To the graduate council:

I am submitting herewith a dissertation written by Susan Reagan Strickler entitled "Chronic Physical and Emotional Distress: Fighting a Battle or Finding a Balance?" I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Psychology.

Robert G. Wahler, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor and
Dean of the Graduate School

CHRONIC PHYSICAL AND EMOTIONAL DISTRESS:

FIGHTING A BATTLE OR FINDING A BALANCE?

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Susan Reagan Strickler
May 1997

DEDICATION

This dissertation is dedicated to my husband

Wayne Strickler

for whose support I will always be grateful

and

to my parents

Ralph and Kate Reagan

who have both supported my endeavors and

have given me invaluable educational opportunities

ACKNOWLEDGMENTS

This research project represents a journey for me, both personal and professional; its impact on my life cannot be overestimated. I want first to acknowledge the contribution of the courageous individual who agreed to participate in this research project. She deserves credit, for her determination to understand the pain she experienced, for her wish to help others who live with a chronic health problem, as she has. I am deeply indebted to my doctoral committee members, Dr. Robert Wahler, Dr. Michael Nash, Dr. Richard Gillespie, and Dr. Warren Jones, for their interest in my professional development, and for their efforts on my behalf.

The volunteers who helped with data recording and analysis will be remembered and appreciated - particularly my son Mark, who introduced me to ideas in his profession which helped me better understand my own work. I want to thank my daughter Kathryn, and my husband Wayne for understanding when I worked while they played without me. And finally, I want to recognize and thank my friend Alisa Vollmer, who never failed to encourage me when I needed her support.

ABSTRACT

Chronic illness has reached epidemic proportions in Western societies, and comorbidity of emotional and physical disorders is substantial. Despite the underlying unity of mind and body, a dualistic biomedical model of illness continues to prevail in the Western medical system, assuming that all disease is connected with a specific physical cause, and that physical treatment alone is adequate to provide a cure. Individuals and society at large are portrayed as engaging in a "war" or battle against illness, in which the goal is to control and defeat this dreaded enemy. Our predominantly action-oriented fighting mode is in contrast to the model of acceptance and understanding espoused by more "primitive" healing practitioners.

This study examined the progression of a single individual's treatment for a chronic pain syndrome known as Reflex Sympathetic Dystrophy, as a dynamic process which includes biological, psychological, and social elements. Verbal transcripts of psychotherapy sessions were analyzed, along with physiological measures of peripheral vascular response and subjective ratings of pain-related intensity and affect. Quantitative analysis of outcome measures showed that by the end of her psychological treatment, the participant had developed a more complex and tolerant view of herself and her ecosystem. Both pain intensity and pain-related affect decreased, while peripheral finger temperature stabilized within a clearly defined modal range. The theoretical concept of "balance" was operationalized, and shown to be an element important in the individual's healthy functioning.

PREFACE

This study represents at least 20 years of interest on the part of the author in adjunctive treatment of individuals with medical problems using psychological interventions, beginning with the work of Simonton and Simonton in treating cancer patients. Initially, my curiosity was satisfied by occasional readings in the field of "psychosomatic" or behavioral medicine, in addition to the little that was offered in required reading for a Master of Arts degree in Psychology. By the time my doctoral studies began in 1991, I was focusing my activities in other areas of the profession. When I returned to school, I was given the opportunity to read extensively, and the encouragement to think about what I was learning. As a result, I again turned to the important topic of how we as individuals heal, both physically and emotionally. It is through the study described in this paper that I was able to look closely, over an extended period, at the struggle of one person who courageously faced her pain, and learned not to battle with, but to accept it. She was able to mobilize her own capacity for growth and healing and to take responsibility for changing her life. Paradoxically, by accepting the pain, she was able to change its meaning, to see its value, and ultimately, to significantly decrease its influence in her life.

Chapter One introduces the dilemma of chronic illness in our culture, and provides a rationale for the study. Specifically, chronic illness is considered as an example of a complex biopsychosocial entity experienced by living systems.

Chapter Two presents a review of the relevant literature, beginning with a discussion of what is meant by the term "complexity." The text continues with definitions of chronic pain, along with an examination of its treatment in the medical and psychological literature. Finally, major tenets of systems and chaos theory are discussed as they may apply to chronic pain.

Chapter Three examines the concept of "balance" as it applies to living systems. The idea of balance is considered in depth, as is it crucial to the design and conceptualization of the present investigation.

Chapter Four examines the methodology of the study. The participant who volunteered to take part in this study is described, as is the nature of the interviews, measures used, data collection, and analysis of data. An explanation of transcript coding procedures is provided, and a rationale provided for study design and inclusion of specific measures used to gather data.

Chapter Five present results of the study, showing post-treatment changes across all measures. The sixth and final chapter discusses this project along with its broader implications for research and practice.

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CHAPTER I

INTRODUCTION

Today, chronic disease has replaced acute, infectious disease as the difficulty most confronted by health care practitioners (Wickramsekera, 1988). As a result, the health care system in the United States has undergone drastic change as it attempts to adjust to an aging population with multiple chronic illnesses. There has been a push by policymakers and administrators to concentrate primarily on controlling costs, in part by limiting access to health care providers, as well as by decreasing the availability of those relatively more expensive assessment and treatment services. Despite the concern connected with cost control, the prevailing biomedical treatment model has as a rule not been seriously questioned by those who reimburse for treatment. Engel (1960, 1977, 1978, 1980) has long argued against this conceptual model for provision of health care. In doing so, he maintained that:

> "The biomedical model can make provision neither for the person as a whole nor for data of a psychological or social nature, for the reductionism and mind-body dualism on which the model is predicated requires that these must first be reduced to physico-chemical terms before they can have meaning . . . The crippling flaw of the model is that it does not include the patient and his attributes as a person, a human being. . . . Hence, the essence of medical practice perforce remains beyond the reach of science." (1980, p. 536).

In fact, studies have found that only 12-25% of health care use can be predicted by an objective finding of physical disease (Berkanovic, Telesky, and Reeder, 1981). Kroenke and Mangelsdorff (1989) reviewed the records of over 1,000 patients who

visited an internal medicine clinic over the course of three years. They found that in less than 16% of the cases examined was the origin of the most common somatic complaints identified as being physical. It was the opinion of the authors that in approximately 75% of cases in which the origin of the complaint was unknown "it was probable that many of the symptoms . . . were related to psychosocial factors" (p. 265). Cummings and Follette (1968) found that more than 60% of all visits made to a large health maintenance organization (HMO) were made by individuals with no diagnosable physical disorder. Thus, it seems likely that co-occurrence of psychological and physical illness is considerable. In a study by Katon and Sullivan (1990), 41% of patients with chronic physical illness acknowledged having a recent or concurrent psychological disorder. A recent study which explored the co-morbidity of chest pain and psychiatric disorder evaluated 334 patients who presented with acute chest pain for panic disorder and depression. Panic disorder was diagnosed in 17.5% of the patients, and depression in 23.1%. Further, the investigators found that the likelihood of an emergency room visit for chest pain in the preceding year was significantly higher for the patients who had been diagnosed with either panic disorder or depression (Yingling, Wulsin, Arnold, & Rouan, 1993).

Based on data which has emerged to date, the link between emotional and physical disorders seems to be a substantial one. Clearly, psychosocial factors which often go unrecognized can significantly influence both the need and the demand for medical services (Fries, et. al., 1993). Interestingly, psychotherapy services which

address these psychosocial factors has been shown to reduce patients' emotional and physical distress, as well as serving as a cost effective adjunct to traditional medical treatment (Cummings and Follette, 1968). Barlow (1996) cites evidence to support the fact that:

> "Psychotherapeutic procedures with proven efficacy exist for physical disorders such as cardiovascular disease and cancer . . . and these procedures can extend and even save lives. Incontrovertible evidence now exists that psychological interventions change brain function and, very likely, brain structure as at least part of their mechanism of action" (p. 1052).

In discussing the relationship between psychological maladjustment and physical illness, Martin and Friedman, et. al., (1995) caution the reader to remember that correlations between physical and emotional distress do not mean that psychological maladjustment is "causing" physical illness, or vice versa. They conclude that long-term ". . . studies of mental and physical health provide one of the best means of untangling these complex . . . webs" (p. 382). They go on to suggest that future studies should attempt to identify complex ways in which the two may be related, rather than seeking to find direct causal links.

One of the multitude of chronic conditions for which individuals commonly present for treatment is pain. The experience of chronic pain has often been described as enigmatic, and characterized by complex interactions between "mind" and "body." Until Melzack and Wall's landmark gate control theory was put forth (1965), pain was most often conceptualized in dualistic fashion, as either in the mind or in the body, depending upon the theorist's particular point of view. Melzack and Wall encouraged

both the medical and psychological communities to view pain as an interactive process (Fordyce, 1992), in which the body functions as a holistic system, rather than operating as separate mental and physical components. In 1986, Melzack commented: "Chronic pain is too complex, with too many interacting combinations, to expect to find some magical elixir or incantation that will abolish it."

Bonica, who was active throughout his career in both the treatment and study of chronic pain, wrote that "pain is the most complex human experience and the most frequent reason patient seek medical counsel" (1992, p. xx). It is a health care issue which is estimated to directly affect one third of the American population (Bonica, 1992) at an annual expense of approximately $70 billion (Turk, 1994). Low back pain alone is said to be the most expensive "benign" condition in industrialized countries, and is the number one cause of disability in people under the age of 45 (Gatchel, Polatin, & Kinney, 1995). Cost estimates of this condition reveal that low back pain costs about $16 billion annually, slightly more than half of which is expended to reimburse surgical treatment of this condition (Holbrook, Grazier, Kelsey, & Stauffer, 1984). As is presumably the case with any complex phenomenon, there are important differences in the fundamental assumptions employed to conceptualize pain, based on one's theoretical model.

Purpose of the Study

William Bevan published a thought provoking article which addressed the current state of psychological inquiry. He wrote about the challenges that psychology

faces in attempting to assemble a coherent body of knowledge as he remarked:

> " . . . The character of psychology is increasingly manifest in the rapid proliferation of narrowly focused and compulsively insular camps, a proliferation that seemingly knows no limits. We persevere in looking at small questions instead of large ones, and our view of the forest is forever obscured by the trees . . . Preoccupation has frequently been at the level of data. Few writers have been concerned explicitly with fundamental metaphysical issues: most have been narrowly focused, and the prevalent tone, despite the occasional theoretical fanfare, reflects a persistently tentative no-frills empiricism. It has been a long time since there was much talk among psychologists of grand explanatory schemes or of world views. When I suggest we look to new models . . . I believe it essential that they should recognize both the great complexity and dynamic quality of the phenomena with which psychologists deal" (1991, p. 475-6).

In fact, this investigation is one which was *not* designed to produce substantive empirical data. It is an epistemological enterprise intended to bring together the Cartesian mind-body dichotomy, and to present human beings as dynamic, living organisms whose behavior may be affected by non-linear principles described as "chaos theory." This investigation aims to investigate the co-occurrence of chronic physical and emotional illness in a single subject. Jones (1993) has referred to this sort of research as an "empirically based, context-sensitive, discovery-oriented single case study" (p. 372). This particular research project compares physiological (peripheral vascular response) and psychological (verbal/transcript) data gathered over a period of approximately 12 months of psychotherapeutic treatment in an outpatient pain clinic. It is hoped that the study can expand that literature which serves to broaden the conventional definition of health and disease by encouraging those who study and provide health care to address their inherent complexity. Rather than viewing an

individual as composed of separate and isolated "mind" and "body," the evidence presented in this paper may allow a union of what have often been considered disparate phenomena.

Some Thoughts on Methodology

Preserving the essence of the phenomenon under investigation necessitates the use of a methodology which will allow systemic behavior to be seen in its richness and variability. Commonly employed statistical analyses are often based on measures of central tendency, and as such they view the behavior of the system under investigation as represented by a single number which has been abstracted from an array of available data. The mean (all values summed and divided by total number of cases) can be highly misleading, particularly when the system is free to expand its activity in only one direction. Body temperature is an example of behavior which is constrained based on the limits of the organism. In a person with no infection, temperature is likely to vary within limits on the lower end of the continuum more readily than on the higher end, where a reading over 98.6 indicates fever. If actual temperature data were plotted by frequency of occurrence, one would probably see a distribution which reflects a strong negative skew, given the system's freedom to expand in that direction under normal circumstances. Thus, the mean could be grossly influenced by any extreme scores in a left-hand direction, and would not accurately represent the total distribution of temperatures.

In studying the behavior of a complex system whose behavior changes over

time in non-deterministic fashion, one would be interested in knowing about the *variation* of such a system's activity by observing *patterns* which are present. Prigogine (1989) described the function of continual variation in systemic behavior as providing "order through fluctuations," while Capra (1996) contended that observing the pattern inherent in a living system is critical to understanding it. In discussing this point, he wrote:

> " From the systems point of view, the understanding of life begins with the understanding of pattern . . . Systemic properties are properties of a pattern. What is destroyed when a living organism is dissected is its pattern. The components are still there, but the configuration of relationships among them—the pattern—is destroyed, and thus the organism dies . . . While it is true that all living organisms are ultimately made of atoms and molecules, they are not 'nothing but' atoms and molecules. There is something else to life, something nonmaterial and irreducible—a pattern of organization" (p. 81).

The reductionistic tradition of using averages as abstractions to represent complex patterns omits much of what is interesting and relevant to the study of a given phenomenon, misrepresents its essential characteristics, and strips it of meaning. Variation in this case is best understood as variation or change over time within the system *as a whole*, and not as a simple statistical abstraction based on mean values. Traditionally, "variance" as a statistical measure of difference has been considered to be "error," because it represents a push away from the mean or expected value of the distribution of data; variance, or difference, may be treated as a mistake.

I would argue that neither human beings nor their behavior can be accurately portrayed by an abstracted measure. I certainly would not be in favor of averaging my

tears or laughter over the course of a month — or a year — to come up with a mean value which represented my mood during that period of time. The number would not help in understanding the meaning of such smiles or tears in my life, nor would it allow me to appreciate the waxing and waning of my emotions. It seems important to the understanding of any change over time, particularly in the case of complex systemic behavior, to look at the variation of all components, rather than narrowly abstracting a mean value, or "standard" deviation (the traditional statistical measure of variation) to represent the whole.

Time series and Fourier analysis of the same data can reveal dynamic patterns of rigidity or flexibility which are characteristic of the behavior of living organisms. Unlike traditional statistical analyses in which extreme scores cancel each other out, plots of data over time and frequency can allow the investigator to discern dynamic rhythms in the movement of the data. A time record can be thought of as a finite number of consecutive samples of the input signal. A graph in which temporal data is plotted according to its change over time may be thought of as simplistic, however, it provides a view of the system's movement that cannot otherwise be seen. Fourier analysis transforms the time record into a frequency record. The signal measured across time is actually a complex waveform composed of simpler components, or frequencies.

Mathematically, any signal can be represented by the amplitudes associated with a particular frequency range (Figliola & Beasley, 1991). Fourier analysis allows a

precise definition of relationships among various frequency components within a particular signal measured across time. Thus, the investigator is able to observe and measure systemic behavior from yet another perspective. Fourier analysis acts much like a prism; it transforms complex information into simpler components much as the prism transforms white light into its color spectrum. For that reason, Fourier analysis is also called "spectral" analysis, as an indication of its function. Gleick (1987) described spectral analysis as "like graphing the sound frequencies that make up a complex chord in a symphony . . . The main tones show up as vertical spikes: the louder the tone, the higher the spike" (p. 205).

Fourier or spectral analysis provides the investigator with information about relationships within the system as a whole which is not otherwise available. Data from such an analysis can be plotted with frequency on the X axis and amplitude on the Y axis, making visual inspection of the data in graphic form possible. Hayes, Blaine, and Meyer (1995) have argued that "qualitative analyses and graphic display can help communicate complex time courses of dynamic variables . . . (which) may be difficult to communicate statistically" (p. 22). In discussing the limitations of conventional diagnostic analysis of cardiac data, Goldberger, Rigney, Mietus, Antman, and Greenwald (1988) contended that using measures associated with central tendency can result in misleading conclusions. As they noted:

> "Time series and spectral analyses of the same records . . . clearly show that different runs of sinus rhythm (with identical means and standard deviations) are not necessarily equivalent. For example, one subject may show physiological heart rate variability with a broad . . . spectrum.

> Another with nearly identical heart rate mean and variance may show oscillations . . . reflecting an instability in cardiovascular control" (p. 987).

Clearly, a problem in this case lies in attempting to measure, and thus to simplify something which is in essence not reducible in a meaningful way. However, I believe that there are measures which will allow the investigator to look at the system in a more holistic fashion. Granted, *any* measure must be abstract to some degree, as the act of measuring itself disturbs the essence of the phenomenon. In discussing our attempts to measure natural phenomena, Heisenberg said: "What we observe is not nature itself, but nature exposed to our method of questioning" (1971). Systems thinking encourages the investigator to alter the experimental methodology from one which is "objective" to one which is "epistemic." In this way, the methods of research are driven by the question itself, and become an essential part of the inquiry.

Given the inherent limitations, it *is* possible to observe complex systemic behavior in a more comprehensive manner than traditional measures based on central tendency permit. Fourier analysis can be an invaluable tool, allowing the investigator to look at multiple parameters of the system via visual inspection of the plot which is generated. Indices such as (1) amplitude range (scope encompassed by the plot's vertical peaks), (2) definition of peaks (distinctly formed versus poorly formed, or "mounded"), (3) area under the curve of the plot (distance from the X axis), (4) frequency range encompassed by system's behavior (broad versus narrow), and (5) actual amplitude of vertical peaks (are most high, moderate, or low amplitude?). In addition, variation in

the system's behavior can be seen by looking at actual variation in the spikes portrayed on an FFT (Fourier Fast Transform) plot (Are they equally spaced and uniform in height across the frequency spectrum?).

Time series graphs also show variation in the system's behavior, but over time rather than frequency. Abrupt changes in behavior over time can be easily recognized by significant fluctuations over its course. Stability and change over time are not difficult to notice when each data point is plotted consecutively. Fractal patterns illustrating the presence of self-similarity can also be observed visually in an inspection of graphically presented data.

The modal (most probable) value in a given data set can also be useful in understanding a complex system's behavior with more accuracy than can a score based on "the average." For instance, if a group of 10 girls had 10 apples to eat, the mean of this group would be one; that is, each of the girls would be expected to possess one apple. Suppose that one of the girls has an apple tree in her back yard, and she is in possession of all 10 apples. The distribution of apples to girls would be skewed due because of extremes in apple ownership. The modal value in this case would be zero; most of the girls have no apples. In this case, the modal value of zero would unquestionably tell more about the fortunes of the members in the group than would the average. While means drift and wander in the direction of extreme values, the mode can help discern that behavior which is most characteristic of a non-random system, it can reveal that behavior which most often occurs. Given the fact that a

distribution of physiological data will not be random due to the limits imposed upon it, and the resulting strong likelihood that it will be skewed, the modal value should in fact be a more accurate representative of that system's actual behavior than other measures of central tendency.

It is my belief that the reality of a system's behavior lies in its movement and flow — in its balance, or variation, rather than in the stasis of a fixed value which has been derived from the whole. Clearly, this argument for the importance of variation is not new, but is in some ways similar to one that Charles Darwin made over a century ago (1859). In Darwin's theory of natural selection, it is an organism's variation which enables it to adapt successfully to its environment, and thus to survive. Darwin, however, believed that variation occurred by *chance* (random mutation). Systems thinking views variation as, in fact, *co*variation—which reflects an ongoing relationship between the organism and its environment rather than a one-way event. Despite the limitations of this theory, Darwin respected the importance of variation in life as a process which revealed its inherent richness and diversity. I, too, am arguing that in considering data gathered from a living being, that data can best be understood in its complexity, rather than based on abstractions which strip away its essential meaning.

Ultimately, this dissertation is a conceptual project; I have undertaken it for the purpose of looking again at the long debated and perplexing mind-body relationship. In this spirit, I quote Pascal, as cited by Miller (1978):

> "Let no man say that I have said nothing new - the arrangement of the material is new . . . Just as the same thoughts differently arranged

form a different discourse, so the same words differently arranged form different thoughts" (p.42).

CHAPTER II

REVIEW OF THE LITERATURE

What Is Complexity?

> The farther and more deeply we penetrate into matter, by means of increasingly powerful methods, the more we are confounded by the interdependence of parts . . . It is impossible to cut into this network, to isolate a portion without it becoming frayed and unravelled at all its edges.
>
> —T. de Chardin, 1959

Webster's Unabridged Dictionary defines complex as: "having many varied interrelated parts, patterns or elements and consequently hard to understand fully . . . a conjunction of varied contributing or interacting factors, elements or qualities." McShea (1993) described complexity as follows:

> "The complexity of a system is generally acknowledged to be some function of the number of different parts it has, and of the irregularity of their arrangement. Thus, heterogenous, messy, or irregularly configured systems are complex, such as organisms, automobiles, compost heaps, and junk yards. Order is the opposite of complexity. Ordered systems are homogeneous, redundant, or regular, like picket fences and brick walls" (p.731).

Complexity, then, must be a property of *systems*. As defined by Capra (1982), a system is an "integrated whole whose properties cannot be reduced to those of smaller units." Schwartz (1990) posited that two basic conditions must be in effect in order for a system to exist and function effectively: (1) its components must be connected, and (2) information *between* components must be accurately transmitted and processed. Thus, the emphasis in a complex, systemic point of view is on the unit in relationship to other units, not on independent parts which can be taken apart and

analyzed separately. Attributes of one part affect others, so that each unit reflects the characteristics of its associates; each part is both constrained and enriched by the arrangement of the whole system. From this perspective, at least as much importance is given to connections between units as to the units themselves, and behavior is regarded as a two-way proposition. The unit of observation is seen in conjunction with its neighbors, meaning that the behavior of one part of a system cannot be understood without attention to its interrelation to the others. Implicit in the behavior of a system is a dynamic flux; as one part changes so must the next, and the next, and so on in continuous progression.

Stein (1989), in *Lectures in the Sciences of Complexity*, pointed out that there is no universal agreement as to what constitutes a complex system. Such diverse topics as infectious disease (Glass and Mackey, 1988), evolutionary genetics (Feldman, 1989), economics (Arthur, 1989) neural networks (Palmer, 1989), atmospheric variability (Pierrehumbert, 1991) and human decisionmaking (Mosekilde, Larsen and Sterman, 1991) have been considered to be examples of complex systems. There are, however, several commonalities which exist among the disparate phenomena which are thought of as complex (Stein, 1989). The first characteristic which complex systems have in common is their nonreducibility. They cannot be broken down, analyzed and reduced to something simpler in order to be more easily understood. In some instances when a smaller unit is examined, its structure is found to be similar to the organization of the whole. This self similarity at different scales is a fractal dimension, reminding the

observer that the *essence* of the whole remains unchanged, whether expressed on a macroscale or a microscale. When one attempts to reduce the system's behavior to linear proportions, the phenomenon in question disappears. It can't be treated as an isolated piece of a jigsaw puzzle, in which the independent parts are arranged neatly alongside each other to form a completed picture. It is the complexity of the unified whole which reminds one that there are no separate units in this paradigm; there is no additive linear process whose sum will capture the nature of the whole. Landsberg (1991) reminds us that reality must be "mutilate(d)" in order to explain phenomena in nature. Microscopic and macroscopic must be considered to be separate systems, although "in truth they are just part of one larger system (p.57)."

Second, complex systems are capable of *surprise*, of genuine creativity (Gleick, 1987). Their behavior is not simply the result of information which has been programmed into the system; complex structures generate unpredictable outcomes. Although the movement of one part is strictly determined by changes in the others, the ultimate behavior of that system as a whole cannot be predicted or controlled. This creative process is one in which parts of a system cooperate with each other, inhibiting and shaping each other, continually maintaining the conditions necessary for spontaneity so that something new and different can originate. Thus, there is no single "right" answer to a problem, no one "neat and clean" solution. Complex systems remind us that there is messiness in the real world, that there may be several solutions to any one particular problem, and that the system's "choice" reflects a

continual tension which exists between its parts. In scientific circles, however, messiness and unpredictability have been attributed to incomplete knowledge, resulting in the supposition that if prior conditions are known sufficiently, a system's behavior can be predicted accurately (Mosekilde, Larsen, & Sterman, 1991). This premise mistakenly excludes complex phenomena such as chaotic systems, whose behavior encompasses both randomness and determinism.

In his discussion of the tensions inherent in living organisms, Konrad Lorenz (1963) characterized instincts as complicated interactions of several reciprocally influential physiological causes which operate as "a ship commanded by many captains," each voicing an opinion, enabling the whole assemblage to reach a better solution "as the result of their mutual effort" (p.88). The tensions inherent in a complex system might be understood in a similar fashion. After working together, the captains of a systemic ship would become accustomed to consulting with each other in particular situations which occur more often than others; perhaps they begin to base their judgments on prior decisions which have seemed to turn out especially well. Thus, although each situation is unique, patterns will emerge — patterns which reflect the adaptations made as a result of both the interplay among captains and the success of their previous decisions. The more often these adaptations are believed to be effective in bringing about a desired outcome, the more likely they are to be used in the future.

It is important to a system's efficient operation that its responses not become

too "locked in" or rigid, but that those in command can be flexible enough to adapt to changes in the environment. To function optimally, a balance must be maintained between strategies which have worked in the past and the flexibility necessary to respond to demands of a current situation. Gleick (1987) describes this characteristic as "robustness": how well a system can withstand disturbance versus the degree to which it can operate flexibly in a variety of conditions. One may surmise that complex systems are not rigid. In order to remain a part of the flow of life, they must rise and fall, embracing both order and disorder. The spontaneous, self-organizing dynamics which are characteristic of a complex system reflect its adaptability; they represent an essential function by which the system operates to maintain its balance and viability as it changes to meet the demands of continual variation in both internal and external environments. The process of establishing and maintaining an optimal rhythm requires both stability and flexibility; perhaps it is in the rhythm of this ebb and flow that constancy lies.

Toward a Definition of Chronic Pain

Bonica's definition of chronic pain, as " . . . the most complex human experience . . ." challenges the reader to think of that condition as one example of a complex phenomenon, which as such is orderly in its complexity rather than lawful in its simplicity (Keller, 1985). In 1986, the International Association for the Study of Pain defined pain as "a constellation of unpleasant sensory, perceptual, emotional, and mental experiences and certain associated autonomic, psychological, and behavioral

responses provoked by injury or acute disease." This explanation takes into account multiple contributing factors, rather than suggesting a simple cause-effect relationship. Despite formal acknowledgment of the multifaceted nature of pain, health care providers who treat it often rely in practice on the mechanistic model of the past. Hollister (1988), a physician who has practiced both neurosurgery and psychiatry, wrote about a colleague who explained that he could not afford to understand a more complex point of view "too well, because I might not be able to continue doing neurosurgery on the basis that I presently do." Practitioners are often at a loss when they struggle to integrate "mind" and "body" in a paradigm which was intended to do just the opposite.

As a result of the complications which arise when one attempts to either study or to treat pain as a characteristic of complex systems, a common strategy has been to simplify the problem by looking at nociception, a reflexive process which is often described as purely sensory. Nociceptive stimuli appear, however, to entail the activation of both the somesthetic and limbic systems (Dane & Kessler, 1994). Since the limbic system is associated with generation and mediation of emotional responses, evaluation of the meaningfulness of stimuli must occur very early in the process.

Epstein (1994) has hypothesized that an "experiential," or unconscious mode of information processing is intimately associated with emotions, and that as a result of this connection, physical as well as emotional health is affected by our mental activity. Recently, Fields (1997) has hypothesized that pain messages can be altered "in transit"

within the central nervous system (CNS) by modulating circuits which are activated by psychological factors. He stated that in this model "attention, expectation, emotional stress, anxiety, and negative affect" are induced by and can powerfully alter one's subjective response to pain. Thus, pain perception may involve multiple inputs, including both cognitions and emotions. However, much of the experimental medical literature devoted to the study of pain is based on the sensory component of nociception and not on pain perception or affective experience. The distinction is an important one, since research devoted only to sensory mechanisms is as a result significantly limited in its generalizability. This body of research clearly embraces an artificial separation of psyche from soma, implying that complex phenomena are ultimately reducible, and that each can be studied independently in a meaningful way.

Relevant Theoretical Perspectives

Models of sensory perception have been divided into monistic and dualistic camps since that phenomenon began to be studied. Plato proposed the existence of two realities, mind and body, and held that differences in sensory experience exist because of the limitations of our sensory apparatus. His paradigm was objectivist, assuming that reality exists independent of any human understanding, a point of view which was later to be championed by Descartes and sanctioned by the Catholic church. Aristotle, on the other hand, emphasized the interactive nature of sensation, positing relationship between the sense organ and the nature of the object sensed. His ideas portrayed a dialectic between stimulation and responding; we respond to the world, and

change it in the process. Thus, sensation is seen as a series of dynamic interchanges and not simply a reaction to an "objective reality."

In today's pain literature, a paler form of this dispute is argued as "peripheralist" versus "centralist." Peripheralists view both acute and chronic pain in a nociceptive model, emphasizing the physiological, sensory components of pain experience. Persistent pain which cannot be explained solely by the extent of tissue damage is described as having "functional overlay," or psychological factors imposed onto, yet separate from, the nociceptive stimulation (Crue, 1992). The peripheralist believes that nociceptive input is stimulation which exists apart from the observer, and that psychological factors are separate and additive in a linear fashion. Centralists hold to a more interactional position which states that chronic pain is generated, not simply by nociceptive stimuli at the periphery, but in large part by central nervous system mechanisms, such as experience and memory, which lie within the organism, interacting with nociceptive stimulation to produce the experience of chronic pain.

In addition to the ongoing argument between those who believe in a clearly objectivist world and the proponents of a more subjective experience, there has been another controversy among pain theorists - the disagreement between specificity and patterning. Specificity can be defined as the idea that certain stimulation specifically activates particular receptors, which in turn excite specific neural pathways (Hoffert, 1992). In this theoretical model, stimulation is carried in ascending fashion by affective nerves in the periphery through the spinal cord, and then to the brain. Specificity was

inherent in Descartes' thinking, and physiological research by scientists such as Lotze, Schiff, and von Frey (Bonica, 1990) supported the position until its simplicity began to be called into question in the 1930s. During the mid-1930s, Nafe (1934) put forth the idea that pain perception is produced by spatial and temporal *patterns* of neural stimulation, rather than by excitation of specific neural pathways. Also supporting a non-specific theory of pain perception, Beecher (1956) wrote about soldiers' experience of pain on the battlefield. The men he described had received wounds which were sufficient to "cause" pain, yet the soldiers apparently did not experience pain, and refused narcotic pain relief. Much earlier, in 1866, neurologist Weir Mitchell had published a short story entitled "The Case of George Dedow," in the *Atlantic Monthly* (Mitchell, cited in Melzack, 1992). Mitchell described a case of phantom limb pain in which the hero has had an arm and both legs amputated. Dedow awakens from surgery to the sensation of sharp pain and cramping in his left leg, only to be told that his legs have been "took off." Experiences such as these belie the simple cause and effect principles underlying specificity theory, and suggest that more complex processes must be at work.

In 1965, Ronald Melzack, a psychologist by training, in collaboration with surgeon Patrick Wall published the influential "gate control" theory of pain perception. Melzack and Wall's theory directly addressed the temporal patterning of neural input. Pain fibers, which are smaller in diameter, fire more slowly, and as a result their input is transmitted more slowly into the spinal cord. Melzack and Wall's model suggested that

as long as the pain fiber is firing without interruption, with its impulses slowly conducting into the spinal cord, pain will be perceived. However, if neural fibers of larger diameter which fire more rapidly are stimulated at the same time, their impulses reach the spinal cord first, setting up an inhibitory pool of neurons which blocks input from the smaller, slower pain fibers; in other words, they suggested that pain can be directly influenced by an alternate pattern of counter-stimulation.

In addition, the gate control model proposed that pain perception is influenced not only by ascending message from peripheral nerves, but that descending messages can influence one's experience of pain as well. When a person is frightened, angry, or sad, for example, the "gate" will be opened to a greater degree, resulting in one's pain being perceived as more intense and unpleasant. Since its publication, portions of this model have been disproved by other investigators (Burgess & Perl , 1973), and other of its hypotheses have been strengthened, particularly with regard to the *complex* (author's italics) influence of descending modulation (Hoffert, 1992). In 1992, Melzack suggested that "the brain contains a . . . network of neurons, that, in addition to responding to sensory stimulation, continuously generates a characteristic pattern of impulses indicating that the body is intact and unequivocally one's own . . . I further propose that as the matrix analyzes sensory information, it imprints its characteristic neurosignature on the output. (One's) neurosignature may be likened to the basic theme of an orchestral piece (p. 123)."

Thus, in the medical literature thinking seems to have shifted towards viewing

pain as spatial and temporal patterns of neurological impulses: rhythms generated by the system itself, by stimulation which impinges upon it, and by interactions between the two. Continuing in the spirit of Melzack's musical metaphor, one could consider such rhythms as providing reference points in a system's functioning, much as rhythmic patterns in a musical piece mark off time into equal segments. Sloboda (1985) characterized rhythm as giving a musical composition re-identifiable locations. Once such markers are established, ongoing activities can take place without undue confusion, and behavior can be organized and carried out cooperatively between parts of a system. An example of physiological rhythm is shown by the electroencephalogram. Normal EEGs are rhythmic and well regulated by subcortical impulses which fire synchronously, just as epileptic EEGs are dysrhythmic. Rhythm shapes and constrains neural firing which is otherwise chaotic; rhythm channels disorder into patterns with a common underlying theme. Thus, energy is shaped and constrained with rhythm, and from flux a pattern is created. The question of patterning would seem to be critically important when one considers the process by which pain which began with an external stimulus continues to be perceived by the organism long after its original wound has healed: pain which is defined as chronic.

Acute and Chronic Pain

Pain has commonly been temporally divided into two categories: acute and chronic (Aronoff, 1992). Previously, acute pain was considered to be that which persisted for six months or less. Crue (1992) wrote that this distinction is a temporally

arbitrary one which actually says nothing about the underlying mechanisms of the perceived pain. Pain which persists for one month after the expected healing time of the damaged tissue (Bonica, 1990), and which is associated with a non-malignant condition is known as chronic benign pain. Acute pain is thought to serve the purpose of warning an individual of danger, of providing a signal so that the organism can take corrective action. Chronic pain, however, is not understood as serving a signal purpose: "Chronic pain . . . . becomes disassociated from many of the physiological evidences of nociception . . . Nevertheless, these patients report high levels of pain at the same time that they appear physically comfortable" (Hoffert, 1992, p.23). Schwartz (1988) characterized chronic pain as "dys-disease" — a disease process which has ceased to function in the way that it was intended, as a specific signal that something is wrong.

Chronic pain is a phenomenologically different experience than acute pain. Sternbach (1974) maintained that an important difference between the two involves *meaning*. While acute pain is easy to understand and frequently can be treated successfully, chronic pain often seems senseless to both doctor and patient. The physician most likely has not been able to explain this pain to the patient's satisfaction, which renders its purpose as a warning confusing to the patient at best, and frightening at worst. It may be that medical interventions seem to intensify the pain rather than diminish it. Thus, those who experience chronic pain typically feel misunderstood and alone. It is not difficult to understand why feelings of helplessness and hopelessness are

frequent companions of the chronic pain patient, or why s/he can become focused on pain to the exclusion of other activities.

Coping strategies which have worked to distract one from life's regular annoyances prove ineffective with chronic pain, and hypervigilance to one's distress serves to escalate the intensity of suffering. For some chronic pain patients, the phenomenological world becomes narrowly centered on themselves, in large part excluding consideration of others around them. The longer physical pain persists, the more psychologically dysfunctional the patient appears to become. Crooks and Tunks (1985) studied chronic pain patients attending a pain clinic and patients who relied on family physicians for care. They found that the pain clinic group reported more intense and constant pain, and experienced more difficulty in coping with day-to-day activities. Chapman, Sola, and Bonica (1979) reported more severe psychological disturbance in patients who were treated in a pain clinic than those seen in other outpatient settings by anesthesiologists. Chronic pain touches all areas of one's life, from the financial losses which mark the patient's inability to work, to social disruption which occurs as a result of the patient's paradoxical position of feeling both dependent on and isolated from those around him or her.

Chronic Pain and Behavioral Medicine

As noted previously, chronic disease has replaced acute, infectious disease as the difficulty most confronted by health care practitioners (Wickramsekera, 1988). The discrepancy between clearly demarcated disease categories which traditional training

prepares one to treat and physical complaints related to a person's behavior and lifestyle has engendered a profound health care crisis in Western society. Capra (1982) wrote that despite an unprecedented increase in health care costs, the overall health of the populace has not improved significantly. Increases in life expectancy can be largely accounted for by decreases in infant mortality related to social changes rather than to dramatic improvements in medical care, despite impressive technological developments. Cassel (1990), an epidemiologist, stated that "throughout all history, disease, with rare exceptions, has not been prevented by finding and treating sick individuals, but by modifying those environmental factors facilitating its occurrence." He advocated increasing the strength of social supports as the most important means of promoting health. Assuming the accuracy of this information, the relationship between medicine and health is certainly called into question.

Most likely the boundary between health and disease is *not* as clearcut as our training model professes; it appears that when one attempts to put aside the ambiguity inherent in living, a mechanistic model begins to crumble and "(unravel) at all its edges" (de Chardin, 1959). In order to provide a more dynamic framework for both conceptualizing and treating health and disease, the interdisciplinary field of behavioral medicine was formally introduced at the Yale Conference on Behavioral Medicine in 1978 (Schwartz & Weiss, 1978). It was formed for the purpose of facilitating interaction between disciplines, and integrating work at different levels, from cellular to societal influences on health and disease. The premises on which behavioral medicine

rests are those of general systems theory, which was itself defined during the late 1930s through the 1950s. Los Angeles newspaper columnist Michael Ventura (1992) noted that it was during this period when radical innovations occurred in both sciences and the arts, concluding that increased complexity constituted a critical thread from which the innovations of those times were woven. Theories of complexity recognize that taking into account relationships among parts which make up a unified whole, or system, are necessary to an understanding of its workings.

General Systems Theory

The writings of biologist von Bertalanffy (1956/1968) were critically influential in explicating a theory of systems, which he defined as a set of elements standing in interaction, challenging the prevailing reductionistic scientific perspective. Systems theory was actually developed by a group of interdisciplinary scholars in response to revolutionary advancements in physics which had led to the technological capability of nuclear weapons manufacture and use. Miller (1978) described contributors to this endeavor as representing the fields of history, anthropology, economics, political science, sociology, social psychology, psychology, psychiatry, medicine, neurophysiology, mathematical biology, physics, physiology, and the humanities. He defined general systems theory as "a set of related definitions, assumptions, and propositions which deal with reality as an integrated hierarchy of organizations of matter and energy" (p. 9).

Systems theory assumes that levels of organization exist in the whole, and that

they are connected to each other in hierarchical fashion; each level is a both a subsystem and a suprasystem — a part with regard to the whole and a whole related to its parts. For example, living organs function as subsystems with respect to human beings, while serving as suprasystems with respect to the cells that comprise them, just as humans are subsystems of their larger society, and suprasystems relative to their physiological parts. According to this theory, at higher levels the parts of a system both become increasingly complex and possess a greater likelihood of generating new behaviors or properties (Butler, 1959).

A primary contribution of this view to scientific thought lies in its assertion that parts of any system cannot function in isolation, and in its contention that they cannot be separated from other parts without ultimately destroying the operation of the whole. Brilliouin (1951) maintained that preventing communication between parts of a system would result in "death by confinement," and Miller (1978) compared a lack of relationship between systemic parts to the second law of thermodynamics, concluding that entropy, or disorder must increase in such circumstances.

Also important in understanding the systems position is its emphasis on dynamic process. While any model of the world must take into account both change and stability, a reductionistic view assigns primary importance to stasis, assuming a stance characterized by rigidity and predictability, rather than by flexibility and adaptive self-organization. Systems theory holds that in order to survive and remain viable, a system must continuously adapt to and interact with its surroundings. In the exchange, both

system and context are changed, so that each in some sense reflects the other. Clearly, systems theory echoes much of earlier Aristotelian thought.

Schwartz (1988) described systems thinking as constructivistic, as opposed to reductionistic, in that it emphasizes interactive effects of individual parts, which are only expressed together as a behavior of the whole, rather than in isolation. The bidirectional premises (interactive parts of a system regulating each other at multiple levels) of systems theory is logically associated with the study of cybernetics, or regulatory processes. Cannon (1932), in his influential book, *The Wisdom of the Body*, hypothesized that the body operates in homeostatic fashion to maintain stability in the face of change. He wrote: " . . . a certain degree of constancy in a complex system is itself evidence that agencies are acting or are ready to act to maintain that constancy." This self regulation, based on both negative and positive systemic feedback, is thought to preserve order via restraints (Bateson, 1972) imposed by events both within and without the system. Negative feedback restrains the system by moving it in a direction which minimizes stress, while positive feedback magnifies its behavior, causing a move away from the previous state. In order to be able to function effectively, parts of the system *must* be connected. Rothstein (1958) contended that "An organization presupposes the existence of parts . . . The parts must interact . . . were there no communication between them, we would merely have a collection of individual elements isolated from each other." Thus, it is in the connection of parts that the system is both enabled and constrained.

In a departure from Cannon's original premise which held that organisms respond to disturbing or stressful influences by returning to a constant homeostatic condition, Dubos (1990) contended that organisms change fundamentally with each new experience. In his view, health is represented by creative adaptation, which can be defined as one's ability to envision and move toward new choices or possibilities in what appear to be problematic circumstances. Dubos suggested that homeostatic functioning is important, but that an organism's steady state continually changes, with health resulting not from the return to a static baseline, but from the ability to perpetually create a new sense of stability from the flux of ever changing influences.

Those who have contributed to the theoretical premises upon which behavioral medicine rests recognized the futility of dualistic conceptualizations of health and disease. This understanding has facilitated a shift from simplistic, causal explanations to more complex, multifaceted views of human functioning, views which include not only physiological, but psychological and social elements as well.

Psychological Theories Relevant to Chronic Pain

Psychoanalytic theorists were the first to attempt an explanation of pain's psychological component, and their ideas predominated in the literature from the 1940s to the mid 1960s (Gamsa, 1994). According to this perspective, pain acts to express unconscious, unresolved conflicts. Both Thomas Szasz (1957) and George Engel (1959) were instrumental in presenting formulations in which the chronic pain sufferer was viewed as communicating via the body what could not be conveyed directly. It has

also been suggested that chronic pain patients are alexithymic (Catchlove, Cohen, Braha, & Demers-Desrosiers, 1985) meaning that these individuals lack developmentally sophisticated means to communicate their emotions, such as verbal expression of thoughts and feelings. Thus, they are thought to suffer physiological symptoms in the absence of what would be more appropriate psychological distress.

Bloom (1990) published results of four studies examining the relationship between affect and the development of language in infants and young children, based on the assumption that language is a means of emotional expression primarily, rather than simply a tool used for the purpose of designating or influencing objects or events. As the result of her work, she discovered that infants who spend more time in neutral affect expression, that is, those who are less emotionally labile, are able to learn language earlier. Bloom speculated that the more often an infant responds to a situation emotionally, the less reflective and evaluative that infant is able to be; strong expression of emotion usurps the necessary attention and energy required to respond in a more even-handed and accurate fashion. She hypothesized that language does not replace emotional expression, but that it allows an individual to more explicitly communicate something about him or herself. Cichetti and White (1990) cited evidence suggesting that maltreated 19-month-old infants showed a decreased ability to recognize themselves in a mirror and produced fewer words to describe their internal emotional states. In addition, when presented with aggressive stimuli, the infants were found to process them more quickly and with less distortion than those with neutral,

nonaggressive content. This data supports the ideas that children who find themselves in more emotionally volatile situations are at a disadvantage with regard to the development of a stable picture of themselves and their feelings, and that interpretation of one's environment is clearly influenced by previous experience. These findings support the importance of addressing the relationship between affective modulation, perception of threat and somatic responsiveness.

Depression has also been hypothesized to be a psychological variable which "causes" pain (see Pilowsky, 1988, for review), although when viewed in a simplistic cause-and-effect paradigm, results have been mixed as to the direction of causation. An interesting study is the one in which Zelman (1991) found that inducing sadness in *normal* volunteers reduces pain tolerance. In any event, the fact that a high percentage of chronic pain patients suffer from depression has been well established (Geisser, Robinson, Keefe, & Weiner, 1994). In a recently published longitudinal study (Magni, Moreschi, Rigatti-Luchini, & Merskey, 1994) based on data collected from the general population of the United States, and not gathered simply from pain clinic or hospital samples, prior depressive symptoms were found to be associated with the development of chronic musculoskeletal pain. Conversely, chronic musculoskeletal pain also anticipated the development of depression. The authors concluded that their two hypotheses (i.e., [1] pain→depression and [2] depression→pain) could not be viewed as mutually exclusive, but both remain to some degree true *at the same time*. This formulation is consistent with much current literature devoted to the study of chronic

pain, which de-emphasizes a direct, causal relationship between chronic pain and emotional disturbance or personality organization, and instead speculates that multiple factors interact to produce the phenomenon.

Behavioral explanations of chronic pain began to assume importance in the 1970s, largely due to the influence of Fordyce at the University of Washington. These have since evolved into a model which includes cognitive components as well, and so are known as cognitive-behavioral conceptualizations. The earlier behavioral approaches tended to be mechanistic, utilizing a strictly linear model which discounted the context in which patients experienced their pain, however the addition of cognitive components has brought more breadth and flexibility to the paradigm. Turk (1994, p. 47) explained that the cognitive-behavioral model "suggests that behavior, emotions, and in some cases physiology are influenced by interpretation of events, rather than solely by physiological factors and characteristics of events per se." This conceptualization is directly related to Melzack and Wall's gate-control theory, which suggested that cognitive factors play a definite role in mediating pain perception. Thus, particular thoughts, behaviors, and coping strategies are assumed to alter one's experience of pain as well as the associated suffering.

By employing psychophysiological measures such as EMG (electromyograph) levels, changes in autonomic functioning, or rates of neural firing, some studies have attempted to assess the influence of cognition and emotion on pain perception. Flor, Turk, and Birbaumer (1985) found that patients who presented with back pain

demonstrated significantly elevated levels of muscle tension in their backs when discussing their pain or stress. When muscle tension in the back was measured during a resting condition in which participants were *not* discussing pain-related difficulties, their EMG levels were not notably different from those of healthy individuals, or from patients with pain in other locations. Neither the healthy group nor the patients who were not experiencing back pain showed increased muscle tension in the back when discussing stressful or pain-related topics.

Fields (1988) cited a study by Duncan, Bushnell, Bates, and Dubner (1987), which illustrated that neurons which transmit pain messages can be activated by behavioral contingencies in the absence of nociceptive stimulation. In this investigation, monkeys were trained to press a level following a light cue, after which heat was applied to the skin. Researchers identified cells in the dorsal horn of the spinal cord which fired when the heat was applied. They found that after several trials in which the noxious stimulus was paired with light, some of the cells discharged in the absence of heat, leading them to conclude that neural pathways which transmit pain can be activated when no peripheral stimulation is present. Fields surmised that chronic pain might be thought of as an "attentional problem," hypothesizing that patients who are especially vigilant with regard to their pain can amplify it, increasing the intensity of the sensation. In a study conducted by Jamner and Schwartz (1986), subjective ratings were used to measure pain responsivity to electric shock. Hypervigilance, or increased attention to the unpleasant stimulus, did predict greater responsivity to pain. Thompson

(1988) reviewed the literature related to pain perception and the cognitive variable of perceived control. She concluded that the studies reviewed contained a common theme: the *meaning* given by an individual to his or her pain moderated the perceived aversiveness of the situation.

Recent publications by Melzack and his colleagues (Melzack, 1992; Coderre, Katz, Vaccarina, and Melzack, 1993) continue to support the importance of CNS (central nervous system) involvement in pain perception. In a 1992 paper, he took a clearly constructivist position, stating: "The brain does more than detect and analyze inputs; it *generates* (this author's italics) perceptual experience even when no external inputs occur. We do not need a body to feel a body . . . Sensory inputs merely modulate that experience; they do not directly cause it" (p. 126). And in an extensive review of the literature related to the contribution of the CNS to chronic pain, Coderre, et al. wrote that pain perception "does not simply involve a moment-to-moment analysis of afferent noxious input, but rather, involves a dynamic process which is influenced by the effects of past experiences. Sensory stimuli act on neural systems which have been modified by past inputs, and the behavioral output is significantly influenced by the 'memory' of these prior events" (p. 276).

The Construction of Experience

Just as the "centralist vs. peripheralist" camps argue in medicine, "direct vs. constructivist" positions continue to be debated in psychology. As is apparent from Melzack's statements with regard to pain, those who support a constructivist position

hold that events in the real world are not informative in and of themselves (see Best, 1992). On the other hand, direct theories assume that sensory information is both organized and informative as it comes from the environment, and that it does not require elaboration or interpretation by CNS processes. The constructivistic position is inherently probabilistic, assuming that the "real" world can be known only with a measure of uncertainty. This view is represented by Gregory (1973), who commented that "perception is not determined simply by the stimulus patterns; rather it is a dynamic searching for the best interpretation of the available data . . . Just how far experience affects perception . . . is a difficult question to answer . . . But the senses do not give us a picture of the world directly; rather, they provide evidence for checking hypotheses about what lies before us. Indeed, we may say that a (perception) *is* a hypothesis, suggested and tested by sensory data" (p. 11-12).

Neuroscientists Maturana and Varela wrote about the struggles that they encountered in questioning the nature of cognition and perception (1980). Based on their work in this area, they hypothesized that perception cannot be understood as a representation of external reality. Maturana proposed that perception is, instead, the continual *creation* of new relationships within the nervous system. He believed that since neural activity is a part of the organism, the external world cannot be objectively constructed. These investigators believed that perception and cognition do not represent an external world, but that they *generate* one, that living *itself* is the process of cognition.

If cognitive processes are not conceded to have a place in perception, then it is ultimately limited to unmediated physiological processes. A constructivist stance is integrative, and thus more compatible with systems thinking. It assumes that cognition is directly connected with physiology, just as physical processes directly influence mental activity; neither can be artificially separated from the other. Again the theme of connection-disconnection emerges. Body and mind, sensation and perception, emotion and cognition: Each pair can be viewed as either dichotomous or continuous, and each calls into question the relationship between physical processes and subjective experience.

Schwartz (1984, 1987, 1988, 1990) in his psychobiological systems model, has hypothesized that self-attention enhances connection within living systems. This idea seems consistent with the view among cognitive psychologists that paying attention seems to strengthen sensory input. Theoretically, self-attention augments feedback related to one's one state of well being. Conversely, Schwartz has speculated that if systemic connections are impaired, the organism's ability to self-regulate and function effectively will suffer. He also suggested that the strength of any particular connection can be altered either positively or negatively via direction of attention and personal interpretation based on prior experience. In summary, Schwartz proposed that attention enhances connection, which promotes self-regulation, leading to ordered, rhythmic behavior. The behavior which results is thought to be more automatic, requiring less energy for the system to carry out effectively.

As discussed previously, systems theory emphasizes the importance of information flow, both within systems as well as between them. The amount of information processed must be large enough to allow the system to generate workable hypotheses, yet selective, so as not to overload the system's functional capacity. Since organisms cannot process every stimulus which impinges on their receptors, pattern analysis seems to be an efficient strategy for attending to salient features of a stimulus array, and for making an informed decision based on partial information. If this is so, to what specific stimuli does the organism choose to attend? Best (1992) described attention as "resource allocation," going on to say that "the processing of stimuli depends in part on . . . dispositions of the cognitive system." Keil (1991) maintained that cognition "should be considered in its functional role for each organism in terms of that organism's typical encounters with its environment." Thus, attention is regarded by some as dependent upon both characteristics of the individual and upon specific experience in the world, and not based upon simple patterns of stimulus-response processing.

If direction of one's attention is an individual matter, then particular stimulus features become salient for different individuals. Mineka and Sutton (1992) found attentional biases related to both anxiety and depression. They speculated that anxious individuals automatically direct their attention toward threatening stimuli, and that the attention is diverted without conscious awareness; depression seemed to be related to memory of negative self-referential information. McNally (1994) also reported that

people diagnosed with panic disorder more often interpret situations as threatening, as well as attending selectively to threatening stimuli. The conclusions of these papers support Cichetti and White's previously cited infant study in which maltreated children were observed to notice primarily threatening aspects of their environment. Attentional biases may preclude accurate processing of information by directing systemic resources toward features of one's environment which are deemed to be meaningful by the individual. Clearly, the constructivist argument has been made that those who suffer chronic benign pain may play a part in determining the nature of their experience via allocation of attention, as well as by the meaning that they assign to it.

In 1890, William James wrote: " . . . . that the bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur IS the emotion" (cited in Laird and Bresler, 1990). Other arguments have certainly been made since to support the theory that physical arousal begins with exciting thoughts. Just as Epstein (1994) hypothesized that cognition and emotion are closely connected, Mandler (1984, 1990) has also suggested that cognition is closely linked to emotion. He speculated that evaluative cognitions determine the quality of one's emotions, and that visceral activity (autonomic arousal) adds another dimension to them, contributing a feel of intensity. According to this position, autonomic nervous system arousal is related to an individual's subjective evaluation of any given situation, specifically to the degree of discrepancy between one's expectations and the actual circumstance. Thus, the amount of difference between one's belief about how the

world "should" be and the way it is experienced as being is theorized to produce physiological arousal. Presumably, this arousal may or may not be detected by the individual.

Lazarus (1990) emphasized the importance of cognition to emotional experience. In this regard, he wrote: "To say that emotion affects cognition, which it surely does, requires that we recognize that such emotion includes some of the very cognitive activity that is being affected in the 'causal' relationship between emotion and cognition. One cannot truly speak of an emotional system as an entity separate from the cognitive system . . . and to do so tests the logical limits of what we might mean about cause and effect" (p. 13).

There are important implications in such a constructivist position for a systemic theory of chronic pain. Models of emotion such as those presented by Epstein, Mandler, and Lazarus imply that thought and emotion must be connected in order for the organism to function optimally. This proposal is clearly compatible with the systems emphasis on information flow within and between systems. If thought and emotion are artificially separated, as in some psychological defenses, then theoretically the individual would be unable to effectively adapt on an ongoing basis to the challenges posed by life, due to an impediment in the flow of information. Because of its emphasis on a cognitive contribution to the experience of emotion, it could be inferred that a cognitive position prohibits recognition of such defensive strategies (Weinberger, 1990). However, Lazarus (1990) acknowledged that "thought and

emotion can be kept apart, as in what is clinically referred to as defenses such as distancing, isolation, depersonalization, repression, denial, or dissociation . . . . When people use them, they are said to be out of touch with their emotions, and with the environmental conditions influencing them."

Systemic Regulation and Emotional Expression

The psychological literature examining such defensive control of emotion is both extensive and historically rich. In his attempt to understand the mechanisms of hysterical reactions, Freud (1915/1989) surmised that people keep disturbing emotions "at a distance from the conscious" using the defensive strategy of repression. He viewed repression as a highly individual matter, which in all cases however, involves the process of preventing an exciting thought or idea from coming to awareness. Kihlstrom (1994) commented that essentially, hysteria involves narrowing the field of consciousness. Implicit in this explanation is the restriction of attention to particular features of one's environment, and as Kihlstrom's summary of Janet's ideas suggested, dissociation of other, distressing features.

Horowitz, et al. (1993) conducted a single case study which examined defensive control of emotional expression using multiple measures, including psychophysiological variables and analysis of verbal protocols. He focused on the patient's ability to integrate, rather than split off, distressing thoughts and emotions related to the death of a family member. Results of the study demonstrated that during therapy sessions in which disturbing events and feelings were figural, the patient showed discordant levels

of emotionality: complexity of verbal discourse decreased, while nonverbal behavior (ANS activity as measured by heart rate and peripheral finger temperature) increased. The investigator concluded that warding off disturbing emotions in an attempt to control them results in a lack of connection between cognitive and emotional processes. Findings of a study conducted by Shedder, Mayman, and Manis (1993), which also questioned the relationship between psychological defensiveness and physiology, indicated that participants who were judged to be more defensive showed higher levels of physiological reactivity than either those who were considered "nondistressed" or subjects who admitted serious psychological problems. Differences between the "defensive" group and other participants was large enough to be both medically and statistically significant. The same group of subjects showed a higher level of verbal defensiveness as well. Similarly, Weinberger, Schwartz, and Davidson (1979) conducted an experiment in which they found that while "repressors" *reported* significantly less anxiety than a low anxious group of subjects, they *behaved* in a more anxious manner, as measured by response latencies, than participants in a high anxious group.

Pennebaker and his colleagues (1987; cited in Azar, 1994) have hypothesized that failure to verbally disclose disturbing events is associated with heightened physiological arousal, and thus with long-term health problems. In this view, the act of inhibiting or attempting to control "ongoing behavior, thoughts, and feelings requires physiological work." In fact, based on empirical findings in the 1987 study, he

characterized people who actively resist disclosing their thoughts and feelings as "repressors." Supporting the initial hypothesis of heightened physiological related to low disclosure was their finding that disclosing events which were personally upsetting resulted in decreased autonomic arousal, and thus in less physiological stress.

There is strong evidence in the literature that social support, a genuine interpersonal connection with others, can both prolong life and improve health (Hafen, Frandsen, Karren, & Hooker, 1992). Baum, Grunberg, and Singer (1992), in a review of literature related to biochemical effects of emotions, cited research by Kagan, Reznick, and Snidman (1988), showing that inhibited children exhibit greater sympathetic reactivity as well as higher systemic levels of cortisol, when compared to more outgoing children. The same pattern of higher autonomic responsivity and corticosteroid levels was found in infants following maternal separation (Tennes, Downey, and Vernadakis, 1977), and in young monkeys separated from their mothers (Coe, Weiner, Rosenberg, and Levine, 1985). Speigel (1983a, 1983b, 1989, 1991) investigated the effects of group support on women with advanced breast cancer. The 86 participants in his 1989 study were randomly assigned to either a "routine care" group or to an experimental support group. Results indicated that women in the experimental group were significantly less anxious and depressed, experienced less pain (half as much as women in the control group), and on average lived longer. Friedman, et al. (1995), concluded that social stressors (parental divorce and instability of one's own marriage) are significantly related to longevity, and thus become important risk

factors for premature death. Stable social support may provide people with the opportunity to disclose relevant thoughts and emotions, and then to integrate them into the fabric of life experience rather than excluding them from awareness. The studies cited suggest that there is a decided physiological advantage to social connections, which provide opportunities for emotional disclosure and integration.

From a systemic perspective, chronic repression leads to disregulation within the system; information is not allowed to flow freely and it cannot feed back to regulate systemic operation. Schwartz (1990) has likened repression to "disattention," in that attention is focused on less threatening stimuli, either internal or external, and those which are more disturbing are avoided. The lack of attention to distressing thoughts, emotions, and events may result in a deficit of negative feedback, without which the system cannot regulate itself rhythmically. With empirical research which seems to support this hypothesis, Jamner and Schwartz (1986) showed that repressive subjects were willing to endure a higher level of electric shock than people who were judged to be less defensive, based on self report inventory. Conversely, hypervigilance, or intensified attention, promotes a narrowed focus on the feared stimulus, amplifying one's experience of pain, as has been discussed previously. Thus, hypervigilance also fosters disregulation, in that events which might be construed as neutral by others are interpreted as threatening by the perceiver, and may have the effect of heightening autonomic arousal as well (Mineka and Kihlstrom, 1978).

Wegner (1990) surmised that attempts to control unwanted thoughts and

emotions actually creates a state of mind in which the feared stimulus becomes *more* threatening, and produces a more powerful emotional response than it would have had it been confronted and integrated into one's frame of reference; such a "fear of fear" paradigm proposes that trying *not* to think of something makes it all the more certain that one will recall it. In a recent presentation of his ironic theory of control (1994), this investigator suggested that under certain conditions, sensory monitoring, or attention, can be *more* effective than distraction in decreasing the perception of pain. Presumably, one's attempts to control anxiety actually produce heightened arousal via the constant surreptitious monitoring which must be carried out in order to detect its presence. As Wegner wrote, "Unfortunately, what people believe to be the medicine turns out to produce the disease" (p. 417). Although this position may initially appear to contradict the view that vigilance to the painful stimulus increases the intensity of perceived pain, it may in fact be seen as complementary to that view. Recognition of a distressing stimulus is necessary before it can be realistically interpreted and integrated. While hypervigilance can distort the distress by exaggerating its perception, and lack of attention can promote disconnection, recognition of such a negative event provides the information necessary to move the organism back into a more balanced position.

The tenets of ancient Taoist teachings are consistent with this opinion, and assert that any inflexible attitude naturally produces its opposite. Rather than clinging rigidly to one position or another, one must attempt to develop a proper attitude for observing and understanding the contrasts which are experienced in life: opposites are

seen as purely relative, complementing each other with the flow of time. Eastern philosophy stresses a homeostatic balance in one's relationship with the world, and flexibility in living. In this regard, a simplistic model of emotional "repression" versus "release," or "connection" as opposed to "disconnection," must give way to a more complex conception of the importance of balance and effective *direction* of attention in the process of emotional expression. The issue appears not be whether or not to attend, but how to do so in a way that promotes systemic regulation. As Friedman (1994) suggested, "the issue of whether to repress or express negative emotion may be somewhat of a red herring; the problem may arise from having the chronic imbalance in the first place" (p.39).

Systems and Chaos: A Delicate Balance

Complex systems must continuously maintain a balance which incorporates aspects of both order and disorder. One's first impression of the term "chaos theory" may suggest a model marked by disorder and unpredictability: a system out of control. However, even chaotic systems, although apparently *dis*orderly, do seem to encompass an underlying regularity, despite their apparent randomness (Gleick, 1987). In other words, both order and disorder coexist, with the balance between them constantly shifting. This situation, in which opposites act together, is an example of the principle of complementarity.

Complementarity was introduced into the field of modern physics by Niels Bohr in 1927 (Holton, 1973). He proposed that scientists should not attempt to reconcile

the contradictory concepts inherent in classical and quantum theoretical positions, and contended that nature could be accurately understood only through descriptions which are seemingly contradictory. Bohr asserted that a description of the universe could be reached, not by simplifying it into a single model, but instead by allowing what appear to be paradoxical explanations to coexist, completing the whole with their differences. In other words, he believed that " . . . it is possible to express the wholeness of nature only through a complementary mode of descriptions." The position was stated in other words by Becker (1973), when he wrote: " . . . the problem of man's knowledge is not to oppose and to demolish opposing views, but to include them in a larger theoretical structure." From this perspective, it becomes clear that order and disorder, continuity and discontinuity, construction and reduction, can be seen as part of a larger whole. In such a paradigm, the question becomes not one of "cause" and "effect," but instead one must ask *how* what look to be dichotomous elements work together to produce both stability and change within the system.

Living systems are complex systems which exhibit chaotic behavior (Gleick, 1987, Glass and Mackey 1988, Basar, 1990, Neuringer and Voss, 1993, Thelen, 1994, 1995). Kauffman (1991) explained it this way:

> " . . . Certain properties of complex (biological) systems are becoming clear. One phenomenon found in some cases . . . is the randomizing force of deterministic 'chaos.' Because of chaos, dynamic, nonlinear systems that are orderly at first may become completely disorganized over time. Initial conditions that are very much alike may have markedly different outcomes" (p. 78).

Chaotic behavior is thought to include certain characteristics. First, it is variable, yet stable; seemingly random, yet precisely determined. Physiological rhythms are dynamic, systemic phenomena; they cannot exist separately, but interact on multiple levels, influenced by both internal and external events. Oscillations in rhythm are reflected in phenomena such as normal heartbeat and respiration, which are sometimes thought of as "steady states," meaning that they maintain a degree of constancy in the face of continually changing conditions. Steady states, however, can be disturbed, or "perturbed," by even small changes, depending on the condition of the system and the particular features of the environment which act to promote change. Thus, during certain periods, nonchaotic systems may make a transition from one steady state to another, demonstrating chaotic behavior in the interim.

It is particularly important to recognize that chaotic systems demonstrate a "sensitive dependence on initial conditions"; that is to say, there is an interdependence between system and stimulus which makes long-term prediction of future behavior impossible. Sensitive dependence refers to a circumstance in which the system's ultimate behavior is far removed from its initial state, as well as much different from that of a similar system, although only a minute variation in initial conditions may exist between the two. Any effect, no matter how small, is magnified exponentially, rendering the system's long-term behavior uncertain. This ongoing interdependence between system and environmental influence makes possible the creative self-organization of chaotic systems. Order is fashioned from disorder, and disorder

follows order in this dynamic process of change.

Finally, the behavior of chaotic systems appears to be "noisy," meaning that their rhythms can fluctuate irregularly, producing a state which seems independent of the previous one. Noise can be thought of as the erratic, random behavior of a system. It may also be thought of as an artifact of the process of observation and measurement, those "chance" fluctuations which cannot be explained. Interestingly, Bohr believed that "the study of nature is the study of artifacts that appear during an engagement between a scientist and the world in which he finds himself. And these artifacts are seen through the lens of theory. Thus, different experimental conditions give different views of 'nature'" (Bohr, cited in Holton, 1973, p.120). Mpitsos (1990) has suggested that the noisy variability which is associated with chaotic behavior may be an important source of information. The behavior of dynamical, and in particular of chaotic systems, is best described, not as linear, but as a function of the space within which it occurs. As the system's behavior evolves over time, it can be conceptualized as forming a certain pattern within the "state space." As it moves, its orbits show the same pattern over time, never quite repeating, but twisting and turning and folding in upon themselves to create their own distinctive shape. Minute features contained in this pattern are amplified as the chaotic process unfolds, revealing, what is known as a fractal. Crutchfield, Farmer, Packard, and Shaw (1986) defined fractal as "an object that reveals more detail as it is increasingly magnified" (p. 51). It follows, then, that fractals provide a wealth of information; they allow aspects of a phenomenon which

were previously hidden, or even nonexistent, to be seen. Thus, from something which at first seems meaningless, structure and meaning evolves.

Complex dynamical systems contain *attractors*, which are points or states in which the system prefers to reside (Casti, 1991). Thelen (1995) discussed attractor states as they relate to human motor development, describing them as "patterns of behavior which are preferred by the system . . . . They act as attractors in that the system 'wants' to perform them" (p. 84). Crutchfield, Farmer, Packard, and Shaw, who are pioneers in the study of chaos, described an attractor as "what the behavior of a system settles down to, or is attracted to" (p. 50, 1986). Attractors demonstrate the system's capacity for self-organization (Graf and Elbert, 1990). Chaotic attractors have been found to be fractal structures, and as previously discussed, they create information by virtue of their variability. Attractors can be visually portrayed by turning the numbers which represent them into pictures. When this is done, the attractor begins to be represented by a *pattern*. Even the simplest attractors, represented by one point in space, change as they move. The point changes from moment to moment, revealing dynamic movement in systemic behavior, and the pattern displayed by the attractor represents the system's habitual behavior.

An attractor, then, may be thought of as a pattern of behavior which is preferred by the system, as a pattern of behavior to which it has become accustomed. Attractors are, in essence, points of order; they refine and give shape to the surrounding chaos. Through the behavior of its attractors, the system is able to channel

disorder into patterns with a common theme, or rhythm; the patterns are never exactly the same, yet they are quite similar. It is the attractors which are able to provide constancy in change. It is the attractors which possess the property of stability.

Gleick (1987) described the boundary between attractors in a dynamical system as a "threshold of a kind that seems to govern so many ordinary processes, from the breaking of materials to the making of decisions" (p. 233). The boundary is a position of *choice*. As the system's behavior moves through the typical pattern of the attractor, it may remain in a position close to the boundary, or edge, of the attractor's influence. Interestingly, even though it is at the boundary where choices are made by the system, the boundary is also the place where it is most difficult to escape the attractor's pull. Given this information, it becomes clear that a position near the boundary must be characterized by tension, the tension of a system choosing between competing options.

Any one system can have many attractors, or states of equilibrium. Kauffman (1991) hypothesized that the number of attractors available to a given organism is positively related to both the number of genes and cell types of the organism. In his model, the number of possible attractors increases exponentially from 10^2 in bacteria to greater than 10 to the sixth power in humans. Thus, humans have a multitude of attractors available from which to choose at any given moment, and these attractors exist at various levels of systemic behavior. Individuals may rigidly limit their choices, playing it safe by relying too often on a few characteristic behavior patterns. On the other hand, we may become confused when we move impulsively to choose too many.

Investigators looking at the functioning of the human body through the lens of chaos theory (see Goldberger, Rigney, & West, 1987, Goldberger & West, 1990) have made some fascinating observations. Contradicting traditional mechanistic assumptions, which assume normal physiological functioning to be regular and stable unless disturbed by illness, Goldberger and his colleagues found that cardiovascular and other systems display more *variable* behavior when they are young and healthy. Conversely, they discovered that increasingly regular and stable behavior could indicate aging and disease. In observing rhythms generated by the human heart, the investigators found that approximately 13 hours before cardiac arrest, the heart's rhythms were constant - a model of stability. Eight days before arrest, the same heart showed a significantly higher rate of variability. Further comparisons revealed that the rhythms of a healthy heart appear to be erratic, resembling the irregular pattern of a chaotic attractor. Related to these studies, these researchers wrote: "Irregularity and unpredictability, then, are important features of health. On the other hand, decreased variability and accentuated periodicities are associated with disease (p. 44)."

Conclusions such as these allow us to move our thinking beyond simple mechanism, as well as to extend dynamic systems theory as it applies to living organisms. Chaos can be seen as not only a transition state, but as one of the normal conditions of life. Chaos verifies the assumption of inter-relationship and demonstrates that complex behavior can occur, even in the simplest systems. Its processes allow an appreciation of the importance of flexibility at all levels, and emphasize the remarkable

ability for creative self-organization which healthy organisms possess. Chaos theory brings scientific thinking close to Bohr's notion of complementarity; it provides a conceptual framework within which nature's inherent dichotomies, such as order and disorder, connection and disconnection, determinism and free choice, can be acknowledged and accepted together. Science can begin to understand the means by which one's thoughts and choices directly influence physiology, and how, at the most minute level, physiological processes may govern thoughts, decisions, and evaluations.

As discussed previously, the experience of pain can be thought of as initiated via bidirectional rhythms of neural firing. Neural dynamics have been shown to be nonlinear, and often chaotic (see Barton, 1994; Basar, 1990); thus, attractors are identified in patterns of neural discharge (see Freeman, 1990). This brings to mind Melzack's thoughts related to the generativity of neural activity, and the mediating, rather than causative effects of sensory stimulation. Fields (1997) hypothesized that attention and expectation in themselves may be sufficient to produce pain sensation in the absence of peripheral stimuli. In this regard he wrote:

> "Pain transmission neurons at all levels of the neuraxis are under modulatory control from somatosensory cortex and from limbic forebrain structures . . . These pain modulating circuits are engaged *by psychological factors* [this author's italics], and they exert bidirectional control over pain transmission neurons . . . The facilitatory control is particularly interesting because it offers the possibility of generating a pain signal by central activation of spinal neurons without input from peripheral nociceptors" (p.157).

Thus, rhythms influenced by both sensory and psychological events may mediate the ongoing chaotic activity of the brain by shaping and giving structure to the ongoing

flux. These rhythms may both restrain and harmonize the apparent disorder, producing both long- and short-term effects.

In the short term, sensory and psychological input may create fluctuations in the brain's electrical signals, producing rhythms which quickly appear and disappear as the dendrite is polarized and depolarized. Order emerges from chaos only to be subsumed by it. Interestingly, in this model it can be imagined that order exists, yet is hidden during periods of chaotic behavior, while during periods of seeming stability, chaos waits as well.

Over a longer period of time particular rhythmic patterns, similar in structure, tend to be repeated. It is these patterns which may ultimately form a system's attractors. Perhaps the process proceeds as follows, similar to Freeman's (1990) conception of the development of attractors during olfaction. With each pattern of excitation, a particular subset of receptors activates a certain subset of neural cells. These cells are interconnected by excitatory synapses, where connections are strengthened each time the cells fire. Repeated excitation results in increased sensitivity as well as in a lower firing threshold. With continued excitation, strengthened connections and a lowered threshold for discharge mean that ultimately, if a small portion of that group of cells is excited, the entire group will fire. Freeman concluded that "the subset of sensitive receptors leads progressively to the ultimate inclusion of all those . . . cells . . . which project into a nerve cell assembly. These strengthened, mutually excitatory connections give the property to the assembly that, if any fraction

of the sensitive receptors (is excited), their input . . . excites the entire assembly in stereotypic manner . . . The subset of receptors activated . . . defines the basin of the attractor, and the nerve cell assembly . . . determines the spatial structure of the limit cycle oscillation" (p. 69).

Implicit in the formation of such attractors is neural excitation produced not only by sensory stimulation, but also that produced by psychological processes such as attention, thoughts, judgments, and emotions. The physical and psychological stimuli must interact to produce an individual's perception of pain. Thus, the sensory experience of pain is likely to be linked at a cellular level with cognitive processes, as those influences combine to produce one's own pattern of neural excitation. From the underlying chaotic rhythms come rather stable attractor states, to which the system returns more and more easily with experience.

The process described here is both reflexive (see Hebb, 1949) and creative. It is reflexive in that stimulation results in particular patterns of neural firing, and that repeated stimulation (reinforcement) lowers the firing threshold. However, it is also creative in that uncertainty, and thus possibility, is inherent in its operation. Small effects can be magnified, rendering prediction of any given individual's experience impossible. Further, one's thoughts and emotions relative to the injury form an integral part of his or her final experience. Thus, even small differences in psychological outlook between individuals can result in markedly different experiences of pain, given the same physical stimulus. The individual thus helps create his or her experience, but

can never precisely determine its outcome.

Certainly this model calls into question the nature of psychological defense mechanisms as discussed earlier, as well as the undisputed emphasis on systemic connection. How can repression and dissociation, for example, be understood? In the preceding explanation, as opposed to *dis*connection, such adaptations actually indicate a strengthening of connections at the cellular level. I believe that the important issue here is the *scale* on which behaviors are examined. When an observer looks at the individual from the perspective of autonomic indicators, it is clear that disconnection may appear to characterize behavior. This effect may not be apparent when the same individual is observed carrying out normal daily activities, and it may also disappear on a smaller, cellular scale. Obviously, the relativism inherent in this explanation emphasizes the importance of qualification. While "repression" or "dissociation" may be valid constructs relative to a particular scale and method of measurement, and while they may give the impression of disconnection given that scale or method, on other levels connections appear to be strong and rigidly fixed.

Balance, perhaps, becomes a more accurate gauge of an organism's adaptation than connection or disconnection, order or disorder. Friedman's ideas seem to support such a conclusion. The constructs we use to describe behavior are relative to the level at which they are observed, and to the methods used to measure them. A danger lies in assuming that disorder and disconnection are to be avoided, while connection and order are to be enhanced. While mechanical systems break down in conditions of disordered

disconnection, living systems have the capacity to adapt creatively in such circumstances. Perhaps only when living systems can tolerate both order and disorder at all levels, and when the interplay between them is balanced, can the organism relate to its world most effectively.

CHAPTER III

THE IMPORTANCE OF BALANCE

> Life does not rest; it is not rigid, but like a fountain eternally rises and falls. In its rising and falling lies its constancy. —R. Wilhelm (1979/1956)

From its most basic level, the human body functions by maintaining a dynamic balance, which changes on the basis of both internal conditions and varying environmental demands. Far from being stable and predictable, human beings can be viewed as complex organisms who are equipped to balance a multiplicity of forces, shaping the constant flux with rhythms of naturally generated cycles of rest and activity. Cardiovascular disease, repression and chronic pain may represent instances in which the organism becomes rigidly entrenched, attracted to states which either limit or amplify the amount of disorder present in a given system; they may exemplify situations in which the system is functioning either in a highly chaotic fashion, or represent instances in which the system's behavior has crystallized into a high degree of order.

To define health as simply the absence of illness ignores the tension inherent in living; it ignores the constant process the constant process of compromise necessary to reconcile and constrain opposing energies. It is this process of dynamic adaptation which makes possible that state of balance which necessitates an ongoing exchange between the shifting forces of creation and destruction.

Both chronic physical pain and persistent emotional distress can lead to a situation in which imbalance is the rule rather than the exception. People who

experience such chronic imbalance often describe themselves as engaged in a "battle" or "struggle." They seem to feel tired and depleted, as if their energy is gradually being exhausted in the conflict with an alien adversary. One patient described her dilemma as follows: "It (pain) makes me feel tired all the time. I feel like I'm always fightin' with it, but I can never win. I want to try so hard to do what I can, and then I get frustrated because I can't do any good. It just rattles your nerves all the time." Another explained it this way: "It's (pain) like the bogeyman, like a blob which almost erases me. You're always tryin' to push it back, to control it. You struggle with it, but when I try and try and I still can't fix it, I feel out of control." Or, "It's like fightin' with somebody, but seems like there's nothin' I can do. And I wonder, 'Why me?'" These statements obviously were not made by individuals who have given up, but by people who resolved to "fight it (their pain) with everything I've got," an attitude which is viewed as courageous in our culture, despite the toll that it takes.

The society in which we live supports these hostile characterizations of distress, as evidenced in statements made by nationally recognized organizations such as " . . . . the war against cancer," or " . . . . battle with mental illness." The lead story in a recent psychological publication announced: "APA and CDC join forces to combat illness" (Caviliere, 1995). Newspaper headlines periodically declare defeat when a prominent citizen "loses the battle with cancer." Drugs are described as "magic bullets" which will wipe out disease. In a recently published account of his early experiences as an infectious disease specialist (Verghese, 1994), a physician characterized his professional

battle to treat AIDS patients as he wrote: " . . . . the five medical journals I subscribed to . . . . were clogged with papers about AIDS . . . . And each journal had the story of the rising numbers, the changing epidemiology . . . . I thought of these reports as dispatches from the front reaching me in my war room . . . . The army was advancing, and every second stolen from the war made me feel guilty" (p. 222).

Unfortunately, when illness or disease is portrayed in this manner, the situation becomes one in which a person fights with some aspect of himself, while maintaining the illusion that he is combating an enemy. It may be that the energy used to fight one's illusory enemy is channeled away from a more natural healing process into a struggle with what the patient perceives to be an all-powerful monster. The constant struggle for control, whether it manifests as denial of illness, or as exaggeration of its symptoms, stems from the belief that one must perpetually be on guard against threat of the dreaded disease: a disease which cannot be accepted as part of the person. It is seen as "the not me," a frightening unknown enemy. Certainly, when illness is discovered it seems only natural to believe that the disease has come about as the result of forces beyond one's control. Helplessness and fear are likely to appear as a consequence. Since an individual may have no idea what has "caused" the illness, s/he is likely to look to traditional medicine to "fix" it. Our mechanistic model encourages patients to see themselves as objects to be repaired by skilled technicians who are better equipped to do so than the person who is ill. The idea that one naturally possesses a potential for self-healing is foreign in such a model, and science and technology come to be valued

above the people who create them.

Pursuit of control in the healing process by both patient and health care provider encompasses the prevalent belief that in our society almost anything can be fixed; it is an attitude which receives great emphasis in Western culture. In an article specifically addressing psychology's role in understanding the concept of "control," Shapiro, Schwartz, and Astin (1996) stated:

> "Most of the Western psychological research on control has focused on an active, altering mode of control to influence or change a situation . . . Another mode of control is a yielding one, accepting the situation of oneself. In Western psychological research, this mode has been perceived as being of secondary benefit, to be utilized in order to accept that which is not within one's active personal control . . . However psychological theory, research, and practice are beginning to recognize the importance of this accepting mode of control as a complementary balance to active change strategies as well as a therapeutic goal in its own right" (pp. 1218-1219).

An over-emphasis on active control of symptoms may in fact be quite detrimental to the patient's ultimate healing, both physical and emotional. The notion that strength comes from dominance suggests avoidance of interdependence and cooperative relationship. In fact, rather than wishing to control or dominate the body, wise practitioners have for centuries respected its inherent healing power, understanding that social and cognitive processes could have a significant influence on physical well-being. Mind and body are but different aspects of the same phenomenon; even to speak of "mind" and "body" emphasizes a dichotomy which in reality does not exist. Pert (1993) asserted that mind is an element in:

> " . . . every cell of the body. The mind is not configured to the space

> above the neck . . . . The mind is some kind of enlivening *energy* (this author's italics) that enables cells to talk to each other, and the outside to talk to the whole organism . . . . Part of being a healthy person is being well integrated, with all of the systems acting together . . . . Emotional fluctuations and emotional status directly influence the probability that the organism will get sick or be well . . . . That says to me that we'd better seriously entertain theories about the role of emotions . . . . in disease, and that we'd better pay more attention to emotions with respect to health" (pp. 188-191).

In this theoretical model, there is no hierarchy of top over bottom, no "mind over matter;" instead a dynamic network exists in which elements function synchronously.

Weil, himself a physician and surgeon, commented in *Health and Healing* (1987): "It is a misnomer to call medicine 'the healing art.' The healing art is the secret wisdom of the body. Medicine can do no more than facilitate it." In the fifth century B.C., Hippocrates taught that health requires a balance between disparate elements. In opposition to the prevailing Sophist theory which stated that medicine should start with the individual and from him deduce a correct treatment, Hippocrates held that man is not a fixed quantity, but an ever-changing sequence of states. Thus, it is the whole of a person's life, and not simply a fixed condition, which should be the object of concern.

Theoretically, a therapeutic strategy which emphasizes balance recognizes the disease or symptom not as alien, but as a part of oneself which has become exaggerated in proportion to the system as a whole. The first task of patient and health care provider is *not* to do battle with the disease, but to accept it, and then to devise a treatment strategy geared toward establishing a perspective which incorporates moderation of the symptom while finding its relationship to the whole without

assigning it undue importance. Acceptance of physical illness or emotional distress automatically disengages one from the battle, just as it requires relinquishing the illusion of control. Such a strategy requires one to acknowledge *both* strength and weakness as essential to life. In this conceptualization it is assumed that "perfect health," or absence of symptoms can never be achieved; complete freedom from distress is a fallacy. Degrees of illness and health occur together, exemplifying Bohr's principle of complementarity (Holton, 1973). What becomes important is the individual's resilience in the face of this complex, ever-shifting balance - the ability to allow variability within limits, while maintaining the energy and flexibility necessary to remain in a state of relative equilibrium.

As discussed previously, a great deal of variation, including chaotic activity, is to be expected in a system which is operating within a state of dynamic equilibrium. Goldberger, Rigney, and West (1992) discovered that variability is a mark of health and vitality, while increasingly regular behavior may signal aging and disease. Thus, frequent fluctuations in systemic behavior appear to be desirable. Conceptually, how might it be that someone who can allow fluctuation as the rule rather than the exception will be better able to remain healthy, while the person who fights to maintain control as signified by either extreme variation or rigidity, may be at greater risk for illness? In beginning to answer this question, I quote again from Verghese, as he considers his own uncharacteristic feelings of helplessness and lack of control while awaiting the birth of his child. " . . . . It was a strange feeling to be in this hospital as an

observer . . . . Upstairs, a young man on a respirator had his every breath and sigh controlled by me, a young girl inhaled an antibiotic I had prescribed. Elsewhere, in other rooms, my handwriting was on many a chart. But in this room my function was simply to wait" (p. 140). In this passage, the author describes waiting and observing as a "strange," and unfamiliar position. I daresay that his is not an unusual reaction. Accustomed to taking charge, to *doing* something, most would view a position of acceptance and detached observation with skepticism at best; it flies in the face of commonly accepted folk wisdom as well as most professional training.

In Western society today, acceptance is often seen as a stance marked by passive yielding, or "giving in" to the adversary. Lao-tzu (1972), the fifth century Chinese philosopher and contemporary of Confucius, taught that a yielding stance was to be preferred. He wrote: " . . . Those who conquer must yield; And those who conquer do so because they yield . . . Under heaven nothing is more soft and yielding than water. Yet for attacking the solid and strong, nothing is better." His example portrays water as it flows easily, yielding to the terrain over which it flows. However, ultimately it is the water which survives, and the physical features which are worn away.

Acceptance has to do with one's focus of attention, with the perspective from which he or she regards a given situation. Acceptance is seeing something as it is, from a multi-dimensional rather than a uni-dimensional point of view. It requires cultivation of the capacity for self observation, for toleration of tension, and it calls for a proactive

rather than a reactive stance. It allows an individual to observe the moment unfolding and subsequently *choose* to participate, rather than being swept into it. Paradoxically, when one attempts to fix or to control something or someone, that activity arises as a *re*action, and does not represent autonomous behavior.

Waiting and observing, rather than judging and controlling, demand patience, along with the time involved in exercising restraint. They require communication, either with oneself (introspection) or with another (interaction). In this age of fast-paced action and immediate gratification, toleration of the tension inherent in waiting is unfamiliar to many. However, acceptance of that which is confusing or distressing teaches the lesson of compromise through reconciliation of opposing pressures. By waiting, the individual becomes skilled in balancing conflicting influences while preserving a dynamic stability. In other words, s/he experiences constancy in change.

Consistent with society's discomfort with waiting is the fact that time has now become a commodity. In this regard, Schor (1991) wrote that people in America are "predictably . . . spending less time on the basics, like sleeping and eating. Parents are devoting less attention to their children. Stress is on the rise, partly owing to the 'balancing act' of reconciling the demands of work and family life" (p. 5). As the result of social, political, and economic influences in this country, the delivery of health care is now linked to a provider's productivity, leaving little room for an interpersonal therapeutic relationship to evolve. Preoccupation with "fixing" and "hurrying" and "doing" is antithetical to the act of observation, which requires that a person take the

time to notice that which is discordant so that a pattern can be discerned. Once that which seems chaotic can be seen, accepted, and understood to a greater degree, then one is in a position to entertain many more opportunities for change.

These ideas are not new to psychology. Freud (1912/1959) advised psychoanalysts to cultivate an attitude of "evenly hovering attention . . . . For as soon as attention is deliberately concentrated in a certain degree . . . . one point will be fixed in the mind with particular clearness and some other consequently disregarded" (p. 324). In a contrasting theoretical model, behavioral therapists teach parents to use "time out" when disciplining their children. The purpose of such an intervention is to allow both parent and child to wait before taking further action, as well as to consider the effects of their previous behavior. From a more neutral position, the individual may be better able to recognize and then to choose a productive course of action. From what was previously a blur of feelings and events emerges clarity, and from chaos emerges order. Operating as one who is watchful and attentive, rather than driven to act by forces within and without, s/he is better able to act in synchrony with those forces, and to respond adaptively to them. There are enormous implications associated with such a view when it is applied to the physiological realm as well as the psychological. Rather than relying solely on a highly technical, rigidly compartmentalized approach to medicine, it suggests that healing may be directly linked to application of an individual's own resources.

The phenomena which psychologists study are not constant. Whether it be

interpersonal relationships, or chronic pain, or reaction time, or life stress; they are made up of rhythmic patterns in which peaks and valleys are apparent. Disconnection is as essential as connection; pain is as important as pleasure. Life is not stable, and regularity is fleeting. Two people who are in harmony at one moment may be at odds with each other the next, just as the intense pain which is present now may be experienced quite differently later. As Gottman (1993) observed, "Negativity is as necessary as positivity for the survival of a marriage . . . Negativity appears to be dysfunctional only when it is not balanced with . . . positivity" (p. 14).

An individual must be able to accept the constant flux inherent in life. Developing an attitude of acceptance and neutrality can facilitate the clarity necessary to recognize relationship with the elements which make up one's world. Certainly, events in one's life can disrupt the balance of health, both physical and emotional, and just as certainly, both physical and emotional factors are involved in restoring a condition of health. The question of just *how* mind and body interact to do so is virtually uncharted territory, unparalleled in its complexity. Therefore, investigators who inquire into the process must be both innovative and aware of their own limitations. As he considered the nature of a complex universe, Einstein (1938) wrote:

> "In our endeavor to understand reality we are somewhat like a man trying to understand the mechanism of a closed watch. He sees the face and the moving hands, even hears its ticking, but he has no way of opening the case. If he is ingenious, he may form some picture of a mechanism which could be responsible for all the things he observes, but he may never be quite sure his picture is the only one which could explain his observations. He will never be able to compare his picture with the real mechanism and he cannot even imagine the possibility of

the meaning of such a comparison" (p. 31).

Psychological scientists are challenged to imagine new pictures, to design experiments which touch the realm of the physical in new ways. Markers such as frequency, intensity and temporal sequence of physiological rhythms may move the observed patterns into a domain of non-linearity. The state of balance or equilibrium considered in this paper is not based on traditional linear assumptions, but encompasses a dynamic non-linearity which may appear to signify the state of non-equilibrium, rather than one of homeostatic balance. Clearly, it is similar in character to Dubos's (1990) conception of dynamic adaptation, a return to health by virtue of continual change in the status quo.

What Is *a Balanced Adaptation?*

It is one thing to discuss the idea of balance; to operationally define and measure this concept is more difficult. Measuring complex processes in the psychological realm cannot be absolute or exact, and findings will not be readily generalizable without further study. Because complexity is a fundamental dimension shared by both physiological and psychological systems, their inherent non-reducibility and self-similarity must be taken into account when considering either definition or measurement. These dimensions involve nonlinear, rather than traditional linear relationships. Nonlinear dynamics is a branch of science which is applied to complex physical systems (Goldberger and West, 1987). It includes the concept of fractals, defined as structures and processes which are irregular, and which cannot be identified

by a single scale of length or time. For example, the coastline of California can be thought of as a wiggly line which manifests more and more detail as the scale of examination is decreased; as one comes closer to examine its smaller wiggles and wrinkles, more become apparent. These endless twists and turns make definite measurement impossible, however the degree of irregularity appears to remain constant across scales (Gleick, 1987). Classical geometric forms are straight lines and circles and rectangles; they do not demonstrate more detail at smaller scales, but remain the same. Thus, fractal mathematics describes complex shapes and processes which evolve over time in a way that classical mathematical operations cannot.

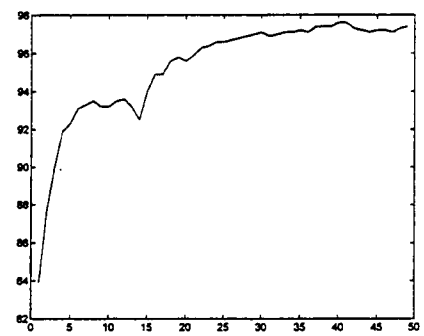
Fractals are used, not only to examine complex structures, but are also helpful in studying complex processes which evolve over time, processes which cannot be characterized by a single scale of time. Cardiovascular activity is such a process. It cannot be defined by an single rate or frequency, as it fluctuates between many different frequencies over multiple time periods (days to hours to minutes to milliseconds). Processes associated with the nervous system, such as epilepsy, Parkinson's disease and manic depression have also been studied using these non-linear mathematical analyses, as have white-blood-cell counts in leukemia (Goldberger, Rigney, and West, 1990). The graphs presented in Figure 1 illustrate particular behavior associated with the autonomic nervous system (peripheral vascular response). From the jagged lines which are produced, one may form inferences about complex processes which cannot be seen directly. As they study irregularities present in what have previously been thought to

be stable processes, investigators have found that relatively wide fluctuation in frequency of responses is desirable. What advantage does highly variable behavior offer as opposed to that which is more stable and regular? Systems whose behavior encompasses a wide range of possible options can function in many conditions; they can be thought of as both more adaptable and more flexible. It is important that a system's responses do not become too stable or regular in order that it may cope adequately with an unpredictable and always changing environment. To function optimally, a balance must be maintained between strategies which have worked previously and those which are required to respond to novel demands. Gleick (1987) described such a balanced adaptation as "robustness": the degree to which the system can withstand disturbance, operating flexibly in a variety of conditions. It has been hypothesized (Kauffman, 1991) that systems which function on the boundary between order and chaos serve as "an attractor for evolutionary dynamics" (p.82), because they have the flexibility to adapt quickly to changing circumstances. In computer simulations using a Boolean network, Kauffman was able to observe self-organization in this complex system. He examine systemic behavior as orderly non-linear systems became chaotic, as well as the converse, when the behavior of highly disorganized systems crystallized into rigidity. Based on this work, the investigator speculated that the behavior of successful networks showed a tendency to converge toward the border between chaos and order.

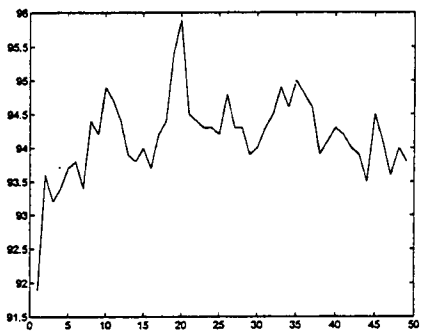
Healthy systems cannot be rigid. In order to remain viable, their behavior must

continually change, "like a fountain eternally ris(ing) and fall(ing)" (Wilhelm, 1979/1956). Therefore, the observer may surmise that patterns which display greater variability, *within limits*, indicate a healthier, more balanced adaptation, whereas an unvarying configuration may depict imbalance and distress.

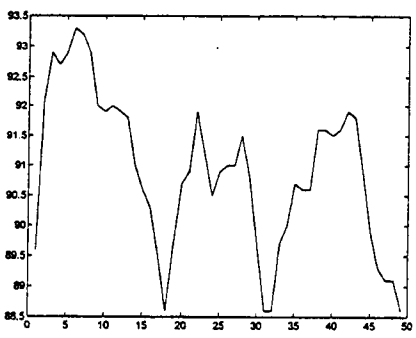
In Figure 1, variations in peripheral vascular response characterized by a single temperature reading, or by a few closely spaced readings show little variation (A), while temperatures which include a wider range of change display more widely variable behavior (B). In Figure 1 (C), one observes variability in the extreme - abrupt change with no gradual preparation before the system's behavior varies dramatically.



(A)



(B)



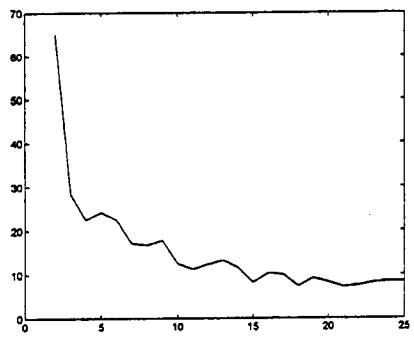
(C)

Figure 1. *Change in Peripheral Finger Temperature Over Time*

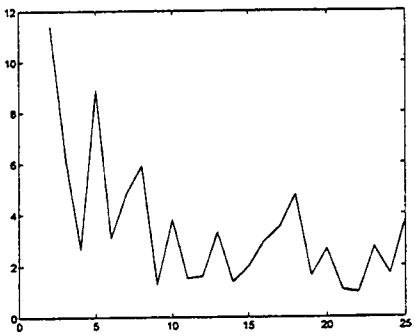
In this conceptualization, healthy functioning, marked by a balance between order and variability, would be represented by Figure 1(B), while Figure 1(A) and (C) indicate different conditions of imbalance or distress.

Processes such as these have been further examined using spectral, or Fourier Fast Transform (FFT) analyses. An FFT analysis transforms time domain data (amplitude versus time) such as that presented in Figure 1, into frequency domain data (amplitude versus frequency). FFT analysis separates a complex waveform into the simpler, specific frequencies which it includes. As the time signal, or complex waveform, is transformed into its component frequencies, the frequencies are converted into vertical peaks, which have a particular amplitude and position along the frequency (X) axis. As discussed in Chapter I, the transformation made by Fourier analysis can be compared to the transformation made by a prism, which separates white light into its spectrum. The prism separates the more complex energy of white light into its simpler component wavelengths, which are represented by colors in the spectrum (Figliola & Beasley, 1991). The FFT presentation of a time waveform is also called a spectrum, indicating that it depicts a complex waveform by showing its simpler functions.

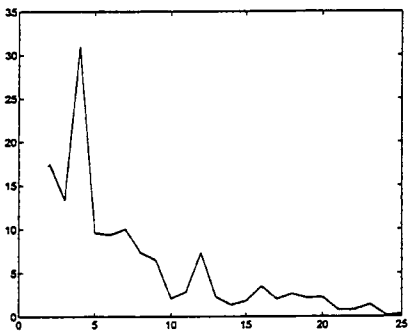
Spectral analyses conducted on the data given in Figure 1 allow one to see the data from a different perspective. The graph in Figure 2 (A) reveals an essentially flat spectrum, suggesting the possibility that there is little variability in contributing frequencies. The FFT plot in Figure 2 (A) in fact shows poorly defined vertical peaks, and a restricted range of amplitude. On the other hand, the FFT plot shown in Figure 2



(A)



(B)



(C)

Figure 2. *Peripheral Finger Temperature Across Frequency*

(B) is characterized by several well-defined spikes of moderate amplitude, representing a wider range of functioning. Figure 2 (C) depicts a combination of clear and poor definition; after the first two peaks, which represent diffuse, low frequency energy, little definition can be seen in the plot.

The graphs presented in Figure 2 illustrate the rigidity present in data (A) as well as the balanced variability in data (B) along with a rather unbalanced presentation in plot (C). It follows then, that a nonlinear, fractal model would predict that imbalance (physical or psychological distress) should be associated with a decrease in variability as indicated by features of both the time series waveform and the FFT plot,

or with abrupt and dramatic changes in systemic behavior, indicating that the behavioral repertoire of the system is more limited. Conversely, health or balance should be indicated by greater variability and moderation in systemic behavior. Systems, and particularly living systems, must operate under a wide range of conditions. Thus, they must be adaptable and flexible in order to cope with an unpredictable environment. However, abrupt changes can destabilize the system, rendering it unable to cope adequately.

Lack of variation also signifies a marked decrease in the flexibility with which the system or individual responds to the ever-changing demands of his or her day-to-day life. Interestingly, the FFT transformations presented may allow one to observe another factor involved in the maintenance of systemic balance: energy expenditure. The spectral analyses presented suggest that the system represented by data (A) is expending more energy than is the system represented by data (B), while (C) is also characterized by inefficient, nonproductive functioning. Measurement and analysis of the behavior of physical systems have shown that the lower the noise floor, or the closer the system's behavior stays to the X axis, the more efficiently the system is operating (Berry, 1994).

Perhaps not only does variability play a part in differentiating between the diseased (A) and (C), and healthy systems (B), but expenditure of energy may also be a factor. The person whose behavior is illustrated in Plot A or C may feel exhausted, like the pain patients who were quoted previously in this paper. Not only does s/he have a

limited repertoire of coping strategies to deal with stresses which present themselves, but an enormous amount of rather diffuse, poorly focused energy must be expended in order to maintain the system's stability. This individual's response capacity is severely restricted, and efforts to respond to life's demands strain the few reserves which are present. A healthier adaptation is hypothesized to be presented by Plot B. In this example, the system is able to respond both flexibly and efficiently. The definite, moderate spikes which are present indicate that several frequencies of focused, directed energy contribute to this system's overall functioning.

A case history which exemplifies one individual's rigid psychological adaptation is that of Ms. T. Elizabeth is a 58 year old woman who has been treated for the past seven years for chronic back and neck pain. She reported that she has had six surgeries over the past three years; prior to the surgery, she was treated primarily with narcotic and steroidal medication. In clinical interview, Ms. T. judged that although her pain is severe, the symptom which distresses her most is her chronic fatigue. In this regard, she commented, "I'm so tired most of the time, *exhausted*; I never feel rested. Everything is so much effort, and so I wind up giving up more and more and more, until there's nothing left." Elizabeth's adaptation in life has been to attempt to control people and events around her. She explained, "I've always been persistent and independent. I guess I'm overbearing . . . . I mean, I have a strong personality. I know what I want, and I know how to get it without running over people to do it. I've always kept busy to keep from goin' nuts; to keep things off my mind. I just don't let

'em bother me! I guess I never did know how to slow down. I've always had too many responsibilities, too much to do. And nobody would ever help me. But then, I don't want to depend on anybody else . . . . I'm so tired."

Ms. T's adaptation has no doubt been influenced by both social and individual factors (biological/psychological). She was raised by two alcoholic parents, and experienced emotional and physical abuse during most of her childhood. Elizabeth dropped out of school in the ninth grade due to an unwanted pregnancy, marrying three years later. She remained in an abusive marriage for 18 years, having three children by the time it ended. This woman explained that she ended the marriage after her middle child deliberately shot himself at age 22. Her two daughters have both experienced serious substance abuse and legal difficulties. Most likely, Ms. T. has felt it necessary to respond to the confusion and turmoil present in her life by maintaining an inflexible adaptation of overcontrol. It is her independence and competence of which she is proud. Although these qualities have helped her to bear a life filled with uncertainty, it is likely that they have also contributed to both her physical and emotional distress. Elizabeth prefers to deny her emotional distress, except for the "frustration" which to her seems clearly related only to her physical pain. Probably, if her coping strategy were graphed, it would look quite similar to Graphs A, reflecting both invariability as well as the excess energy used to maintain this unnatural position. Her response to the chaos present in her life is to try to maintain "control," to attempt to remain steady (busy, strong, responsible) in the face of constantly changing conditions, rather than

accepting and changing with them. Ms. T's adjustment, characterized by continual activity, has left her unable to see any order in life with the exception of that which she attempts to create herself.

Order In Chaos?

It is important to remember that the highly variable, chaotic functioning of a nonlinear system differs from the colloquial understanding of the term "chaos," which implies random behavior careening out of control. Deterministic chaos is constrained; along with disorder there *always* exists an underlying regularity. Order and disorder coexist, with the balance between them constantly shifting to accommodate changing conditions, and to allow for the emergence of novel behavior. The graphs presented in Figures 1 and 2 illustrate both this dynamic balance and the lack of it. Data depicted by graphs (B) show the flexibility of a system which can allow for constant change, as well as the presence of a reserve of energy. This system has a wide range of possible responses and the stamina with which to carry them out. Because of its relatively broad repertoire of behaviors, there is a good likelihood that it can choose a response which fits with whatever demands are placed upon it; because of its energy reserve, it will be able to effectively carry out its responses to completion. Graph (A) in Figure 1 represents a system with quite stable behavior, and Graph (A) in Figure 2 shows that the system's range of possible responses is severely limited. This system will tend to display similar behaviors, regardless of situational demands, and will presumably experience difficulty performing productively. Plot (C) depicts a system whose orderly

behavior has been disrupted by sudden change, which has had the effect of destabilizing its behavior. Clearly, the systems represented by data in Graphs (A) and (C) will as a rule not be equipped to cope with unpredictability or irregularity in its environment. In System A, behavior is narrowly focused, encompassing only a small window of potential action, making effective adjustment all but impossible. In System C, abrupt change mandates a significant amount of poorly focused energy expenditure in efforts to re-stabilize its functioning.

Balance, then, can be thought of as an adaptation which includes varying degrees of order and disorder which fluctuate unpredictably within limits. It can be thought of as one's ability to accept and live with change rather than believing it to be feared and in need of control. The purpose of balance lies in allows a system to develop more synchronous relationships with its environment, making possible complimentary relationships with other systems which impinge upon it, both internal and external. It also allows the system to change its behavior quickly as needed, and to conserve its resources by efficiently responding to demands placed upon it.

In view of the preceding discussion, it appears that any measure of systemic balance must encompass both choice and energy expenditure. Presumably, a system whose functioning is marked by balanced adaptation can choose new behaviors as they are appropriate and then move on, relinquishing the old with minimal exertion. The push and pull of competing tensions with a system is a familiar concept for most individuals. At the level of conscious behavior, we are aware of having to make

decisions many times each day. Using the logic of fractal self-similarity, one can imagine this process occurring at different levels both within and without the human organism. Gleick contended that "for people trying to understand the nature of complexity, the truly interesting behavior would turn out to be the irregular noise created by conflicting pulls" (1987, p.49), meaning the points at which systems choose, or decide to behave one way or the other. In chaos theory, this point is called the "boundary." A boundary is the threshold where a dynamical system chooses between competing options (Gleick, 1987). Kauffman (1991), who has studied complex systemic behavior using Boolean networks, contended that "networks on the boundary between order and chaos may have the flexibility to adapt rapidly and successfully through the accumulation of useful variations" (p. 82). A system whose functioning lies on the boundary, being flexible enough to encompass the tension inherent in that position, may be able to adapt most easily to the demands placed upon it. One may infer, then, that if its behavior moves too far away from that position at the boundary, its behavior becomes either increasingly rigid or chaotic. Thus, a system's behavior is most flexible at the boundary, and a balanced system may be one whose most characteristic behavior remains close to the border between order and chaos, where it stands ready to vary most easily. Capra (1996) described systemic variation in a living organism in this way:

> "A living organism is characterized by continual flow and change in its metabolism, involving thousands of chemical reactions. Chemical and thermal equilibrium exists when all these processes come to a halt. In other words, an organism in equilibrium is a dead organism. Living

> organisms continually maintain themselves in a state far from equilibrium, which is the state of life . . . This situation is so different from the phenomena described by classical science that we run into difficulties with conventional language. Dictionary definitions of the word 'stable' include 'fixed,' 'not fluctuating,' 'unvarying,' all of which are inaccurate to describe (living organisms) . . . Although very different from equilibrium, . . . the same overall structure is maintained (in living organisms) in spite of the ongoing flow and change of components" (p. 180-181).

Markers of Balance in a Variable System

If one considers that both choice and energy expenditure may be indications of balanced adaptation in a dynamic system, how are these to be observed? Perhaps purposeful, directed behavior, or "choice," may be seen in the distinct vertical spikes of the FFT (Fourier Fast Transform) plot. Whereas the poorly focused "mounds" may represent rather diffuse and nonproductive forces driving the system, clearly delineated frequency spikes which give the time signature its identifiable characteristics may indicate the presence of definite choices which motivate or compel the system's movement. Conversely, sharp spectral peaks which are disproportionately high may represent choices which are too strong, relied on too often to maintain systemic status quo. It may be the well-defined peaks of moderate amplitude which indicate that the system is poised on the boundary between stability and instability.

Energy expenditure may be assessed by visual observation of both amplitude of frequency peaks and by the area under the curve of the plot, which lies just above the X axis. The greater this distance is from zero (the floor of the FFT plot), the more probable it is that the system is expending excessive amounts of energy (Berry, 1994).

The more diffuse and undifferentiated its frequency peaks, the more likely it is that the energy which is being expended is unproductive and inefficient.

Assuming the above hypotheses are accurate, balance in a system, meaning its display of clearly directed, efficiently enacted behavior, may be observed by visual inspection of the following parameters of an FFT plot: (1) **amplitude range** (scope encompassed by its vertical peaks from floor to highest amplitude), (2) **definition of spikes** (distinctly formed versus poorly formed or "mounded"), (3) **area under the curve** of the plot (distance from X axis), (4) **frequency range** encompassed by the system's behavior (broad versus narrow), and (5) **actual amplitude** of vertical peaks (are most high, moderate, or low amplitude?). It is to be expected that in a balanced system, amplitude range, actual amplitude of peaks, and area under the curve will be moderately low, reflecting minimal energy expenditure. It is also expected that frequency range and definition of peaks will be high, depicting the system's clear direction and wide behavioral repertoire.

Kauffman (1991) has called networks on the boundary between order and chaos "poised" systems. Whereas orderly systems are characterized by a low level of connection between their component parts, resulting in behavioral changes which are few and small, chaotic systems are quite fluid, and a minimal disturbance can cause "avalanches of damage" (p. 82). Poised, or balanced systems, are neither frozen into rigidity, nor are they spilling over their boundaries. Instead, they encompass both order and chaos, both stability and instability. "Highly chaotic networks would be so

disordered that control of complex behaviors would be hard to maintain. Highly ordered networks are too frozen to coordinate complex behavior" (Kauffman, 1991, p. 82). Thus, one would expect the behavior of a balanced system to vary readily, but *in moderation*, and in doing so, to promote optimal communication and coordination of behavior throughout the system.

Chaos, Antichaos, and Human Beings

As discussed earlier in this chapter, the behavior of human beings is governed by many attractors or points of order at all levels of systemic operation. The patterns of an individual's behavior (attractors) can be glimpsed in examples of systemic activity from the release of neruotransmitters to the firing of neurons; from body temperature to cardiovascular rhythm; and from the variations of one's speech to the idiosyncrasies of personality. All represent individual choices which are made on countless occasions daily.

Often, an individual chooses without realizing that a choice has been made. Functions such as cellular activity, heart rate, or respiration are taken for granted as governed by physiology. For example, when someone chooses to talk about her physical pain, she most likely objectifies that "pain," believing it to be separate from the language used to describe it. It is known that a variety of factors, including anxiety, expectation, and attention, can engage pain modulating circuits. (Recall the study in which Flor, Turk, and Birbaumer [1985] found that patients who presented with back pain experienced significantly higher levels of muscle tension in their back when

discussing back pain.) In choosing to speak of the pain, the individual in fact chooses to engage physiological processes associated with pain and with all of its emotional and physical concomitants. In spite of her wish to separate pain from the rest of her life, it remains inextricably connected.

Attractors at one level engage attractors at another, despite the individual's naiveté with regard to this interaction. The more often an individual speaks about her pain negatively, for example, triggering an associated cascade of cognitive and physiological activity, the more easily this enactment can be repeated the next time—and the more difficult it becomes for her to think, speak, or "fire" in different patterns. Although attractors organize what would be an otherwise chaotic system, they can easily foster rigidity and encourage the individual's behavior to crystallize into a high degree of order. Should this individual decide to change her behavior, she is likely to feel uncomfortable, to experience tension as her behavior reaches the boundary of the attractors which have guided it. In fact, she will probably experience an even stronger desire *not* to change than she has felt previously. In other words, she will feel worse before she feels better, because the pull of the attractors and the subsequent tension generated becomes greatest at the boundary. As the grip of the previously imposed order is loosened, an individual may feel more confused or frightened. Moving into the boundary region of an attractor must *seem* like a chaotic place to be, particularly compared to the stability to which the individual has been accustomed.

It is both unconventional and exciting to think of behavior such as speech, body

temperature, and emotions as "attractors," as points of choice in an individual's behavioral repertoire. It is *essential* to view them as related to each other. Most often they have been objectified and treated separately, as if they actually do stand alone. This study assumes that an individual's behavior represents patterns of attraction which operate at different systemic levels. In doing so, it makes an assumption which is critical to system's thinking: "What we call a part is merely a pattern in an inseparable web of relationships" (Capra, 1996, p. 37).

If one takes into account the connections between different levels of systemic functioning in any individual, then it makes sense that behaviors, or attractors, at different levels will vary in relation to each other. Thus, changes in personal narrative should be somehow reflected by changes in indices at other levels, such as interpersonal relationships (more macroscopic) or skin temperature, neurotransmitter flow, and cellular firing (more microscopic).

For an individual to take advantage of new possibilities in her life, patterns must continually change; behavior must be close enough to the boundary to permit such change. So, an individual's behavior must be stable enough to allow for continuity, yet flexible enough to facilitate change. In this model, stability and instability coexist within limits, and the notion of "balanced" functioning becomes important. When the limits of either stability or instability are constrained, the individual is unable to function optimally, resulting in either "antichaos" (too much rigidity over time) or "chaos" (too much fluctuation over time). A person whose systemic functioning is out of balance

will experience prominent symptoms at some level. Whether the "prominent" symptomatology is given its distinction as primary due to observer bias, to actual malfunction, or to both is an interesting question. It is important, in any case, not to be naively concerned with the primary presenting symptom to the exclusion of other indices of imbalance which are not as easily noticed.

This study is concerned with three primary measures, each representing a different level of systemic operation; the participant's pain complaint seemed primary when treatment was begun. In addition to pain ratings, language (personal narrative) and peripheral finger temperature are included as indices of systemic functioning. As such, they are assumed to be closely related to each other, and to the individual's primary complaint of pain. It is hoped that results of the investigation will shed light on this intriguing perspective.

CHAPTER IV

> Rule-bound methodology frequently degenerates into methodology by formula. Formalized methodology claims priority in science, but in doing so . . . it involves itself in a contradiction; namely, it pretends to know how to achieve knowledge before that knowledge has actually been achieved . . . Life is not so easy . . . That is the most direct road to shallow science by the numbers.
>
> — William Bevan (1991, p. 479)

METHOD

Design

Audio recordings over the course of behavioral medicine treatment for chronic pain were sampled at 18 points from August, 1994 until June, 1995, and transcribed in a standardized manner (Mergenthaler & Stinson, 1992). The records were independently scored according to personal narrative coding rules developed by Wahler & Castlebury (1996). In addition, psychophysiological recordings (peripheral vascular response - finger temperature) were made during each session.

Elaboration of Personal Narrative Coding

This coding system was developed for use in psychotherapy research, based on arguments by McAdams (1989) that a person's stories of her family and community experiences are historical accounts of unknown validity. Wahler and Castlebury hypothesized that changes in an individual's personal narrative should be followed by changes in her perceptions, as well as by changes in the quality of her interpersonal exchanges. They went on to suggest that the concepts of continuity and synchrony may be important indices of quality in one's relationships. Synchrony was defined as "sensitivity and responsiveness," resulting in interpersonal exchanges marked by

"harmony and cooperation" (p.3). Continuity was explained as the maintenance of quality, or synchrony in a relationship over time. Based on these assumptions, they developed a rating system which scores personal narrative on several dimensions of both Coherence and Relationship Quality. Each verbal transcript was divided in "chapters" based on themes as defined by the raters. Once prominent themes were identified, the raters were asked to answer "yes" or "no" to 12 questions pertaining to either Coherence or Relationship Quality (see Table 1); 12 codes were assigned independently by two raters for each chapter of each treatment session. The transcripts were coded in random order, and not according to their occurrence chronologically, thus raters were blind relative to the temporal order of sessions. The correlation coefficient calculated for inter-rater reliability was .90.

Table 1. *Personal Narrative Coding Questions*

Coherence	**Relationship Quality**
1. Upon reading the narrative, do you *clearly* understand the narrator's point?	1. Is cooperation evident in the chapter plot?
2. Are all the ideas happenings presented relevant to the topic of discussion?	2. Is warmth attributed to any character?
3. Is at least one idea or happening elaborated beyond its initial introduction?	3. Is any character depicted as open to other people's views?
4. Are actions, thoughts, and feelings ascribed to each character?	4. Is there evidence of hope or optimism in the chapter?
5. Does the narrator's story follow a clear and orderly progression?	
6. Is the narrator's story free of tangential remarks?	
7. Is the narrator's response free of vague or contradictory thought?	
8. Do parts of the narrator's story fit together to form a sensible whole?	

Psychophysiological Recordings

The selected psychophysiological variable (peripheral finger temperature) was intended to measure autonomic arousal. Peripheral vascular response was measured using a digitized temperature probe connected to an Orion 8600 biofeedback system. Means and standard deviations were computed by the Orion system for each minute during the treatment session. In addition, a time series plot of the data was graphed at the end of the session.

Subjective Pain Ratings

Severity or intensity of pain is quite difficult to assess. As opposed to other measures of physiological functioning, such as temperature or heart rate, for example, there is no objective measure of pain intensity (Barber, 1996). Its evaluation depends on the individual's best estimate of severity. At each session, the patient was asked to judge the intensity of her pain on a scale which ranged from 0 (absence of pain) to 10 (intolerable pain). As discussed previously, the experience of pain is composed of both sensory and affective elements. In recognition of the affective component of her pain, the patient was also asked to answer the question, "How much does the pain 'bother' you?" on the same zero to ten scale. Often, sensory and affective elements are given different numerical ratings, although they represent the same time period. The combination of ratings provides important information about a patient's attitude toward the pain and its amenability to treatment.

Rationale for Design and Selection of Measures

Single Case Design

Nadon and Laurence (1994) propose that "scientific understanding of individual change can be advanced most effectively by initial, rigorous idiographic case studies by practitioners who are closest to the phenomena" (p. 87). Certainly a topic as complex as the one which has been the subject of this discussion cries out for a methodology which, while encompassing a degree of scientific rigor, also allows for the possibility of relativism in both its design and in its conclusions. If a "hard" science such as theoretical physics, with its mathematical rigor and theoretical precision can embrace relativism and uncertainty, then our "soft" psychological science must be willing to consider the value of this position.

In 1993, *The Journal of Clinical and Consulting Psychology* devoted an entire issue to an examination of single case research. In introducing this issue, Jones (1993) commented:

> "As a method of inquiry, single-case research has been relegated conventionally to the role of discovery or hypothesis generation. New developments in the methodology of intensive single case designs have extended its applicability to the testing of clinical theoretical constructs . . . . It has often been noted that psychotherapy research has had little influence on either theory building or clinical practice. The primary means of clinical inquiry, teaching, and learning in psychotherapy has been and still remains the case study method . . . . Statements about psychotherapy that are derived from group data typically have little direct relevance for the clinical problems that are presented to the psychotherapist, so that much of the therapy research enterprise has remained peripheral to clinical practice and to the major theoretical and intellectual currents in the field"

(p. 317).

Clearly the contributions of single case research to clinical psychology have been instrumental in advancing knowledge in this area. The early work of Freud, Pavlov, Wundt, Fechner, and Watson, among others, both raised questions and stimulated research which continues to be redefined and debated to the present. In 1961, Gordon Allport stressed the importance of the study of individual cases in psychological research based on the uniqueness of the individual, however in 1963, Campbell and Stanley scathingly characterized this design as "of almost no scientific value . . . . It seems well-nigh unethical at the present time to allow, as theses or dissertations . . . . , case studies of this nature (i.e., involving a single group observed at one time only" (p. 6-7). Apparently their criticism was taken to heart by psychological scientists; such research methodology has often been maligned or at least de-emphasized in the training of students. Although the single case research designs in the literature do involve the study of a single group or individual, they are not "one shot case studies," but require that data be collected at numerous points over time. As Hilliard (1993) explained, "Each variable can only take one value at a specific time point within an individual; thus, repeated measures of the variable(s) over time within the subject are involved . . . From this perspective, a focus on variability . . . . is at the very heart of . . . the research" (p. 374).

Substantive criticisms of single case studies which must be addressed in considering this method of investigation are: (1) aggregation of data across cases, (2)

generality of findings (3) replication of findings, and (4) validity. Obviously, these are related concerns. Most psychological research is based upon aggregation of data across subjects. The rationale for this strategy is that if multiple measures are taken either over a randomly distributed sample, or over a reasonable time period, means will cancel extreme responses, thus lowering error variance. However, single case methodology supports a case by case analysis. Data are not to be aggregated, even over as few as two cases; otherwise, both contextual and individual differences, which presumably provide the primary justification for this research strategy, are lost. Single case study is most often undertaken in order to emphasize and understand individual variation rather than to minimize it as "error."

Precisely because single case studies do focus on one dyad or individual, a principal objection to their use has been the presumption that results display a lack of generalizability. Between-group designs are often believed to be more generalizable because they employ aggregated data sampled from a relatively large group of individuals. It is important to recognize, however, that the primary element in scientific study may not be statistical averages across means, but the theoretical basis of study design and the relevance of results. Investigation of cardiovascular processes have shown that mathematical analyses based solely on means and variances can be patently misleading when interpreted in isolation. Kazdin (1982) argued that a single case approach may actually increase rather than decrease generality of findings. He contended that interventions which produce dramatic effects are more likely to

generalize, because they are much more apparent than are more subtle effects discovered via individual case study:

> "Indeed in any particular between-group investigation, the possibility remains that a statistically significant difference was obtained on the basis of chance. The results may not be generalizable to other attempts to replicate the study, not to mention to different sorts of subjects. In single case research, extended assessment . . . . coupled with dramatic effects, makes it implausible that the changes in performance could be attributed to chance" (p. 283).

Chassan (1979) has also insisted that the intensive study of a single subject over time can yield more meaningful information than summary, or "end-point" observations drawn from a larger number of individuals.

Replication would appear to provide the investigator with a strategy for examining generality of results from one individual to another. Clearly, this position makes intuitive sense. In fact however, all attempts at replication necessarily deviate from the original experiment; this is particularly true in the area of clinical study. Since confounding factors are much more likely to be present in psychological studies than in the "harder" sciences, and since single case studies in fact emphasize some of these situationally occurring factors (traditionally known as "error variance"), it is not only possible, but almost certain that attempts at replication in single case studies will lead to inconsistent results. As Kazdin commented: "There is no way within a single investigation or even in a series of single-case investigations to identify clearly the basis for the lack of generality" (p. 285). Herein lies both a strength and a weakness of single case research. Its strength comes from its ability to facilitate discovery and

understanding of a phenomenon in a way that methodology which emphasizes aggregation and comparison of group means cannot. Although results may in fact be *more* generalizable, as Kazdin and Chassan claim, their relevance is almost impossible to accomplish via single case replication. It is at this point that the nomothetic approach can complement an idiographic one by providing another broader, yet more diffuse perspective on the phenomenon in question.

Finally, how does the design of a single case study achieve validity? The investigator always hopes to validate his or her experimental hypothesis. In other words, s/he hopes that theory and data will support each other. The question then becomes: To what degree to the subject's responses consistently support one's theory? Cronbach (1989) argued that:

> ". . . the task of validation is *not* to uphold a test, a practice, or a theory. Ideally, validators will prepare as debaters do. Studying a topic from all angles, a debater grasps the arguments pro and con so well that he or she could speak for either side" (p. 3). He goes on to say that with respect to validity, "many methods have heuristic value, ranging from exploratory factor analysis to case studies of persons with extreme scores . . . Any type of inquiry, then, that seems likely to sharpen interpretive questions or to suggest explanations should be welcome (p.13) . . . . This is a reminder that knowledge evolves slowly and indirectly, thus one can be prideful about contributing to the advance without the hubris of insisting that one has the 'correct' theory" (p. 14).

Practically speaking, because single case studies embrace much of the "variance" which is excluded by between-group designs, it seems appropriate to try to identify as many factors as possible which influence the behavior under consideration, and observe their relationship with the phenomenon and with each other. This is the same principle

which Cronbach stated when he wrote, "Perhaps the best we can hope for regarding construct validation is to offer a generalization and try to locate the boundaries within which it holds" (1989, p. 15). Always to be remembered in considering validity are the relative and dynamic nature of relationships in the real world.

In order to gain an understanding of the essential nature of one person's experience of chronic pain and its associated emotional concomitants, particularly in recognition of both the unique conceptualization and the inherent complexity involved, it seems well-advised to collect repeated measures over time on a single subject in order to appreciate the phenomenon under investigation.

Personal Narrative

Robert Coles quotes William Carlos Williams as saying: "Their story, yours, mine—it's what we all carry with us on this trip we take, and we owe it to each other to respect our stories and learn from them" (1989, p. 30). Presumably, an individual's stories bring together events and relationships experienced in life, based on a coherent theme. Polkinghorne has hypothesized that the more complete one's personal story is, the more integrated the self will be (1988). Thus, personal narrative is an important means of organizing our life experience into stories and in turn, of creating a meaningful identity. Coherence can be thought of as the ability to configure one's life in an integrated fashion, to see the whole in its entirety; relationship quality can be understood as the ability to tolerate the uncertainty inherent in what is seen. Both are important elements in one's ability to make connection in a meaningful way with the

world at large. Since connection is thought to be important to a system's adaptive functioning (see Kauffman, 1991), then the behavior of a balanced system, which is by definition functioning adaptively, should be characterized by high levels of both coherence and relationship quality, as observed in verbal narrative.

Obviously, stories are methods of verbal report; verbal accounts are measures of conscious, volitional behavior. After examining the literature describing analysis of verbal report as research methodology, Wilson concluded: "Verbal protocols are an excellent methodology to study the contents of consciousness" (1994, p. 251). He cautioned, however, that verbal report is best used in combination with other measures, such as physiological recordings, which provide the investigator with access to material which is not available from verbal protocols.

Psychophysiological Recordings of Vascular Response

Monitoring of nonconscious physiological processes provides a check on verbal statements, as well as allowing the investigator to look at another aspect of the individual's behavior. A 1995 NIMH behavioral science task force report concluded that psychological research can be enhanced "by collecting behavioral observations . . . and recording concurrent psychophysiological reactions" (p. 195). Zajonc and McIntosh (1992) reviewed data which examined the correspondence between various physiological measures and their subjective emotional correlates. They concluded that heart rate and peripheral finger temperature possess the highest discriminative value relative to one's emotional experience. Horowitz and his colleagues (1993) have used

verbal disclosures combined with physiological reactivity to assess the impact of brief psychotherapy in a single case study. Transcripts of three therapy sessions were analyzed and divided into thematic units, which were then scored for "communicative expression," "social acts of discourse," "dyselaboration," "emotionality," and autonomic arousal, as measured by heart rate and peripheral finger temperature. The investigators concluded that the methods and procedures they used allowed them to productively investigate the process of single-case therapy by permitting analysis of the contrast between verbal report and nonconscious processing over the course of psychological treatment. However, these investigators were not concerned with the "balance" concept in their analyses, thus their study's relevance to the contrast discussed in this prospective study remains unknown. Peripheral vascular response (finger temperature) was chosen for this investigation both because of support for the measure in the literature, as cited above, and because of the nature of the patient's presenting pain syndrome, reflex sympathetic dystrophy, in which temperature change in the affected extremity (abnormally warm or cold) is important to accurate diagnosis.

Subjective Rating of Pain Intensity and Affective Involvement

Empirically, the subjective ratings appear to be the weakest measures in this study. Although one group of investigators (Kiernan, Dane, Phillips, & Price, in press) believes that a nociceptive reflex known as R-III may be an accurate measure of pain sensation, estimates of pain intensity have, to date, been based solely on patient report, as in this study. Despite their subjective nature, it is important to ask individuals who

are in pain to judge both its sensory and affective intensity as best they can, in order to better arrive at an understanding of the meaning of their experience of pain.

Evaluation and Treatment of the Participant

The participant, Ms. X, was a former clerical worker in her mid-40s. After evaluation by primary care physicians, this woman was referred to an outpatient pain clinic for treatment of Reflex Sympathetic Dystrophy Syndrome, a disorder of the sympathetic nervous system. Individuals who are diagnosed with this disorder typically experience minor injuries which inexplicably escalate into a chronically painful disorder which in the medical literature has been divided into three stages, based on the severity of the disease; it involves *no* quantifiable nerve damage. The sensation of burning pain is the primary complaint of those diagnosed with RSDS; other symptoms may include restriction of motion and loss of use of the affected limb, muscle spasms, swelling, changes in skin temperature and color, joint tenderness and stiffness, extreme sensitivity to heat and cold, hair loss or growth, and softening of bone. If left untreated, individuals diagnosed with RSDS may lose total use of the affected limb, muscles may atrophy, and osteoporosis may occur. Dane, Owens, Brunk and Rowlingson (1988) stated that spontaneous remission occurs in less than five percent of cases, and that RSDS pain becomes so debilitating that it is not uncommon for patients to ask for amputation of the affected extremity.

Depending on the particular presentation of symptoms, there may be no visible evidence of physiological disorder at the time of examination. As a result of both its

poorly understood mechanisms, and the frequent scarcity of "physical evidence," this syndrome has proven difficult to treat using standard medical interventions. It has thus has gained the reputation of affecting more "neurotic" individuals, and functioning as a primarily psychological disorder. Recent data suggests that the number of RSDS cases is increasing, especially among adolescents and young adults.

Usually, the severity of a patient's symptoms appear to be out of proportion to the extent of injury. For instance, six months prior to Ms. X's referral, she simply mashed the fingers of her right hand against a door at the office where she worked. She intended to push the door open and enter, while a co-worker on the other side was forcing it in the opposite direction. Since that time, she reported feeling constant, burning pain in both the right hand and arm. Range of motion in the right arm was significantly affected as well, and she has not worked since shortly after she was injured, being unable to carry out her clerical responsibilities due to the nature of her injury.

During clinical interview, this woman reported a history of chronic health problems, including severe allergies to particular foods, pollens and dust, chronic asthma, bronchitis sinusitis, and at least yearly bouts with pneumonia. She also recounted an upbringing filled with constant abuse, both physical, emotional, and sexual. Ms. X. revealed a history of serious emotional difficulties, including suicide attempts, self-mutilation, frequent dissociative episodes (She was previously diagnosed as having "Multiple Personality Disorder."), chronic substance abuse, and eating

disorder. She said that she had been hospitalized on multiple occasions, both for psychiatric and physiological disorders, as well as being seen in psychotherapy off and on since late adolescence. She participated in various support and self help groups such as Narcotics Anonymous and Overeaters Anonymous, as well as in a group with the identified goal of serving individuals who have experienced sexual assault.

Ms. X. possesses a remarkable dissociative ability, but at the time of her initial visit to the pain clinic, she had not able to escape the pain associated with her injury; nor had she been able to "force" her hand and arm to move as they did before her accident. She often rated her pain as averaging "8 or 9" on a scale ranging in intensity from 0 (absence of pain) to 10 (intolerable pain). Throughout the course of her psychological treatment at the Pain Center, the patient was taking no medication to decrease the pain. When asked what her pain might say if it spoke, she replied, "It would say: 'Stop; slow down. You go too fast.'" This patient indicated that she had been nicknamed "Whirlwind" by friends, because she had previously maintained such an active lifestyle. Ms. X characterized her pain as "a jolt" or "vibration," and explained that she experiences a loss of control when it is present. The more intense her pain, the more frightened she feels.

Due to the complex nature of this woman's psychological and physiological difficulties, a circumscribed therapeutic focus was maintained, in which physical pain was considered to be the primary issue. However, the boundary between physical and emotional pain is certainly not clearcut, thus the treatment was frequently directed to

emotional aspects of the patient's experience of pain. Treatment goals included: assisting Ms. X. in learning to cope with the changes in her life brought on by her pain, and decreasing the intensity and duration of the RSDS. The theoretical conceptualization of this patient's treatment was closely tied to "balance," which was defined as accepting and living with changes which occur in one's life. Also emphasized in this conceptualization was developing the patient's ability to quiet and calm herself at any given time, cultivating a moment-to-moment awareness by paying attention to things she would have ordinarily attempted to dismiss, including her pain.

Weekly 50-minute psychotherapy sessions were conducted from 8/94 to 6/95. Audiotape recordings and psychophysiological readings were taken in many of the sessions, and analyzed as discussed above. This participant was given an informed consent document which described the nature of the research, its risks and benefits, guarantees of confidentiality, and levels of permission for use of the transcribed material.

Course of Psychotherapy

Treatment of this patient was guided by the investigator's understanding of systems thinking; tenets of Eastern philosophy also informed clinical theory, as they are quite compatible with a systemic, or holistic, approach. Specifically, the patient's emotional and physical distress were presented to her as being related at a basic level from the beginning of treatment. In addition, the issue of control was central to this work. The idea of being able to accept and acknowledge one's situation as fully as

possible versus the need to control it was a primary theme during the course of this therapy. Looking clearly at what Ms. X had hoped to avoid or eliminate and embracing it as a meaningful part of her life is a strategy which was employed for the purpose of encouraging the patient to perceive her world from a different perspective. The patient's pain was valued for what it could teach, and not despised for the changes it brought to her. No "battle" was waged against pain as the enemy; instead, a truce was called, and the way cleared for peaceful coexistence.

In summary, two themes were critical to the therapeutic work in this case: (1) Development of the ability to accept and live with change rather than to fear and attempt to control, or restrict it, and (2) Development of the ability to "be still and wait," to tolerate the tension which is inherently present in change. This clinical strategy is similar in many respects to the Eastern concept of "nonaction." Nonaction is not pacifism in the Western sense, but a actually, "a readiness to act the part in the phenomenal world assigned to (one) by time and his surroundings" (Wilhelm, 1979/1956, p. 7). It is an acausal technique for living in and understanding the world; in fact, it is a theory of opposition and apparent paradox.

Prigogine has investigated the behavior of systems which maintain themselves in a state far from equilibrium, which he calls a "dissipative state" (1989). He believes that living systems are examples of such dissipative states, and that for their successful functioning, opposites such as structure and change, stillness and motion, must coexist. This position echoes ancient Chinese philosophy, which holds that the presence of

opposites is necessary for entities to be experienced and appreciated in their own right. However, these opposites are not regarded as enduring, but as *always changing*, passing from one into the other. Thus, in acknowledging and even embracing one's pain, the way is cleared for pain to pass. Holding on to the experience only makes more likely to continue. Confucius taught that one's concern should not be to assume a fixed attitude that is forcefully maintained under any circumstances, because an inflexible attitude naturally produces its opposite. Rather, an individual should strive to be in harmony with whatever situation life presents (see Wilhelm, 1979/1956). These ideas, although centuries old, were crucial in this present-day treatment of chronic pain.

Mathematical Analyses

After personal narratives (psychotherapy session transcripts) were coded, regression coefficients were calculated between Coherence and Relationship Quality, and a scatter plot was drawn to graphically depict the relationship between these two variables over time. Data used in these correlational analyses included the numbers assigned as chapter ratings by each coder. Testing for statistical significance of coefficients was carried out using a model presented by Cohen and Cohen (1983). Coherence and Relationship Quality ratings were also examined using spectral analysis. In addition, these two variables were compared with parameters of the Fourier plots of temperature data generated for each session, using either correlational analysis or scatterplot, depending on limitations imposed by the data sets.

Correlation coefficients were calculated between subjective Pain Intensity and

Affect Ratings, and between Pain Ratings, Coherence and Relationship Quality scores. These were also tested for significance and graphed as scatter plots.

Examination of peripheral vascular response data (finger temperature) was carried out primarily through the use of Fourier analysis. Temperature data from each session was analyzed separately, and FFT plots were drawn. Temperature data was also analyzed in segments representing particular stages in the therapy, each with its representative graphic display. Scatter plots which visually present various indices depicted on the FFT plot (amplitude range, frequency range, frequency definition, and amplitude) were drawn to illustrate relationships between these parameters and the temporal order of psychotherapy sessions. Temperature data was also plotted across time for each session, and cumulatively. Frequency distributions of the temperature data were calculated and plotted for each session, and modes were calculated for each session based on these; an overall frequency distribution and modal temperature was determined as well, across each minute of all sessions. Finally, the four moments of the probability distribution of temperature data were calculated, including mean, variance, skewness, and kurtosis. Each of these was correlated separately with the Personal Narrative variables of Coherence and Relationship Quality.

CHAPTER V

RESULTS

Presentation of Findings

In examining the analysis of data generated by this study, visual display of patterns through the use of graphs is the primary vehicle of presentation. The argument has been made consistently in this paper that the operation of complex systems can be understood best by studying their patterns of activity, which provide clues about how they behave as well as about how they are organized. This strategy organizes the data to reveal its various shapes and rhythms, along with their fluctuations. The reader will likely be accustomed to seeing the results of data analysis presented more often as single numbers with their associated probabilities. For the purposes of this study, s/he is asked to look at pictures instead.

Personal Narrative: Coherence and Relationship Quality

The variables of Coherence and Relationship Quality were found to be positively related ($r=>87$; $p>.001$). Based on these data sets, Figure 3 shows three distinct stages in therapy, marked by a gradual improvement in both Coherence and Relationship Quality scores.

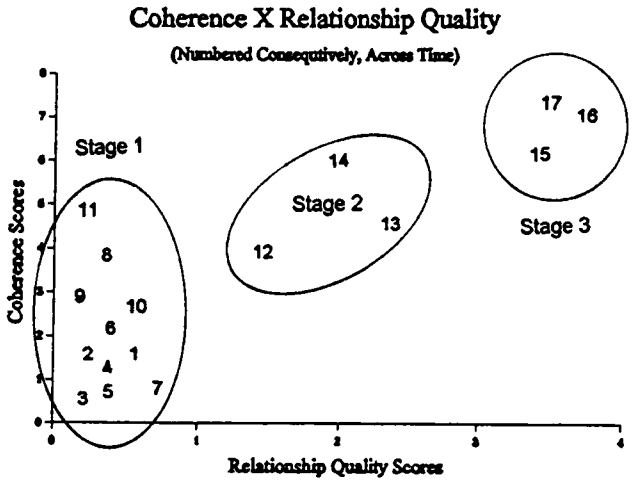
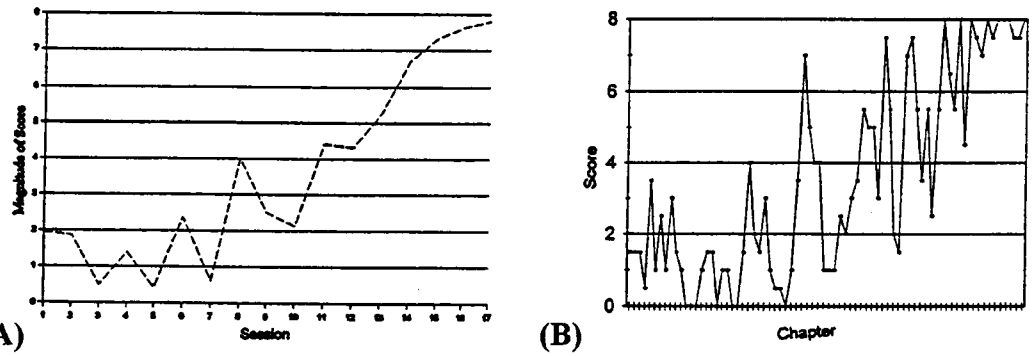


Figure 3. *Coherence and Relationship Quality Across Time Numbered Chronologically, by Session (8/94-6/95)*

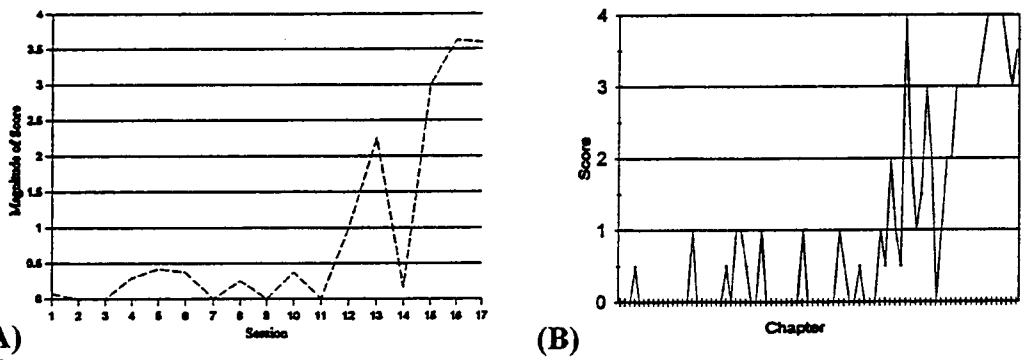
The graphs of coherence scores across time (Figures 4A and 4B) display a range of fluctuation over the course of the sampled sessions, along with an overall positive improvement in Coherence scores. Figure 4(A) was plotted with session means, averaging the scores given by the two raters, while Figure 4(B) was plotted by individual chapter. Apparently, Ms. X obtained a more complex and tolerant view of herself and her ecosystem during the last stage of treatment.

The graphs of Relationship Quality across time (Figures 5A and 5B) also depict overall positive improvement in scores, however it appears that the ability to "keep still," tolerating tension while holding onto hope, was more difficult for Ms. X to develop. Visually, Figures 5A and 5B portray a image of struggle, even as the horizontal line struggles to break free of its position on the abscissa, returns, and finally climbs beyond the floor of the graph.



(A) (B)

Figure 4. *Coherence by session (A) and by chapter (B) Across Time*



(A) (B)

Figure 5. *Relationship Quality by session (A) and by chapter (B) Across Time*

Spectral plots of Coherence (Figure 6) and Relationship Quality (Figure 7) suggest that Coherence is the more well-developed ability, its plot being marked by clearly defined peaks of moderate amplitude within the lower half of the frequency range. Higher frequencies, however, appear to be characterized by mounds of diffusely expended energy rather than by clearly directed, driving frequency spikes. As indicated by times series plots (Figures 5A & B), the spectral plot of Relationship Quality (Figure 7) suggests that Ms. X has struggled to develop this dimension of herself. Note the poorly formed peaks across the entire frequency spectrum, as well as their consistently low amplitude.

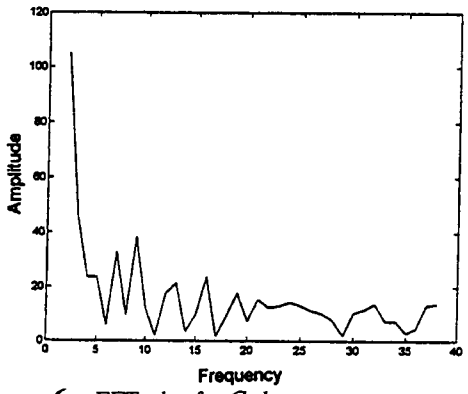


Figure 6. *FFT plot for Coherence*

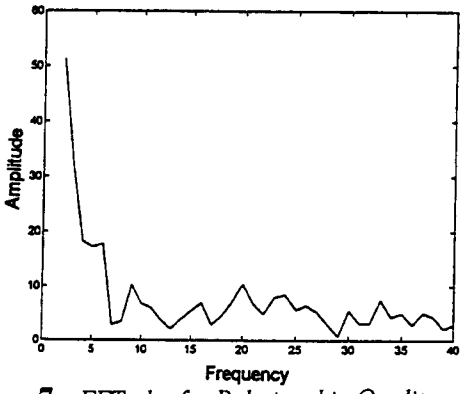


Figure 7. *FFT plot for Relationship Quality*

These figures (6 and 7) suggest that although Ms. X is becoming more holistic in her outlook, and is able to see her world as more complex than she had allowed previously, she continues to have difficulty tolerating what she sees. If, in fact, her perceptions have changed over time, we would expect to see changes in pain ratings and temperature readings as well in recognition of their systemic connection.

Subjective Rating of Pain Intensity and Affect

Figure 8 clearly shows the change over time in ratings of both pain intensity and pain-related affect. The patient's subjective judgment of her pain intensity dropped throughout the course of treatment, as did her estimation of "How much does the pain bother you?" Figures 9 (Pain Intensity) and 10 (Pain-Related Affect) also display the progression of her ratings during the treatment process. Pain Intensity and Affective Involvement scores were shown to be positively related ($r=.92$; $p>.001$). Analyses of these variables with Coherence and Relationship Quality indicated a trend toward consistently strong, negative relationships between the variables.

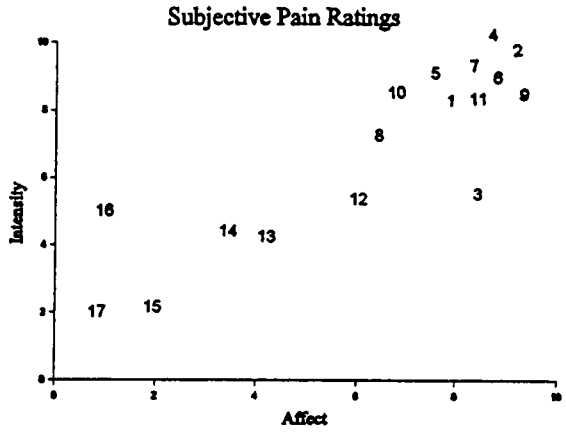


Figure 8. *Change in Pain Intensity and Affect Ratings Over Time, Numbered Chronologically*

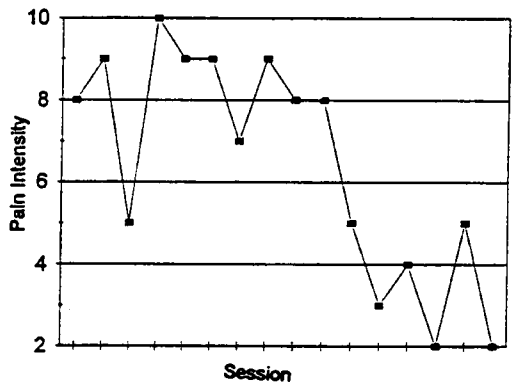


Figure 9. *Pain Intensity Across Time*

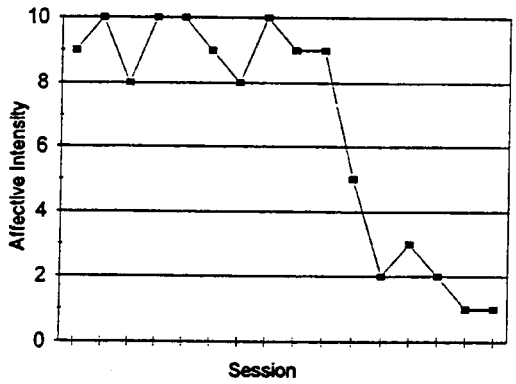


Figure 10. *Affective Intensity Across Time*

Data analysis also indicated that Subjective Pain Ratings and coded Personal Narrative scores tended to change in correspondence with each other. As Pain Intensity scores decreased, both Coherence and Relationship Quality scores increased. This trend suggests that as the patient developed a more tolerant and hopeful view of her world, she experienced less pain. In similar fashion, as Affective Intensity scores declined, Ms. X's coded Coherence and Relationship Quality scores increased, leading one to consider that as the patient's view of her world changed, not only did she experience less pain, but she was less disturbed by the pain which was actually present.

Psychophysiological Recordings

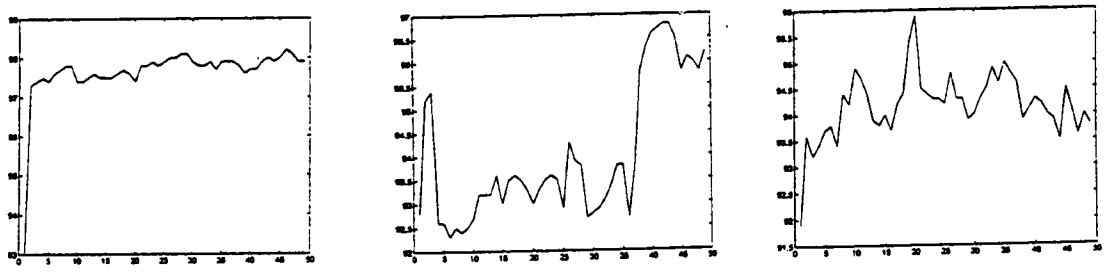
Time Series Plots

Visual inspection of time series plots generated from temperature recordings made during each session revealed that systemic behavior (temperature) varied according to three primary patterns. The first pattern could be recognized by its overall rigidity and lack of variation, as shown in Figure 11A below. This pattern was evident in approximately 18% of the data sets. Clearly, this highly *in*variant mode of functioning is not thought to characterize balanced adaptation.

A second pattern of behavior over time was observed when the system tended to change its behavior abruptly, to the point that after the change, it seemed to take an entirely different course (see Figure 11B below). Gleick (1987) describes such a sudden and discontinuous change as a "phase transition" (p. 127), or bifurcation. This sort of dramatic change in the quality of systemic activity is characteristic of chaotic

activity. Ms. X described her experience at such times in terms of "falling off a cliff." About 41% of the temperature data sets displayed this particular pattern.

The third observable pattern was noted in the system's tendency to vary its behavior erratically while on some recognizable course; despite its variability, there seemed to be some connection between previous, present, and past activity, while there was also a great deal of difference. Further, when the system's behavior *did* show abrupt variation or change in course, the observer could see evidence that systemic activity was subsequently brought back into line relative to previous behavior. Figure 11C is an example of this pattern. Close to 40% of temperature data sets were characterized by this pattern of activity. Pattern C more often represented systemic behavior in later treatment sessions, while A and B appeared earlier on in therapy.



(A) **(B)** **(C)**

Figure 11. *Three Primary Patterns of Systemic Activity, Over Time*

Moments of the Temperature Distribution

Analyses of peripheral finger temperature data were also done by finding the four moments of each of the 17 frequency distributions (mean, variance, skewness, and kurtosis) in order to test the argument made previously, that numbers related to central

tendency would be of limited assistance in describing complex systemic behavior. Each of the moments, for each distribution as well as for an overall distribution, was correlated with Personal Narrative variables of Coherence and Relationship Quality; the relationship of these variables with the four moments of the overall distribution is shown in Table 2 below.

Table 2. *The Four Moments of the Frequency Distribution of Temperature (measures of central tendency), and their correlation with Coherence and Relationship Quality*

1st Mean	2nd Variance	3rd Skewness	4th Kurtosis
Mean X Coherence r = .07	Variance X Coherence r = –.1	Skewness X Coherence r = –.004	Kurtosis X Coherence r = –.04
Mean X RQ r = .21	Variance X RQ r = –.04	Skewness X RQ r = –.36	Kurtosis X RQ r = .04

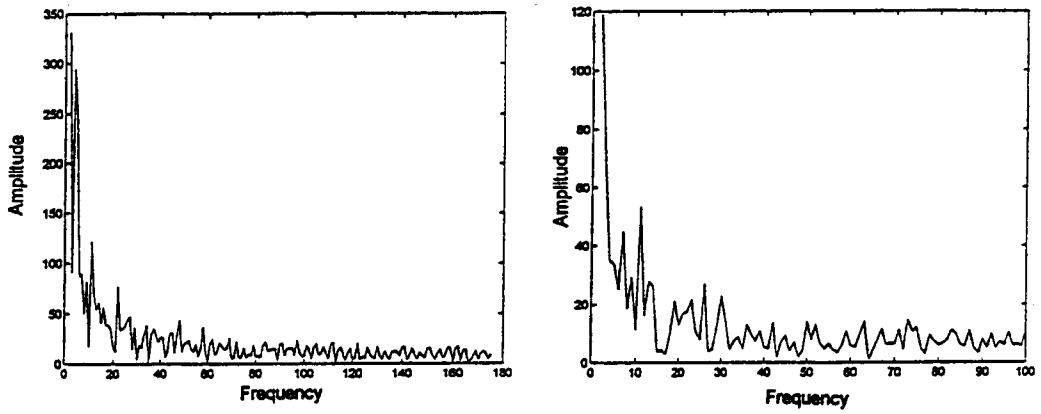
Skewness appears to be the only summary characteristic which tended to related to either Personal Narrative variable. The tendency toward negative skewness is marked in these distributions, presumably because temperature is much more likely to vary toward the left side of any given distribution, as hypothesized previously. As suspected, other measures of central tendency did not covary in any systematic way with other indices of systematic behavior.

Examination of Temperature Data Using Fourier Analysis

Temperature data was examined with the use of Fourier Fast Transform

analysis. Digitally recorded temperatures were subjected to spectral analysis, and plotted by frequency for each session included in this study. By diagramming and systematically comparing various parameters of the individual FFT plots, it was possible to learn more about indices which are typical of adaptive functioning.

The first third of the treatment data gathered in this project was analyzed using Fourier techniques, and compared with the last third of the data. To examine the resulting plots, indices of adaptive functioning such as (1) broad frequency range, (2) moderately low, yet (3) well-defined vertical peaks, (4) moderately low amplitude range, and (5) distance of the signal from the X axis of the plot, were considered. The diagram of spectral analysis drawn from the first stage of treatment (Figure 12A) is marked by several indices of less than adaptive functioning, including high amplitude range (25-325), rounded spikes, and overall high amplitude across all vertical peaks. Figure 12B shows clear differences relative to the first plot; its range of amplitude is not nearly as great, and neither is overall amplitude of vertical peaks. Peaks are generally well-defined, and of moderately low amplitude. In general, Figure 12B is characterized by moderation in its parameters, while in Figure 12A, the system seems to be functioning at a consistently high level. Thus, visual inspection of the data again supports the notion that variation within limits is the more adaptive course, which excesses, either in the direction of overly rigid or of overly disorganized behavior, may impair a system's balanced adjustment if they are the strategies which are maintained over an extended period of time.



(A) *1st stage of psychotherapy* **(B)** *3rd stage of psychotherapy*

Figure 12. *FFT Plot of Temperature Data*

Figure 13 presents the relationship between "frequency definition" and "amplitude," with these parameters for each treatment session classified as "Low," "Moderate," or "High." Frequency definition can be described as the degree to which the vertical spikes are delineated on the plot, while amplitude is described as height of the peaks. Numbers on the diagram indicate the chronological order of each session. By visual examination of the following diagram, it is possible to see that the last four treatment sessions, in which the patient's scores were improved on other measures (Personal Narrative and Pain Ratings), can all be found in the same area, with vertical peaks distinguished by high frequency definition and moderate amplitude.

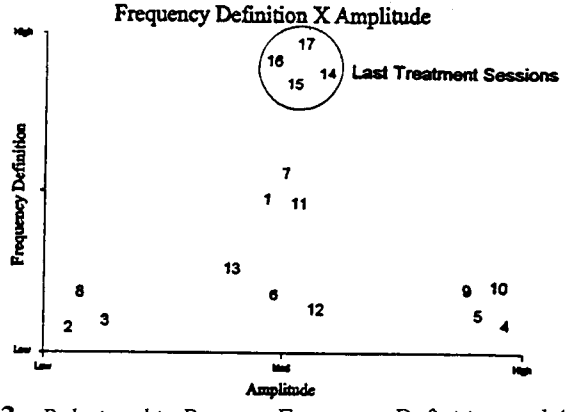


Figure 13. *Relationship Between Frequency Definition and Amplitude*

The next diagram, Figure 14, shows the relationship between frequency definition and *range* of amplitude, where amplitude range is defined as total scope encompassed by the plot's vertical peaks. In this diagram, the sessions appear to be clustered, as they are in Figure 13, with the last sessions again grouped together. Thus, the sessions in which the patient demonstrated improvement in personal narrative and subjective pain ratings can be characterized as having FFT plots with clearly defined vertical peaks and a moderately low range of amplitude.

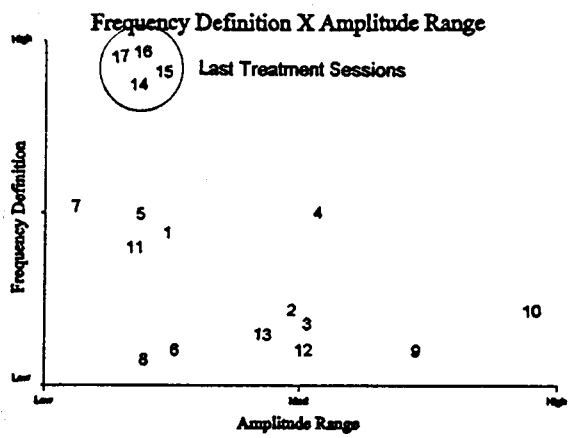


Figure 14. *Relationship Between Frequency Definition and Amplitude Range*

Figure 15 shows the relationship between "frequency range," defined as the scope of the frequencies encompassed by the system's behavior (broad, moderate, or narrow) and amplitude range. While the diagram indicates that this system's behavior occupies a variety of different positions on the plot, again, the patient's final sessions are found together, moderately low in amplitude range while high in frequency range.

Figures 13-15 all lend support to the hypothesis that adaptive systemic behavior is to be found within a limited range of possible options. Sessions during the last stage

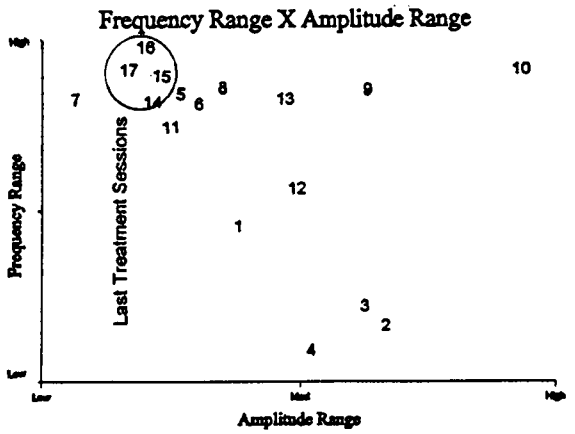


Figure 15. *Relationship Between Frequency Range and Amplitude Range*

of psychotherapy, in which the patient demonstrated the most improvement in personal narrative and pain rating scores, are also marked by clustering of certain FFT parameters: (1) broad frequency range, (2) moderately low, yet (3) well-defined vertical peaks, and (4) moderately low amplitude range.

Modal Behavior of the System

Time series data was organized into an overall frequency distribution which included all temperature readings recorded during the course of the study. This distribution is shown in Figure 16. Its skew is negative, its peakedness indicates a relatively high degree of kurtosis, and it is obviously bimodal, with the largest number of temperature readings falling between 93.5 and 97 degrees Fahrenheit. When one examines the diagram of modal temperatures for each session plotted across all sessions, an interesting pattern emerges. Modal temperatures for the last six sessions all fall within a modal range, while those of previous session, for the most part, lie

outside of it. Variation with the temperature range between 93.5 and 97 could be thought of as an attractor state for this system, since that is the pattern of behavior in which the system eventually settled.

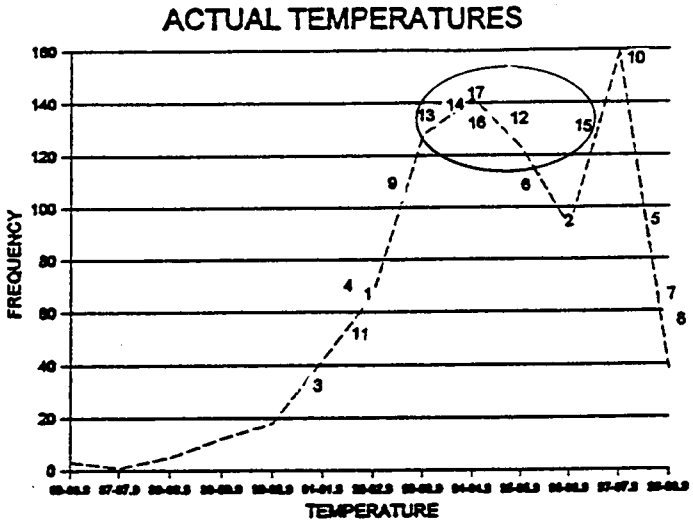


Figure 16. *Frequency Distribution of Actual Temperatures, Across Sessions*

The data presented in this chapter provide clear evidence to suggest that variable behavior within limits is an indication of adaptive functioning. Both rigid and chaotic behavior can contribute to a system's successful operation; rigid behavior is a sign of stability, and chaos allows the system to open itself to a wider variety of possibilities. However, *either* carried to extreme can result in imbalance and disease.

CHAPTER VI

DISCUSSION

To understand process, cycles, patterns is to recognize the beauty of the moment unfolding. It is to be present. —Native American spiritual teaching, (Ywahoo, 1987)

Dust as we are, the immortal spirit grows
Like harmony in music; there is a dark
Inscrutable workmanship that reconciles
Discordant elements, makes them cling together
In one society.

—William Wordsworth

Patterns of discourse, patterns of emotion, patterns of physiology — These are the phenomena which have been gleaned from the data for consideration in this study. Patterns are the basis of existence in living systems. They are dynamic fluctuations, existing not in isolation, but interacting on multiple levels. As living beings, humans are continually engaged in rhythmic patterns which provide organization to our existence and continuity to our day-to-day life. In the absence of these attractors, our experience would be one of perpetual chaos. It is vital to recognize, as data from this study point out, that the patterns of our life are always connected with each other on levels of which we are not aware. This finding is consistent with those of other researchers who have been concerned with the link between psychology and physiology. Zajonc and McIntosh (1992) presented evidence to support the notion that facial action as simple as smiling or scowling alters hypothalamic temperature, which either impedes or facilitates the release of neurotransmitters, thus modifying emotional responses. They

wrote:

> "That facial action, breathing, and cooling are involved in the mind-body interface is an idea that has been around for more than 2,000 years . . . After 23 centuries, we turn again with promise to examine the relation between hypothalamic temperature, emotional states, and emotional expression" (p. 71).

Schwartz and his colleagues at the UCLA School of Medicine (Baxter & Schwartz, et. al., 1992, cited in Glausiusz, 1996) found by inspecting positron-emission tomography (PET) scans, that psychotherapy itself could change the chemistry of the brain. They examined PET scans of 18 patients who were being treated for Obsessive Compulsive Disorder (OCD), ranging in age from 25 to 51, before and after 10 weeks of psychotherapy without medication. The investigative team found distinct changes in brain function after a 10-week treatment. By changing cognitive and emotional patterns as they were taught to "tolerate the fearful messages the brain receives . . . and change (their) responses" (p. 36), patients were able to change their brain chemistry. In summarizing the study, Schwartz concluded: "We used to think that once you got past your twenties, there wasn't a lot you could do to change your brain . . . But this is strong evidence that the brain is plastic—and is plastic much later in life than people previously thought" (p. 36).

In a recent presentation, Fields (1997) introduced an interactive model of the operation of the central nervous system (CNS) relative to an individual's experience of pain, in which he delineated specific mechanisms of action. He contended that there is a powerful and bidirectional interaction between sensory pain messages and emotion,

and that in fact the CNS systems which govern pain and emotion "overlap and interconnect" (p. 153). His research has shown that these CNS structures in the limbic forebrain "provide a major input to pain modulating circuits" (p. 156). Based on his own investigations and those of others, Fields stated that he believes attention and expectation may, in and of themselves, be sufficient to produce pain sensation in the absence of any peripheral noxious stimuli. Pain transmission neurons at all levels of the neuraxis appear to be regulated by structures which are also critical in the processing of emotion. This means that pain modulating circuits are activated by psychological factors as well as by peripheral stimulation. Thus, an individual's affective experience of pain (how much it "bothers" him) directly affects "How much it hurts." The question is not: "Are emotional factors important in one's experience of pain?" but "Is the individual aware of their importance?"

The present study supports the idea that the ways in which an individual interprets her world in patterns of verbal disclosure affect other patterns which are active in her life, including those which modulate the experiences of pain and body temperature. It is these interconnected patterns, or attractors which define our existence. We are creatures who can be known by the patterns which connect us to ourselves and our neighbors. Melzack (1992) proposed that one's experience of identity is related to his neurosignature, which he described as "a pattern of connectivity between neurons" (p. 123). As Fields also insists, it is the pattern of connections—the brain *processes*, and not actual sensory stimulation which generate

our perceptions of ourself and our world.

In writing about the importance of pattern, Evelyn Fox Keller (1985) reminded the reader that Newtonian laws of cause and effect apply only in limited circumstances; our world is in fact much more subjective and less categorical than modern science has allowed. She suggested that instead of thinking of the world as governed by immutable laws, the concept of order may be more accurate. Order in this view is defined as *patterns* of organization which include, but are not limited to, the mechanistic laws previously assumed to govern nature. Instead of being a machine in the Newtonian sense, nature seems to possess qualities which are subjective, such as unpredictability, cooperation with neighboring systems, sensitivity to small variations, reflection of previous history in current systemic behavior, and creativity. The chaos which creates disorder in life is also the vehicle of its greatest potential. When constrained and shaped by energy, chaos promotes variation and creativity, adding "spice" to one's life.

By virtue of their instability, attractors allow for the spontaneous emergence of a new order; in doing so they promote variation supported by structure. A Newtonian model encourages one to think of what is more in terms of what is less. It suggests that the world can be understood by reducing phenomena to their basic building blocks, which are assumed to represent their essential qualities. Systems theory insists that nature cannot be understood by analysis of individual parts. It reminds us that there really are no parts — that the "parts" are actually *patterns* of organization. It shifts the focus from parts to patterns, from objects to relationships.

Rhythms, or patterns of behavior are important not only to the system itself, but are just as important to its neighbors; they allow for reciprocal transmission of information from one individual to another, connecting the two as part of a larger network. Scientists have long believed that bacteria, which are the oldest, most abundant, and most well-adapted organisms on earth, were "rugged individualists" (Losick and Kaiser, 1997, p. 68). Despite the fact that bacteria were known to live in colonies, it has been thought that they operate independently and simplistically relative to their host environment. Investigators have now found that bacteria communicate in sophisticated ways both with other bacteria and with their plant and animal neighbors, using various *patterns* of chemical release to "speak." This communication has been found to be reciprocal between sender and receiver "in a pathway that regulates the development of both organisms" (p. 72).

Earlier, neuroscientists Maturana and Varela (1980) had concluded that bacteria were capable of both perception and cognition. These investigators believed that even the simplest organisms can perceive changes in their environment and in turn, respond to these variations. Based on their observations, they defined cognition broadly, as a process which involves perception, emotion, and action, and not simply "thinking." The Santiago theory, as Maturana and Varela called it, collapsed the distinction between mind and matter, linking cognition and physiology at the basic level of cellular behavior. It refuted the Cartesian model of mind as independent "thinker," suggesting that cognition is a process which includes systemic behavior at all levels.

Neuroscientist Candace Pert, who has systematically investigated the functioning of the human immune system, has reached a similar conclusion. In this regard, she wrote:

> "The body is the outward manifestation of the mind. I would go further. When we document the key role that the emotions, expressed through neuropeptide molecules, play in affecting the body, it will become clear how emotions can be a key to the understanding of disease . . . We are all aware of the bias built into the Western idea that consciousness is totally in the head. I believe (my) research findings indicate that we need to start thinking about how consciousness can be projected into various parts of the body . . . A mind is composed of information, and it has a physical substrate, which is the body and the brain, and it also so has another immaterial substrate that has to do with information flowing around. Maybe mind is what holds the network together" (1990, pp. 154-155).

Losick and Kaiser found that not only is the particular chemical pattern of communication important, but its level or dose is important as well. Patterns of systemic behavior examined in the present study also indicate that not only is the pattern important, but that its level or range is also important to the organism's adjustment. Analysis of peripheral finger temperature data showed that an optimal range existed, outside of which the patient's functioning was presumably out of balance, as inferred by the relationship of temperature data with pain ratings and personal narrative. Further, upon inspections of various parameters of the FFT plots generated by temperature data, it became clear that during sessions in which pain ratings and personal narrative were most improved from a clinical standpoint, systemic behavior showed striking similarities after spectral analysis. The idea that "everything has its place," is common in folk literature. In an extension of this idea, Lévi-Strauss wrote that:

> "Being in their place is what makes them sacred for if they were taken out of their place, even in thought, the entire order of the universe would be destroyed. Sacred objects therefore contribute to the maintenance of the order of the universe by occupying the places allocated to them" (1966, p.10).

Smith (1992) pointed out that our language retains the essence of this early insight in our use of the word sublime. The sublime is that which remains within its limit, as derived from the Latin *sub - limen*. Various psychological theories hold that the individual's acceptance of himself as he is serves as a marker of maturity; one does not attempt to be what he is not. Psychodynamic theory has called estrangement from one's true feeling and identity the "false self" (Masterson, 1988), while Thoreau put it this way: "Shall a man go and hang himself because he belongs to the race of pygmies, and not be the best pygmy that he can? Let every man mind his own business and endeavor to be what he was made . . . A man does best when he is most himself" (cited in Epstein and Phillips, 1978). Acceptance of what is includes both recognizing one's own worth as well as allowing the other to be "as is." It means that the individual can tolerate the tension which necessarily exists with the continual change and diversity of his world, rather than attempting to control or restrict its natural flow.

Our assumptions about the importance of both pattern and of variation within limits appear to have been validated in this study by the results of data analysis. As Ms. X became better able to conceptualize her world in its complexity, and to tolerate the discomfort and tension that a more complex view brought her, the physiological index of peripheral vascular response was marked by increased variability within specific

limits. She was able to take herself out of the battle with pain, which had been the primary presenting problem, by accepting its presence in her life. With acceptance came the opportunity to choose between more than the two options with which she entered treatment: (1) pain and (2) the struggle to eliminate it entirely. Ms. X had tried in the past to control her pain. Control implies the artificial restriction of a natural flow, while choice connotes one's decision with regard to where to enter it. Once she stopped fighting, Ms. X was able to free up energy which she had previously used in the struggle to rid herself of pain. She was able to choose ways in which she could live with her pain, improving the quality of her life while moderating her activity level. The choices which she made were certainly influenced both by her past history and by current external conditions, two of which were pain and participation in psychotherapy.

In one of her early treatment sessions, Ms. X commented that her friends had nicknamed her "Whirlwind" because she kept so busy; she said that she didn't notice that she was tired until she became exhausted. Later in therapy, as she became able to relax and pay attention to her body rather than shutting out its signals, she remarked: "I've just started noticing what it feels like to be rested. Before, the pain was all I could notice; I didn't notice the exhaustion. But now, I don't react like I used to, and I stay with that rested place that I'm noticing more, if I feel like it's gettin' used up."

Energy and pattern must operate together. The energy available to an individual at any given time is important in allowing for patterns to be expressed which promote balanced, adaptive systemic functioning. Perhaps it is a free flow of energy

which provides vitality and constraint of energy which promotes rigidity. Analysis of temperature data indicated that during the last stage of therapy, when Ms. X reported that she could notice when she was feeling rested, systemic functioning was indeed more efficient; there was a more conservative expenditure of energy as observed on FFT plots. Energy and pattern, tension and rhythm, must work simultaneously. Energy motivates the process; it provides the systemic impetus to shape the flux while pattern provides a structure within which the system can operate. Both movement and form are equally important to balanced functioning. As the Taoist writer observed: "All chaos must be refined before it can be given shape . . . Spirit, energy, life, or that which gives shape, is primary and essential. However, that which assumes shape becomes central" (Wilhelm, 1956/1979). Capra (1996) described the relationship between pattern and energy over time in this way: "The process of life is the activity involved in the continual embodiment of the system's pattern of organization" (p. 159). The link between the pattern and its resulting structure is energy, the process which drives its movement over time.

This continual process, in which energy modifies pattern, bringing forth new forms of behavior, must be the essence of the self-organizing process of life. Within it, stability and instability coexist, maintaining a delicate balance as they act in collaboration with one another. In this process, we can glimpse opposition being turned into cooperation as their complementary forces unite to produce greater systemic good. Spiritual writers of all cultures have described this reconciliation of

opposites as the point at which one reaches spiritual unity. In writing about the attitude of the Simple Man, Chuang Tzu said:

> "(It) is one in which this and that, yes and no, appear still in a state of non-distinction. This point is the Pivot of the Law; it is the motionless center of a circumference on the rim of which all contingencies, distinctions and individualities revolve. From it only Infinity is to be seen, which is neither this nor that, nor yes nor no. To see all in the yet undifferentiated primordial unity, or from such a distance that all melts into one, this is true intelligence" (XXII).

I believe it is not by accident that principles endorsed by spiritual traditions of all cultures seem consistent with the findings of this study—principles such as stillness and toleration of tension, reconciliation of opposites, emphasis on connection and cooperation between living systems versus competition and struggle, and finally, principles of moderation, of balance which is achieved through remaining within one's limits. Granted, it is not within the scientific method to either prove or disprove spiritual truths, given the objective limits of its model. "Science cannot change in this way without destroying itself" (Weinberg, 1974, p.42). However, the scientific enterprise itself can only be strengthened by acknowledging similarities in the findings of its research processes with wisdom which has been preserved across cultures throughout the history of our world; spiritual wisdom may both inform and add meaning to the scientific endeavor.

Unfortunately, since Newton and Descartes, science has looked with disfavor on the manner in which spiritual principles might inform its own practice. Huston Smith described the situation in this way:

> "I have (previously) argued that the triumphs of modern science went to man's head in something of the way rum does, causing him to grow loose in his logic. He came to think that what science discovers somehow casts doubt on things it does not discover; that the success it realizes in its own domain throws into question the reality of domains its devices cannot touch. In short, he came to assume that science implies scientism: the belief that no realities save ones that conform to the matrices science works with—space, time, matter/energy, and in the end number—exist" (1992, p. 34).

In reference to this topic, physicist David Bohm commented: "The immeasurable is the primary and independent source of all reality . . . Measure is a secondary and dependent aspect of this reality" (1974, p. 70). Thus, while science has contributed much to the state of our knowledge, its sphere can reach only a part of our world, and its discoveries must be viewed, not as absolute, but as limited and approximate. Let us consider the idea that the actual processes of nature are actually much more fantastic than we can imagine. The concept that mind is distributed throughout the body, and is not located solely in our brain, the notion that cognition, emotion, and physiology are interconnected seem farfetched to many who have been steeped in the science of the past. In considering the limits of human sensory experience, Finkelstein commented that, respecting nature, "We haven't the capacity to imagine anything crazy enough to stand a chance of being right" (cited in Smith, 1992, p.106).

While Darwin's nineteenth century world was one of struggle, today's scientific discoveries are showing us that a new world view needs to encompass cooperation and symbiosis; that we need to understand how systems rely on and work with each other in *inter*dependent rather than *in*dependent fashion. Strategies which emphasis control

and domination, over either ourselves or others, will ultimately prove fruitless. The science of the West, which has emphasized power and independence, must be broadened and moderated by inclusion of its more recent findings. Our world is unquestionably complex at all levels; chaos theory provides us with a model which includes this complexity as normal to everyday life. Unfortunately, the destructively simplistic reductionism which has pervaded Western scientific enterprise has been unquestionably accepted by most; the effect of this unquestioning acceptance has been to suppress a great deal of the potential inherent in the process of living. For instance, Ms. X has the power to choose to change her view of the world, and in doing so, she can affect the physical pain that she feels; she can alter the way her body works. This power is not an example of "mind over matter" nor is it illusory; it is an actual example of choosing to participate in guiding processes which have commonly been thought to be out of the sphere of one's influence.

The dominant Western biomedical paradigm has reduced disease to physical states that can be treated separately from an individual's psychological or social milieu. It favors technique over person, replication of scientific procedures, and objectivity (Good, 1987). In the biopsychosocial paradigm which guides traditional "folk" medicine, the individual's body, mind, and soul are considered to be an interconnected whole; the assumption is that changes in one part of this system affect changes in the others. This model integrates the spiritual with the physical, providing meaning to the patient as it does so. We know that it is critical to the patient's experience of illness

that she finds a way to render it meaningful in the larger context of her life (Thompson, 1988; Sternbach, 1974). Objective science itself is silent on questions of existential and spiritual content. Maybury-Lewis spoke to this issue when he wrote:

> "Modern society is intensely secular; even those who regret this admit it. The irony is that, after excluding the mystical tradition from our cultural mainstream and claiming to find it irrelevant to our concerns, so many of us feel so empty without it" (1992, p.v).

Leslie (1980) remarked that even though Western biomedicine is almost always less scientific than it appears, its practitioners and followers throughout the world view practitioners of alternative therapies as "quacks" or charlatans. While it is important to make some distinction between genuine healers and those who would take advantage of another's vulnerability, the difference between them is far from clearcut. There is a large literature to support the efficacy of placebo treatments, which mobilize the individual's internal healing systems, although these have also been discounted by many who maintain a "fundamentalist" Cartesian perspective. In fact, the beliefs of those who rigidly exclude the idea that patients can and must participate in their own healing are quite similar to other religious fundamentalists. Biomedicine is a secular religion resulting from overemphasis on the principles of a science which excludes all truths save its own as valid. Is this not why holy wars are waged—in service of religious beliefs which have become political? Speaking through his fictional "Chief of Medicine," medical ethicist Howard Brody wrote, in *The Healer's Power*:

> "Medicine and religion spring from the same well deep within the human spirit, and they have much in common. They try to address the most profound fears of humanity, and ultimately there are two ways

> to do this—through meaning and through magic . . . And we who would accept the priesthood of healing the sick must have our magic . . . We do realize that our scientific and objective posturing is a sham and that the priesthood is our real business . . . Do you think I am so blind as not to realize that today's texts will appear quaint and primitive to our successors? Do you think I would fail to see that our lasers, scanners, and computerized toys are just a finer and richer set of stage props? The only difference is that our predecessors may have truly believed. I cannot believe; I know too much" (1992, p. 9).

Brody goes on to argue that power lies with the physician; that patients want no part of it, preferring to depend upon their healers to save them. This paper takes issue with that position, insisting that people must be offered the opportunity to use their *own* power and potential in the service of their healing. This is a difficult issue to resolve, and one which has profound implications for the treatment of illness.

Although modern medical technology can certainly make a contribution to the treatment of disease in our society, the experience of illness exceeds what biomedicine is able to treat, and we must concede the necessity of looking to other approaches to discover what it misses. We must also admit the necessity of surrendering a portion of the established power to individuals who have previously been deemed peripheral, including patients themselves and healers who practice other therapeutic approaches. Diseases are not discrete states which affect a single organ or physiological system; they cannot be understood apart from their place in the whole. Mathematician Kurt Gödel, who proved that in mathematics the whole is always greater than the sum of its parts, staunchly maintained that:

> "Except in trivial cases, you can decide the truth of a statement only by studying its meaning and its context in the larger world of . . . ideas . . .

> Mankind will never know the final secret of the universe by rational thought alone. Scientists will never achieve ultimate success; there is no final verdict in the courtroom of science giving us absolute truth" (cited by Casti, 1991, p. 283).

This study has attempted to apply tenets of complexity theory, which shifts one's focus from the properties of the parts to the organization of the whole, in order to operationalize the concept of "balance" as it applies to the physical and emotional functioning of one individual. Surely, both this author and the reader are in agreement that a point of view cannot be either "proved" or "disproved" by a single case study, or even by a plethora of studies. Skeptics will certainly find a way to discredit these findings, while proponents may accept them too easily. I am inclined to believe that truth, as someone once said, it betrayed by its repetition. Contributions of the present study lie in its painstaking examination of the experience of a single individual over time, and in the consistency of its findings with recent theories of complexity which expand rather than reduce one's view of the world. It allows the reader to see connections between an individual's thoughts, emotions, and physiology which are not normally assumed to be connected. It emphasizes the importance of observing patterns rather than relying on simple numbers, which can never capture more than a single aspect of their referents. Finally, it suggests that spiritual truths can complement those uncovered by science, that spiritual principles can demonstrate consistency with scientific findings, and that they can contribute meaning to its enterprise. It suggests that science and spirituality can operate as opposites which coexist, and that in doing so, they provide a unity and clarity which has been previously lacking in Western

thought.

Results of this study clearly suggest that the reductionist message of Western science is seriously flawed, and that its dogma provides a narrow and limited view of human potential. Life is an *emergent* property; it organizes itself in the moment-to-moment give and take of systemic activity rather than being controlled or directed from afar. Based on the current findings, it operates best when it displays balanced activity characterized by variation within circumscribed limits, which incorporate both rigidity and chaos as they arise. Individuals are much more than the firing of neurons, the release of neurotransmitters, or the particular arrangement of genes. As our technology enables us to study phenomena of increasingly smaller magnitude, it is important not to lose sight of the larger context in which they function systemically.

There are clear practical implications for such a perspective. In the treatment of disease, a holistic model places responsibility for active participation in the healing process squarely on the shoulders of the individual who is ill. It does not cast blame—the crux of this position is not to cause people to feel responsible both for being sick and for not improving. Instead, it offers a potential far greater than most of us have imagined we might possess. The argument against offering individuals the information that they can take part in their healing for fear of assigning blame is logically a weak one. Every day some new study is announced in which the effects of smoking, or diet, or lack of exercise are explained, while at the same time individuals are encouraged to modify their lifestyle in order to take advantage of associated health benefits. Should

this information be withheld so that individuals will not blame themselves if they do not successfully follow the advice given? I argue that withholding information about the interrelationship of thoughts, feelings, and physiology advances the position that it is better to do *nothing* than to try to do anything of significance when the outcome is less than certain.

The essence of the problem is not that an individual may try and fail to affect the course of his illness, but that he may inappropriately blame himself if his efforts do not succeed (Epstein, 1989). In "failing" to cure himself, the individual may not remove the disease, but may in fact improve the quality of his life to a significant degree by adding meaning to it which had previously been excluded. If enlarging one's understanding of health and illness improves the quality of his life and does not cause the individual to avoid taking other action when necessary, then it makes an important contribution. The problem is not in trying, it is in demanding a guaranteed result. Often patients expect a guaranteed result from their physician when they enter a medical office expecting to be "cured;" when this is not the outcome they feel angry at the physician for not "doing enough": "I know there's something there—they just haven't found it yet." Ironically, it is the biomedical establishment which has in part promoted this "magic" formulation that has been so readily accepted in our society.

In his book, *The Broken Heart,* cardiologist James Lynch concerns himself with these same metaphysical issues. He laments the fact that:

> " . . . few patients describe themselves as hypertensive; instead they assert that they 'have' hypertension. I ask patients where they got 'it.'

> Because we have accepted the hydraulic model of the human cardiovascular system, we have disconnected blood pressure from any sense of personal involvement. So if you have hypertension and the disease is an object, it makes perfect sense to take 'something' for 'it'" (1990, p. 80).

Ms. X was forced to confront these issues when she encountered chronic pain. She demonstrated that, despite her history of severe medical and emotional problems, she had the potential to significantly affect her own healing when she was encouraged to view pain as connected with other parts of her life. She was committed, not to getting rid of the pain, but to accepting it as a part of herself and finding a way to integrate it into her day-to-day experience. This was by no means an easy task, as Ms. X changed her categorical thinking into a more modulated view of the world. In doing so, she identified and reconciled opposites which had plagued her for years. Physical and emotional healing did occur, although there was no "cure" to be found at the end of treatment. In fact, at that point in time Ms. X was not expecting to find one.

This research project has transcended the traditional boundaries of psychology, in terms of both content and methodology. It has devoted itself to broadly based metaphysical questions which are in urgent need of consideration in today's society, one that is increasingly marked by specialization and territorialism. It encourages collaborative effort across disciplines, and advocates for the discovery of meaning in a larger context than that which has been offered by either our discipline or by our scientific enterprise as a whole. By allowing values as well as facts to inform both our research and our clinical pursuits, and by conceding the limits of our practice,

professionals across many disciplines can assume a more responsible role in holding up a model for those who look to science for guidance. Let us have the integrity to accord to others the power which is rightfully theirs, as well as to acknowledge our limitations as scientists and healers. And finally, like Ms. X, let us have courage enough to tolerate the tension which such changes in perspective will necessarily engender, and wisdom enough to apply them in our day-to-day endeavors.

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VITA

Susan Strickler earned her B.S. and M.A. degrees in psychology in 1975 and 1978, respectively. Since 1978, she has practiced as a licensed psychological examiner both in publicly funded organizations, and in private practice. She has extensive clinical experience across age groups, from children to the elderly. Dr. Strickler's primary research focus during her doctoral studies has been in the area of health psychology, reflecting a belief that treating symptoms without regard for the larger context in which they occur is ultimately ineffective, whether the problem is a child conduct disorder, or chronic pain.

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