofeedback and relaxation training	Single subject AB	Decreased EMG and pain levels observed.	None
Todd & Belar (1980)	1--low back	EMG back-muscle biofeedback, relaxation training, and stress inoculation	Single subject AB	Depression improved, but EMG and pain levels were unchanged.	None
Varni (1981)	3--arthritis	Progressive muscle relaxation, breathing exercises, and guided imagery	Single subject AB with multiple baseline control	At follow-up, clinically significant pain reductions, sleep improvements, mobility increases, and analgesic-use decreases.	14 months
Wolf, Nacht, & Kelly (1982)	1--back	EMG recorded and patient trained to equalize EMG level on right and left sides of spine	ABAB	During treatment (B) phases, EMG tended to equalize, but not during A. MPT showed increases in pain only during B.	None

Table 2.2.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Flor, Haag, Turk, & Koehler (1983)	18--rheumatoid arthritis	(a) EMG biofeedback (relevant muscles) + cognitive + home practice coupled to pain cues, (b) pseudo-feedback, (c) waiting-list control	3 group pre/post	Pain: a > 2 & 3 intensity and duration; MPT: sensory nonsignificant, affective a > b & c, cognitions a > b & c; cognitive questionnaire: a > b & c; medication: nonsignificant; doctor contact: a > c; EMG: questionable, 1 best reduction.	None
Nouwen (1983)	20--chronic low back pain	(a) EMG biofeedback (erector spinae), (b) waiting-list control	2 group pre/post	EMG: Group a decrease, Group b nonsignificant; pain: nonsignificant	None
Large & Lamb (1983)	18--chronic muscle pain	(a) Waiting period, (b) control--no feedback, (c) EMG biofeedback--pain site	Single subject ABC	Pain: b & c reduced pain, a increased it in 2/6 orders of presentation (bac, bca); EMG: b = c in decrease.	None
Linton & Melin (1983)	17--chronic low back pain	(a) Waiting-list control, (b) rehabilitation treatment, (c) b + applied relaxation	3 group pre/post	Pain: c > a (c = 28% decrease); medication: c > a; (b not applicable); activity test: c > a & b social activities; evaluation c > b satisfaction, activity; all other variables nonsignificant.	None
Keefe, Schapira, Brown, Williams, & Surwit (1981)	18--chronic low back pain	(a) EMG biofeedback, (b) progressive relaxation, (c) transfer training: 30 1-minute repetitions per day	1 group pre/post with continuous measurement	EMG: decrease within and between sessions; pain: decrease within sessions; tension: decrease within and between sessions.	None

Table 2.2.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Linton & Gotestam (1984)	15--chronic low back pain	(a) Waiting-list control; (b) applied relaxation at out-patient; (c) applied relaxation + operant day-ward program for medications, pain, and activity	3 group pre/post + single subject	Expectancy: nonsignificant; pain: b > a; exercise: c > a; activities of daily living: b & c > a; down-time: nonsignificant; depression: b & c > a; anxiety and mood: non-significant; goals: b > c.	9 months[a]
McCauley, Thelen, Frank, Willard, & Callen (1983)	17--chronic low back pain	(a) relaxation, (b) self-hypnosis		a & b improved significantly compared to pretest and placebo controls on all variables but up-time. Group differences: a > b at follow-up pain intensity and MPQ.	3 months[b]
Turner (1982)	36--chronic low back pain	(a) waiting-list control; (b) progressive relaxation (1/daily); (c) cognitive behavior: goals, relaxation + imagery, iden. cognitions + affective responses to pain, self-statements	3 group pre/post	b & c improved pain, depression, disability (SIP); b & c > a SIP, pain; self-ratings: c > b goals, pain tolerance, activities.	1.5-2.0 years[c]

[a]Maintained improvements, both groups: pain, applied relaxation > applied relaxation + operant program; nonsignificant group differences on other variables.

[b]Generally maintained; relaxation > hypnosis for pain intensity and MPQ.

[c]Progressive relaxation and cognitive-behavior groups decreased health-care use and pain intensity compared to pr; nonsignificant between groups all variables.

Between 1982 and 1986, the relaxation approach was used in five studies employing biofeedback; these studies had mixed results. Flor, Haag, Turk, and Koehler (1983) found that biofeedback was better than no treatment or pseudo-therapy for pain, but the group difference with regard to EMG level was not significant. Keefe, Schapira, Brown, Williams, and Surwit (1981) reported a decrease in EMG, but they observed decreases in pain only during feedback sessions. Nouwen (1983) reported significant EMG decreases in his biofeedback group, but pain was not reduced significantly. To confuse matters even further, Large and Lamb (1983) found that both biofeedback and pseudo-biofeedback could reduce EMG and pain under certain conditions.

The data concerning biofeedback do not furnish convincing or conclusive evidence as to its utility. Electrode placement and differences in training procedures might have accounted for some of the variance in results. In addition, the site of pain might have influenced the outcome.

Various forms of relaxation training have been used in remedial studies. Sanders (1983) found that progressive relaxation was the most important component of his program. Turner (1982) compared progressive relaxation with no treatment and a coping strategy based on relaxation and cognitive strategies. Although both active treatments resulted in significant improvements, Turner found few differences between subjects treated with progressive relaxation and progressive relaxation plus cognitive methods.

Linton and Melin (1983) added applied relaxation to a day ward's rehabilitation program and compared it to the ward's regular rehabilitation treatment in a waiting-list control group. The results supported the idea that adding applied relaxation to this program led to improvement in a variety of variables. Linton and Gotestam (1984) continued the research and found that applied relaxation by itself led to improvements of approximately the same magnitude as did both applied relaxation and an operant program. The operant-plus-relaxation group was somewhat better on variables of activity and medicine use, whereas the applied-relaxation group was superior on pain-intensity ratings.

The results of these studies indicated that relaxation training was effective in treating certain aspects of chronic pain. Although none of the researchers compared relaxation training with biofeedback, Linton (1986) stated that relaxation training was at least as effective as biofeedback in treating chronic pain. Turner and Chapman (1982) said that biofeedback has had mediocre results in reducing pain because it is too simple an approach for such a complex problem.

The Cognitive Approach

Cognitive-behavioral therapy has become increasingly popular in recent years. The cognitive program includes several approaches to regulate pain. In this approach, pain is seen as an experience mediated by cognitions. If this approach successfully negotiates pain, there might be a concurrent change in other pain-related

behaviors, such as activity and medication intake. Regardless of the origin of pain, modifying cognitions may reduce pain levels and provide the patient with a better method of dealing with it (Linton, 1982).

There is little evidence that cognitive strategies are effective in treating chronic pain (Tan, 1982) or that they are the treatment of choice (Linton, 1980). A lack of studies, in combination with poor designs and the use of cognitive with noncognitive treatment, does not allow one to draw conclusions regarding the effectiveness of the cognitive approach in treating pain (Sanders, 1979). In addition, the clinical validity of this approach has not been tested (Sanders, 1979).

On the positive side, however, Rybstein-Blinchik's (1979) four-group study suggested that cognitive strategies may be useful in a clinical setting. Whether the effects of cognitive treatment are strictly cognitive or rather relate to a general relaxation response is an important theoretical question that needs to be addressed.

Between 1980 and 1985, no additional studies were conducted on the use of purely cognitive strategies. However, three reviews related to this topic have been published. Pierce (1983) reviewed cognitive-behavioral approaches to treating chronic pain. The author classified them as either pain directed, requiring restructuring or distraction, versus stress directed. A common element of stress-directed programs is relaxation. However, there is no empirical evidence that the addition of the cognitive techniques is helpful (Linton, 1986). Pierce (1983) stated that

there are not enough substantial data, particularly with regard to pain, to draw firm conclusions about the utility of cognitive aspects of stress-directed techniques.

Tan (1982) and Turk, Meichenbaum, and Genest (1983) evaluated literature including laboratory studies. Turk et al. concluded that laboratory studies, as a group, have not shown one cognitive strategy to be superior to strategies subjects bring with them to the laboratory. Tan and Turk et al. acknowledged that few researchers have investigated chronic pain other than headache. The review of cognitive approaches to date showed the need for more research. Linton (1986) acknowledged that not enough is known about cognitive approaches to controlling chronic pain.

Turner and Romano (1989) acknowledged the beneficial effects of cognitive-behavioral therapies in the field of psychotherapy. However, no study was found in which a purely cognitive approach was used to treat chronic low back pain.

Table 2.3 contains information on five outcome studies using the cognitive approach.

The Multimodal Approach

Because pain is a complex problem that is influenced by many variables, the multimodal approach is an attempt to increase improvement by using several techniques to control as many pain variables as possible. The multimodal approach includes operant, relaxation, and cognitive strategies, in addition to a wide range of other techniques.

Table 2.3.--Outcome studies using the cognitive approach.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Levendusky & Pankratz (1975)	1--abdominal	Progressive relaxation, covert imagery, cognitive relabeling,	Uncontrolled case study	Drug use decreased and pain was "moderated."	None
Cautela (1977)	1--arthritis	Progressive relaxation, covert conditioning, extinction of pain	Uncontrolled case study	Pain free and reduced drug intake at follow-up.	8 months
Rybstein-Blinchik (1979)	44--diverse	(a) conversation control, (b) reinterpret., (c) cognitive therapy with pain-irrelevant condition, (d) cognitive therapy with pain-relevant condition.	4 group pre/post	b > a,c,d pain behaviors and descriptive words; b > a,c and d > a pain intensity	None
Rybstein-Blinchik & Grzesiak (1979)	5--diverse	Cognitive reinterpretation	1 group pre/post	Decreased pain ratings, pain behaviors, and words to describe pain; pain intensity not significantly lowered.	5 weeks
Hartman & Ainsworth (1980)	10--diverse	(a) alpha feedback, stress inoculation; (b) stress inoculation, alpha biofeedback	2 group pre/post	a > b pain "approaching significance."	6 weeks

Weak designs characterize the investigations reviewed in this section. The studies either used single-subject AB designs or single-group pre/posttest designs. A broad range of dependent variables was used in the investigations.

In these studies, considerable improvement in such variables as pain reports, drug use, mood, and activity was reported at discharge and at follow-up. The clinical significance of these improvements as a group is difficult to judge. The studies varied in methodology and treatment; in many of them, the actual data were not reported. The preliminary nature of some of the studies and weak designs in others prevent one from drawing conclusions about the utility of their approaches (Linton, 1982). Because several techniques were employed, it is difficult to determine the efficiency of a particular component by itself. However, despite the research problems involved in multimodal treatments, their popularity seems to be increasing (Linton, 1982). The promise of multimodal treatments lies in combining the most effective aspects of various approaches.

Weak designs of the one-group type continue to plague the multimodal approach. This problem makes it difficult to isolate the active ingredients of the approach. Each clinic or study has used somewhat different treatment components, giving the multimodal approach an "everything but the kitchen sink" character. In addition, comparing studies is difficult because the actual treatments usually have not been described in detail (Linton, 1986).

Another difficulty with the multimodal approach is that, the more components the subject participates in, the lower the level of compliance and memory of information tend to be (Linton, Melin, & Gotestam, 1984). Although treatments should be broad based, they also should consist of as few and as potent components as possible (Linton, 1986). Follow-up reports exist, but there is no evidence that analyses of effective treatment packages are being conducted. This reflects the complexity of conducting such controlled investigations in the pain-clinic setting.

The preceding criticism provides a foundation for reviewing two recent studies of multimodal treatment programs. Maruta, Swanson, and McHardy (1990) performed a 3-year follow-up study of patients who had been treated in a multidisciplinary pain-management center. At the end of the 3-year follow-up, 46.6% of the successfully treated patients had maintained their improvement. This was viewed as an indication of the long-term efficacy of the MPC treatment.

Connally and Sanders (1991) included cognitive coping strategies as a treatment variable in the evaluation of pain treatment. They examined the ability of initial overt pain behavior and cognitive coping strategies to predict chronic low back pain patients' subsequent responses to lumbar sympathetic nerve blocks and general interdisciplinary pain rehabilitation. Cognitive coping strategies were assessed using the Coping Strategies Questionnaire. This instrument measured the cognitive coping techniques of diverting attention, reinterpreting pain sensations, making coping self-statements, ignoring pain sensations, praying or hoping, and

catastrophizing. The results indicated that, the more overt the pretreatment behavior, the poorer the outcome. The researchers concluded that overt pain behavior might well be a significant predictor variable for specific and combined interdisciplinary pain rehabilitation techniques.

Specific studies in which the multimodal approach was used are summarized in Table 2.4.

Conclusions

The information obtained over the past 20 years has provided considerable support for the efficacy of some behavioral pain-management techniques. Over the years, studies have had almost exclusively positive results. Appropriate methodology has allowed researchers to draw more definite conclusions. Studies of operant programs have provided strong evidence that the main activity and medication programs are effective. In at least 30 controlled studies, positive results have been shown for the behavioral approach to pain management. However, researchers have had difficulty demonstrating that overt pain-communication behaviors such as pain, talk, rubbing, grimacing, and the like, were reduced through the operant approach. Reductions in pain-intensity ratings also have resulted from treatment, although only a few of the researchers who found decreases in pain ratings used proper pain-rating methods. Controlled studies either combined relaxation with the operant treatment or did not show a clear reduction in pain

Table 2.4.--Outcome studies using a multimodal approach.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Seres & Newman (1976)	100--low back pain	In-patient operant conditioning plus biofeedback, relaxation, education, and psychotherapy	1 group pre/post	Medication use changed from 87% of the patients to 5% at discharge and 22% at follow-up. Activity and mobility increased and were maintained at follow-up.	3 months
Gottlieb, Strite, Koller, Madorsky, Hockersmith, Kleeman, & Wagner (1977)	72--low back	In-patient program of assertiveness training, education, drug reduction, biofeedback, vocational restoration, and physical therapy	1 group pre/post	At discharge, 69% were clinically and functionally improved, and 81% were working or seeking vocation.	1 month
Seres, Newman, Yospe, & Garlington (1977)	36--low back	Same as Seres & Newman (1976)	1 group pre/post	At follow-up, mobility and exercise tolerance was increased, decreased drug use and medical consultations. While pain decreased significantly during treatment, a 15% increase was noted at follow-up.	80 weeks
Khatami & Rush (1978)	5--diverse	Out-patient relaxation or biofeedback training, cognitive therapy, and operant family therapy	1 group pre/post	Pain, depression, medication use, and hopelessness decreased significantly at discharge. Gains maintained at follow-up.	1 year
Newman, Seres, Yospe, & Garlington (1978)	36--low back	Same as Seres & Newman (1976)	1 group pre/post	At follow-up, exercise and mobility increased, medication dosage decreased, but the majority of patients had the same or worse pain than on admission.	80 weeks

Table 2.4.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
De Benedittis (1979)	15--diverse	In-patient operant conditioning plus hypnotherapy and psychotropic drugs	1 group pre/post	At discharge, mean pain ratings decreased 75%, mean medication use decreased 77%, and mean activity levels increased 55%. Improvements maintained at follow-up.	1 year
Gottlieb, Alperson, Koller, & Hockersmith (1979)	47--low back	Same as Gottlieb et al. (1977)	1 group pre/post	At follow-up, 46% of patients working or seeking vocation and continued to use pain-control skills.	1 year
Hudgens (1979)	24--79% low back	In-patient operant conditioning like Fordyce et al. (1973) plus family therapy	1 group pre/post	77% rejected, 10% refused, and 8% dropped out of treatment. Family relations, work status, MMPI, activity level, and health care use improved. Medications reduced to zero. 75% of patients maintained gains at follow-up.	6 months-2 years
Khatami, Woody, & O'Brien (1979)	6--diverse	Same as Khatami & Rush (1978)	1 group pre/post	Decreased hopelessness, pain, anxiety, and depression.	None
Block, Kremer, & Gaylor (1980)	36--diverse	In-patient operant conditioning plus physiological self-regulation, cognitive therapy, and communication skills	1 group pre/post	Decreased pain and depression, and increased assertiveness.	None

Table 2.4.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Taylor, Zlutnick, Corley, & Flora (1980)	7--diverse	In-patient detoxification, relaxation training, and supportive therapy	Single subject AB	At follow-up, 6/6 had significant pain decreases, 2/6 mood improvements, and 2/7 activity increases; 5/6 were using fewer medications.	6 months
Timming, Cayner, Malec, Harvey, Schwettmann, & Chosey (1980)	40--diverse	In-patient operant conditioning program plus education, relaxation, cognitive and group therapy	1 group pre/post	Activity seemed to increase; none of the patients was using medications at discharge.	None
Arakawa (1981)	131--diverse	Out-patient relaxation, hypnosis, reduced medications, nerve blocks, TNS, and acupuncture	1 group pre/post	Patients having severe pain were reduced from 92% to 46% at follow-up; 47% of the patients reduced their medication intake and increased activity levels.	2 years
Chapman, Brena, & Bradford (1981)	100--diverse	Out-patient detoxification, nerve blocks, physical therapy, education, and reinforcement of "well" behaviors	1 group pre/post	At follow-up, pain significantly decreased, fewer patients used drugs and in lower doses, and daily activities significantly increased.	21 months
Herman & Baptiste (1981)	75--diverse	Out-patient education, group and cognitive therapy, relaxation and desensitization training, nerve blocks, medication	1 group pre/post	Decreased depression and pain; improved attitude. Analgesic intake not significantly reduced.	None

Table 2.4.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Keefe, Block, Williams, & Surwit (1981)	111--low back	In-patient EMG-assisted relaxation, generalization of relaxation training, self-paced medication intake, psychotropic drugs, and physical therapy	1 group pre/post	Subjective tension ratings and EMG levels decreased significantly, pain reduced 29%, and 49% of patients lowered their medication intake; 63% reported increases in activity.	None
Malec, Cayner, Harvey, & Timming (1981)	32--not stated	In-patient operant treatment similar to Fordyce et al. (1973) plus coping and vocational counseling	1 group pre/post	At follow-up, 57% of patients not using narcotics, relaxants, or tranquilizers; 75% employed or in training, and 86% had the same or less pain. Overall, 37% deemed successfully treated.	6 months-3 years
Tyre & Anderson (1981)	13--diverse	Inpatient detoxification; relaxation training; physical, occupational, group, and family therapy	1 group pre/post	At discharge, medication use was reduced to 0, pain tended to be decreased, and 8 of 13 were working or in training. Gains maintained at follow-up.	1 year
Wang, Illstrup, Nauss, Nelson, & Wilson (1980)	407--diverse	Out-patient relaxation, medication reduction, activity program, nerve blocks, trigger points, injections, acupuncture	1 group pre/post	At follow-up, 42% of the patients had some pain relief for 1 month or more, 50% used fewer analgesics, and 40% had increased activity levels.	1-3 years

Table 2.4.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Gottlieb, Alperson, & Koller (1982)	72--mainly chronic low back pain	Biofeedback, psychological counseling, medication reduction, case conference with patient, physical therapy, information, and milieu therapy	1 group follow-up	Increase in number working (45%), pain and medication level related to work status (those working had fewer problems), health visits increased significantly for unemployed.	
Lutz, Silbert, & Ohlson (1983)	57--chronic low back pain, neck, shoulders	Physical therapy, occupational therapy, injections, medication reduction, psychotherapy, biofeedback, hypnosis, relaxation, stress management	1 group follow-up	Overall improvement (all variables); single variables: improved pain, lifestyle, medication intake.	
Maruta, Swanson, & McHardy (1990)	249--chronic pain, various sites	Cognitive/operant conditioning, physical rehabilitation measures, medication management, education, group psychotherapy, biofeedback, supportive psychotherapy	Independent rating	46% maintained improvement at follow-up, same as 1-year follow-up.	3 years
Connally & Sanders (1991)	19--chronic low back pain	Interdisciplinary pain rehabilitation, lumbar sympathetic blocks	2 x 3 repeated measures Anova	Patients showing more overt pain behavior did not respond as well to lumbar sympathetic blocks or interdisciplinary pain treatment.	None

ratings. Linton (1985) and Sanders (1983) agreed that operant treatment programs resulted in "moderate" decreases in pain ratings.

Relaxation methods continue to be widely used, as demonstrated by the number of studies in which these techniques were employed. In controlled studies, biofeedback has had mixed results. Limited support exists for its efficiency when used alone. On the other hand, there has been more support for the utility of relaxation training. Relaxation training has resulted in significant reductions in pain reports, along with moderate improvements in medication intake, activity, and mood. Applying relaxation to everyday problem situations, such as using it as an active coping strategy, may be more effective than employing static training, but the evidence is still insufficient to draw any sound conclusion. The biofeedback programs with the best results have used some form of coping (Flor et al., 1983; Keefe et al., 1981). Sanders (1983) and Turner (1982) used ordinary progressive relaxation in a program that required a good deal of practice. This suggests that a major difference between successful and unsuccessful programs may be the method of training and employing the relaxation.

Linton (1985) believed that the operant and relaxation approaches are most effective in changing those behaviors toward which they are primarily oriented--activity levels and medicine use as opposed to subjective pain ratings, respectively. A generalization of treatment effect seemed to occur in both operant and relaxation programs, but variations in the studies did not allow the reviewers to determine the extent of generalization.

Linton and Gotestam (1984) and Sanders (1983) examined the effects of relaxation in comparison to the results of some operant techniques. They found relaxation to be surprisingly effective in comparison to operant approaches. Linton (1985) questioned the need for in-patient operant ward programs. He believed that patients who had a moderate problem with chronic low back pain would require only an out-patient program, whereas in-patient treatment might be required for effective management of severe cases with narcotic addiction, very low activity levels, and the like. Linton and Gotestam (1984) and Linton et al. (1985) showed that out-patient behavioral treatments could be as effective as ordinary (nonbehavioral) in-patient rehabilitation programs but cost only a small fraction of what in-patient programs cost.

Mellin, Jarvikoski, and Verkasalo (1984) found no substantial difference between rehabilitation center and out-patient treatment in terms of physical measurements or back pain indices. Fordyce (1976) said that, historically, treatment for chronic pain had to occur in an in-patient setting to afford staff control of those factors that were thought to reinforce or maintain pain behavior. This treatment, although effective, was costly; the average cost of a 4- to 6-week program ranged from $20,000 to $36,000.

Cicala and Wright (1989) compared 25 patients with work-related injuries who were treated as in-patients at the University of Tennessee Center for Pain Management with 25 matched patients who were treated in an out-patient program. In both cases, the

treatment approach was multidisciplinary and involved the same staff; treatment consisted of psychology, physical therapy, occupational therapy, and medical coverage. The single measure of successful treatment was whether the patients returned to gainful employment. Fifty-two percent of the in-patient subjects returned to work, as compared to 44% of the out-patients. The average cost per patient on an in-patient basis was $22,848, whereas the average cost per patient on an out-patient basis was $7,640--only about one-third the cost of an in-patient program.

Guck, Skultetly, Meilman, and Dowd (1985) compared an in-patient multidisciplinary pain-management center treatment group of 20 patients to 20 no-treatment control patients. At 1 to 5 years follow-up, 60% of the treated patients met all the criteria established for success, whereas none of the untreated patients met those criteria. Treated patients reported less interference with activities, more up-time, lower pain levels, less depression, and fewer hospitalizations than untreated patients. At follow-up, more treated patients than untreated patients reported employment and fewer used narcotic or psychotropic medication.

In evaluating relaxation treatment, researchers have tried to determine the role that EMG level plays in the perception of pain. Keefe et al. (1981) found that subjective ratings of pain and tension correlated significantly with EMG level ($r = .61$), but EMG was not related to pain reduction. Nouwen (1983) demonstrated that EMG levels could be decreased but did not find a concomitant decrease in pain. Large and Lamb (1983) found a correlation of .67

between present pain and pre-session EMG. Wolf, Nacht, and Kelly (1982) found that increases or decreases in EMG level beyond a "normal" range produced more pain for their patients. Thus, the evidence suggests that absolute EMG levels might be less important than providing the patient with an active method of coping with and controlling the pain.

Turner and Clancy (1986) used 74 patients with chronic low back pain to assess the effectiveness of group out-patient cognitive-behavioral and operant-behavioral treatment. Both treatments resulted in significant changes in types of coping strategies used to deal with pain. In this context, coping refers to thoughts and behaviors people use to manage their pain or their emotional reactions to pain, in order to reduce emotional distress.

Two years later, Turner and Clancy (1988) used 81 mildly dysfunctional patients with chronic low back pain in a study to compare the efficacy of behavioral approaches in treating chronic pain. Subjects were randomly assigned to an operant-behavioral treatment, a cognitive-behavioral treatment, or a waiting-list control condition. The operant-behavioral and cognitive-behavioral treatments were conducted in eight out-patient group sessions; the results demonstrated decreased physical and psycho-social disability. The operant-behavioral patients showed greater pre- to post-treatment improvement, as rated by the patients and their spouses, than did the cognitive-behavioral patients. The operant behavioral patients leveled off in improvement at the 6- and 12-month follow-ups, whereas the cognitive-behavioral group continued

to improve over the 12 months following treatment. At 12-month follow-up, patients in both the operant-behavioral and cognitive-behavioral groups remained significantly improved; no significant difference was found between the two treatment groups.

Compliance is an essential concern in fulfilling any treatment. In the pain programs reviewed, patients were instructed to continue to practice relaxation and other exercises at home. Compliance data were reported in several studies, although the method of obtaining such information was usually global estimates or follow-up rating questionnaires, which are considered rather weak. The general conclusion was that patients did continue to practice their assignments, but more infrequently than advised (Linton, 1985).

The long-term effects of multidisciplinary pain clinic treatment are a significant issue. Long-term follow-up data have been given prominent attention in the literature (Miller & Le Lieuvre, 1982). Since 1983, good to excellent maintenance has been reported; even further improvements have been noted in some follow-up studies. The methodology, in general, has suffered from the usual problems seen in this type of research: low return rates, the use of global ratings and questionnaires, nonblind collection of data, and the like. More work is needed in this area, but there is no compelling reason to believe that the gains documented in the case studies were not generally maintained.

Outcome and follow-up studies have stressed that substantial and statistically significant improvements can be obtained through

the use of MPCs. Nevertheless, it is extremely difficult to rehabilitate subjects to their prepain level of functioning. Complete medical rehabilitation of all patients is an unrealistic goal; the alternative is to accept many types of chronic problems. Because a return to the preproblem state usually is not possible, treatment should be oriented to helping the patient live as normally and productively as possible. An alternative is to prevent the development of chronic pain.

Predicting the Treatment Outcome of Multidisciplinary Pain Clinics

Introduction

Diagnostic procedures have become increasingly sophisticated, making it possible to determine the organic basis for many patients' chronic pain and to choose appropriate medical or surgical treatment. However, some patients' pain does not respond to surgical or medical treatment, and other individuals are not satisfied even after repeated negative medical/surgical work-ups. Therefore, the management of disability/suffering, rather than relief, is a reasonable therapeutic goal.

The management of chronic pain allows individuals to learn to lead useful and satisfying lives despite the pain. Patients are able to increase their activity and become more efficient in caring for themselves. They gradually become able to reduce pain medication and to improve family relationships (Fordyce, 1974; Fordyce et al., 1973; Sternbach, 1974). Although many patients improve, others fail. Effort and expense could be spared, and more

success could be achieved in the treatment of pain, if referring and admitting physicians as well as team members could distinguish beforehand which patients are most likely to benefit from treatment and which are not. It is in this regard that prediction studies have been undertaken by individuals involved with MPCs. Representative studies of this nature are discussed in the following section.

Prediction Studies

Maruta et al. (1979) attempted to ascertain which chronic pain patients are likely to benefit from a pain-management program and whether these individuals could be identified before treatment. They studied differences that were discernible at the beginning of treatment; the sample comprised a group who succeeded and did well at 1-year follow-up and a group who failed. The researchers established the following admission criteria for patients with pain that resisted treatment: (a) a complete medical and psychiatric evaluation; (b) a pain problem of 6 months' duration or longer; (c) no related malignant disease; (d) no specific medical, surgical, or psychiatric approach applicable; (e) no litigation; and (f) the patient's acceptance of the treatment program.

Maruta et al. considered selected data for the patients in the study. They looked at personal and clinical history, medical/surgical diagnosis, subjective pain level at start of program, and score on the MMPI. The researchers analyzed these data by using the two-tailed t-test and the chi-square procedure.

The results of Maruta et al.'s study indicated that the success and failure groups did not differ significantly in terms of age, gender, or marital status. No significant difference was found in how many pain-related drugs the patients were taking, or whether they were receiving disability compensation. The two groups differed significantly on prior duration of the pain, work time lost because of pain, number of prior surgical procedures related to the pain, dependence on medication, and pain level at the beginning of the program.

Maruta et al. concluded that the likelihood of success in pain management declined with an increase in prior duration of pain, work time lost, number of prior operations, and level of pain at the beginning of the program.

The researchers noted that composite MMPI profiles for women in each group on the Hypochondriasis, Depression, and Hysteria scales were elevated, but even though the elevations for the failure group were greater than those for the success group, the differences were not significant. The composite profiles for men in each group on the Hypochondriasis and Hysteria scales were slightly more elevated than those of women, but the differences in elevations between the success and failure groups were not significant.

As a result of the experiment, the researchers concluded that duration of pain and lost work time were significantly longer for the failure group than the success group. Pain of less than 3 years' duration and lost work time of less than 1 year were favorable indicators. Pain of 5 years' duration or more and lost

work time of 1.5 years or more were unfavorable indicators. The number of operations related to pain was significantly higher in the failure group than the success group. The researchers concluded that three or more surgeries for pain were unfavorable predictors. Zero or one operation was a favorable indicator.

Pain level was significantly higher in the failure group than in the success group. Pain levels of 7 or more were deemed unfavorable, whereas levels of 5 or less were determined to be favorable. The higher drug dependency found in the failure group was seen as an unfavorable predictor.

The preceding items, along with elevations on the Hypochondriasis and Hysteria scales of the MMPI, differentiated the two groups. Admission criteria using the above-mentioned information would assist in quick practical assessment and selection of good candidates for multidisciplinary pain-management programs.

Block et al. (1980) compared 36 consecutive admissions to a behavioral-medicine program for chronic pain management. They segregated subjects according to source of referral: medical-subspecialties referrals (treating physicians) and disability referrals. Disability referrals came from the state worker's compensation board, independent rehabilitation consultants, and rehabilitation nurses working for disability insurance companies. The disability-referred patients reported having work-related injuries that prevented their return to work; they received maintenance settlements and full medical insurance.

Block et al. found that both groups reported comparable severity of pain on admission. Both groups indicated a much lower mean level of pain at discharge. The medical-subspecialties-referred group reported a lower severity of pain than the disability-referred group. Analysis of covariance indicated a reliable difference between the groups with regard to severity of pain complaints at discharge. Both groups showed a decrease in pain severity, but the disability-referred patients did less well than those referred by medical subspecialties. The researchers concluded that the apparent failure of the disability patients to benefit from the behavioral-medicine intervention was not due to the duration of their presenting complaint; their complaints were of a shorter duration than those of patients referred by medical subspecialties. In contrast, Maruta et al. (1979) found that failure to benefit from treatment correlated positively with duration of presenting complaint.

The major result of Block et al.'s study was that, although all patients experienced a decrease in pain severity, the disability-referred group did not benefit to the same degree as patients referred by medical subspecialties.

The authors concluded that the behavior of disability-referred patients in an operant-model pain program could be maintained if positive consequences, such as money, were contingent on the complaint. They contended that this operant notion of pain complaint can provide guidance in making clinical decisions. Patients involved in litigation centering on pain complaints require

careful assessment for motivation to engage in treatment. If patients cannot afford to reduce or extinguish the pain complaint, there is little purpose in establishing high expectations regarding treatment; hence, limited treatment goals should be adopted.

Painter et al. (1980) stated that MPCs help individuals suffering from chronic pain. Follow-up studies have demonstrated that treatment populations maintained gains for an extended period or experienced only a modest decline. After reviewing individual patients' records, Painter et al. found that one-fourth to one-third of the sample continued to progress, whereas a similar proportion declined rapidly to preadmission levels of function, despite demonstrable improvement during the MPC program.

The authors attempted to discover the reason for this decline because the regression of these patients represented a failure of treatment. The authors questioned whether certain factors were peculiar to individuals who experienced a decline following treatment because they believed that these patients should not be offered expensive treatment.

Painter et al. grouped causal factors conceptually into four areas: incentives, attitudes, operant factors, and psychological variables. Questionnaires were sent to 500 participants in the 1977 program at Northwest Pain Center; 145 of them responded. In addition, telephone interviews were conducted with 10 randomly selected nonrespondents. The researchers compared the 25 most successful patients (success group) with an equal number of patients

who had experienced initial success and subsequently regressed (failure group).

Painter et al. found that substantial change took place as a result of treatment at the MPC. The total group maintained a significant reduction in pain severity over time. A smaller portion of the sample proceeded to improve, in part because they continued to follow through with the active principles of the MPC approach. For about one-fourth of the patients, substantial gains declined after a few months.

Men were somewhat less likely than women to maintain gains. Divorced people were more likely than married patients to continue improving after discharge. The researchers thought the most significant observation concerning whether to treat was the relationship between age and long-term success. There appeared to be a curvilinear relationship in that patients in their twenties were more likely to regress than were those who were over 50.

The researchers found that the failure group was more likely than the success group to receive compensation at the time of follow-up. The implication of this finding is uncertain. The authors said the presence of a real disability was itself the cause of continued compensation. However, they also said their findings suggested that a lack of incentive favoring a healthy, pain-free way of life might have caused patients to regress. The authors could not explain their finding by asserting that patients who were most severely disabled were those who did not work, because this was not the case. Success or failure of treatment was not related in the

expected way to duration of disability, nor to subjective levels of pain or disability at admission or discharge.

Subjects' educational level did not correlate with overall success, but it was associated with regression. Individuals with less education and correspondingly less opportunity for nonphysical work were more prone to regress after making initial gains. Painter et al. found that indices of depression were strongly associated with success and failure. Their findings indicated that the success group reported having significantly more depression at the time of admission.

The authors summarized their findings by stating that the most striking difference between groups was the change they reported in their lifestyles following treatment. Individuals who regressed reported very little change in patterns of communication or reinforcement after they left the program, whereas the success group showed considerable change. This suggests that pain-treatment work with families can help reduce operant maintenance of pain behaviors and can improve communication.

Keefe, Block, Williams, and Surwit (1981) had as their subjects 111 patients with chronic low back pain who were involved in a comprehensive behavioral-treatment program emphasizing relaxation procedures. The 28 patients who had the greatest decrease in pain were compared to 28 patients who had the least decrease in pain. The findings were discussed in terms of implications for behavioral assessment and treatment.

Keefe et al. found that patients who reported the most pain relief had had fewer surgeries, were not on disability payments, and had had continuous pain for a shorter length of time; they also had higher initial pain ratings than the group with the least decrease in pain.

MMPI scores were not available on all the patients who were compared. However, the scores that were available (15 for the best group and 10 for the worst group) indicated that MMPI scores were not associated with outcome. In general, the patients tended to have elevated scores on the Hypochondriasis and Hysteria scales. This study as well as that of Painter et al. (1980) suggested that elevated scores on these two scales were not associated with good or bad outcome of behavioral treatment.

The authors summarized their study findings by saying that patients with chronic low back pain are not a group of "crocks, losers, or malingerers" for whom treatment is doomed to end in failure. They believed that a growing body of research is defining variables that are predictive of treatment outcome. The results of this study suggested that the likelihood of treatment success may vary, depending on patients' individual characteristics.

Aronoff and Evans (1982) sought to replicate the results of Maruta et al.'s (1979) study. Aronoff and Evans studied 104 chronic pain patients to predict treatment outcome from their MPC. The researchers used four outcome measures: staff judgment, patient judgment, change in patient scores, and change in mood. Of the variables examined in the study, only age was found to be a

predictor of outcome. The significant negative correlation of age with outcome indicated that older patients had lower rates of success. Aronoff and Evans believed this finding reinforced the need to screen older patients more carefully. They believed it is important for MPCs to develop a commonly accepted set of instruments such as the MPQ and the Profile of Mood States because they do not depend on the evaluator's judgment. Use of these instruments would allow a transfer of information regarding the outcome of treatment from group to group.

Turner, Robinson, and McCleary (1983) used 135 patients with chronic low back pain in an MPC setting as subjects for their experiment. They evaluated the effectiveness of several measures in predicting response to conservative treatment for these patients. The measures used in the study included pretreatment demographic variables, scores on the MMPI, patients' ratings of pain caused by daily activity as measured by the Activities Discomfort Scale, and physicians' ratings.

Turner et al. analyzed their results to determine which pretreatment variables were most highly associated with outcome. They calculated correlation coefficients between pretreatment demographic and medical variables, physicians' ratings, patient-completed measures, and patients' follow-up ratings of pain relief, pain intensity, and return-to-work activities. The only statistically significant predictor of pain relief at follow-up was patients' scores on the Hypochondriasis scale of the MMPI. The

higher the patients' scores on this scale, the greater their level of dysfunction. The findings of Turner et al.'s study indicated that patients with high scores on the Hypochondriasis scale were less likely to improve than were patients with low scores on this scale.

In her study, Carlsson (1984) divided 58 patients suffering from pain of a nonmalignant origin into three groups. Group 1 consisted of patients whose long-term outcome of treatment could be classified as good, Group 2 included patients who reported at least "good" pain relief at short-term assessment, and Group 3 included patients with no favorable effect of treatment. Carlsson used a pain questionnaire designed by the Department of Neurosurgery at the Karolinska Hospital in Stockholm, Sweden, to gather data for the study.

Significant differences were found among groups with regard to employment status and location of pain, as documented by Fischer's Probability Test and the Pearson chi-square procedure. These findings indicated that employment status and location of pain could be used to predict treatment outcome. Carlsson admitted the questionnaire had poor validity; there was a lack of agreement between the questionnaire data and patients' interview responses.

Melzack, Katz, and Jeans (1985) included 145 patients with low back and muscular skeletal pain in their experiment. Using a weighted-rank method in a one-way repeated-measures multiple analysis of variance design, the researchers compared patients who were receiving compensation with those who were not receiving

compensation. Melzack et al. found that the two groups of patients had identical pain scores and pain-descriptor patterns. They had similar scores on the MMPI pain triad of Depression, Hysteria, and Hypochondriasis, and were similar on several other personal variables, as well. Patients who were receiving compensation had significantly lower scores on the Affective and Evaluative dimensions of the MPQ and made fewer visits to health professionals, as compared to patients who were not receiving compensation.

Dworkin, Handlin, Richlin, Brand, and Vannucci (1985) studied 454 patients with chronic pain to evaluate the relationship between compensation benefits, litigation, and employment status, and short- and long-term treatment outcome. Univariate analysis indicated that compensation benefits and employment status both predicted poor short-term outcome. When employment status and compensation benefits were analyzed jointly using multiple regression analysis, employment was found to be statistically significant. Employment significantly predicted long-term outcome in a third analysis; compensation and litigation did not.

Dworkin et al. (1984) compared 79 clinically depressed patients with chronic pain to 375 nondepressed pain patients with respect to medical and social history, physical examination, treatment, and treatment response. The diagnosis of depression was based on an assessment by physicians who were pain specialists.

The data were analyzed using a two-tailed t-test and the chi-square test of statistical significance. For nondepressed patients,

beneficial response to treatment was found to be related to a greater number of treatment visits, not receiving worker's compensation, fewer previous types of treatment, and low back pain. For depressed patients, beneficial response to treatment was found to be related to being employed at the beginning of the treatment program and pain of shorter duration. The authors concluded that depressed chronic pain patients were not very different from those not suffering from depression.

Guck et al. (1986) used 77 chronic pain patients in a 1- to 5-year follow-up study in an attempt to determine whether long-term outcome can be predicted. The pretreatment variables used in the analysis included age; gender; marital status; diagnosis; number of months since onset of pain; receipt of compensation; pending litigation; educational and occupational levels; use of non-narcotic, narcotic, or psychotropicmedications for pain; number of pain-related hospitalizations; and number of pain-related surgeries. Using stepwise discriminant analysis, the researchers found that successfully treated patients were less likely to be receiving compensation, were younger, were less likely to be taking psychotropic medications, and had undergone fewer pretreatment pain-related surgeries than unsuccessfully treated patients. They also found that, in combination with each other, these five pretreatment variables could be used to classify a significant proportion of the patients (70%).

Hurri (1989) undertook a study to compare treatment-group versus control-group subjects on sociodemographic factors, variables

related to work, severity of low back pain, and eight clinical measurements. The sample comprised 177 patients with chronic low back pain. The most important predictor of the outcome of treatment, as well as of spontaneous recovery, was patients' scores on the Work Satisfaction Index. The results of the t-test and chi-square analysis suggested that work satisfaction was strongly associated with changes in the subjective functional capacity of patients with chronic low back pain. Hurri concluded that a variety of psychosocial factors might have influenced the treatment outcome for these patients, necessitating particular attention to the social network of the patients' occupational environment.

Bigos et al. (1991) evaluated factors associated with work-related back injuries. They found that subjects who hardly ever enjoyed their jobs were 2.5 times more likely to report a back injury than were subjects who almost always enjoyed their job tasks.

Kleinke and Spangler (1988) used as the subjects of their study 72 patients with chronic back pain from a multidisciplinary treatment center in a 28-day in-patient program. Subjects were divided into two groups: patients receiving worker's compensation and those not receiving worker's compensation. Treatment outcome measures included the MPQ, an audio-visual taxonomy, the Beck Depression Inventory, the Profile of Mood States, behavioral ratings by a primary nurse, demographics, and the MMPI. Multiple regression analyses, along with a two-tailed t-test, were used in analyzing the data.

The results showed that patients who were receiving worker's compensation had less favorable scores on treatment-outcome measures at admission and upon discharge from the pain program. However, no significant differences were found between patients receiving and those not receiving worker's compensation benefits with regard to the amount of improvement on treatment-outcome measures. Although patients receiving worker's compensation benefited from treatment at an MPC, they presented a challenge to professionals to develop individualized programs. The researchers believed that individualized programs would bring these patients' range of scores on performance and treatment outcome closer to that of patients who were not receiving worker's compensation. The researchers found a significant relationship between MMPI scores and treatment results. High scores on the MMPI Depression and Hysteria scales predicted treatment success, based on measures of improvement from admission to discharge.

Table 2.5 contains a compilation of information on outcome studies in which a prediction approach was used.

Pain Measurement

Regardless of individual discipline or scientific focus, pain researchers hold the goal of achieving scientific understanding and clinical control of pain. The development of a valid, reliable, and flexible measure is required to meet the researchers' goal. Progress in pain measurement has been slow due to the complex

Table 2.5.--Outcome studies using a prediction approach.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Maruta, Swanson, & Swenson (1979)	172--chronic pain, multiple sites	Compared success and failure groups	t-test, chi-square	Favorable pain 3< years; work <1 year, 0-1 operations.	1 year on failure group
Block, Kremer, & Gaylor (1980)	36--chronic pain, multiple sites	Compared disability referrals and medical subspecialty referrals	Anova	Patients in litigation carefully assessed for motivation, limited treatment goals.	None
Painter, Seres, & Newman (1980)	50--chronic pain	Compared success and failure groups	t-test, chi-square	Incentive compensation with healthy lifestyle indices of depression strongly associated with success.	Yes
Keefe, Block, Williams, & Surwit (1981)	44--low back pain, 14--psych. diagnosis, 27--neuro. diagnosis	28 best versus 28 worst group	t-test, chi-square	Greatest pain relief for patients with continuous pain for shorter length of time, higher pain level on admission and associated with greatest success.	None
Aronoff & Evans (1982)	104--chronic pain	Outcome measures, staff judgment, patient judgment, change in pain score, change in mood	R, chi-square	Negative correlation with age.	None
Turner, Robinson, & McCreary (1983)	135--chronic low back pain	Demographic data, MMPI, ADS, physicians' ratings	Multiple regression (stepwise), chi-square	Patients with Hypochondriasis scale elevations on the MMPI were less likely to improve.	6-12 months

Table 2.5.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Carlsson (1984)	58--nonmalignant origin	Group 1: good long-term outcome, Group 2: short-term effect, Group 3: unsatisfactory effect	Fischer exact probabil. test, Pearson's chi-square	Gainful employment was a favorable prognostic sign, unilateral vs. bilateral location of pain.	None
Melzack, Katz, & Jeans (1985)	145--low back and musculoskeletal pain	Compensation vs. noncompensation	Weighted-rank method, one-way repeated measures multivariate analysis of variance	Compensation patients had lower Affective or Evaluative MPQ scores and fewer visits to health professionals.	None
Dworkin, Richlin, Handlin, & Brand (1984)	454--chronic pain	79 clinically depressed patients compared to 375 not depressed	Not stated	For depressed patients, employment at beginning of treatment predicted significantly greater short-term outcome.	None
Dworkin, Handlin, Richlin, Brand, & Vannucci (1985)	454--chronic pain	Compensation, litigation, employment	Univariate analysis, multiple regression	Compensation benefit and employment predicted poor short-term outcome; employment predicted long-term outcome, but compensation and litigation did not.	None
Dworkin, Richlin, Handlin, & Brand (1986)	454--chronic pain	79 clinically depressed patients compared to 375 not depressed	two-tailed t-test, chi-square	Nondepressed patients improved with greater number of treatments, no worker's compensation, fewer previous treatment types, and when pain was of shorter duration. Depressed patients employed at beginning of treatment showed most improvement.	None

Table 2.5.--Continued.

Study	N/Pain	Treatments	Design	Results	Follow-Up
Guck, Skultetly, Meilman, & Dowd (1986)	77--chronic pain	Age, gender, marital status, compensation, diagnosis, educational level, length of pain, use of psychotropics or Rx, number of pain surgeries, and hospitalization	Stepwise discriminant analysis	Successfully treated patients less likely to receive compensation, younger, less likely to have psychotropic Rx, undergone fewer pre-treatment pain-related sequences.	1-5 years
Hurri (1989)	177--chronic low back pain	Treatment vs. control group sociodemographic factors, variables related to work, severity of low back pain, eight clinical measures	t-test, chi-square	Work satisfaction was most important predictor of outcome of study.	None
Kleinke & Spangler (1988)	72--chronic back pain	MPQ, PPI, and PRI audio-visual taxonomy of pain behavior, Beck Depressed Inventory, Profile of Mood States, behavioral rating by primary nurse, demographics, MMPI	Multiple regression, two-tailed t-test	Worker's compensation recipients challenged professionals to develop individual plan. High scores on MMPI Depression and Hypochondriasis scales, good treatment success.	None

perceptual experience involved in pain. Pain can be quantified only indirectly.

Pain researchers have adopted four major approaches to operationalize and quantify pain. The major approaches can be classified into four groups. They are (a) animal laboratory research, (b) human subjects laboratory research, (c) human physiological correlates, and (d) clinical pain assessment.

Clinical pain assessment is involved with not only the evaluation of pain relief following pharmacological intervention but, more recently, with the assessment of the human pain experience. Beecher (1959) influenced the field, arguing that quantifying the intensity and duration of pain was not enough. He proposed that the reaction component of pain, its emotional dimension, was the basic issue in clinical pain control.

Since Beecher, greater attention has been given to the scaling of pain as opposed to the measurement of pain relief. Measurement of behavior has been used as a basis for inference about clinical pain states. Pencil-and-paper test instruments have been developed to quantify multiple dimensions of the pain experience from subjective reports.

Clinical pain measurement can be divided into three categories: behavioral measurements, subjective pain reports, and scaling based on word descriptors. Behavioral measurements include observational data and self-reported behaviors. These measures can be reduced to frequency of rate of occurrence. Subjective pain reports include

category judgments and visual analog scales. In category judgments, subjects are given a structured categorized scale and asked to rate each stimulus on that scale, which usually indicates pain intensity. The visual analog scale (VAS) requests that the subject indicate the intensity of his or her pain by marking a 10 cm line labeled "no pain" at one end and "the worst pain possible" at the other. Investigators equate the length of the line produced with the estimate of pain to produce a number from 1 to 10 to indicate pain intensity. A variation of this concept is for the subject to categorize the level of pain numerically. Usually "no pain" is at one end (1) and "the worst pain possible" is at the other (10). The subject records the level of pain perceived. Scaling based on word descriptors (adjectival) was pioneered by Melzack and Torgerson (1971) and refined by Melzack (1975) when he introduced the McGill Pain Questionnaire (MPQ). This instrument is reviewed in depth in the following section.

The McGill Pain Questionnaire

Introduction. Achieving scientific understanding and clinical control of pain is the common goal of pain researchers. This goal holds true regardless of the researcher's scientific focus or individual discipline. To attain this objective, a valid, reliable, and flexible pain-measurement instrument is required. Measuring pain in this way is an attempt to quantify an intricate perceptual experience.

Pain is a complex perception as opposed to a simple sensation. Individuals suffering from pain use language as a medium to relate their perception of pain to significant others. Scientific measurement procedures have focused on pain as an individual sensory quality that varies only in intensity. However, although intensity is a noteworthy dimension of pain, to describe pain only in terms of intensity is like describing the visual world only in terms of light, failing to consider color, pattern, texture, and other dimensions of the visual experience. The complexity of pain extends beyond the multiple dimensions of sensation; affective and motivational aspects must also be recognized.

Failure to consider the motivational-affective dimension of pain seriously restricts the total picture of the pain experience. The motivational dimension is crucial to the concept of pain as a perception, recognizing past experience, attention, and sensory quality and intensity. If researchers consider only the sensory features of pain, they are ignoring the most important part of the pain process--the motivational and affective properties.

Melzack (1983) summarized the role of motivation in the pain process as accounting for the multidimensional properties of pain experience and behavior. He wrote:

> (a) The sensory-discriminative dimension of pain is determined primarily by activity in the rapidly conducting spinal systems; (b) the powerful motivational drive and unpleasant affective characteristics of pain are subserved by activities in reticular and limbic structures that are influenced predominantly by the slowly conducting spinal systems; and (c) neocortical or higher central nervous system processes, such as evaluation of the input in terms of past experience, exert

control over activity in both the discriminative and motivational systems.

Melzack (1983) assumed that the three categories of activity interact to provide perceptual information concerning location, magnitude, and spatiotemporal properties of the noxious stimulus; motivational tendency toward escape or attack; and cognitive information based on analysis of multimodal information, past experience, and the probability of outcomes of different alternative responses. The three forms of activity may influence motor mechanisms that account for the complex pattern of responses that researchers call pain.

The McGill Pain Questionnaire (MPQ) is one of the most widely used instruments for scaling pain. The MPQ is a paper-and-pencil instrument designed to quantify the sensory, affective, and evaluative dimensions of the pain experience. (A copy of the MPQ is contained in Appendix A.) Subjects are shown 20 sets of word descriptors; each set contains up to six words relating to one dimension of pain and arranged in ascending order. Subjects are then asked to choose the appropriate word from each set.

History and development of the MPQ. Melzack and Torgerson (1971) developed a new approach to the problem of describing and measuring pain in human beings. The defined pain as a specific sensation that can vary, not only in intensity but also in an endless variety of qualities.

Melzack and Torgerson believed they could begin specifying the qualities of pain. They chose specific words and categorized them

to describe pain. Next, they attempted to scale these words on a common intensity dimension. The researchers classified the words used to describe the different aspects of the pain experience into three major classes: (a) sensory qualities--words that were used to describe temporal, spatial, pressure, and other properties; (b) affective qualities--words that were related to tension, fear, and autonomic properties of the pain experience; and (c) evaluative--words that described subjectively the overall intensity of the total pain experience.

Melzack and Torgerson (1971) further divided these classes into 16 subclasses, each of which consisted of words that appeared to be similar. These words were selected because of their importance to people trying to describe their pain to a physician. The final classification was intended to represent the most parsimonious and meaningful set of subclasses possible that still included the important qualitative properties. The researchers went on to determine the validity of the final organization of the word descriptors.

Melzack and Torgerson (1971) performed two experiments to study the problem of describing and measuring pain in human beings. As a result of these experiments, the researchers discovered four important points: First, many words in the English language can be used to describe pain. Second, a high level of agreement existed in how words were placed into classes and subclasses representing dimensions of pain. Third, people from different cultural, socioeconomic, educational, and linguistic backgrounds gave many

words the same or approximately the same position on an intensity scale. Finally, there was considerable agreement on how much pain each word represented to the subjects involved in the study.

The fact that many words are used to describe the experience of pain supports the concept that the word "pain" is a label that represents a myriad of experiences. This refutes the notion that pain is a single modality with one or two qualities.

The distinction between the sensory and affective dimensions of pain requires clarification. The motivational-affective properties of pain are demonstrated by clinical syndromes. Subjects with lesions of the frontal lobe infrequently complain of severe clinical pain. A lobotomy will not disrupt sensory pathways; its prevailing effect is on the motivational-affective dimension of the pain experience. Both the aversive quality of pain and the desire to seek relief appear to be diminished. Subjects who are congenitally insensitive to pain have no apparent sensory loss. They can feel prickling, warmth, cold, and pressure. These subjects provide accurate reports of increasing stimulation, but the input does not cause intense pain. This suggests a distinction between the sensory-discriminative and motivational-affective dimensions of pain. Melzack and Casey (1968) believed that both dimensions are influenced by processes of the higher central nervous system, such as attention, prior experience, and situation.

Melzack and Torgerson (1971) defined pain in terms of

> . . . a multidimensional space comprising several sensory and affective dimensions. The space comprises those subjective

> experiences that have a somatic component and produce behavior aimed at stopping the conditions that produce them. If injury or any other noxious input fails to evoke aversive drive, the experience is not called pain. Conversely, anxiety or anguish without somatic input is not pain. (p. 58)

The compiled evaluative words demonstrate the brain's capacity to evaluate the importance or urgency of the overall situation. The words represent a judgment that is based not only on sensory and affective qualities, but on additional previous experiences, capacity to judge outcome, and the meaning of the situation. This judgment reflects the total circumstances at a given time and locates the position of the pain within the multidimensional space for the individual.

Description of the MPQ. Melzack (1975) formalized his work in refining a pain questionnaire as an experimental tool for studies of the effects of various methods of pain management. Initially, Melzack and Torgerson (1971) had used three classes--sensory, affective, and evaluative--consisting of 16 subclasses of descriptors for the evaluation of pain. However, many patients found that certain key words were not included. Patients sometimes used an additional set of words--cool, cold, and freezing--to describe their pain. Thus, the researchers found that a fourth class of words--miscellaneous--consisting of four subclasses were essential for an adequate description of some types of pain (Melzack, 1975).

Each descriptor data type represents a quantitative index of pain and can be used to indicate the extent of change in pain quality and intensity as a result of some procedure. When the MPQ

is administered before and after the procedure, the difference can be expressed as a percentage change from the initial value.

The MPQ provides quantitative information that can be analyzed statistically. The questionnaire is sufficiently sensitive to detect differences among different methods that are used to relieve pain and provides information about the relative effects of a particular procedure on the sensory, affective, and evaluative dimensions of pain. Melzack (1975) intended that investigators in other laboratories and clinics would refine the MPQ, leading to a universal tool with which to measure and assess pain. Using such an instrument would facilitate rapid exchange of data among investigators of the clinical pain phenomenon.

The MPQ provides three types of data with which to analyze the word-descriptor information gathered in the questionnaire (Melzack, 1975). The first type is the Pain Rating Index (PRI), which is based on the rank value of the words in a scoring system in which subjects give the word in each subclass implying the least pain a value of 1, the next a value of 2, and so on. The values subjects give to the words are added up to obtain a score for each category--PRI(S) for Sensory, PRI(A) for Affective, and PRI(E) for Evaluative, and PRI(M) for Miscellaneous--and a total score for all categories--PRI(T). The second data set is the number of words chosen (NWC). The third is the present pain intensity (PPI), the number-word combination chosen as the indicator of overall pain intensity at the time the questionnaire was administered. Initially, Melzack used a

fourth measure, the PRI scale, which was based on scale values obtained by Melzack and Torgerson. However, Melzack found that the PRI scores obtained from the rank values and the scale scores correlated so highly that he began to use the rank-value procedure almost exclusively.

To refine the MPQ and to facilitate the exchange of information among investigators of pain, Kremer, Atkinson, and Ignelzi (1982) developed an alternative method of scoring. They calculated a score for each dimension

> . . . by summing the rank order intensity value for each dimension and dividing that summated value by the total possible score on that dimension. This procedure yields values ranging from 0 to 1.0, with 0 indicating that the patient selected no words from a particular dimension to describe his pain and 1.0 indicating that the patient selected all of the highest ranked descriptors in a particular dimension to describe his pain. (p. 115)

Kremer et al.'s calculation makes it simpler for the clinician to use the MPQ and disseminate the information to others on the MPC team. If the clinician uses Melzack's PRI rank values, one has to recognize that there are 42 words in the sensory group, 14 words in the affective group, 5 words in the evaluative group, and 17 words in the miscellaneous group. If the clinician states, "Subject 3 has a PRI(S) of 23," this information may be difficult for other members of the team to understand. However, if the clinician uses Kremer's method, he or she provides a simple percentage. Thus, the clinician is able to state, "Subject 3 has a PRI(S) of 55%." This presentation of the information is easily understood and more readily disseminated.

Test administration. The individual administering the MPQ reads the instructions and the sets of words to the patient (Melzack, 1975). The patient is to select only those words that describe his or her pain at the time the questionnaire is being administered. It is important that the subject understand the meaning of the words in the questionnaire; in turn, the person administering the instrument should be patient and understanding (Melzack, 1975). Melzack found that two things became apparent in the administration of the MPQ. First, subjects were highly selective in choosing and rejecting words. Second, subjects were grateful to be provided with words to describe their pain.

Klep, Dowling, Rokke, and Schafer (1981) evaluated MPQ profiles according to administration format: researcher-administered versus self-administered. No significant difference was found between the two modes of administration.

Reliability. Reliability means that an instrument measures the same thing consistently. Pain instruments must be shown to yield reproducible data. Reliability considerations become problematic when the variable under study, such as pain, is subject to variation across time. Assessing the reliability of pain scales is confounded by the subject's memory capacity; that is, the subject might recall the pattern of responses of an earlier occasion. Also, the pain experience has an inherent fluctuating quality (Reading, 1983). Because the MPQ requires a number of judgments for each dimension under study, the reliability of the scores obtained on the instrument is likely to be increased over those obtained through the

administration of an instrument with a single rating scale (Reading, 1983).

Grahman, Bond, Gerkovich, and Cook (1980) found the MPQ to be a major step toward quantifying the subjective aspects of pain. Their repeated administrations of the MPQ to cancer patients resulted in a consistency index of 75%, within a range of 35% to 90%, between the first two administrations. The results came from both single and multiple administrations of the MPQ in two samples, each composed of 18 cancer outpatients who were in pain. These results are comparable to those reported by Melzack (1975), in which the consistency of word choices by 10 cancer patients over 3 days ranged from 50% to 100%, with a mean of 70.3%. These findings provide support for the use of the MPQ as a reliable, multidimensional measure of pain.

Hunter, Phillips, and Rachman (1979) studied patients' ability to remember and report their pain consistently. They administered the MPQ to 16 patients who were experiencing pain as a result of a neurosurgical procedure, such as a lumbar puncture or myelogram. None of the subjects had an organic disorder that would have impaired their ability to recall. The researchers assessed pain recall by administering the MPQ after an interval of 1 to 5 days. The results support the reliability of patients' retrospective pain reports, as indicated by a high consistency in score profiles from the three administrations of the MPQ.

Validity. Validity is the extent to which a test measures what it is supposed to measure. A number of studies have been performed in a variety of clinical settings including the MPQ as a dependent measure. This testifies to its acceptability in clinical assessment.

Face validity. Kremer, Atkinson, and Ignelzi (1981) evaluated chronic pain patients' reports of pain intensity on the Visual Analog, Numerical, and Adjectival scales of the MPQ. The results indicated that all patients were able to complete the Adjectival scale, but 11% were unable to complete the Visual Analog scale. There was a 2% failure rate on the Numerical scale. The patients who completed all three scales indicated a significant preference for the Adjectival scale. Results of a chi-square test indicated that this preference was reliable ($X^2 = 7.56$, $p < .025$). The basis for this preference did not appear to be related to gender, etiology of pain, affective variables, or selected psychological variables. The result of the study testifies to the MPQ's acceptability. This evidence serves to support the face validity of the MPQ.

Construct validity. Melzack and Torgerson (1971) addressed construct validity through the organization of words describing the different aspects of the pain experience into classes and subclasses. They first presented the major classes and subclasses of words to 20 subjects with college educations. Subjects were asked whether each word belonged in the subclass. Words with less than 65% agreement were used in a forced-choice test with 20 additional subjects, who were also asked to assign each word to a

category. A second study was done with three groups of subjects: 140 introductory psychology students, 20 physicians, and 20 patients. Melzack and Torgerson were then able to place words in each category in rank order on the basis of the mean ratings or scale values of each set of words for each of the three groups. There was substantial agreement that the words fell into particular categories or classes.

Melzack (1975) obtained data from 29 subjects who participated in a study of the effects of brief, intense electrical pain. Highly significant intercorrelations were found between PPI percentage changes and the percentage changes for each of the PRI indices, as follows: Sensory = .91, Affective = .82, Evaluative = .96, Miscellaneous = .92, and Total = .94. Melzack believed the MPQ provides valid indices of some of the dimensions of pain and that the questionnaire can be used to determine the effects of different therapeutic manipulations.

Crockett, Prkachin, and Craig (1977) attempted to determine empirically the nature and minimum number of dimensions necessary to describe responses to the MPQ. They compared two groups; one group received experimentally induced pain, and the other was composed of referrals to a back pain diagnostic clinic at a general hospital. Using an unweighted least-squares solution, the researchers found five factors to be significant: (a) immediate anxiety, (b) perception of harm, (c) somesthetic pressure, (d) cutaneous sensitivity, and (e) sensory information. These factors overlapped

considerably with Melzack and Torgerson's (1971) a priori classification of pain descriptors. The similarities were found in the factor groups loaded with items from Melzack and Torgerson's Affective and Sensory dimensions.

Leavitt, Garron, Whistler, and Sheinkop (1978) provided further support for the dimensions postulated by Melzack. Using 131 patients from the clinical services of three neurosurgeons and five orthopedic surgeons, the researchers determined the frequency with which particular words were used in describing back pain. A principal-component analysis with varimax rotation was applied to the correlation matrix for back pain. Seven interpretable factors were obtained, accounting for approximately 76% of the variance. The preponderance of affective-evaluative descriptors in two factors and specific sensory qualities in the remainder provide support for Melzack and Torgerson's general taxonomy of pain.

Reading (1979) administered the MPQ to 166 women complaining of dysmenorrhea who were attending gynecological clinics. Subjects' responses to the MPQ were subjected to factor analysis, and four factors were derived. Two of these factors reflected sensory qualities of the pain experience. Two factors relating to the reaction component of the pain also were noted. Reading's findings support the distinction between the sensory and reaction components of the pain experience.

Prietro et al. (1980) reported the results of oblique and orthogonal rotation of factors for a sample of patients with back pain. In analyzing subjects' responses to the MPQ, the researchers

found that four factors accounted for 51% of the total variance in responses. Three of the factors were composed solely of the Sensory, Affective, and Evaluative descriptor subclasses. The fourth factor was defined by both the Sensory and Affective subclasses. The researchers asserted that their study was based on appropriate statistical methodology, overcoming the deficiencies of previous investigations. They viewed the results as providing strong support for Melzack's (1975) three-factor conceptualization of the MPQ. The close correspondence between the factors in their study and Melzack's classifications of pain descriptors provides assurance that investigators and practitioners may continue to use Melzack's Sensory, Affective, and Evaluative pain rating indices.

McCleary, Turner, and Dawson (1981) examined the relationship between measures of emotional disturbance and the dimensions of the pain experience, in an attempt to discover the nature of the principal dimensions of pain. They used the MPQ to quantify the pain experience. Results of a factor analysis indicated that the relationships between pain descriptors and indicators of emotional disturbance were consistent. On the MPQ, patients with excessive somatic concern described their pain in terms of evaluative and affective descriptors, whereas those with significant somatic concern, depression, and hysteria described their pain as frightening.

Reading (1982) factor analyzed the MPQ scores obtained from women experiencing acute postepisiotomy pain. A comparison of these

patients' scores with those of chronic pain groups revealed specific sensory qualities and combined emotional-sensory dimensions. The results suggest that acute pain might involve less differentiation of the Sensory, Affective, and Evaluative dimensions than does chronic pain.

The distinction between sensory and affective subgroups was confirmed in the above-mentioned studies. The results lend support to the practice of deriving scale scores. These researchers also demonstrated, but with less consistency, the existence of an evaluative component.

Researchers investigating the relationship between MPQ scores and concomitant assessments of the psychological state also have addressed the construct validity of the MPQ. Kremer and Atkinson (1981) used a population of chronic pain patients to examine the relationship between subjects' scores on the Affective dimension of the MPQ and independent measures of affect and infirmity. The major finding was that the Affective dimension of the MPQ appeared to have good construct validity. Subjects who had high scores on the Affective dimension of pain reported significantly greater scores on depression, anxiety, and somaticization than subjects who had low scores on the Affective dimension. This finding demonstrates that the Affective dimension of the MPQ provides a valid summary of the affective status of this population, supporting the interpretation that the Affective dimension has good construct validity.

McCleary et al. (1981) studied MMPI profiles in relation to MPQ scores. In a multiple-regression analysis, the researchers used the

MMPI results as criterion variables and the MPQ scales as predictors. McCleary et al. found that scores on the Affective dimension contributed to the prediction of MMPI profiles. They pointed out that patients who experienced more emotional disturbance tended to describe their pain as more intense, frightening, unbearable, and burdensome. The Affective dimension was related to signs of emotional disturbance, independent of descriptions of pain intensity.

Pearce and Morely (1989) examined the construct validity of the MPQ through the use of an experimental technique attempting to bypass conscious processing. Researchers performing the Stroop task show subjects a series of colored words printed in another color. Red would be printed in blue ink, and subjects would be asked to name the color in which they are printed. If the subject is to name the correct color name, the competing response must be inhibited by the attentional process. Active inhibition is achieved at the expense of attentional resources. This reduces the attentional capacity available for processing the correct response, resulting in a slower response time.

Pearce and Morely (1989) hypothesized that the Stroop interference effect would be most marked for pathological groups in tasks that use words that activate the predominant accessible constructs. They contended that the Stroop procedure may be used in an experimental analysis of the MPQ's construct validity. The researchers predicted that chronic pain patients would show greater

interference on words representing the pain construct, on the assumption that the construct is chronically activated in pain patients. Pearce and Morely predicted that words representing the affective component of pain should produce greater interference than sensory words, on the assumption that one characteristic of chronic pain patients is the dominance of negative-pain-related affect.

The differences between chronic pain patients and controls on the sensory and affective Stroop tasks supported the prediction that the pain group would have more cognitive representation of sensory and affective components of pain in comparison to the control group. Pearce and Morley concluded that chronic pain patients are more susceptible to interference effects when stimuli are pain related. Thus, through the use of an experimental technique from cognitive psychology, further validity was attributed to the MPQ.

Concurrent validity. The concurrent validity of the MPQ has been supported in a number of clinical trials. Reading (1979) investigated the concurrent validity of the MPQ by comparing the pain scores of women relying on pain killers and those denying the regular use of analgesics. The use of analgesics was related to the total questionnaire score, as well as to the score on the factor composed of Evaluative and Affective dimensions, reflecting the reaction component of pain. Reading suggested that the reaction to pain (in terms of taking medication) was more closely related to the significance attached to the pain, as indicated by reaction words, than it as to the level of sensation experienced.

Van Buren and Kleinknecht (1979) used the MPQ to investigate pain reports following oral surgery (extraction of the third molar). The researchers found that higher scores on the Sensory, Affective, and Evaluative dimensions and on the PPI rating were related to longer recovery times and increased use of both narcotic and non-narcotic pain medication. The findings support the contention that all four subscales of the MPQ tap some responses indicative of the pain experience.

Klepac, Dowling, and Hauge (1981) supported the validity of interpretations drawn from MPQ differences in clinical practice and research. They found that subjects describing cold presser pain (subjects immersed their left hands in a container of ice water maintained at 2 +/- 1 degrees Centigrade through refrigeraion and addition of ice chips) had significantly higher scores than did those exposed to tooth shock (electrical stimuli delivered to healthy maxillary incisors in low current levels and increments required for tooth-pulp stimulation). Those subjects describing tooth shock received two ascending series of electrical shock below sensation threshold and in increasing increments through reported sensation threshold and to pain threshold levels. At this point, half of the subjects were stopped and asked to complete the MPQ to describe the most intense sensations they had experienced; the other half were continued to pain tolerance, after which they completed the MPQ. Similar procedures were utilized with subjects describing cold presser pain. Half of the subjects removed their hands at pain

threshold and completed the MPQ. The other half continued to tolerance before completing the MPQ.

Subjects who described tolerance levels of stimulation scored higher on all measures than those exposed to threshold levels of pain (Klepac et al., 1981). The differences reached acceptable levels of statistical reliability on the Sensory, Evaluative, and Total dimensions, and on the PPI rating. The results clearly supported the validation of the MPQ. The researchers found that pain threshold, as compared to pain tolerance, was associated with lower scores on two of the three global measures of intensity (PRI and PPI), as well as on three of the four subscale scores. The findings supported the utility of the MPQ in describing intensity and qualitative differences in pain, in both laboratory and clinical studies. The usefulness of the MPQ in comparing the various types of pain of interest to clinicians and researchers was also reinforced by the results of this study.

Hunter and Philips (1981) obtained additional support for the concurrent validity of the MPQ. They found significant correlations between subjects' MPQ scores and diary-card ratings of the intensity and duration of headaches. The total intensity of pain quality and the affective response to pain were significantly associated with the intensity and duration of headaches. The sensory qualities of the experience and pain evaluation were associated only with pain intensity.

Discriminant validity. Reading's (1981) comparison of MPQ profiles of women experiencing pelvic pain supported the

discriminant validity of the MPQ. He found that patients with acute pain, as compared to those with chronic pain, displayed greater use of sensory word groups, testifying to the pronounced sensory input from the damaged perineum. The chronic pain patients, in contrast, used affective and evaluative word groups more frequently. The results of this study reflect the diagnostic potential of the MPQ. This is consistent with Reading's clinical observations that subjects will display distinctive score profiles according to the nature of the pain. Thus, the MPQ is efficient in distinguishing among patient groups.

Conclusions. The MPQ has been found to have acceptable reliability, as well as face, construct, concurrent, and discriminant validity. Since its introduction in 1975, the MPQ has been recognized as a useful instrument with which to obtain data on both qualitative and quantitative aspects of pain. A major advantage of this instrument is that it scales pain multidimensionally.

The widespread acceptance of the MPQ is demonstrated by its translation into Finnish (Ketovuori & Pontinen, 1981), German (Stein & Mendl, 1988), Arabic (Harrison, 1988), and Dutch (Vanderiet, Adriaensen, Carton, & Vertommen, 1988). The relatively recent translations of this instrument have not been as extensively supported as the English version.

The Department of Health and Human Services of the Commission on the Evaluation of Pain (1986) reviewed many of the principal

measures of pain behavior. Special attention was given to the MPQ. The Commission reported that the MPQ is a widely used and accepted instrument with which to address the sensory, cognitive, and emotional aspects of pain.

In a report by the Institute of Medicine (1987), the MPQ was described as "perhaps the most thoroughly evaluated multidimensional scaling device for pain." It is the standard by which other measures of subjective pain states are compared.

The Affective Dimension of the McGill Pain Questionnaire

Historically, psychological distress in chronic pain patients had been viewed as the cause of the pain in these individuals. Excessive somatic concerns and personality traits commonly have been named as a cause of chronic benign low back pain. However, research has not supported this point of view. White and Gordon (1982) found these same characteristics in individuals with objective causes of back pain. Waddell, Pillowsky, and Bohn (1989) found that subjects with abnormal illness behavior had higher levels of objective physical impairment, pain, disability, psychological distress, time off from work, and previous surgeries than individuals with normal illness behavior. This finding supports the belief that psychological distress, abnormal illness behavior, and signs appear secondary to physical problems. Taking this line of inquiry a step further, Keefe, Crisson, Urban, and Williams (1990) found that patients having few physical findings showed the fewest pain behaviors. Conversely, patients with more physical findings exhibited the most pain behaviors. This suggests that the

combination of psychological distress, physical complaints, and physical findings is far more complicated than historically perceived.

Findings of the previously mentioned research indicated the importance of evaluating psychological or affective distress. The Affective dimension of the MPQ is an effective tool for this purpose. It holds significant interest and implications for future research.

The Affective dimension of the MPQ has been evaluated in a variety of clinical settings. Research results have demonstrated that pain patients with a medical diagnosis suffer as much affective distress as patients without identifiable organic etiology (Stanton, 1990). Researchers using the MPQ have been unable to discriminate between medical and psychiatric diagnoses (Kremer, 1983). The most reliable use of pain language, then, might be as an index of affective distress.

Kremer (1983) demonstrated that affective descriptors of pain are better predictors of psychological distress than are patterns of sensory and affective descriptors. He also found that the MPQ measure of affect is important because it is part of a pain-assessment instrument and therefore is not presented as a measure of psychological distress. Many chronic pain patients are sensitive to any implication that their pain complaint is mental, and using an obvious measure of psychological distress could alienate them. Because it is not obvious what the Affective dimension of the MPQ is assessing, it can be of considerable clinical utility.

McCreary (1981) found that patients with high scores on the MMPI Hypochondriasis scale described their pain as more intense and as high in terms of affective and evaluative descriptors on the MPQ. The MMPI Depression and Hysteria scales, reflecting emotional disturbance, were also associated with a more intense description of pain and higher scores on the Affective dimension of the MPQ.

Aronoff and Evans (1982) provided further support for the effectiveness of the Affective dimension of the MPQ as a measure of emotional distress. Their results corroborated the finding that the Affective and Sensory dimensions of the MPQ correlated with the MMPI Hypochondriasis scale. They further stated that the MMPI Depression scale was related only to the Affective dimension of the MPQ.

Affect and Worker's Compensation

The combination of affective distress and receipt of worker's compensation has been investigated in a number of studies. Mendelson (1982) and Pelz and Mersky (1982) found that patients with low back pain could not be categorized neatly into worker's compensation and non-worker's-compensation groups. Both groups, worker's compensation and non-worker's compensation, had higher levels of psychological disturbance than the normal population, but they did not differ from each other. In contrast, Melzack (1985) found that patients with low back pain who received worker's compensation had significantly lower scores on the Affective dimension of the MPQ and fewer visits to health professionals, as compared to their counterparts who received no compensation.

Dworkin (1985, 1986) studied chronic pain cases and found that compensation predicted poor short-term outcome. In his 1986 study, Dworkin found that nondepressed individuals who were not receiving worker's compensation improved with a greater number of treatments than did depressed individuals.

Kleinke and Spangler (1988) found that elevations on the MMPI Depression and Hysteria scales predicted positive treatment success. They also found exceptions to this generality, leading them to conclude that recipients of worker's compensation must be regarded individually. Similarly, Block et al. (1980) found that patients who were in litigation needed to be assessed carefully for motivation and also needed to have limited treatment goals.

Summary

This chapter contained a review of literature related to the physiology of chronic pain, the transmission of pain signals, and theories regarding pain. The writer also discussed the results of multidisciplinary treatment programs for low back pain and research on the prediction of treatment outcomes of multidisciplinary pain clinics (MPCs). The McGill Pain Questionnaire was reviewed in depth, as was the Affective dimension of the McGill Pain Questionnaire (MPQ), and the relationship of affect to receipt of worker's compensation. Results of outcome studies using an operant approach, the relaxation approach, the cognitive approach, a multimodal approach, and a prediction approach were summarized in tabular form.

CHAPTER III

METHODOLOGY

Introduction

The primary purpose of this study was to determine the existence and nature of any relationship between patients' scores on the Affective dimension of the MPQ and the outcome of an MPC treatment program. A secondary purpose was to determine what combinations of MPQ Affective score, demographic variables (age, educational level, spouse's employment, marital status, employment status at intake, involvement in litigation, involvement in rehabilitation, and sources of income), and historical variables (length of chronicity, number of hospitalizations, number of surgeries, and number of past employers) best predict the outcome of treatment.

The methodology used in conducting this observational study is described in this chapter. First, the research questions and hypotheses are restated. The study site and the treatment process are then discussed. Next, the sample-selection procedure is explained, and the sample is described. The instruments employed in the research are discussed in detail. The data-collection and data-analysis procedures used in the study also are presented.

Research Questions

The following research questions were posed to guide the collection of data for this study:

1. Will subjects' scores on the Affective dimension of the MPQ correlate positively with successful outcome following treatment in an MPC?

2. Will the MPQ Affective dimension scores of subjects in the worker's compensation group, the group covered by no-fault automobile insurance, and the group receiving no financial support differ over the course of treatment: at intake, upon completion of the program, through follow-up?

3. Is there a difference in the treatment-success rates of the three groups (those receiving worker's compensation, those covered by no-fault automobile insurance, and those receiving no financial support)?

Research Hypotheses

The following hypotheses were formulated to guide the analysis of data gathered in this study:

Hypothesis 1: Chronic pain patients' scores on the Affective dimension of the MPQ at intake will correlate positively with successful outcome following treatment in an MPC.

Hypothesis 2: Subjects with high scores on the Affective dimension of the MPQ at intake will have a nonlinear pattern of Affective dimension scores over the course of treatment, upon completion of the program, and at follow-up.

Hypothesis 3: There will be no difference in the treatment-success rates of the three study groups: those receiving worker's compensation, those covered by no-fault automobile insurance, and those receiving no financial support.

Description of the Study Site and the Treatment Process

Mary Free Bed (MFB) Hospital and Rehabilitation Center in Grand Rapids, Michigan, was the site of the study. MFB is a large, nonprofit hospital and rehabilitation center that draws patients from all of western Michigan. MFB's pain program is multidisciplinary. A team approach is used; the team includes an orthopedic specialist, a family physician, a physiatrist, a physical therapist, a psychologist, and a program manager. Because the chronic pain problem is so complex, a treatment approach is required that incorporates the various areas of medicine to provide patients with the tools they need to gain control of their pain.

Patients are referred to MFB by a physician or a third-party insurance carrier. Selection of patients for the MFB pain program is a critical process. Prospective patients undergo a comprehensive evaluation designed to determine whether they have ongoing medical problems that can account for the pain. If a medical basis for the pain is identified, an appropriate referral is made. The prognosis for treatment is then determined. If it is decided that the patient is a candidate for MFB's program, the duration and intensity of treatment are recommended.

After a patient is accepted into the pain program, team members from the various disciplines converge to emphasize individual education. The average length of treatment is 4 to 6 weeks, but the program is designed to meet individual needs as assessed by the team. Some patients are seen as infrequently as once a week for 6

weeks, whereas others are seen as intensively as twice a day for 2 weeks.

The patient's visit to the clinic might consist of physical therapy, group or individual sessions with the team psychologist, biofeedback sessions, and education on body mechanics. Each patient's improvement is evaluated weekly by the team in a conference designed to monitor the patient's progress and to modify the treatment plan according to the individual's needs.

The pain program is viewed as a learning experience designed to help the patient develop independence. The patient learns exercise regimens, physical therapy, and body mechanics, as well as how to apply behavioral-medicine strategies and psychology in learning to cope with the pain. The ultimate benefit is realized 3 to 6 months after completion of the program when the patient applies these modalities in daily life outside the program.

Selection and Description of the Sample

Patients were obtained from the chronic pain program of Mary Free Bed Hospital and Rehabilitation Center (MFB). All records of patients from 1986 through 1990 were reviewed to identify patients who would be appropriate subjects for this study. Beginning from a list of 105 patients, the researcher applied several selection criteria. Patients selected for the study had to have suffered from low back pain. Low back pain was defined as pain originating or centering at or around the lumbar or sacral area of the back. The pain had to be of at least 6 months' duration before the patient

began treatment. The subjects had to be voluntary participants in the program. A favorable recommendation had to have been made by the multidisciplinary team to allow the client to participate in the program. Medical records had to indicate that no additional medical treatment was needed. Successful completion of the program was required for the patient to be included in the sample. The subjects had to have completed the program at least 6 months before the follow-up procedure. Further, a review of the charts had to demonstrate that the MPQ had been administered at intake, at least three times during the course of treatment, and at least once through follow-up. The chart review reduced the number of subjects to 85.

A letter was sent to each subject in the sample (Appendix B), describing the study and advising them that their participation was voluntary. MFB's follow-up questionnaire was enclosed, along with the Productivity of Life Questionnaire. A stamped, self-addressed envelope was attached for the subjects' convenience. Approximately 30 days after the initial follow-up letter was sent out, a second request, duplicating the previous mailing, was sent. After approximately 30 days, the researcher attempted to telephone the subjects who had failed to respond to the mailed request. Three individuals declined to participate in the study. An additional seven subjects declined to provide follow-up information over the telephone or could not be contacted.

Of the 85 patients in the sample, 75 provided responses to the follow-up questionnaire. This resulted in a response rate of 88%. The 75 subjects were divided into three groups for comparison purposes. Forty-three subjects were receiving worker's compensation benefits, 11 were receiving automobile no-fault benefits, and 21 were not receiving any form of subsidized financial support.

The sample was representative of other follow-up studies (Guck, Skultety, Meilman, & Dowd, 1985; Turner & Clancy, 1986) and prediction studies (Aronoff & Evans, 1982; Carlsson, 1984; Guck et al., 1986; Keefe, Block, Williams, & Surwit, 1981; Kleinke & Spangler, 1988; Maruta, Swanson, & Swenson, 1979; Painter, Seres, & Newman, 1980) when considering variables of age, education, gender, marital status, length of chronicity, and number of surgeries for pain. This sample was similar to Keefe et al.'s (1981) sample, which the researchers described as fitting "most of the characteristics commonly ascribed to the chronic low back pain syndrome in North America" (p. 233). Demographic characteristics of the sample are presented in Chapter IV.

Instrumentation

The instruments used in the study are discussed in this section. The three instruments used in the research were the McGill Pain Questionnaire, the Productivity of Life Questionnaire, and a follow-up questionnaire used by MFB.

The McGill Pain Questionnaire

The McGill Pain Questionnaire was reviewed in depth in Chapter II. A summary of its reliability and validity is given in the following paragraphs.

The MPQ is a reliable instrument (Hunter & Philips, 1981). As a result of their study, Hunter and Philips demonstrated the ability of patients to remember pain and report it consistently.

The MPQ has been found to have face validity (Kremer, Atkinson, & Ignelzi, 1981). Construct validity has been demonstrated by a number of researchers (Kremer & Atkinson, 1981; Leavitt, Garron, Whisler, & Sheinkop, 1978; McCreary, Turner, & Dawson, 1981; Prieto et al., 1980; Reading, 1979, 1982). The MPQ has been used in a number of clinical trials to provide information that supports its concurrent validity (Buren & Kleinknecht, 1979; Hunter & Philips, 1981; Reading, 1979, 1981, 1982). Discriminant validity has been shown in distinguishing between patient groups (Dubuisson & Melzack, 1976; Reading, 1982).

The affective dimension of the MPQ was used to measure the level of affective distress acknowledged by each individual patient. Patients' scores on the MPQ Affective dimension were obtained at intake, weekly throughout the course of treatment, and at follow-up.

The Productivity of Life Questionnaire

To measure the subjects' level of productivity, the Productivity of Life Questionnaire developed by DeJong and Hughes (1980) was used. (A copy of the Productivity of Life Questionnaire

is contained in Appendix C.) This questionnaire was one of two outcome measures used in the study.

DeJong and Hughes developed the Productivity of Life Questionnaire (PLQ) to evaluate a range of rehabilitation outcomes among persons with spinal cord injury (SCI). Traditionally, programs have been judged solely on the number of patients who are able to return to work following treatment. As important as this is, it is an incomplete criterion. DeJong (1981) pointed out that many disabled people make uncompensated, yet substantial, contributions to both home and community. In an effort to evaluate people's ability to live more productively following rehabilitation, the PLQ was developed. Productivity was evaluated in terms of contributions made to family and community life, not solely in terms of gainful employment. The questionnaire examines five dimensions of productivity by evaluating respondents' participation in (a) gainful employment--whether they worked full time, part time, or not at all; (b) homemaking--includes one or more of meal preparation, house-cleaning, food shopping, and supervising children or dependent adults; (c) school or educational programs--full time, part time, or not at all; (d) formal organizations--including both disability-related organizations and nondisability organizations, i.e., the local Rotary Club, school, PTA, fraternal organizations, and so on; (e) leisure-time activities, active--where the individual leaves home to attend recreational events or to visit friends, and passive

--where the individual remains at home to watch television or have friends visit.

Consideration was given to the degree of participation in each activity. The individual's productivity outcome was defined according to the activities in which the person participated and the degree of participation. The best possible outcome is an individual's participating as fully as possible in all activities. The worst possible outcome is the individual's failure to participate in any of the activities except a form of passive leisure.

The results for the 111 persons in DeJong and Hughes's (1980) study group were collapsed into 12 outcomes, based on similarity and frequency of occurrence. A 42-member panel from the Massachusetts Interagency Council on Independent Living (ICIL) ranked and weighted the outcomes. The ICIL members ranked outcomes involving employment or school as the most productive; those involving formal organizations or homemaking were ranked the next most productive. Outcomes involving only active leisure or passive leisure were ranked the lowest. The productivity outcomes were classified as most productive, moderately productive, and least productive. (The rankings and weightings of productivity outcomes are shown in Appendix D.)

To determine whether there were any significant differences in the weighting of outcomes among ICIL members, data were analyzed based on members' age, gender, and disability status. No statistically significant differences in weightings were found,

based on age and disability status. There was a difference on the basis of gender. Women tended to give more weight to productivity outcomes involving homemaking when it was the major nonleisure-time activity than did men. These results indicate that the PLQ has satisfactory interrater reliability (DeJong & Hughes, 1980).

The Follow-Up Questionnaire

The follow-up questionnaire used by MFB is regularly sent out at 1-month, 3-month, 6-month, and 12-month intervals. The questionnaire contains items asking the former patients whether they were working at the time of discharge, are presently working--if so, list employer, type of job, length of employment, and hours per week. If they are not working, subjects are asked whether they are involved in a job club or job search. (A copy of this questionnaire may be found in Appendix E.)

A special section of four questions relates to worker's compensation or automobile no-fault coverage. These questions relate to vocational rehabilitation and the type of training, if any, with which subjects were involved. The clinic was also concerned with whether the subjects had obtained second-injury certification.

The questionnaire contains the MPQ. MFB also questions the individuals about whether they are using the stress-reduction techniques taught in the program. They are also queried as to the level of depression, if any. The follow-up form has questions on pain medication, physician treatment, new pain problems, and

surgery. There is a section on flexibility, exercise, and body mechanics. The questionnaire concludes with a section on participation in light cleaning, meal preparation, laundry, heavy cleaning, and yard work.

Return to work was defined as an individual's having successfully obtained employment and maintained it for at least 3 months. Participation in rehabilitation was defined as a subject's taking part in a structured vocational rehabilitation program with a specific vocational goal. Subjects' return to work and participation in a rehabilitation program constituted a dichotomous outcome measure for this study, while the Productivity of Life Questionnaire provided a continuous outcome measure.

Data-Collection Procedures

Before beginning to collect the data for this study, the investigator submitted the research proposal to the Michigan State University Committee on Research Involving Human Subjects (UCRIHS). Upon receiving approval from UCRIHS (see Appendix F), the researcher sought and obtained permission to conduct the study from MFB's Education and Research Committee and the hospital's Human Subjects Review Committee.

The initial predictive data were gathered from the Pain Rehabilitation Program Attachment (see Appendix G), contained in patients' files at MFB. Patients' scores on the MPQ (which had been administered weekly during treatment, as well as demographic and historical data, were obtained by reviewing this attachment.

Information obtained from the chronic back pain clinic and that received from the subjects was recorded on a data summary form (Appendix H). All data obtained from these procedures were coded and recorded by medical number only, to protect patients' anonymity and to ensure that their responses would remain confidential. Patients' names were not used in this study.

Data-Analysis Procedures

Correlations were calculated among many subject characteristics, including scores on the MPQ and treatment outcome. The formula used for the correlation coefficients is as follows:

$$r = S_{xy}/S_x S_y = \frac{\sum_{i=1}^{N} (x_i - \bar{x})\,(y_i - \bar{y})}{\{ [\sum_{i=1}^{N} (x_i - \bar{x})^2] [\sum_{i=1}^{N} (y_i - \bar{y})^2] \}^{1/2}}$$

where:

x_i = the ith observation of variable x

y_i = the ith observation of variable y

n = number of observations

$\bar{x} = \sum_{i=1}^{N} x_i/N$ = mean of variable x

$y = \sum_{i=1}^{N} y_i/N$ = mean of variable y

This formula is to be used when examining linear relationships between variables. It is based on the following assumptions:

1. For each value of x, the distribution of the associated y values is a normal distribution and vice versa.

2. The y means for each value of x fall on a straight line--the relationship is linear. The same is true for each value of y.

3. The scatterplots possess homoscedasticity--the variance in the y values is uniform across all values of x. Conversely, the variance in x values is constant for all values of y.

Regression analysis was used to determine the relationship between sets of predictor variables and outcomes. The outcome (y) measures used in this analysis were productivity of life, return to work, and participation in a rehabilitation program.

The regression model used in this analysis is as follows:

$$y = b_0 + b_1x_1 + b_2x_2 + \ldots + b_nx_n + e$$

where:

b_0 is the intercept and

b_1 through b_n are regression coefficients.

This model is based on the following assumptions:

1. The y scores are normally distributed at all points along the regression line; that is, the residuals are normally distributed. (There is no assumption that the independent variables are normally distributed.)

2. There is a linear relationship between the x's and y's at all points along the straight regression line; the residuals have a mean of zero.

3. The variance of the residuals is homogeneous at all points along the regression line.

4. The independent variables are fixed.

The second hypothesis evaluated the effect of group membership on productivity by using the fixed-effects ANOVA procedure. This was used to evaluate continuous and categorical variables. The formula for this procedure is as follows:

$$y_{ij} = \mu + \alpha_j + \varepsilon_{ij}$$

where:

y_{ij} = productivity score of subject i in group j,

μ = grand mean,

α_j = effect of group j (by type of compensation), and

ε_{ij} = error.

This procedure is based on the following assumptions:

1. The outcome observations are drawn from normal populations.

2. The observations are random samples from the population.

3. The error terms for any group are independent and normally distributed with a mean of zero and variance σ^2.

The second assumption must be qualified in that the subjects were not completely randomly sampled from a definable population. However, this limitation is inherent in studies of chronic pain patients. The sample used in this study is typical of patients with chronic low back pain, treating with MPC's across the country. Keefe et al. (1981) stated that the characteristics are commonly ascribed to subjects suffering from chronic low back pain syndrome

in North America. It is not expected that the sample is biased in any way.

The second hypothesis was further evaluated by utilizing the hierarchical linear model (HLM). The HLM is a two-level model involving repeated measures expressed as a growth model. HLM models can represent any number of levels. This research uses HLM in considering a two-level problem. The hierarchy involves individual growth parameters for subjects (level 1) and between-person variation among growth parameters (level 2).

The general formula for the HLM results at the individual (first) level is as follows:

$$y_{ti} = \pi_{oi} + \pi_{1i}t_i + \pi_{2i}t_i^2 + e_{ti}$$

for i = 1 to 69 people, observed on t_i occasions (varies from 4 to 12 observations

y_{ti} = affect of subject i at time t

π_{oi} = intercept

π_{1i} = instantaneous growth rate for person i

π_{2i} = the curvature or acceleration in each person's growth trajectory for affect

Pretest-posttest designs traditionally have been used to evaluate the results of MPC programs. Such designs have been recognized as inadequate for studying individual change (Bryk & Weisberg, 1977; Kleinke & Spangler, 1988; Rogosa, Brand, & Zimowski, 1982). However, the HLM has been found to be a satisfactory means

for measuring change and assessing multilevel effects (Bryk & Raudenbush, 1988).

The HLM has developed out of three themes of methodological work (Bryk & Raudenbush, 1988): the mixed model ANOVA, random coefficient regression, and the statistical theory of covariance components. The two-level HLM model requires specification of two interrelated equations. This research uses a within-unit (person) and a between-person model.

The HLM for research on individual growth provides an adequate measure of individual change. The y_{it} is the observed status of individual i at time t. This is a function of a systematic growth trajectory (or growth curve) plus random error. It is assumed that the systematic growth over time is represented as a polynomial of degree k; in this case, k is 2.

It is assumed that errors, e_{it}, are normally distributed with a mean of zero and constant variance (Bryk & Raudenbush, 1988). An important feature of the above equation is the assumption that the growth parameters vary across individuals (Bryk & Raudenbush, 1988). The between-person model represents this variation. For each of the three (k = 0 to 2) individual-growth parameters, we let

$$\pi_{ki} = b_{ko} + b_{k1}x_{k1i} + b_{k2}x_{k2i} + \ldots + b_{kj}x_{kji} + u_{ki}$$

where

x_{kji} = jth measured characteristic of the individual, either background (e.g., gender or marital status) or group membership (type of compensation)

b_{kj} = the effect of x_j on the kth growth parameter

u_{ki} = the random effects (errors or residuals) with full covariance matrix, T, dimensioned (3 x 3), for

i = 1 to 69,

j = 1 to 22, and

k = 0 to 2.

Thus we have

$$\pi_{0i} = b_{00} + b_{01}x_{01i} + b_{02}x_{02i} + \ldots + b_{0p}x_{0pi} + u_{0i},$$

$$\pi_{1i} = b_{10} + b_{11}x_{11i} + b_{12}x_{12i} + \ldots + b_{1p}x_{1pi} + u_{1i}, \text{ and}$$

$$\pi_{2i} = b_{20} + b_{21}x_{21i} + b_{22}x_{22i} + \ldots + b_{2p}x_{2pi} + u_{2i}.$$

This model is used in research on change to perform a number of functions. This model describes the structure of the mean growth trajectory. It is used to estimate the extent and character of individual variation around mean growth. The model allows us to assess the reliability of measures of both status and change. It also allows estimation of the correlation between a subject's entry status and rate of growth, and examines correlates of status and change. It further allows assessment of the adequacy of between-subject models by estimating the reduction in unexplained parameter variance. The model also improves estimates for each individual's growth trajectory and prediction about individual future growth (Bryk & Raudenbush, 1988).

The important component for this part of the statistical analysis is that the growth parameters differ over time between subjects. One growth curve is not assumed to describe the growth of every individual. The second-level model then tries to explain differences in the curves.

The third hypothesis was analyzed by use of the chi-square test of association. This is based on a 2 x 3 contingency table in the case examined here.

The formula is as follows:

$$\chi^2 = \sum_{r=1}^{2} \sum_{c=1}^{3} n_{.c} \frac{(P_{rc} - \hat{\pi}_{r.})^2}{\hat{\pi}_{r.}}$$

Each cell's contribution is the square of the discrepancy between the observed and expected proportions $(P_{rc} - \hat{\pi}_{r.})^2$. P_{rc} is the proportion of the observations in each column that falls into each row, divided by the expected proportion $(\hat{\pi}_{r.})$ and multiplied by the number of observations in the column $n_{.c}$ for that cell. The sum of this result for all cells is then the chi-square statistic for the contingency table (Glass & Hopkins, 1984, p. 287). This is used to test hypotheses about the association between the two variables, success and group membership.

Observational Research

This study was designed to avoid methodological problems that often characterize observational research. In an effort to overcome limitations of collecting observational data, a reliable and valid self-report instrument, the MPQ, was used. Thus, objective data were obtained through self-report. These data related to the complex set of behaviors referred to as chronic low back pain.

A problem that exists in observational research is the presence of the observer. This problem was minimized as a result of

impartial collection of data through telephone calls and the mailing of questionnaires.

The difficulty associated with the time factor was overcome by using existing data on the subjects from MFB records. This provided data collected by independent observers not previously associated with the research.

Descriptive variables were used in this research. They have an advantage over inferential and evaluative variables because they require little inference on the part of the researcher (Borg & Gall, 1971) because inferential variables require inference from a sample to a population, which might or might not be justified.

Recording observations was straightforward. The observational variables identified to be used in the study were listed on the data-collection form. This was easy to use because the categories were well defined and did not require a high degree of inference.

The issue of training observers was avoided in this study as a result of the use of the MPQ and MFB's intake and follow-up questionnaire. The MPQ was scored in the traditional manner by individuals with a number of years of experience with the procedure. MFB's questionnaire provided straightforward descriptive data.

The MPQ is viewed as an unobtrusive measure. This effectively minimized observer bias. There was minimal exposure for the researcher to have an influence on the subjects. This effectively eliminated the subjects being influenced by the researcher's purpose. Observer bias was not involved because the descriptive variables did not call for conclusions or inferences.

Rating errors were avoided through the use of the standardized measure, the MPQ. The error of central tendency was avoided through the use of variables measured on a dichotomous scale. The halo effect also was avoided because personal contact with subjects in the study was avoided.

It is believed that contamination was avoided in this study as a result of the data-collection procedures and the clear definitions of success stated before collection of data began.

Summary

The methodology of the study was explained in this chapter. The research questions and hypotheses were restated, and the sample and study site were described. Sample-selection, data-collection, and data-analysis procedures were discussed. The instruments used in the study were described, with emphasis on the development, reliability, and validity of the MPQ. The results of the data analyses conducted for this study are presented in Chapter IV.

CHAPTER IV

RESULTS

Introduction

An analysis of the data is presented in this chapter. The statistical analyses were calculated at the Michigan State University Computer Center. The Statistical Package for the Social Sciences (SPSS-X) computer program was used to analyze the data. The HLM package (Bryk, Raudenbush, Congdon, & Seltzer, 1986) was used for the hierarchical analysis.

Demographic Characteristics of the Sample

The demographic results of the study are presented in this section. The results are summarized in Tables 4.1 and 4.2.

A total of 75 subjects (33 men and 42 women) participated in this study. Forty-three subjects (57.3%) were receiving worker's compensation when they participated in MFB's program. Eleven subjects (14.7%) were receiving auto no-fault benefits at the time of their participation in MFB's program. The other 21 subjects (28%) were not receiving any financial assistance as a result of their physical impairment.

The subjects ranged in age from 17 years to 78 years at the time of their involvement in MFB's program. The average age of the participants was 39.7 years.

Table 4.1.--Distribution of dichotomous variables used in analysis.

Variable	Yes (%)	No (%)
Worker's compensation	57	43
Automobile no-fault	15	85
High school graduate	77	33
Married	69	31
Spouse employed	28	40
Retired or employed	25	75
Litigation	23	76
Rehabilitation involvement	43	49

Table 4.2.--Distribution of continuous variables used in analysis.

Variable	Minimum	Maximum	Average
Age	17 years	78 years	39.7 years
Education	6 years	18 years	12.2 years
Length of pain complaints	6 months	20 years	36.5 months
No. of days hospitalized	0 days	42 days	2.5 days
Surgeries for pain	0 surg.	9 surg.	1.3 surgeries
Number of employers	1 emp.	6 emp.	2.3 employers

Seventeen of the subjects (22.9%) had not completed high school, whereas 58 of the subjects (77.1%) were high school graduates. The average level of education of the subjects was 12.3 years.

Fifty-two subjects (69%) were married; 23 (31%) were not. The spouses of 21 subjects (28%) were not employed. Thirty of the spouses (40%) were employed at the time of participation in the study. Spouse-employment data were missing for 24 subjects (32%).

A distinction was not made between not employed and seeking work and chronically unemployed.

Employment status was unrelated to gender, as indicated by a correlation coefficient of .04. Men and women tended to be unemployed in roughly equal proportions. Nineteen of the subjects (25%) were employed or retired at the time of participation in the program. Fifty-six subjects (75%) were not employed.

The average number of employers for subjects before entering the program at MFB was 2.3. Fifty-six subjects (80%) had three or fewer employers before entering the program. Fourteen subjects (20%) had between four and six employers. This is a lower number of employers than one would expect to see; the hospital records only the number of major employers during adult life. Also, the number of employers is a factor in evaluating candidates for participation in the program, so applicants with many short-term employers may be screened out (Kremer, 1991).

Thirty-seven subjects (49%) had one source of income at the beginning of their participation in MFB's program. Thirty-three subjects (44%) had two sources of income in the household, and five subjects (7%) had three sources of income.

The average length of chronic pain was 36.5 months. The range of chronicity was from 6 months to 20 years. The average number of days hospitalized for pain in the past year was 2.5 days. However, 45 subjects had not been hospitalized for pain. Eleven subjects had missing data in this area. Those hospitalized for pain spent an average of 8.5 days in the hospital.

The average number of surgeries for pain relief was 1.3. Thirty-one subjects (41%) did not have any surgery. Nineteen subjects (25%) had one surgery. Fifteen subjects (20%) received two surgeries for pain relief. Five subjects (7%) had three surgeries, and five subjects (7%) had four or more.

Fifty-seven subjects (76%) did not have litigation pending when they began their participation in MFB's program. Seventeen subjects (23%) were involved in some form of litigation. One subject did not report this information.

McGill Pain Questionnaire Results

The McGill Pain Questionnaire results are summarized in Table 4.3. A Present Pain Intensity (PPI) of 72.8 (on a scale of 0 to 100) indicates a moderately high level of overall pain intensity. A sensory score of 51.3 indicates that they have selected a combination of words that reflect a moderate level of discomfort. This level of sensory discomfort seems proportionately lower than would be expected, given the average PPI of 72.8. This suggests that they may be experiencing some symptom magnification. An affective score of 25.1 is a mild elevation of affective distress. The evaluative score of 75.8 is moderately high. The number of words chosen (NWC) of 18 is a moderate number.

The results on success of the rehabilitation process were computed in simple percentages. Success was defined as being employed or participating in a rehabilitation program at the time of the last follow-up. The unsuccessful group numbered 29 (38.7%).

The successful group included 38 (50%) individuals who returned to work and 8 (10.7%) individuals who were participating in rehabilitation, a total of 46 (61.4%).

Table 4.3.--McGill Pain Questionnaire results.

Variable	N	Mean	SE	Min.	Max.
PPI	75	72.8	2.00	25	100
NWC	75	18.2	1.29	3	65
Sensory	75	51.3	2.36	7	100
Evaluative	75	75.8	3.40	10	100
Affective	75	25.1	2.65	0	86

Correlation Data

The correlation coefficients are presented in Table 4.4. There were several significant correlations; however, the only large significant correlation was that between productivity and the dichotomous measure of outcome (r = -.93). The PLQ was reviewed in Chapter III. It should be noted that high productivity scores, or levels 9 through 12, were the least productive, levels 5 through 8 were moderately productive, and levels 1 through 4 were the most productive.

The first hypothesis, "Chronic pain patients' score on the Affective dimension of the MPQ at intake will correlate positively with successful outcome following treatment in an MPC," was not substantiated by the data. The correlation coefficient was .01 for outcome and affect. The correlation coefficient for affect and productivity was .14.

Table 4.4.--Correlation coefficients.

	Gender	Age	Education	Marital	Spouse employed	Client employed	Litigation	Rehabilitation	Income	Chronicity	Hospitalizations	Surgery	Employers	PPI	NWC	Sensory	Evaluative	Outcome	Productivity	Affect
Gender	1.00	.03	-.08	-.17	-.23	.04	-.24	.23	-.05	.05	-.15	.01	-.05	-.01	.02	-.09	-.04	-.04	-.03	.10
Age		1.00	.02	-.22	-.40	-.27	-.16	-.18	.15	.34	-.16	.21	-.15	-.19	-.07	-.06	-.07	-.26	.24	-.18
Education			1.00	-.68	.22	-.30	-.05	-.15	.10	-.09	.03	.02	.08	-.21	-.19	-.09	.07	.17	-.24	-.30
Marital				1.00	-.39	.12	.07	.11	-.29	-.18	.07	-.12	.02	.13	-.14	-.17	-.01	.17	-.14	-.15
Spouse emp.					1.00	.02	.18	-.04	.35	-.21	.20	.05	-.17	-.22	.14	-.03	.23	-.05	.05	.17
Client emp.						1.00	.17	.22	-.01	-.18	.15	-.02	.10	.26	.20	.12	.16	-.08	.18	.14
Litigation							1.00	-.09	.16	-.11	.28	-.05	.05	.28	-.04	.10	.21	-.17	.10	-.03
Rehab.								1.00	.04	-.26	-.14	.04	.19	.06	.05	.06	-.08	.07	-.09	-.01
Income									1.00	.10	.04	.12	.07	.26	.11	.15	.17	-.24	.15	.16
Chronicity										1.00	-.05	.22	.05	-.14	-.11	-.28	.04	.10	-.25	-.01
Hospitaliz.											1.00	.31	-.05	.03	.03	.06	.10	-.18	.17	.08
Surgery												1.00	-.15	-.17	-.06	-.05	-.22	-.08	.06	-.08
Employers													1.00	.08	.13	.22	.23	.07	-.11	-.04
PPI														1.00	.14	.14	.19	.08	-.11	.03
NWC															1.00	.46	.39	-.14	.27	.64
Sensory																1.00	.16	-.01	.04	.35
Evaluative																	1.00	-.12	.19	.26
Outcome																		1.00	-.93	.01
Productivity																			1.00	.14
Affect																				1.00

Regression Analysis

In an attempt to determine whether any combinations of variables could be used to best predict successful outcome, a regression analysis was used to evaluate the various combinations of variables noted in Table 4.5. The variables that were most significant were used in the analysis. This outcome was best predicted by chronicity, education, marital status, and age. Table 4.5 shows the regression analysis. The results are presented in Table 4.6.

Table 4.5.--Regression analysis for outcome.

	df	Sum of Squares	Mean Square	F	p
Regression	4	2.257	.564	2.62	.042
Residual	66	14.221	.215		
Total	70				

Table 4.6.--Variables in the equation for outcome.

Variable	b	SE(b)	p
Chronicity	.003	.001	.095
Education	.052	.028	.069
Marital	.207	.122	.096
Age	-.012	.006	.058
(Constant)	.099	.462	.832

Note. Alpha was set at .10 for individual coefficients (b).

Although the regression test was significant, the overall percentage of variance explained was very low (R^2 = .14). This regression analysis demonstrated that the younger an individual was, the more likely he or she was to succeed. The longer the individual had suffered from the condition, the more likely he or she was to succeed. The higher the individual's level of education was, the greater potential that person had for success. If an individual was married, his or her chance for success was greater.

The nonsignificant variables were gender, spouse employed, client employed, litigation, rehabilitation, income, hospitalization, surgery, employers, PPI, NWC, sensory, evaluative, and affect scores on the MPQ.

Table 4.7 shows the regression analysis for productivity. The best model explained only 29% of variability in productivity. The significant predictors (alpha = .10) were evaluative, chronicity, client employment, marital status, and sensory measure.

Table 4.7.--Regression analysis for productivity.

	df	Sum of Squares	Mean Square	F	p
Regression	5	231.935	46.387	4.10	.0003
Residual	51	576.906	11.311		
Total	56				

Another regression analysis was conducted to determine the best predictors for successful outcome, as measured by productivity.

Table 4.8 shows the coefficients and standard errors for the above-named variables. It should be noted that the signs of the coefficients ought to be opposite those for outcome because low productivity scores are "good."

Table 4.8.--Variables in the equation for productivity.

Variable	b	SE(b)	p
Evaluative	.038	.016	.021
Chronicity	- .038	.014	.008
Client employed	2.857	1.079	.011
Marital	-2.635	1.048	.015
Sensory	- .044	.026	.097
(Constant)	3.156	3.008	.299

Note. Alpha was set at .10 for individual coefficients (b).

Past research has suggested that several of these predictors would be significant, such as client employment (Carlsson, 1984; Dworkin et al., 1985; Maruta et al., 1979) and marital status (Maruta et al., 1979). Gender (Maruta et al., 1979) and age (Arnoff & Evans, 1982) were not significant as predictors, as previous studies implied. The reason these predictors were not significant may be explained, in part, because the other studies did not use evaluative and sensory as predictors. The inclusion of additional variables will affect the results of a study.

The nonsignificant variables in this analysis were gender, age, education, spouse employment, litigation, rehabilitation, income, hospitalizations, surgery, employers, PPI, NWC, and affect. Litigation and compensation historically have been viewed as negative

characteristics, as pointed out by the following researchers: Block et al. (1980), Dworkin et al. (1985, 1986), Guck et al. (1986), Kleinke and Spangler (1988), and Melzack et al. (1985). Previous studies also supported the concept that pain duration or chronicity was a predictor of limited success (Dworkin, 1986; Keefe et al., 1981; Maruta et al., 1979).

High evaluative scores on the MPQ were significantly related to high productivity scores, with other variables held constant. High productivity means people are not successful in being active participants in life activities. Individuals with high evaluative scores may perceive themselves as significantly disabled by pain and not able to perceive themselves achieving significant change.

High chronicity was related to a low productivity score, which means the longer someone suffered from chronic pain, the more likely he or she was to recover. Those individuals suffering from high chronicity may have been more motivated to practice the modalities presented to them.

If subjects were unemployed at intake, this related to a high (poor) productivity score. Perhaps clients who were not employed might not have wanted to increase their levels of productivity or to be more active; they might have adjusted to the lifestyle of the "disabled." Married clients also seemed to get back into life more quickly. Those individuals demonstrating high sensory scores at intake appeared to increase the quality of life, as demonstrated on the Productivity of Life questionnaire.

Missing Data

The regression analysis was hindered by missing data on several of the variables. The Productivity of Life questionnaire information was missing on 15 subjects. On spouse employment, 24 subjects provided no information. Eleven subjects provided no information on hospitalizations. Six subjects were missing information on rehabilitation. Several other variables were missing information regarding one or two subjects.

An examination of subjects who were missing data seemed to indicate the data were not missing at random. For example, those missing information on the productivity variable were, on average, 1.5 years younger, had fewer hospitalizations (2.1 vs. 2.7), and were less likely to have succeeded in the program (47% vs. 65%). Therefore, the regression analysis excluded cases and variables that may have altered the results.

Affect by Time

The second hypothesis, "Subjects with high scores on the Affective dimension of the MPQ at intake will have a nonlinear pattern of Affective dimension scores over the course of treatment, upon completion of the program, and at follow up," was evaluated by analysis of variance.

Scores were combined across weeks within six time periods. Thus, there were six combined scores called y_{ti}, for t = 0 to 6 for the ith person. The periods were: 0 for intake, 1 through 3 weeks, 4 through 10 weeks, 11 through 26 weeks, 27 through 52 weeks, 53

through 73 weeks, and 79 or more weeks. The highest number of weeks recorded was 188. Table 4.9 provides the means across subjects for each time period, and the means are plotted in Figure 4.1. Figure 4.2 shows mean affect for the successful and unsuccessful groups. These means, especially those for week 26 and thereafter, were based on very low numbers of subjects, and differences were not significant.

Table 4.9.--Mean scores on the Affective dimension of the MPQ for each time period.

Week Midpoint (w_{ti})	Actual Weeks	Week Index (t)	n	Affect Mean
0	0	0	75	25.19
2	1-3	1	187	18.85
7	4-10	2	236	14.87
18	11-26	3	72	13.64
40	27-52	4	34	15.94
65	53-78	5	38	14.58
122	79+	6	42	16.60

The week 0 score was the intake score obtained on the Affective dimension of the MPQ. The affect mean score of 25.19 is a mild elevation of affective distress. Weeks 1 through 3 were the beginning stages of treatment for most individuals. At 18.85, the mean level of Affect was reduced quickly from that of intake. Treatment was completed for most subjects between weeks 4 and 10. Continued reduction in the level of affect occurred during this time period. The measure designated weeks 11 through 26 was taken immediately following completion of the MPC. The level of affect continued to

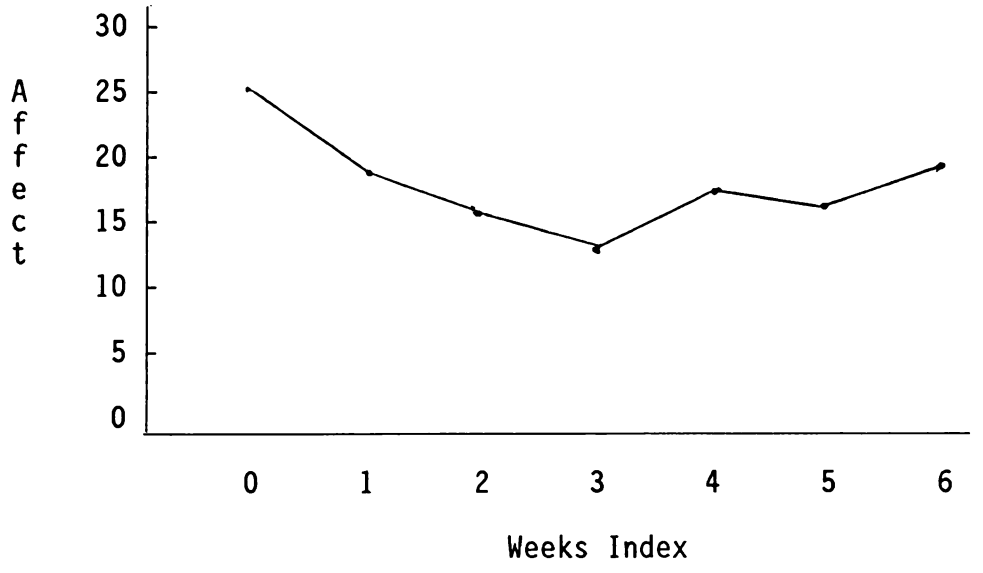


Figure 4.1: Weeks by average affect (all subjects).

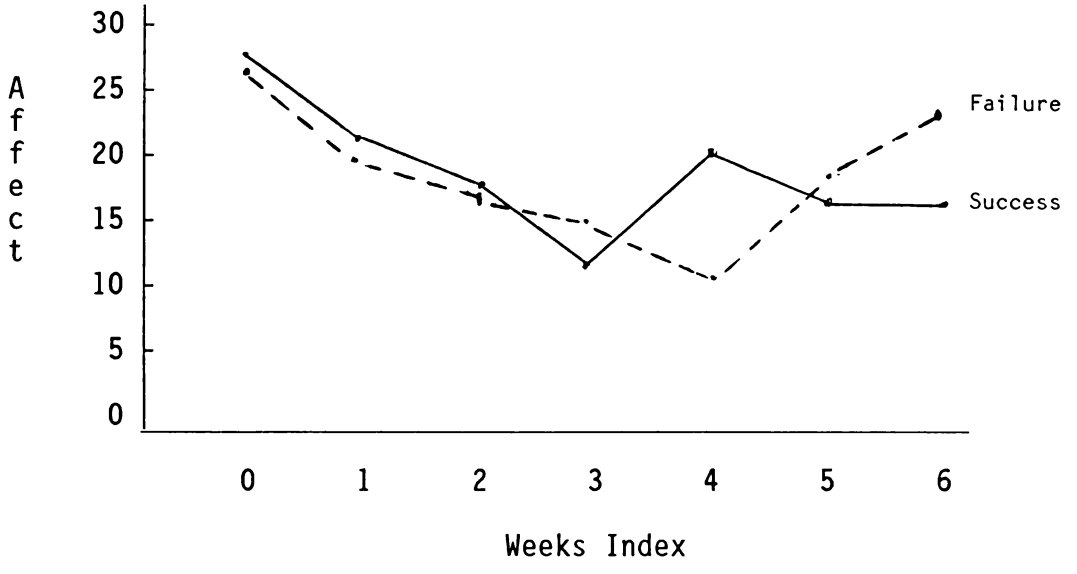


Figure 4.2: Average affect by success/failure.

decrease. However, when the subjects' levels of affect were measured between 27 and 52 weeks, an increase of 2.31% was noted. This was followed in weeks 53 through 78 by a decrease of 2.37%.

This level was still higher than the period measured at weeks 11 through 26. Finally, in week 79 and thereafter, affect scores increased to an average level of 16.60, a higher level of affect than seen since subjects were in treatment.

The means depicted in Table 4.9 were examined by use of repeated-measures ANOVA. The results are shown in Table 4.10.

There was a significant quadratic effect and a significant cubic effect. The means showed a downward trend, but affect seemed to sink and then rise slowly toward the end of the time measured.

Table 4.10.--Analysis of variance: affect over time.

Source	df	SS	MS	F	p
Between weeks	6	7804.89	1300.81	3.20	.004
Linear	1	490.54	490.54	1.21	.270
Quadratic	1	1867.27	1867.27	4.59	.030
Cubic	1	2315.24	2315.24	5.69	.020
Within weeks	677	275295.95	406.64		
Total	683	283100.84			

A problem with this analysis resulted from the recoding of weeks into unequal intervals. The test for trends was not as precise as it could have been if time had been coded into equal intervals. However, the data did not lend themselves to even groupings because measures were obtained with less frequency as time passed. Another related problem is that data did not exist for all subjects in all weeks. The number of people in any week decreased in later weeks.

The Hierarchical Linear Model

The hierarchical linear model (HLM) analysis was used to determine which variables best predicted individual patterns of affect over time. The formula for the HLM within-unit model for affect level is as follows:

$$y_{ti} = \pi_{0i} + \pi_{1i} (w_{ti} - L) + \pi_{2i} (w_{ti} - L)^2 + e_{ti}$$

t goes from 0 to t_i, where t_i is the number of scores available for person i (in weeks 1 through 20)

for i = 1 to 69 people

L = 0, 4, 8, and 12 weeks

y_{ti} = the tth affect score for person i

π_{0i} = intercept

π_{1i} = instantaneous growth rate for person i at time L

π_{2i} = the curvature or acceleration in each person's growth trajectory of affect

w_{ti} = number of weeks past intake, when affect score y_{ti} is obtained

e_{ti} = error term

One of the strengths of the HLM is that it allows for growth modeling. The individual growth model for the affect level of subject i on occasion t is represented in the above equation. Each of the growth parameters in the above equation has meaning. The intercept π_{0i} represents the status of person i at time L. The linear component, π_{1i}, is the instantaneous growth rate (linear

slope) for person i at time L. π_{2i} represents the curvature or acceleration in each person's growth trajectory of affect. Acceleration is a characteristic of the entire trajectory. The status and instantaneous rate parameters depend on the particular choice of the location parameter L. An example would be: If L is set at 8 weeks, then π_{0i} and π_{1i} represent the status and instantaneous rate for person i at that particular time point.

The scores across all time points were modeled in four ways. Each of the four ways of modeling involved anchoring the time variable, i.e. (weeks - L), at a different point, represented by L. The form of the time values (weeks - L) will differ when weeks are anchored at different points, which can allow one to see different aspects of how score patterns change over time. The linear and quadratic terms for L = 0, (weeks) and $(\text{weeks})^2$ are highly correlated. By anchoring weeks at L and creating two predictors (weeks - L) and $(\text{weeks} - L)^2$ at different values of L, the dependence between the two predictors may be reduced. These analyses reveal the differences in slopes and in intercept at all four time points. These time points represent L. The first time point was 0 weeks, which was the intake reading of the MPQ. Subjects were evaluated at that time point as potential candidates for the MPC. The second time point was at 4 weeks. This time point was approximately 1 month after the subjects were in treatment. It was thought this time point represented a minimal amount of time in treatment, after which the effect of treatment on affect could be

measured. The 8-week time point is toward the end of treatment in the MPC. This time point measures affect at the close of treatment and represents immediate feedback on the level of affect. Twelve weeks is the final time point measured because it is approximately 1 month after treatment has ended for most of the subjects.

An important feature of the above equation is the assumption that the growth parameters vary across individuals. The between-patient model is formulated to represent this variation. The between-patient model is as follows:

$$\pi_{ki} = b_k\,0 + b_{k1}x_{k1} + b_{k2}x_{k2} + \ldots b_{k7}x_{k7} + uki$$

where:

x_1 = the subject's litigation status

x_2 = the subject's length of chronicity

x_3 = the subject's number of surgeries

x_4 = the subject's number of words chosen on the MPQ at intake

x_5 = the subject's level on the evaluative scale of the MPQ at intake

x_6 = the subject's level of affect on the MPQ at intake

x_7 = the subject's membership in the auto no-fault group

b_{kp} = the effect of xp on the kth growth parameter

uki = the random effects with full covariance matrix, T, dimensioned (K + 1 x 1)

The uki are random effects that represent the deviations in the growth parameters for subject i from the respective means. It is assumed that the effects are normally distributed with mean 0 and variance-covariance, T.

The growth parameters are viewed as random among individuals, but the sources of variation are unknown. The t statistics provide statistical evidence that each of the parameters in the mean growth trajectory is different from zero. The total parameter variance for each growth parameter is estimated by the diagonal elements of T. The HLM provides a large-sample chi-square test of homogeneity, that is, of Ho: kk = 0.

HLM Analyses

This analysis was performed with the original coding of weeks. The weeks equaled the number of weeks following intake. However, values greater than 20 weeks were dropped because the scores were so few and widespread. Another reason for dropping the later scores was to reduce the possibility that influences outside of treatment were altering the results.

HLM analyses were conducted at four time points--intake, 4 weeks, 8 weeks, and 12 weeks. That is, L was allowed to equal 0, 4, 8, and 12 weeks, respectively, in the four analyses. The average intercept and slope for the within-subjects models are presented in Table 4.11. The intercepts are plotted in Figure 4.3.

Table 4.11.--Average slope coefficients across individual growth models.

	Intake	4 Weeks	8 Weeks	12 Weeks
Intercept	23.77*	16.58*	12.45*	11.38*
Linear effect	-2.18*	-1.42*	-0.65*	0.00**
Quadratic effect	0.10*	0.10*	0.10*	0.10*

*$p < .001$.

**$p = .59$ (ns).

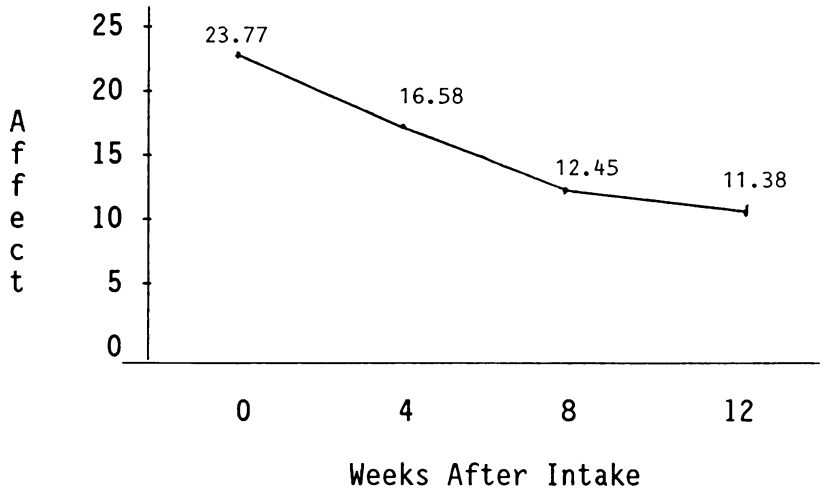


Figure 4.3: Average affect intercepts.

The intercept represents the average affect score at each time point. It rapidly decreased from intake to 4 weeks and slowly decreased thereafter. This indicates that the subjects were obtaining information and training that was beneficial to them. The

subjects' level of affect seemed to be moderated to some degree by their participation in the MPC.

The average slope for the linear effects was negative at the first three time points, indicating a decrease in affect. This decrease was strongest at time 0. After 12 weeks, this average slope was positive, and insignificant. This indicates that the slope for a linear trend in affect was flat, and not significantly different from zero.

The average quadratic term was positive, significant, and constant across all time points. The indicates an overall curvature upward in the affect patterns. While the tendency for affective scores to increase is small, it is significant. Perhaps subjects in the MPC initially experience reduced affect because they are getting relief from pain-management techniques. At the same time, they also are required to face new issues that have been avoided to date, and this may explain the later increase in affect.

The variability in both the intercepts and linear slopes were significant at all four time points. This indicates that the intercept and linear slope differed significantly between subjects. The HLM allows the modeling of these differences. The variability in the quadratic term was not significant at any time point, and therefore that variance was fixed at zero (and unmodeled) for the remaining analyses.

Overview of results. At each time point--intake, 4, 8, and 12 weeks--all 22 predictors of the intercept and slope were examined. Affect at intake was included because it would influence prediction at intake. But, more important, it is involved in predicting affect at the various time points. To keep the same variables constant across all four time points, affect at intake (labeled "base affect") was included at this time point. For the intake analysis, the variables litigation, chronicity, surgeries, number of words chosen, evaluative score, affect at intake, and membership in auto no-fault group were significant predictors, at the .10 level, of either the intercept, the slope, or both.

Insignificant variables were gender, education, age, marital status, membership in worker's compensation group, spouse employed, client employed, rehabilitation, hospitalizations, sensory, PPI, productivity, outcome, and employers.

In the analyses for 4, 8, and 12 weeks, the variables found to be significant were litigation, chronicity, surgery, evaluative, base affect, and membership in the auto no-fault group. Number of words chosen was no longer significant. The four analyses appear in Tables 4.12 through 4.19.

Table 4.12.--Statistical table for HLM coefficients at intake (L = 0).

	b	SE(b)	t-Statistic	p-Value
Intercept				
INTERCEPT	16.11	7.98	2.02	.05
LITIGATION	-5.04	2.89	-1.75	.09
CHRONICITY	0.00	0.03	0.00	.39*
SURGERY	-0.45	0.72	-0.63	.33*
NWC	0.24	0.14	1.74	.09
EVALUATIVE	0.02	0.04	0.44	.36*
BASE AFFECT	0.55	0.06	8.69	.00
GROUP 2	1.49	3.53	0.42	.36*
Slope				
INTERCEPT	-1.73	0.98	-1.76	.09
LITIGATION	-0.64	0.35	-1.84	.08
CHRONICITY	-0.01	0.00	-1.82	.08
SURGERY	0.29	0.08	3.65	.00
NWC	-0.02	0.02	-1.11	.21*
EVALUATIVE	0.01	0.01	1.79	.08
BASE AFFECT	-0.04	0.01	-4.29	.00
GROUP 2	0.92	0.49	1.84	.07
Quadratic Intercept	0.08	0.02	4.28	.00

*Not significant at $p < .10$.

Table 4.13.--Variance components table at L = 0.

Random Parameter	Estimated Parameter Variance	df	Chi-Square	p-Value
Base coefficient	45.67	60	97.29	.00
Week slope	0.21	60	74.17	.10*

*Not significant at $p < .10$.

Table 4.14.--Statistical table for HLM coefficients at L = 4 weeks.

	b	SE(b)	t-Statistic	p-Value
Intercept				
INTERCEPT	10.53	7.98	1.34	.16*
LITIGATION	-7.60	2.92	-2.60	.02
CHRONICITY	-0.03	0.03	-0.95	.25*
SURGERY	0.71	0.74	0.97	.25*
NWC	0.16	0.14	1.17	.20*
EVALUATIVE	0.05	0.04	1.29	.17*
BASE AFFECT	0.41	0.06	6.37	.00
GROUP 2	5.17	3.53	1.47	.14*
Slope				
INTERCEPT	-1.06	0.95	-1.12	.21*
LITIGATION	-0.64	0.35	-1.84	.08
CHRONICITY	-0.01	0.00	-1.82	.08
SURGERY	0.29	0.08	3.65	.00
NWC	-0.02	0.02	-1.11	.21*
EVALUATIVE	0.01	0.01	1.79	.08
BASE AFFECT	-0.04	0.01	-4.29	.00
GROUP 2	0.92	0.49	1.84	.07
Quadratic Intercept	0.08	0.02	4.28	.00

*Not significant at p < .10.

Table 4.15.--Variance components table at L = 4.

Random Parameter	Estimated Parameter Variance	df	Chi-Square	p-Value
Base coefficient	71.33	60	244.11	.00
Week slope	0.21	60	74.12	.10*

*Not significant at p < .10.

Table 4.16.--Statistical table for HLM coefficients at L = 8 weeks.

	b	SE(b)	t-Statistic	p-Value
Intercept				
INTERCEPT	7.71	9.65	0.80	.28*
LITIGATION	-10.19	3.63	-2.81	.01
CHRONICITY	-0.06	0.04	-1.52	.12*
SURGERY	1.87	0.89	2.08	.05
NWC	0.08	0.18	0.47	.35*
EVALUATIVE	0.09	0.05	1.72	.09
BASE AFFECT	0.26	0.08	3.19	.00
GROUP 2	9.04	4.62	1.95	.06
Slope				
SLOPE	-0.39	0.96	-0.41	.36*
LITIGATION	-0.64	0.36	-1.79	.08
CHRONICITY	-0.01	0.00	-1.79	.08
SURGERY	0.29	0.08	3.49	.00
NWC	-0.02	0.02	-1.08	.22*
EVALUATIVE	0.01	0.01	1.73	.09
BASE AFFECT	-0.04	0.01	-4.22	.00
GROUP 2	0.95	0.51	1.85	.07
Quadratic Intercept	0.08	0.02	4.25	.00

*Not significant at $p < .10$.

Table 4.17.--Variance components table at L = 8.

Random Parameter	Estimated Parameter Variance	df	Chi-Square	p-Value
Base coefficient	109.50	60	198.650	.00
Week slope	0.28	60	74.168	.10*

*Not significant at $p < .10$.

Table 4.18.--Statistical table for HLM coefficients at L = 12 weeks.

	b	SE(b)	t-Statistic	p-Value
Intercept				
INTERCEPT	7.38	11.98	0.62	.33*
LITIGATION	-12.72	4.53	-2.81	.01
CHRONICITY	-0.09	0.05	-1.77	.08
SURGERY	3.04	1.09	2.77	.01
NWC	0.00	0.23	0.01	.39*
EVALUATIVE	0.13	0.06	1.93	.06
BASE AFFECT	0.12	0.10	1.17	.20*
GROUP 2	12.53	6.02	2.08	.05
Slope				
INTERCEPT	0.27	0.95	0.29	.38*
LITIGATION	-0.64	0.35	-1.84	.07
CHRONICITY	-0.01	0.00	-1.82	.07
SURGERY	0.29	0.08	3.65	.00
NWC	-0.02	0.02	-1.11	.21*
EVALUATIVE	0.01	0.01	1.79	.08
BASE AFFECT	-0.04	0.01	-4.29	.00
GROUP 2	0.92	0.49	1.84	.07
Quadratic Intercept	0.08	0.02	4.28	.00

*Not significant at p < .10.

Table 4.19.--Variance components table at L = 12.

Random Parameter	Estimated Parameter Variance	df	Chi-Square	p-Value
Base coefficient	142.78	60	146.64	.00
Week slope	0.21	60	74.08	.11*

*Not significant at p < .10.

Intake Analysis

In this section, the results are described in further detail. At intake, the variables significantly predicting the intercept were litigation, number of words chosen, and base affect. The last variable makes sense because the intercept should be higher if the subjects have high affect at intake. More words chosen would also typically lead to higher affect at intake.

Being involved in litigation indicated a lower affect at intake. Perhaps the individuals represented by legal counsel received more information on their rights regarding their situations. They might not have been as apprehensive about legal and financial matters as the other subjects. This may be reflected in their affect scores.

The variables that predicted slope at intake were litigation, chronicity, surgeries, evaluative, base affect, and membership in Group 2 (the auto no-fault group). Those patients involved in litigation showed steeper negative slopes, indicating a quicker drop-off in affect score. Also leading to steeper negative slope were chronicity and base affect. Those patients with more surgeries, higher evaluative scores, and those receiving no-fault benefits saw the overall negative slope reduced (less steep) by these factors. That is, their affect did not drop off as fast. The reason these factors were significant may relate to reasons already stated for litigation, but those individuals with long-term chronicity and surgeries for pain relief may find ways of managing their pain. Those individuals with chronicity may be more ready to

use the principles taught at the MPC. It is important to note that this may be the first time that a group of health professionals recognize and accept their pain problem as real. The acceptance of their pain by health professionals may help to explain the reduction in affect.

An explanation for the significance of Group 2 membership (the auto no-fault group) is that these individuals typically have limited wage support in Michigan, 3 years by statute. These individuals may have support from their employer for return to work, or they may have a job to return to once medical rehabilitation is complete. The individuals receiving auto no-fault benefits are aware of the 3-year limitation of wage support. There is a clearly defined limit to the resources from which no-fault recipients can draw. Individuals receiving worker's compensation have vague references as to the length of their disability and the financial support they may receive.

Week 4 Analysis

The analysis for the 4-week, mid-treatment interval demonstrated that litigation and base affect were significant. NWC was no longer significant at this time point. Again, the same reasons would apply for litigation and base affect being significant. The same variables were significant for predicting the slope at this time point. It appears that these factors were remaining constant during treatment.

Week 8 Analysis

Examining the 8-week interval, which occurred at the end of treatment for most subjects, litigation and base affect were significant for predicting the intercept. But added were surgeries, evaluative, and membership in auto no-fault. Based on the lower level of affect, it would appear that emotional issues were being resolved or dealt with in a positive or constructive manner. Individuals who had a history of surgery showed a significantly lower level of affect, indicating that they were making use of the modalities being presented in the MPC. Individuals who previously received surgery for relief of low back pain are individuals who previously relied on an external variable for the relief of their pain. Since surgery did not relieve them of their pain complaints, the MPC is a viable alternative. These individuals are perceived as having real pain difficulties. The health professionals confirm that they are not the only ones to suffer from these types of prolonged complaints. The techniques provided in an MPC require that the individuals assume responsibility for active participation in the program. They are no longer passive subjects awaiting the surgeon's scalpel. For pain relief to be effective, these individuals must assume more responsibility for their behavior than they did in the past. The people who previously had surgery are now more significantly motivated toward an internal locus of control, as opposed to the external locus of control.

Week 12 Analysis

The 12-week analysis had litigation and base affect as significant variables for the intercept. Chronicity and surgery were additional predictors at this time point, as was evaluative. It seems likely that the combination of surgeries and chronicity were again significant because the individual subjects recognized that they had control over the physical complaints and behaviors they exhibited. Evaluative was having an influence at this time point because of the need for the subjects to make difficult choices at this stage of their treatment. Again, the same predictors were significant for the slope at this time point.

Summary of the Four Time-Point Analyses

The most significant predictor for the intercept at intake was base affect. At 4 and 8 weeks, the most significant predictors were litigation and base affect. At 12 weeks, the most significant predictors were litigation and surgery. Base affect was a significant predictor in the weeks of treatment, but not in the weeks immediately following treatment. Litigation appeared to be important not so much at intake, but when treatment was provided. Following treatment, litigation was a significant variable in the prediction equation. Apprehension over the outcome of treatment may account for this finding.

The most significant predictors for linear slope at all time points were surgery and base affect. This demonstrates that affect at intake was a significant component for predicting decrease in

affect through the course of treatment and at follow-up. The surgery predictor had a positive slope for the linear trend at all time points. This suggests that higher slopes (or a tendency for their affect scores not to decrease) were found for people who had surgery.

The chi-square homogeneity-of-variance tests indicated that the differences in the intercept were not fully explained in any of the four tables. The differences in the week slope were explained by the variables. That is, it cannot be fully explained why someone was higher or lower on affect, but one can explain the linear pattern for everyone.

Success-by-Compensation Analysis

Hypothesis 3, "Success rates will not differ among the worker's compensation group, the auto no-fault group, and the other group," was supported by chi-square analysis of the contingency-table data. The results of this procedure are presented in Table 4.20.

Table 4.20.--Outcome for patients in three compensation groups.

Outcome	Worker's Comp. (%)	Auto No-Fault (%)	Other (%)	Row Total (%)
Failure	17 (39.5)	3 (27.3)	9 (42.8)	29 (38.7)
Success	26 (60.5)	8 (72.7)	12 (57.1)	46 (61.3)
Column total	43 (100.0)	11 (100.0)	21 (100.0)	75 (100.0)

The chi-square test of association (chi-square = 0.77, df = 2, p = .68) was not significant, indicating no relationship between compensation group and outcome.

An ANOVA was conducted to determine whether group differences existed on the productivity variable for the three groups. The results of that analysis are summarized in Table 4.21.

Table 4.21.--Productivity by worker's compensation.

	df	Sum of Squares	Mean Square	F	Sig. of F
Main effects	2	10.88	5.44	0.35	.71
Residual	57	899.85	15.79		
Total	59	910.73	15.44		

No significant differences were found. The three groups did not differ on either outcome variable. These results are similar to those of Mendelson (1982) and Pelz and Mersky (1982), demonstrating that patients with low back pain do not fall neatly into worker's compensation groups and non-worker's compensation groups. The results in this study differed from those of Dworkin (1985, 1986), who found that compensation cases predicted poor short-term outcome.

CHAPTER V

SUMMARY, DISCUSSION, AND IMPLICATIONS

Summary

Pain is a complex problem as opposed to a simple sensation. Scientific measurement procedures have focused on pain as an individual sensory quality that varies only in intensity. Traditional pain theories, such as the specificity and pattern theories, focused on the transmission of pain signals but failed to describe the role of psychological factors in pain perception. Evidence has supported the concept that pain is influenced by activities of the "higher central nervous system."

Historically, descriptions of pain mechanisms have failed to account for the psychophysiological process. This is the cognitive-affective component that motivates the organism to avoid, minimize, or stop the pain as quickly as possible. Melzack and Wall (1965) proposed the gate-control theory of pain, which recognizes the obvious sensory dimension of pain as described by the specificity and pattern theories. The gate-control theory also provides the basis for considering the motivational-affective dimension of pain. Failure to consider this dimension of pain has seriously limited the total picture of the pain experience. The motivational dimension is crucial to the concept of pain as a perception, comprising past experience, attention, and sensory quality and intensity.

Review of Literature

The literature reviewed in this research focused on two areas in which the motivational-affective concept is used as a foundation. The first area was the pioneering work Fordyce did in investigating the psychology of chronic pain. The second area was that of pain measurement, specifically that of the McGill Pain Questionnaire (MPQ).

Fordyce (1968) described the use of behavioral-management techniques for problems associated with treating chronic pain. His publications (Fordyce et al., 1968a, 1968b, 1978) caused a rapid increase in the use of these techniques for treating chronic pain. A discipline known as behavioral medicine has developed over the past 15 to 20 years.

The goal of traditional medical treatment is to remove or relieve the pathogenic process. Since this is often impossible with chronic low back pain, the condition presents a challenge to traditional medical scientists. To meet the demand for relief from chronic pain, multidisciplinary pain clinics (MPCs) have been developed. The various treatment approaches used in these clinics were reviewed in Chapter II.

The *operant approach* views pain as a set of overt responses, such as medication taking, limping, and reporting pain. It recognizes that overt responses are controlled by reinforcers, such as attention or medications, if the reinforcers are given contingent on the pain behaviors. Treatment with this approach concentrates on eliminating the reinforcement of pain behaviors and increasing

healthy behaviors. The operant programs have resulted in clinically significant increases in activity levels and reduction in analgesic intake.

The *relaxation approach* assumes that organic processes are relevant and are influenced by learning. The idea for treatment of chronic pain is to break the vicious pain cycle that exists. This is accomplished by reducing muscle tension and psychological stress to control the pain. The data from studies in this group indicated that many patients may benefit from relaxation treatment.

The *cognitive-behavioral* approach sees pain as an experience that is mediated by cognitions. Because pain is a subjective experience, treatment at the cognitive level is appropriate. If this approach successfully mediates pain, there might be a concurrent change in other pain-related behaviors, such as activity and medication intake. This approach holds that, regardless of the origin of pain, modifying cognitions may reduce pain levels and provide the patient with a better method of dealing with pain. There is little evidence that cognitive strategies are effective in treating chronic pain.

The *multimodal approach* is an attempt to improve the treatment of pain by using several techniques to control as many pain variables as possible. The multimodal approach includes operant, relaxation, and cognitive strategies, in addition to a wide range of other techniques. The clinical significance of the improvements noted as a result of this treatment approach is difficult to judge

because of weak designs and because several techniques are employed. The promise of multimodal treatment lies in combining the most effective aspects of various approaches.

Over the past 20 years, considerable support has developed for the effectiveness of behavioral pain-management techniques. Researchers have demonstrated exclusively positive results. However, it is difficult to rehabilitate individuals to their pre-pain level of functioning. Treatment should be oriented to helping the patient live as normally and productively as possible under the circumstances.

The management of chronic pain allows individuals to learn to lead useful and satisfying lives despite their pain. In an effort to determine which patients are most likely to benefit from treatment, a number of researchers have undertaken prediction studies. The initial work in this field was done by Maruta et al. (1979). The results of that study demonstrated that the likelihood of success in pain management decreased for individuals with an increase in prior duration of pain, work time lost, number of previous operations, and level of pain at the beginning of the program.

Over the years, various researchers have found that subjects with healthy life styles, indices of depression, shorter duration of pain, and gainful employment were favorable candidates for participation in pain clinics. Individuals with litigation pending, receiving compensation, and elevations on the Hypochondriasis scale of the MMPI were judged less likely to succeed.

Researchers investigating the Affective component of the MPQ have found that high scores on the MMPI Hypochondriasis scale related to high scores on the Affective and Evaluative dimensions of the MPQ. Elevated scores on the MMPI Depression and Hysteria scales were associated with high scores on the Affective dimension of the MPQ.

A number of investigators have evaluated the combination of affective distress and worker's compensation. The results of the various studies led the researchers to conclude that subjects with litigation pending or receiving worker's compensation needed to be assessed individually and very carefully for motivation.

The motivational affective component of the perception of pain was formalized in Melzack and Wall's (1965) gate-control theory of pain. Melzack and Torgerson (1971) developed a new approach to describe and measure pain. Melzack (1975) formalized and refined the work he and Torgerson initiated. The MPQ is a verbal-adjective questionnaire that is used to quantify subjects' perceptions of pain on three dimensions: sensory, affective, and evaluative. The MPQ has been found to have acceptable reliability and face, construct, concurrent, and discriminant validity. Since its introduction in 1975, the MPQ has been recognized as a useful instrument with which to obtain data on both qualitative and quantitative aspects of pain.

Purpose

The researcher's purpose in this study was to evaluate the relationship of scores on the Affective dimension of the MPQ to the

outcome of subjects who had participated in Mary Free Bed's multidisciplinary pain clinic. The subjects were grouped by type of insurance-based financial support: those receiving worker's compensation, those receiving automobile no-fault benefits, and individuals not receiving any financial support from the insurance industry.

This researcher also attempted to determine whether the three treatment groups (worker's compensation, no-fault automobile insurance, and no financial support) differed significantly in their scores on the Affective dimension of the MPQ at intake, over the course of treatment, and at follow-up. The level of scores on the Affective dimension of the MPQ at various points over the course of treatment was evaluated using the HLM statistical procedure.

Three research hypotheses were developed to evaluate the concepts of interest in this study:

> Hypothesis 1: Chronic pain patients' scores on the Affective dimension of the MPQ at intake will correlate positively with successful outcome following treatment in an MPC.
>
> Hypothesis 2: Subjects with high scores on the Affective dimension of the MPQ at intake will have a nonlinear pattern of Affective dimension scores over the course of treatment, upon completion of the program, and at follow-up.
>
> Hypothesis 3: There will be no difference in the treatment-success rates of the three study groups: those receiving worker's compensation, those covered by no-fault automobile insurance, and those receiving no financial support.

The Study Sample

To test the hypotheses, 85 patients with chronic low back pain were selected after a review of patients' charts. The MPQ had been

administered to the subjects at intake, at least three times during the course of treatment, and at least once during follow-up. A letter was sent to all subjects in the sample, explaining the purpose of the study and asking them to furnish follow-up information. MFB's follow-up questionnaire was enclosed, along with the Productivity of Life questionnaire. A stamped and addressed envelope was provided for subjects' convenience in returning the questionnaires. Approximately 30 days following the initial request, a second request for information was mailed. After approximately 30 days, the researcher attempted to telephone the subjects who had failed to respond to the mailed request.

Seventy-five subjects provided follow-up information. For comparison purposes, these subjects were divided into three groups, according to the type of insurance support they received. The three groups were (a) worker's compensation (n = 43), auto no-fault (n = 11), and (c) no form of subsidized financial support (n = 21).

Method

The overall design consisted of measuring 18 dependent variables and two outcome measures. The 18 variables were historical, demographic, and related to the MPQ.

Correlation coefficients were computed to determine the linear relationship between scores on the Affective dimension of the MPQ and the outcome of the subjects who had completed treatment in the MPC (Hypothesis 1). Regression analysis was used to determine the relationship between predictor variables and outcome.

The second hypothesis was evaluated by using the fixed-effects ANOVA procedure to evaluate continuous and categorical variables. This hypothesis was further evaluated by using the HLM procedure. The important aspect of this analysis is that it is an attempt to explain the growth parameter over time between subjects.

The third hypothesis was analyzed by use of the chi-square test of association. The analysis procedures yielded the following results.

Correlation and Regression Data

The outcome data did not substantiate that chronic pain patients' scores on the Affective dimension of the MPQ would correlate positively with successful outcome. The correlation coefficient was .01 for outcome and affect. The correlation coefficient for affect and poor productivity was .14. The only large significant correlation coefficient was that between productivity and outcome (r = -.93). This means there was a significant relationship between individuals returning to work or entering a rehabilitation program and those individuals who were productive, as productivity was measured on the PLQ.

In the regression analysis, the overall percentage of variance explained was very low (R^2 = .14). The analysis demonstrated that, the younger an individual was, the more likely he or she was to succeed. The longer an individual had suffered from the condition, the more likely he or she was to succeed. The higher the individual's level of education, the greater potential that person

had for success. If an individual was married, he or she had a greater chance for success.

The regression analysis for productivity explained only 29% of the variability in productivity. The significant predictors in this analysis were evaluative, chronicity, client employment, marital, and sensory.

Affect by Time

The results of the ANOVA procedure evaluating affect over time demonstrated a significant quadratic effect and a significant cubic effect. There was a downward trend, but it seemed to sink and then rise toward the end of the time measured.

HLM analyses were conducted at four time points: intake, 4 weeks, 8 weeks, and 12 weeks. The average affect level decreased from intake to 4 weeks and slowly decreased thereafter.

The variability in both the intercept and the slope was significant at all four time points, indicating that the slope and intercept differed significantly between subjects. The variability in the quadratic term was not significant at any time point and was fixed at zero for the analyses. For the intake analysis, the variables litigation, chronicity, surgeries, number of words chosen, evaluative, affect at intake, and membership in the auto no-fault group were significant predictors of either the intercept, the slope, or both. In the analysis for 4, 8, and 12 weeks, the variables found to be significant were litigation, chronicity, surgery, evaluative, base affect, and membership in the auto

no-fault group. The results indicated that the differences in the intercept were not fully explained at any of the four time points. The differences in the week slope were explained by the variables.

Success-by-Compensation Analysis

The result of the chi-square test of association was not significant (chi-square = .77). This indicated there was no relationship between compensation group and outcome. An ANOVA was performed to determine whether group differences existed on the productivity variable. No significant differences were found. This means that the worker's compensation group, the auto no-fault group, and the no-financial-support group did not differ on either outcome variable.

Discussion

This section contains a discussion of the conclusions drawn from the results of the statistical analyses, within the limitations of the study.

A major conclusion that can be drawn from this research is that no single variable was significant in predicting successful outcome following treatment in an MPC. To further evaluate factors relating to successful outcome, a regression analysis was performed, using the most significant variables; this analysis explained a very low overall percentage of variance. The regression analysis demonstrated that, the younger an individual was, the more likely he or she was to succeed. The longer the individual had suffered from

the condition, the more likely he or she was to succeed. The higher an individual's level of education, the more likely that person was to succeed. If an individual was married, his or her chance for success was greater. The variables age and chronicity have been negatively correlated in previous studies. The percentage of variance explained in this regression analysis was very low (r^2 = .14). It appears that the significance of age and chronicity may be independent of each other. The very low percentage of explained variance indicates idiosyncratic characteristics may be more important in predicting outcome.

The results of this research supported the findings of some previous prediction studies. The studies it supported were those by Arnoff and Evans (1979), whose results indicated a negative correlation of age to success, and Maruta et al. (1979), who found that the fewer operations a patient had, the better was his or her chance for success.

In contrast, the results of the present research refuted those of previous research regarding the length of time an individual had suffered from the impairment. Maruta et al. (1979) said that individuals with pain of fewer than 3 years' duration did better than individuals with pain complaints of longer duration. Keefe et al. (1981) indicated that individuals with continuous pain for a shorter period of time experienced the greatest pain relief. The findings of the present research suggest that individuals will benefit from an MPC pain-treatment program, regardless of the length of time they have suffered from chronic pain.

The controversial concept of compensation has been reviewed in four previous studies. Dworkin et al. (1985) stated that compensation benefits predicted poor short-term outcome but that compensation and litigation did not predict successful long-term outcome. Dworkin et al. (1986) stated that nondepressed compensation recipients did not do as well as nondepressed subjects who were not receiving worker's compensation. Guck et al. (1986) indicated that successfully treated patients were less likely to receive compensation than were unsuccessfully treated patients. Melzack et al. (1985) indicated that patients receiving compensation had lower affective scores than those receiving no compensation. The results from the present study indicated that there was no relationship between affect and outcome. The results also indicated there was no relationship between compensation group and outcome.

A major conclusion that can be drawn from the findings of this research is that the level of affect of chronic low back pain patients at intake cannot be used as a predictor of successful outcome following treatment in an MPC. It does appear that the level of affect, as measured on the Affective dimension of the MPQ, will vary over the course of treatment.

The HLM analyses demonstrated that the variables predicting intercept were litigation, number of words chosen, and base affect. The variables that predicted slope at intake were litigation, chronicity, surgeries, the evaluative dimension of the MPQ, base affect, and membership in the auto no-fault group. The analysis for

the 4-week treatment interval demonstrated that litigation and base affect were significant. At the 8-week level, litigation and base affect were significant in predicting the intercept; also included were surgeries, evaluative, and membership in the auto no-fault group. In the 12-week analysis, litigation and base affect were significant variables for the intercept. Chronicity, evaluative, and surgery were also added as predictors.

The most significant predictor for the intercept at intake was base affect. At 4 and 8 weeks, the most significant predictors were litigation and base affect. At 12 weeks, the most significant predictors were surgery and litigation. Base affect was significantly involved in the affective score during the weeks of treatment, but it did not appear to be significant in the weeks immediately following treatment. The significant involvement of affect during treatment may occur as a result of emotional issues being addressed at that time. The existence of emotional issues in conjunction with the possible termination of benefits, the return-to-work issue, and a significant change in lifestyle may be reflected by the affective dimension. Litigation appeared to be important, not so much at intake, but as treatment was provided, as well as after. The significance of litigation at these points may occur as the result of individuals obtaining legal advice about their rights and reducing the level of affect that they have over possible uncertainty in their future.

The most significant predictors for slope at all time points were surgery and base affect, demonstrating that affect at intake

was a significant component for predicting decrease in affect through the course of treatment and at follow-up. The level of affect at intake may also mean that, the higher the level of affect, the further it is able to decrease, as a function of a regression to the mean. Higher slopes were found for people who had had surgery.

The chi-square homogeneity-of-variance tests indicated that the differences in the intercept were not fully explained in any of the four tables. In contrast, the differences in the slope were explained by the significant variables identified above. The amount of variability explained as a result of the chi-square homogeneity-of-variance tests did not tell why someone was higher or lower on affect. However, the linear pattern could be explained by the significant variables. The researcher could not fully explain why someone was higher or lower on affect, but the linear pattern could be explained for everyone.

At this point it is important to relate the findings of this research to the field of pain treatment. The demographic characteristics of this sample accurately represent the population of individuals suffering from chronic low back pain. This typical sample was analyzed and the results did not demonstrate any significant variable or characteristic that predicted successful outcome. This demonstrates that chronic pain is a complicated issue. The various theoretical approaches and treatment modalities demonstrate that there is no single correct or singularly appropriate approach to the treatment of chronic pain.

Historically, we have seen worker's compensation recipients omitted from research because they were believed to lack the proper motivation to succeed. Since the inclusion of worker's compensation recipients in MPCs, researchers have obtained mixed results over time, leading to the inclusion of a favored population.

The population studied appears to be characteristic of those included in other research projects analyzing chronic low back pain. The important point to remember here is that the individuals participating in the study all had insurance benefits to cover the cost of treatment. If individuals suffering from chronic low back pain without insurance benefits were offered the same type of treatment as offered to this population, would the results be similar? Another question that comes to mind is whether the individuals rejected as candidates for the program fared as well as those accepted in the program. Obviously, the comparison of accepted versus rejected candidates poses a complicated research design and follow-up procedure that would be extremely expensive as far as time and resources were concerned. But, if different people were admitted into treatment programs for chronic pain, would the results be the same? It does not seem as if the demographic variables would be so different for those individuals not considered for the program as a result of limited resources.

It appears that administrators of MPCs are very selective in allowing access to the specific programs. One of the criteria involved in selecting a treatment population involves an attempt to predict those individuals who have characteristics deemed

appropriate by the administrators of the program, i.e., those who will be successful. Of course, we then have the difficulty of defining success. The first problem this points out is that researchers and treaters have decreased the population in an effort to increase success levels.

Another area of concern in the selection process of MPCs is the emphasis on return to work as a measure of success. The successful return to work of subjects receiving treatment in an MPC can be perceived as a financial return for the investment in the program. A financial payback for the funding source allows the investment in the program to be returned. The attention that funding sources attach to financial return on their investment diverts attention from the multitude of benefits an MPC is able to provide to a more diverse population.

This research presented different results based on the inclusion of a broader form of outcome measure. The inclusion of the Productivity of Life Questionnaire demonstrated that other variables were significant in reaching higher levels of productivity. Using broader outcome measures adds another dimension to the treatment of patients with chronic low back pain. Along with a broader form of outcome measure along the lines of the Productivity of Life Questionnaire comes the inclusion of individuals who seek treatment, not to return to the world of work, but to improve the quality of life as well as increase the level of independence in their life. Financially, individuals seeking to

habilitate or rehabilitate themselves to a higher level of independence or increase their quality of life will not be afforded the opportunity for the benefits available in an MPC.

This research has demonstrated that a more sophisticated method of statistical analysis is available to be applied to evaluating patients with chronic low back pain. The HLM method may be used for improving program evaluation.

The current research highlights the importance of the psychological implications of treatment. The results of this research document the decrease in the affective component of chronic pain. The results confirm that psychological issues are being dealt with through the course of treatment. These psychological issues are not only tied to vocational issues, but are intrinsically important to the individual's quality of life. During the course of treatment in an MPC, individuals are in constant contact with mental health professionals. A wide variety of issues may be addressed by the professionals. The exposure to and easy access to mental health professionals offer many opportunities for treatment. The results demonstrate that issues are being resolved. The psychological status of individuals as they progress through the course of treatment is important. The research demonstrated that there is a quadratic effect to the level of affect. This was not investigated any further than the 12-week period in the HLM analysis due to the rapidly declining sample size. The research does demonstrate that there is a return to a higher level of affect as time goes on. The exact extent and nature of the elevation of affect is unclear.

Limitations of the Study

The sampling of the subjects who were involved in the study limited the generalizability of the results. This observational study was limited by sampling to making observations only about the subjects who actually participated in the study. Generalizations beyond the subjects studied are limited because the subjects were not completely randomly sampled from a definable population. This limitation has been inherent in studies of chronic pain patients in the past. However, the sample in this study appeared to be typical of patients with chronic low back pain seeking help from MPCs across the country. As Keefe et al. (1981) pointed out, the characteristics are commonly ascribed to subjects suffering from chronic low back pain syndrome in North America.

Events other than treatment in the MPC that occur between treatment and follow-up may have influenced outcome. Control for historical influences on internal validity was unaccounted for in this study. This weakness is inherent in most follow-up studies of patients with chronic low back pain.

The number of subjects included in the study is another sampling limitation. Seventy-five subjects provided responses. Forty-three of them were receiving worker's compensation, 11 were receiving auto no-fault benefits, and 21 were not receiving any form of subsidized financial support. Twenty-two variables were measured in this research. Hence, the statistical power of the multivariate tests used to analyze the data was reduced. Having a larger number

of subjects and/or a smaller number of dependent variables would have been preferable.

The possibility of maturation of the subjects over an 8-week treatment span is small, but it may have existed and influenced the outcome of the study. There was no way to control or account for this threat to internal validity in the present research.

Testing familiarity may have occurred as a result of repeated exposure to the MPQ. There is always the possibility that the subjects became tired of completing the MPQ periodically, and that they were less than conscientious about responding sincerely to the questionnaire items. The reliability of the MPQ was reviewed, and there did not appear to be statistical regression as a result of using the instrument.

Mortality or the loss of subjects did not appear to affect differentially the measures of dependent variables. This eventuality was covered in the missing-data section.

Interactions between some of the above-mentioned limitations may have added to the threat to internal validity. The interaction with small sample size or maturation could enhance the effect of the threat to the validity of the study.

The true test of the internal validity of this study lies in its external validity. External validity is enhanced by the selection of appropriate and representative samples. The researcher believes that this sample conformed to the characteristics commonly associated with individuals suffering from chronic low back pain complaints in North America. There may be external threats to the

study in that subjects were drawn from one geographic area, that being western Michigan. The western Michigan area may not represent the general economic condition elsewhere in the state. The economy of western Michigan is diverse, being made up of pharmaceutical production, health and cleaning products, and the office furniture industry, as well as automobile-related manufacturing. The majority of the state of Michigan is primarily invested in the automobile manufacturing industry, which had economic difficulty during the period of this study.

Implications for Future Research

The findings from this study did not support the assertion that subjects receiving worker's compensation will fare less successfully than other subjects in a treatment program for chronic low back pain. Similarly, the findings failed to support the view that those receiving auto no-fault benefits will profit less from participating in an MPC than those not receiving benefits. Those individuals receiving worker's compensation and auto no-fault benefits had the same rate of success as those not receiving benefits.

It further appears that there are no significant characteristics that are identifiable to ensure success following treatment. Future research focusing on acceptance criteria might be productive. The question of whether differences exist between those accepted and those not accepted in MPC programs should be explored. Researchers have explored, and continue to explore, differences between subjects classified as successful and those classified as unsuccessful. What

rate of success occurs in that group not selected for treatment? There has been some limited research comparing pain levels of treatment subjects to waiting-list controls, but no study has yet used repeated measures over time. If there are not significant differences in the proportions of successful outcomes among those accepted and those rejected by the program, further consideration is due to those individuals who have been excluded to date. This research has shown that there are not differences between individuals receiving worker's compensation and those not receiving such compensation. Historically, we have seen how those individuals receiving worker's compensation have been excluded from MPC programs in the past. Another area of research would be to examine the characteristics of individuals who fail to complete the MPC program that they initiate.

Historically, researchers have shown that the affective descriptors of pain are better predictors of psychological distress than is the combination of sensory and affective descriptors (Kremer, 1983). However, the present research, using the HLM method of analysis, demonstrated that the Affective dimension of the MPQ was not effective in discriminating between subjects. Future research might follow the levels of all the scales of the MPQ from intake, through treatment, and at follow-up to detect any significant differences. Examination of multiple measures over time could facilitate a more comprehensive understanding of any trends or differences in dimensions of the MPQ that result from treatment.

The use of the HLM analysis method in research on chronic pain patients is of benefit. The research design is complicated, yet it provides a powerful statistical measurement of treatment effects. The HLM method of analysis could be used in combination with a standard pain measure, taken at multiple time points, to compare treatments at different locations, to analyze more effectively the outcomes of the various treatment centers. This would also increase the size of the sample and thereby enhance the internal validity of the study.

APPENDICES

APPENDIX A

THE McGILL PAIN QUESTIONNAIRE

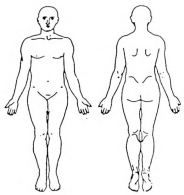
McGill Pain Questionnaire

Patient's Name _____ Date _____ Time _____ am/pm

PRI: S _____ A _____ E _____ M _____ PRI(T) _____ PPI _____
(1-10) (11-15) (16) (17-20) (1-20)

1 FLICKERING QUIVERING PULSING THROBBING BEATING POUNDING	11 TIRING EXHAUSTING
2 JUMPING FLASHING SHOOTING	12 SICKENING SUFFOCATING
3 PRICKING BORING DRILLING STABBING LANCINATING	13 FEARFUL FRIGHTFUL TERRIFYING
4 SHARP CUTTING LACERATING	14 PUNISHING GRUELLING CRUEL VICIOUS KILLING
5 PINCHING PRESSING GNAWING CRAMPING CRUSHING	15 WRETCHED BLINDING
6 TUGGING PULLING WRENCHING	16 ANNOYING TROUBLESOME MISERABLE INTENSE UNBEARABLE
7 HOT BURNING SCALDING SEARING	17 SPREADING RADIATING PENETRATING PIERCING
8 TINGLING ITCHY SMARTING STINGING	18 TIGHT NUMB DRAWING SQUEEZING TEARING
9 DULL SORE HURTING ACHING HEAVY	19 COOL COLD FREEZING
10 TENDER TAUT RASPING SPLITTING	20 NAGGING NAUSEATING AGONIZING DREADFUL TORTURING
	PPI 0 NO PAIN 1 MILD 2 DISCOMFORTING 3 DISTRESSING 4 HORRIBLE 5 EXCRUCIATING

BRIEF	RHYTHMIC	CONTINUOUS
MOMENTARY	PERIODIC	STEADY
TRANSIENT	INTERMITTENT	CONSTANT



E = EXTERNAL
I = INTERNAL

COMMENTS:

APPENDIX B

LETTER TO SUBJECTS

CODE NUMBER_____

Date

Client Name
Client Address
City, State

Dear _____:

I am a graduate student at Michigan State University. I am working with Mary Free Bed Hospital to research the "Relationship of Affect to Treatment and Outcome in Chronic Pain." This research will help to further the understanding of the needs of individuals participating in Chronic Back Pain Clinics so that services can continue to improve for future patients.

Enclosed, please find Mary Free Bed's follow up questionnaire and the Productivity of Life Questionnaire. I hope you will complete the questionnaires and return them to me in the envelope provided. Your participation in this activity will take only a few minutes of your time.

All responses will be treated with strict confidence. You will remain anonymous. Your participation in this request is strictly voluntary.

If you are interested in the results, please circle the response requesting results and I will provide a summary of the results to you when the study is complete. If you have any questions or concerns about participating in this study, please feel free to contact me.

Yours truly,

Paul Delmar, M.A.
Certified Rehabilitation Counselor
6475 28th Street SE
Suite 320
Grand Rapids, MI 49546

616-698-2992

I have read the above letter and understand that I am a voluntary participant in this study. Any future treatment at Mary Free Bed will not be effected by my choice to, or not to, participate in this study. I do / do not wish to receive a summary of the results of the study (please circle choice).

witness_____ signature_____

Client name
Client address
City, State Zip

APPENDIX C

THE PRODUCTIVITY OF LIFE QUESTIONNAIRE

Productivity of Life Questionnaire

Please check the item that best applies to yourself.

1. Are you presently employed?

_____Full time
_____Part time, 32 hours or more per week
_____Part time, less than 32 hours per week
_____Not at all

2. Are you currently enrolled in school?

_____Yes, full time _____No
_____Yes, part time

3. Are you involved in any community organization? (Organizations include both disability-related organizations and nondisability-related organizations, i.e, the local rotary club, school PTA, fraternal organizations, etc.)

_____Yes _____No

4. Are you participating in homemaking activities? (Homemaking activities include one or more of the following: meal preparation, housecleaning, food shopping and supervising children or dependent adults.)

_____Yes _____No

5. Are you participating in active leisure time pursuits? (Leisure time pursuits include going out to public entertainment, shopping, visiting friends or relatives at their home, etc.)

_____Yes, more than 15 times per month
_____Yes, between 6 and 15 times per month
_____Yes, less than 6 times per month
_____No

APPENDIX D

RANKINGS AND WEIGHTINGS OF PRODUCTIVITY OUTCOMES

Rankings and Weightings of Productivity Outcomes

Rank Order	Activities: Was person participating in: Employment?	School?	Organizations?	Homemaking?	Active Leisure?	Rankings: Modal Rank	Mean Rank	Productivity Group	Weightings: Mean Weight	Median Weight	Stand Dev.
1	Yes (full-time)	Participated in at least 1 but not all 3 activities			Yes	1	1.1	Most Productive Group n=17 15.3%	10.0	10.0	0.1
2	Yes (part-time)	Participated in at least 2 out of 3 activities			Yes	2	2.3		9.4	9.4	0.5
3	No	Yes	Yes	Yes	Yes	3	2.8		9.0	9.0	0.7
4	No	Yes	No	Yes or No	Yes	4	4.5	Moderately Productive Group n=39 35.1%	7.9	7.9	1.1
5	No	No	Yes	Yes	Yes	5	5.0		7.3	7.1	1.4
6	No	No	No	Yes	15 times per month	7	6.3		5.8	5.9	1.5
7	No	No	Yes	No	Yes	6&8	7.0		5.7	5.4	1.6
8	No	No	No	Yes	15 times per month	8	7.6		5.3	4.9	1.3
9	No	Participated in at least 1 but not both activities		No	No	9	9.0	Least Productive Group n=55 49.5%	3.8	3.0	1.8
10	No	No	No	No	6 times per month	10	9.7		3.0	2.8	1.5
11	No	No	No	No	6 times per month	11	10.7		2.1	1.7	1.3
12	No	No	No	No	No	12	12.0		0.0	0.0	0.0

APPENDIX E

MARY FREE BED FOLLOW-UP QUESTIONNAIRE

PAIN REHABILITATION PROGRAM
FOLLOW-UP INFORMATION

DATE: _____ PATIENT'S NAME: _____

1 MONTH 3 MONTHS 6 MONTHS 12 MONTHS MEDICAL RECORD #: _____

DATE OF DISCHARGE: _____

Please fill out the information or check the box which is most appropriate. If you are not able to answer a question or do not care to answer a question, please indicate by checking the N/A box.

1. Were you working at the time of discharge from our program?
   Yes [ ] No [ ] N/A [ ]

2. Are you presently working?
   Yes [ ] No [ ] N/A [ ]

   If yes, list employer, job title, length of employment, toleration of job duties, and hours worked per week.

   _____

   _____

3. If not working, are you actively involved in a job search or job club?
   Yes [ ] No [ ] N/A [ ]

   ANSWER QUESTIONS 4-7 ONLY IF YOUR COVERAGE WAS THROUGH WORKER'S COMPENSATION OR AUTO-NO-FAULT.

4. If you are not working, are you involved with vocational rehabilitation?
   Yes [ ] No [ ] N/A [ ]

   If no, explain. _____

   _____

5. Are you working with a rehabilitation specialist?
   Yes [ ] No [ ] N/A [ ]

6. Are you involved in a retraining program?
   Yes [ ] No [ ] N/A [ ]

   If yes, list type and length? _____

7. Have you obtained second-injury certification?
   Yes [ ] No [ ] N/A [ ]

8. Rate the intensity of your pain on a 0-100 scale where 0 is no pain and 100 is pain as bad as it could be.

A. Average pain over past week _____
B. Worst pain over past week _____
C. Least pain over past week _____
D. Present pain intensity _____
E. Comfort level _____

9. Some of the words below describe your pain. Circle all those words that describe your pain at any time during the last week. Leave out any group where there are no words that describe your pain.

1	2	3	4
Flickering	Jumping	Pricking	Sharp
Quivering	Flashing	Boring	Cutting
Pulsing	Shooting	Drilling	Lacerating
Throbbing		Stabbing	
Beating		Lancinating	

5	6	7	8
Pinching	Tugging	Hot	Tingling
Pressing	Pulling	Burning	Itchy
Gnawing	Wrenching	Scalding	Smarting
Cramping		Searing	Stinging
Crushing			

9	10	11	12
Dull	Tender	Tiring	Sickening
Sore	Taut	Exhausting	Suffocating
Hurting	Rasping		
Aching	Splitting		
Heavy			

13	14	15	16
Fearful	Punishing	Wretched	Annoying
Frightful	Grueling	Blinding	Troublesome
Terrifying	Cruel		Miserable
	Vicious		Intense
	Killing		Unbearable

17	18	19	20
Spreading	Tight	Cool	Nagging
Radiating	Numb	Cold	Nauseating
Penetrating	Drawing	Freezing	Agonizing
Piercing	Squeezing		Dreadful
	Tearing		Torturing

10. Are you using the stress management techniques which you learned in the program?
Frequently [ ] Sometimes [ ] Seldom [ ] Never [ ]

11. Have you had periods of time since leaving the program where you have been depressed or anxious to the point where it interfered with your daily functioning? (If you have not been depressed or anxious since you last completed a follow-up questionnaire, answer No.)
Yes [ ] No [ ] N/A [ ]

12. Are you currently using any pain medication?
Yes [ ] No [ ] N/A [ ]

If yes, please list:

	Medication	Dosage	How often
A.			
B.			

13. Have you seen a physician for your pain problem since discharge?
Yes [ ] No [ ] N/A [ ]

If yes, how many times? _____

14. Are you sleeping well at night?
Yes [ ] No [ ] N/A [ ]

15. Have you developed any new pain problems?
Yes [ ] No [ ] N/A [ ]

If yes, explain. _____

_____

16. Have you had any further surgery for your pain problem or are you planning on it?
Yes [ ] No [ ] N/A [ ]

If yes, date and procedure: _____

APPENDIX F

APPROVAL LETTER FROM THE UNIVERSITY COMMITTEE ON

RESEARCH INVOLVING HUMAN SUBJECTS

MICHIGAN STATE UNIVERSITY

OFFICE OF VICE PRESIDENT FOR RESEARCH
AND DEAN OF THE GRADUATE SCHOOL

EAST LANSING • MICHIGAN • 48824-1046

February 20, 1991

Mr. Paul Delmar
7922 Pine Edge Court
Alto, MI 49302

RE: RELATIONSHIP OF AFFECT TO TREATMENT AND OUTCOME IN CHRONIC PAIN, IRB#91-063

Dear Mr. Delmar:

The above project is exempt from full UCRIHS review. The proposed research protocol has been reviewed by another committee member. The rights and welfare of human subjects appear to be protected and you have approval to conduct the research.

You are reminded that UCRIHS approval is valid for one calendar year. If you plan to continue this project beyond one year, please make provisions for obtaining appropriate UCRIHS approval one month prior to February 11, 1992.

Any changes in procedures involving human subjects must be reviewed by UCRIHS prior to initiation of the change. UCRIHS must also be notified promptly of any problems (unexpected side effects, complaints, etc.) involving human subjects during the course of the work.

Thank you for bringing this project to my attention. If I can be of any future help, please do not hesitate to let me know.

Sincerely,

David E. Wright

David E. Wright, Ph.D.
Chair, UCRIHS

DEW/deo

cc: Dr. Nancy Crewe

APPENDIX G

MARY FREE BED PROGRAM--ORIGINAL INFORMATION SHEET

PAIN REHABILITATION PROGRAM

Mary Free Bed Hospital and Rehabilitation Center
235 Wealthy SE
Grand Rapids, Michigan 49503
616-242-9204/242-0482

Please print or type information on this form. Please use black ink if possible.
Check boxes where appropriate.

Name _____ Date _____

Address _____ Type of Insurance Coverage:
(Street)

_____ _____
(City) (State) (Zip)

Telephone (____)_____ Social Security # _____

Date of Birth _____ Age _____

1. Where in your body do you experience pain? _____

_____

2. From whom did you hear about this program? _____

_____

3. a. Is your pain problem the result of an injury? Yes _____ No _____

b. If yes, date of injury _____ Location _____

Description _____

c. If no, when did your pain problem start? _____

Cause? _____

4. a. How many times have you had surgery for your pain problem? _____

b. Dates of surgery (if any) _____

5. Who has treated you for your pain problem? _____

_____

_____

6. a. Who is your present treating physician? _____

b. Who is your family physician? _____

7. What have your doctors told you about the pain? _____

_____

8. Have you had a pain problem in the past (prior to this current problem)? Please explain: _____

_____

9. a. How many days have you been in the hospital for pain problems in the past year? _____ days

b. How many times do you estimate you went to your doctor's office because of your pain problem during the last 12 months? _____ times

c. How many times do you estimate you went to the emergency room for treatment of your pain problems in the last 12 months? _____ times

d. Please estimate how many times in the last 12 months that you received physical therapy treatments for your pain problems. _____ times

10. Please list all prescription and non-prescription medications you now take.

Name	Amount	How often taken
a.		
b.		
c.		
d.		

11. Do you smoke? Yes _____ No _____

12. a. Estimate the number of hours you are lying down each day. _____ hours

b. Do you feel that currently you do at least 80% of the homemaking tasks around around the house? Yes _____ No _____

c. Do you consider yourself active? Yes _____ No _____

d. Do you consider yourself retired? Yes _____ No _____

13. How often do you complete an exercise program?

Daily _____ Weekly _____ Infrequently _____ Not at all _____

14. Please list the treatments you have had for your pain problem. Put an * by any treatment that seemed to help.

Date	Physician	Treatment (or surgery)
a.		
b.		
c.		
d.		

15. a. Circle any of the following that made your pain worse.

sitting standing running lying down driving a car

coughing straining bending lifting twisting

b. Add any activity which worsens the pain (not listed above):

_____

c. Circle any of the following that helps your pain.

rest heat massage exercise brace adjustments hot baths

medicines (Please list): _____

d. Add anything else that helps (not listed above): _____

_____

16. If the pain was not such a major focus of your life, what would you do differently with your time?

a. _____ d. _____

b. _____ e. _____

c. _____ f. _____

17. a. Some of the words below, which are divided into 20 categories, may describe your pain. Please read each group carefully. Circle all words in each group that describe your pain. Leave out any groups where there are no words that describe your pain.

1	2	3	4
Flickering	Jumping	Pricking	Sharp
Quivering	Flashing	Boring	Cutting
Pulsing	Shooting	Drilling	Lacerating
Throbbing		Stabbing	
Beating		Lancinating	

5	6	7	8
Pinching	Tugging	Hot	Tingling
Pressing	Pulling	Burning	Itchy
Gnawing	Wrenching	Scalding	Smarting
Cramping		Searing	Stinging
Crushing			

9	10	11	12
Dull	Tender	Tiring	Sickening
Sore	Taut	Exhausting	Suffocating
Hurting	Rasping		
Aching	Splitting		
Heavy			

13	14	15	16
Fearful	Punishing	Wretched	Annoying
Frightful	Grueling	Blinding	Troublesome
Terrifying	Cruel		Miserable
	Vicious		Intense
	Killing		Unbearable

17	18	19	20
Spreading	Tight	Cool	Nagging
Radiating	Numb	Cold	Nauseating
Penetrating	Drawing	Freezing	Agonizing
Piercing	Squeezing		Dreadful
	Tearing		Torturing

b. Are there any words which are not listed above which you think describe your pain? Yes _____ No _____

18. a. On a scale of 0-100, where 0 is no pain and 100 is pain as bad as it could be, what would you estimate your <u>average or usual</u> pain level has been in the past week? _____

b. Using the same scale of 0-100, what would you estimate your <u>least</u> pain has has been in the past week? _____

c. Again, using the same scale of 0-100, what would you estimate your worst pain has been in the past week? _____

19. What do you expect to achieve by participating in this program?

_____

_____

20. a. Marital Status: Single _____ Married _____ Separated _____

b. If married, is your spouse employed? Yes _____ No _____

c. If yes, what is your spouse's occupation? _____

d. Number of children? _____

e. List all people besides yourself that live in your home:

NAME	RELATIONSHIP	AGE
1.		
2.		
3.		
4.		
5.		

21. a. Are you currently working? Yes _____ No _____

b. If no, has your pain problem affected your ability to work? Explain:

_____

_____

21. c. If you are employed, how many hours per week are you working? _____ hours

d. If you are not working, how many months has it been since you worked last?

_____ months

22. a. Present or most recent employer:

Name: _____ Supervisor: _____

Address: _____
Street City State Zip Phone

Job Title: _____ Wages: _____

b. Dates Employed From: _____ To: _____
How many days absent in the past month: _____

c. Previous Employment:

Name of Employers	Supervisor	Job Title	Wages	Dates

d. Job enjoyed the most: _____

23. Please check as appropriate:
_____ I plan on going back to my old job.
_____ I plan on going back to the same company but a different job.
_____ I need to look for a new job.
_____ I consider myself totally and permanently disabled and thus unable to work.
_____ I choose not to work.
_____ Other, please explain: _____

24. Please check as appropriate:
_____ I plan to eventually work full time (40-hour week).
_____ I plan to eventually work part time (less than 40 hours a week).

25. The biggest barriers to my going back to work are: (Check as appropriate)

_____ My strength and endurance	_____ My employment history
_____ My education	_____ My work skills
_____ The fast pace of my old job.	_____ Fear of losing compensation or disability income
_____ The company's attitude	_____ My lawyer
_____ My attitude	_____ Loss of income
_____ My family's attitude	_____ Fear of hurting myself further
_____ My health history	_____ The economy
_____ Other, please explain:	

_____

26. School:

a. Circle the highest grade completed
Grammar/High School 1 2 3 4 5 6 7 8 9 10 11 12
College 1 2 3 4 5 6
Trade/Business School _____
Other _____

26. c. Are you currently involved in a school program? Yes _____ No _____

d. If yes, please describe: _____

27. a. Are you currently involved in any legal activity as a result of your pain? (For example: Lawsuit, compensation litigation) Yes _____ No _____

If yes, please describe: _____

_____

b. Lawyer's Name: _____

_____ ( )_____
Street City State Zip Telephone

c. Date of pending legal action: _____

d. Do you plan any future legal action? Yes _____ No _____

If yes, please explain: _____

28. Are you currently a client of Michigan Rehabilitation Services or a private rehabilitation company? Please specify: _____

29. a. Please check all sources of income that apply to you and your spouse.

Wages (earned income)	Applicant ____	Spouse ____
Worker's Compensation	Applicant ____	Spouse ____
Auto No-Fault	Applicant ____	Spouse ____
Social Security Disability	Applicant ____	Spouse ____
Unemployment Benefits	Applicant ____	Spouse ____
Social Security Retirement	Applicant ____	Spouse ____
Pension	Applicant ____	Spouse ____
Public Assistance	Applicant ____	Spouse ____
Other (please specify): _____	Applicant ____	Spouse ____

b. Total Monthly Income Before Taxes : $_____

30. Please show your current medical insurance coverage:
Be sure to include all policy numbers.

a. Blue Cross/Blue Shield: Group # _____ Service Code _____

Plan # _____ Contract # _____

b. Medicaid: ID# _____

c. Medicare: Policy # _____

d. Private Insurance: Policy # _____

Name of Insurance Company _____

Address _____

Adjustor's Name _____ Telephone ( ) _____

e. Worker's Compensation/Auto No Fault: (Please circle one.)
Policy # _____ Name of Insurance Company _____

Address _____

Adjustor's Name: _____ Telephone ( ) _____

31. Please list all doctors, hospitals and clinics from whom you will be requesting medical information. (We have enclosed medical release forms that need to be signed and forwarded to the appropriate facilities.)

	Name	Address	Phone #	Last Seen On
a.				
b.				
c.				
d.				
e.				

32. Please list all x-ray departments, hospitals, or doctors from whom you will be requesting x-rays. (We have enclosed x-ray release forms that need to be signed and forwarded to the proper facility.)

	Name	Address	Type of x-ray	Date x-rays were taken (month/year)
a.				
b.				
c.				
d.				
e.				

I understand the above information is confidential and will be shared only with the Mary Free Bed Pain Rehabilitation Team to aid them in evaluating my pain problems.

Furthermore, I also understand that it is my responsibility to contact my doctors and arrange for them to forward to you all pertinent medical records. I understand once you have received this form, my completed medical histories from doctors I have seen for my pain problems, x-rays, and insurance clarification, that you will contact me to set up my initial evaluation.

Finally, I have discussed with my spouse the requirement that he/she will actively be involved with my treatment program. He/she is prepared to participate in my initial evaluation and will attend meetings later at the hospital depending on treatment recommendations.

_____ _____
Applicant's Signature Spouse's Signature

_____
Date

Application, Continued

Page 8

Mark the areas on your body where you feel the described sensations. Use the appropriate symbol. Include all affected areas. Also, using the scale at the bottom of the page, place an X on the scale where you would put your average daily amount of pain.

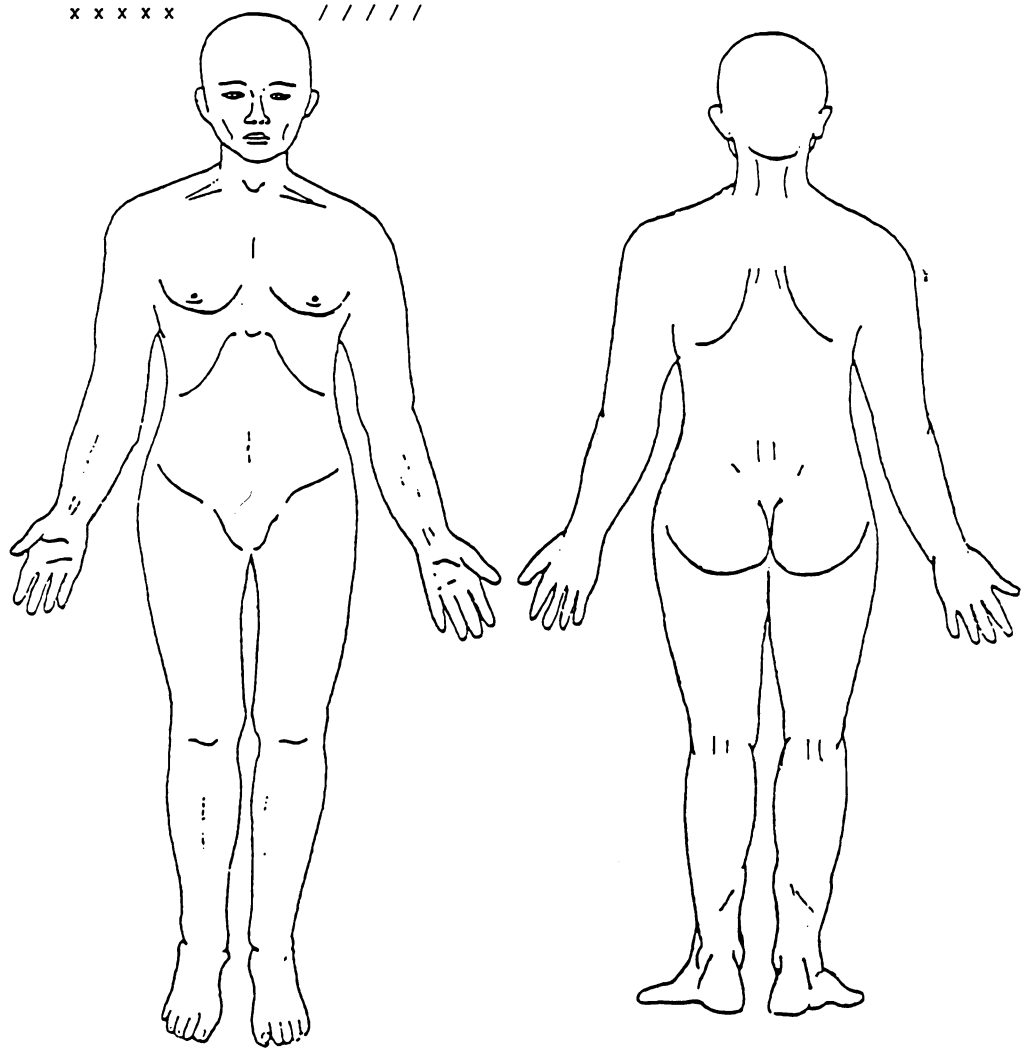
Numbness - - - - -
- - - - -
- - - - -

Pins and Needles o o o o o
o o o o o
o o o o o

Aching . . . . .
. . . . .
. . . . .

Burning x x x x x
x x x x x
x x x x x

Stabbing / / / / /
/ / / / /
/ / / / /



0% No Pain — 10% — 20% — 30% — 40% — 50% — 60% — 70% — 80% — 90% — 100% Unbearable Pain

APPENDIX H

DATA SUMMARY FORM

DATA SUMMARY FORM

NAME: _____
ADDRESS: _____

TELEPHONE _____

DATE OF INTAKE: _____

AGE: _____

EDUCATION: _____

MARITAL STATUS: _____

SPOUSE EMPLOYED: _____

CLIENT EMPLOYED AT INTAKE: _____

LITIGATION: _____

REHABILITATION INVOLVED: _____

SOURCES OF INCOME: _____

LENGTH OF CHRONICITY: _____

HOSPITALIZATIONS: _____

NUMBER OF PRIOR SURGERIES: _____

NUMBER OF PRIOR EMPLOYERS: _____

WC/ NO FAULT / OTHER:

MPQ
PPI:
NWC:
S A E M

NUMBER OF WEEKS IN PROGRAM
DATE/ AFFECT SCORE %

FOLLOW UP INFORMATION

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REFERENCES

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