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AN INVESTIGATION OF RELATIONSHIPS BETWEEN BLOOD NEUTROPHIC FUNCTION AND IMAGERY, TRAINING, IMAGERY RATINGS AND INDIVIDUAL DIFFERENCES

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AN INVESTIGATION OF RELATIONSHIPS BETWEEN BLOOD NEUTROPHIL FUNCTION AND IMAGERY, TRAINING, IMAGERY RATINGS, AND INDIVIDUAL DIFFERENCES

by

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ABSTRACT

AN INVESTIGATION OF RELATIONSHIPS BETWEEN BLOOD NEUTROPHIL FUNCTION AND IMAGERY, TRAINING, IMAGERY RATINGS, AND INDIVIDUAL DIFFERENCES

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This investigation concerned relationships between imagery, training, imagery ratings, and changes in the functions of neutrophils. A neutrophil is a particular type of white blood cell which is associated with the body's immune system. A secondary question of interest was whether specific personality factors would correlate with the blood changes.

Data was collected on eight male and eight female volunteers. All but two of the subjects were Michigan State University students in medicine and psychology. The other two subjects were Lansing businessmen with college degrees. The subjects' ages ranged from 21 to 38 with a mean age of 29.4. All subjects were screened for any health or diet irregularities which might affect their blood results. In addition, any persons who did not believe in the possibility that they might be able to influence their blood cells were excluded from the study.

The study took place over an eight-week time period, and each subject made a commitment to attend six sessions. During the

first session each subject had blood drawn, signed a consent form, filled out a demographic data form and three personality inventories, and had blood drawn again 20 minutes after the first sample was taken.

The second visit was a group session during which white blood cell function was explained and slides of neutrophils were shown which could later be used as a basis for imagery representations.

During the third session, subjects listened to a relaxation/ general imagery tape. The fourth and fifth sessions were group training sessions. Subjects were divided into two groups of eight each. Training consisted of the following: explaining the rationale and purpose of the study, explaining the relaxation/specific imagery procedure and giving suggestions for effective imagery, practicing the imagery procedure as a group, asking subjects to draw pictures of their imagery and rate the pictures according to specified criteria, and answering any questions that arose.

The specific imagery procedure was adapted from imagery instructions given to cancer patients in a comprehensive cancer treatment program. The imagery procedure used in this study was designed to help subjects relax and visualize their white blood cells. They were asked to imagine their white blood cells changing shape, sticking to the blood vessel wall, passing through the vessel wall, and going to places in the body where "garbage" had collected. The entire procedure lasted approximately 20 minutes. Subjects were encouraged to experiment and be playful with their images and adapt the procedure in any way that made sense for them. Articles clarifying both imagery studies and white blood cell function were

distributed, and they were encouraged to read the articles and to practice the technique at home.

Subjects came individually for the sixth session. Blood was drawn, the relaxation/specific imagery procedure was repeated, blood was drawn a fourth and final time, and they drew a picture of their imagery. Subjects were then asked a series of questions about their imagery by the investigator. This recall session was tape recorded, and subjects were later scored independently by three raters for the adequacy of their imagery process.

Blood was obtained on the four separate occasions by venapuncture. The blood samples were examined for changes associated with motility--i.e., white blood cell count, adherence, and cellular shape change. White blood cell count reflects the availability of white blood cells for migration in the blood stream. Changes in white blood cell count indicate whether the cells are free-floating in the blood stream or the extent to which they have attached to the blood vessel wall or have left the blood stream. Only those cells that are circulating are measured by venapuncture. A 25 microlitre sample of blood was diluted in white blood cell diluting fluid. The white blood cells were then counted in triplicate on a Coulter counter. The number of cells were multiplied by 1000 which gives the number of white blood cells per milimeter of blood.

Adherence was determined by the ability of cells to stick to protein-coated surfaces. Percent unstimulated adherence represents the percent of isolated neutrophils that remain attached to a glass cover. The procedure was repeated for neutrophils that were

stimulated by N-formyl-L-methionyl-L-phenylalanine (fMP), a synthetic substance and a chemotactic factor produced by Sigma Chemical Company. F-M-P activates shape change and adherence in the cell. If neutrophils are dysfunctional, their percent adherence will not increase when treated with fMP. Percent stimulated adherence represents the percent of neutrophils treated with fMP that remain attached to the glass cover.

The third measure of immune responsiveness was the capacity of neutrophils to change shape. There are five classifications of cell shapes: round, ruffled, bipolar, uropod, and pseudopod. One measure of chemotactic response is the ability of cells to assume a bipolar configuration upon exposure to a chemotactic factor. The percentage of cells with a bipolar configuration was determined by scoring 100 cells per slide. Shape index scores were determined by multiplying the shape change categories by a factor and adding them. Scores were reported for unstimulated and stimulated shape change.

The instrument chosen to assess imagery was an adaptation of the IMAGE-CA developed by Achterberg and Lawlis (1978) to evaluate the imagery of cancer patients. The present study adapted the following variables from the IMAGE-CA: vividness, leaving the blood stream, strength, general feeling, symbolism, and clinical judgment. In addition, three summary variables were rated: decrease in white blood cell count, shape change, and adherence. The tape-recorded sessions and the drawings of the images were used to determine the ratings. Imagery ratings were correlated with the blood results.

Three psychological inventories were used to measure correlations between personality characteristics and ability to influence neutrophil function. The International Opinion Survey, also known as the Internal versus External Control of Reinforcement Scale (Rotter, 1966), measures an individual's beliefs about who controls his/her behavior and life events. The Type A Inventory was developed by Friedman and Rosenman (1974) to identify personality characteristics which may predispose individuals to coronary heart disease. The Wellness Inventory (Travis, 1977) is a questionnaire which measures degrees of wellness by quantifying wellness behaviors. It was expected that scores on the three inventories would correlate with blood changes.

Hypotheses that neutrophil function would change following a 20 minute relaxation/imagery session were tested. Findings revealed that significant changes occurred for two of the three blood functions. The total white blood cell count dropped significantly ($p < .0001$) as predicted. This finding is particularly significant when restricted to neutrophils. There was a 38 percent drop in neutrophil count, as compared with a 20 percent drop in total white blood cell count. The second blood measure, adherence, also dropped significantly ($p < .05$). Subjects were instructed to visualize an increase in adherence, therefore this finding was in the opposite of the expected direction. There was no significant change in cellular shape following the imagery condition.

The hypothesis that subjects who received higher ratings on the adequacy of their imagery process would have greater changes in

blood function was also tested. Significant correlations were found between imagery ratings for symbolism and white blood cell count and changes in white blood cell count. Significant negative correlations were found between imagery ratings and adherence functions indicating that imagery effectiveness was related to a decrease in neutrophil adherence.

Finally, the three personality variables were correlated with changes in white blood cell function. Some significant correlations were found between Wellness scores and blood changes, however, very few significant correlations were found between Type A and Locus of Control scores and the blood measures.

The results of this study suggest that healthy, motivated subjects can be trained to lower their neutrophil count. It is also possible that the decrease in adherence was due to the drop in neutrophil count--i.e., the adhesive cells were part of the 38 percent that marginated or left the blood stream. Likewise, lack of neutrophil shape change might be explained by a similar possibility, i.e., the cells that had changed shape had marginated or left the blood stream and were unavailable for sampling by venapuncture.

The results also suggest that three independent raters can predict blood function changes, and that effective imagery is related to changes in neutrophil function, particularly adherence function. It would appear that the more individuals are able to visualize their white blood cells symbolically, the more they are able to achieve a physiological effect. The correlations between control

blood samples and imagery ratings suggest that some persons may be more capable of effective imagery than others.

The low number of significant correlations between personality measures and blood changes might be due to the small size and homogeneity of the sample, and/or the low reliability and validity of the measures.

It is unclear what role the placebo effect played in relation to blood function changes. Further investigations which control for the placebo effect might clarify its contribution. Finally, the question of generalizability beyond a highly motivated, healthy, educated sample remains unanswered, and replications of this study using larger and more heterogeneous samples was suggested.

DEDICATION

To my father, whose courage as he struggled to live his life to the fullest inspired me to pursue this study.

To my daughter, Laurie, who often surprised me with her maturity and love by putting her own young needs aside so that I could undertake this endeavor.

To my friends, whose patience, support, and caring make it all worthwhile.

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CHAPTER I

INTRODUCTION

PURPOSE

The purpose of the present study is to investigate the relationship between imagery and white blood cell function. More specifically, will a 20 minute relaxation/imagery session affect the following characteristics of blood neutrophils: white blood cell count, adherence, and shape change?

A study by Achterberg and Lawlis (1978) suggests that persons can be rated according to certain specified criteria as to the adequacy of their imagery, and these ratings will correspond with the progress of their disease. A second purpose of the study is to determine whether three independent raters of an imagery experience can predict the following changes in neutrophil function: white blood cell count, adherence, and shape change.

Personality and life-style factors have also been related to health and illness (Friedman, Meyer & Rosenman, 1974; Rotter, 1954; Strickland, 1977; Pelletier, 1977; Shealy, 1977; Travis, 1977). In addition to testing the primary questions of interest, the study will correlate three personality variables thought to be associated with health with the three neutrophil function measures. The three personality variables which will be correlated with neutrophil changes are Type A personality, locus of control, and wellness habits.

RATIONALE

New definitions of health have been emerging during the past several decades. One reason for this expansion is that while medicine is effective in certain areas--i.e., the treatment of infections, fractures, etc.--some believe medicine to be relatively ineffective in the treatment of stress-related disorders such as ulcers, migraines, allergies, and cardiovascular and respiratory disorders (O'Regan and Carlson, 1979) which are prevalent in society today. Therefore, some investigators have been attempting to define health from a broader perspective. The World Health Organization, for example, has defined health as "physical, mental, and social well-being, not merely the absence of disease or infirmity" (WHO, 1958). The term "holistic health" is representative of this new trend to view health from a broader perspective by considering the well-being of the total individual. A high level of health would consist of an optimal relationship between the physical, emotional, intellectual, social, and spiritual parts of an individual.

In examining the recent concepts of holistic health, three broad categories emerge: biological health, psychological health, and behavioral health. Biological health refers to an individual's ability to adapt to internal and external events in order to maintain an optimal state of balance. Seyle (1976) talks about biological health as an optimal state of balance between outside events and internal adaptation to those events. Top (1964) asserts that the body's immune system is always fluctuating, and germs invade and multiply only when host resistance is low. Smith (1979) has found

during the past few years that sudden stress caused changes, such as an elevation in white blood cell count, in the immune function of three blood donors. Other investigators have also cited evidence indicating that there are relationships between stress and responses of the immune system (Riley, 1981; Engel, 1967; Pelletier, 1977). Stress is a general term which has been defined a number of different ways. Seyle (1974) defined stress as "the nonspecific response of the body to any demand made upon it" (p. 14). This broad definition will be used in this study.

Psychoneuroimmunology, an emerging discipline within the field of behavioral medicine, examines the relationships between stress and immune competence (Riley, 1981). Animal research has shown that stress produces increased plasma concentrations of adrenal corticoids and other hormones which can cause injury to elements of the immune system, such as white blood cells (Roger, Dubey & Reich, 1979). Stress may also be related to hypothalamic activity, and there is some evidence that hypothalamic lesions modify cell-mediated immune response (Schiavi & Camerino, 1976). Since the immune system is a major defense against various pathological processes, stress "may leave the subject vulnerable to the action of latent oncogenic viruses, newly transformed cancer cells, or other incipient pathological processes that are normally held in check by an intact immunological apparatus" (Riley, 1981, p. 1101). Other clinical studies have linked stressful occurrences such as losses or traumatic events to the onset of disease (Holmes & Rahe, 1967; Engel, 1967). In one study, 26 bereaved spouses showed depressed lymphocyte function six weeks

after bereavement (Barthrop, Lazarus, Luckhurst, Kiloh & Penny, 1977).

Thus, biological health is viewed as a dynamic state of being related to the body's continual adjustment to stress. Audy (1973) defines health as a person's ability to recover after a challenge to adapt. However, since the elimination of stress is not a possibility (or desirable state) for most individuals, biological health may be partly a function of how a person deals with stress.

Psychological factors are important in determining how individuals react to stress. Friedman and Rosenman (1974) have identified certain personality factors, such as impatience, ambitiousness, and time urgency, which they believe predispose persons to coronary heart disease. They have labeled an individual possessing a number of these traits as a "Type A personality." Another personality factor thought to be related to health is an individual's beliefs about who controls behavior and life events (Strickland, 1977). This personality construct has been labeled "locus of control" (Rotter, 1954). Beliefs range from "internal," which is a belief that positive and negative events are a result of one's actions and efforts, to "external," which is a belief that events are controlled by outside forces such as chance, fate, luck, and powerful persons.

In addition to personality characteristics, health is also associated with behavioral or life-style factors. Health has been defined, for example, as the maintenance of an optimal capacity necessary for the performance of valued tasks (Parsons, 1972), and a number of researchers have defined health as a function of life-style

habits (Pelletier, 1977; Shealy, 1977; Ardell, 1979). An outgrowth of this perspective has been the development of inventories which measure degrees of health. One example of such an inventory is the Wellness Inventory which is contained in the Wellness Workbook (Travis, 1977). It consists of 100 questions measuring behavioral characteristics such as sleep, safety, nutrition, exercise, and creative activity. Footnotes are also included which explain the health implications of selected items. The Wellness Inventory is based on the belief that self-responsibility is the key to good health.

Health, then, is perceived from a holistic perspective as a complex and dynamic state of being which is affected by many interrelated factors. If stress, psychological characteristics, and lifestyle factors can adversely affect one's health, then perhaps these factors can also enhance health. What are the natural regenerative responses, for example, that account for some populations living longer than others? Why do some persons get well while others do not? The phenomenon of spontaneous remission raises some interesting questions about what mechanisms are responsible for activating the natural healing processes in the body (Everson, 1964; Simonton, 1978).

One mechanism that has been used by clinicians and practitioners for centuries as an aid to mental and physical healing is imagery (Samuels & Samuels, 1975; Achterberg & Lawlis, 1980). Imagery is thought to be related to healing because it involves right brain processes (Bry, 1979). The right hemisphere of the brain is related to intuitive, creative, imagining functions, and the left

hemisphere is thought to be responsible for logical, thinking functions (Ornstein, 1977). The right hemisphere also seems to play a predominant role in emotional processing and therefore is believed to have a more direct connection with autonomic bodily functions (Achterberg & Lawlis, 1980). It appears that left brain verbal messages must be translated into non-verbal or imaginal messages by the right brain before physiological changes can occur. For example, patients who persist in verbally telling themselves to relax may experience difficulty doing so, but if they imagine a pleasant scene, they are more likely to evoke physiological changes consistent with relaxation (Achterberg & Lawlis, 1980; Jaffe, 1980; Simonton, Simonton & Creighton, 1978). Imagery has been used for healing purposes, therefore, because it allows for a shift to right brain functions which are more directly related to autonomic functions.

There are many different definitions of imagery. Visualization and fantasy are often used synonomously with imagery to mean "the internal experience of a perceptual event in the absence of the actual external stimuli" (Achterberg, 1980, p. 27). This definition, which differentiates imagery from simple memory retrieval, will be used in this study.

Visual imagery has been used recently as part of a comprehensive medical treatment program for cancer patients (Simonton, Simonton & Creighton, 1978). Over 300 patients in this program were taught relaxation and imagery procedures. Ninety-eight percent of those who practiced three times per day for fifteen minutes experienced a shrinkage of their cancers. Conversely, those who did not

practice the procedures regularly did not experience a shrinkage of cancer growth.

Based on the results of the Simontons' work, an instrument known as the IMAGE-CA was developed to assess imagery effectiveness (Achterberg & Lawlis, 1978). The IMAGE-CA operationalizes and measures imagery dimensions. These dimensions can, then, be correlated with disease status. There appears to be a correlation between effective imagery, as measured by the IMAGE-CA, and remission of cancer growth. A study by Achterberg and Lawlis (1978) found a .78 correlation between ratings of visual imagery and change in cancer growth two months later. There is a need for further research in this area in order to determine more precisely the effect of imagery on the body's immune system.

White blood cells are associated with the body's immune system. There are five types of white blood cells: lymphocytes, monocytes, eosinophils, basophils, and neutrophils. Neutrophils are the largest and most numerous of the white blood cells, and they are also the most important cells that offer defense against acute infections, especially bacterial infections. They are the first cells to be activated or mobilized in response to a challenge, i.e., inflammation. If neutrophils are absent or dysfunctional in an individual, that person is more susceptible to infection. The degree of dysfunction has been correlated positively with the degree of susceptibility to infection (Smith & Hollers, 1980; Jadwin, Smith & Meadows, 1980). There is some evidence, for example, that children whose neutrophils are dysfunctional die at young ages (Anderson & Smith, 1981).

The principal function of neutrophils is phagocytosis--the eating and digesting of foreign material. In order for neutrophils to perform this function, they must be capable of motility so that they can emigrate into sites in the body where the foreign substances are located. This motility depends on the ability of these cells to crawl and to attach to places in the body nearest to the site of infection. They do this by becoming sticky (or adherent) and changing from a circular to an elongated shape. The inability of these cells to migrate has been linked with a predisposition to infection (Smith, Hollers, Dupree, Goldman & Lord, 1972; Quie & Cates, 1978).

Procedures to examine the adherence and the mechanisms of chemotactic responsiveness of neutrophils have been developed to a high level of reliability (Smith, 1979). Chemotactic factors are agents known to attract cells to sites of infection. Inflammation is thought to cause a production of chemotactic factors which produces a gradient in the body. In chemotactic migration, cells migrate or crawl toward increasing concentrations of chemotactic factors while in a concentration gradient of that factor. One theory holds that neutrophils migrate toward higher concentrations of the chemotactic factor and thus toward the site of infection (Wilkinson, 1974). Change in cellular shape and adherence are necessary for migration to occur. Thus, the following three measures of effectiveness of immune response can be postulated:

1. WBC refers to white blood cell count. The body has approximately five litres of blood. There are 6800 cells per microlitre (ml) or cubicmilimeter (mm^3) of blood, and there are approximately 6,800,000 cells

per milimeter (ml) of blood. Mls. of blood will be used for the purpose of discussion in this study.

WBC reflects the availability of white blood cells for migration. Changes in WBC in a short period of time generally reflect whether the cells are free-floating in the blood stream, or the extent to which they have attached to the blood vessel wall or have left the blood stream.

2. Adherence or adhesiveness (Ad) refers to the percent of isolated neutrophils that remain attached to a glass cover. If neutrophils are dysfunctional, their percent adherence will not increase when treated with FMP.

   FMP, an abbreviation for N-formyl-L-methionyl-L-phenylalanine, is a synthetic substance and a chemotactic factor produced by Sigma Chemical Company. FMP activates shape change and adherence in the cell. Stimulated adherence refers to the adherence of neutrophils that have been treated with FMP.

   As noted previously, the adherent capacity of the cell reflects its readiness for motility and its capacity to leave the blood vessel and migrate to the inflammatory site. Decreased adherence indicates a lower level of readiness or that the adherent cells are no longer accessible to venapuncture, i.e., the most responsive cells have already attached or left the blood stream.

3. Cellular shape change (SC) refers to the shape of neutrophils. There are five classifications of neutrophil cell shapes: round, ruffled, bipolar, uropod, and pseudopod.

   A third measure of immune responsiveness is associated with the capacity of neutrophils to change shape. A neutrophil changes from a round to a bipolar shape by becoming ruffled at the edges, sending out a pseudopod (or front projection), elongating, and eventually sending out a uropod (or tail). An average cell takes approximately two minutes to change from a round to a uropod shape. This process enables the cell to crawl and migrate through the blood vessel by forming a hole in the vessel wall and passing through.

The greater the flexibility of the cells, the more mobile they are. Mobility is associated with ability to respond,

capability of reaching the site of inflammation, and performing the phagocytic function.

Some preliminary experiments suggest that neutrophil function can be influenced in different directions by varying the conditions and context under which the samples are obtained (Schneider & Smith, 1981). In one experiment, a subject's WBC increased and neutrophil adherence remained unchanged after running for 20 minutes. The same subject's WBC dropped and adherence increased following a 20 minute self-induced relaxation/imagery experience. Other preliminary experiments have yielded similar results. Specifically, WBC tends to increase under conditions of stress and exercise (Schneider & Smith, 1981; Murphy, Shade & Vanepps, 1979). Adherence tends to decrease under conditions of stress, but can increase following a relaxation/imagery experience (Schneider & Smith, 1981). These preliminary investigations serve as a basis for this study. They suggest that neutrophil function can be influenced by factors such as stress, exercise, relaxation, and imagery. The use of these techniques have been employed in studies of peripheral and central nervous system function, but there have been no investigations of their effect on the immune system, specifically, neutrophil function (McMahon & Hastrup, 1980). Also, the Achterberg and Lawlis studies (1978) show that cancer patients who practice effective imagery three times per day may experience a shrinkage of their tumors. There have been no known controlled studies, however, investigating the influence of an imagery experience on neutrophil function or correlating effectiveness of imagery with specific neutrophil functions.

REVIEW OF THE LITERATURE

The literature relevant to the research topic spans several separate but interrelated areas. A review of the related literature in these areas is organized under the following major headings: psychosomatic disorders, personality factors, imagery and immunology.

Psychosomatic Disorders

Much of the research on psychosomatic disorders during the past 50 years has been concerned with the question of what factors predispose a person to disease(s). Alexander (1950) has provided one of the most comprehensive attempts to answer this question, although some critics discount his contribution because of his "specificity theory." Alexander suggested that specific psychological conflicts might predispose a certain type of personality to a specific type of disease, i.e., an ulcerative-colitis prone personality is placed in a situation where s/he is expected to succeed but is unable to do so. Over a period of time in this situation, this person would probably develop an ulcer.

In contrast to Alexander's "specificity theory," Engel (1967), Greene (1958), Schmale (1958), Schmale and Iker (1966) have emphasized the nonspecific nature of disease onset. They point to the importance of a generalized sense of loss and helplessness/hopelessness which causes a person to "give up." It is this "giving up" which they believe renders a person unable to effectively cope with his/her environment, and creates a biological susceptibility to illness.

Holmes and Rahe (1967) also support the idea that nonspecific life events can predispose one to disease. They found that a high frequency of life changes, i.e., moving to a different home, changing jobs, divorce, etc., correlated with an increased risk to disease. If an individual tallied a score of 300 points or higher on their Social Adjustment Rating Scale, there was an 80 percent chance that an accident or illness would occur within two years of the life changes. They also found a correlation between the severity of illness and the number of changes in the two year time period.

Selye (1974), notable for his research on stress, also supports the contention that a generalized response to stress occurs. He writes of a "generalized adaptation syndrome" which is the body's general reaction to any perceived threat (p. 26). Selye asserts that the body does not differentiate between types of stressors and responds in a similar fashion to each. Mason (1975) critiques Selye's concept of stress by distinguishing "between a view of nonspecificity as a concept applied to higher level psychological integrative mechanisms rather than to the lower level physiological or biochemical mechanisms . . ." (p. 26). Although Selye's research was based on physiological stress, the general response that he observed is thought to be caused by the response of the pituitary-adrenal cortical system to emotional stimuli, rather than physiological stimuli. According to Mason, there is a growing body of data which suggests that physical stimuli may not stimulate the pituitary-adrenal cortical system unless emotional factors are also present, and that physiological stimuli alone probably trigger complex and

multiple lower level physiological reactions. In essence, Selye's "general adaptation syndrome" is thought to be primarily due to behavioral or emotional stimuli rather than physiological stimuli, i.e., there is a generalized response to emotional stress, but not to physiological stress.

Although there is now considerable evidence that social and psychological factors play a role in the predisposition and inception of disease, there is some disagreement as to whether there are specific personality types who are predisposed to specific diseases. The bulk of current research suggests, however, that there are some correlations between stress, personality factors, and specific diseases.

A number of investigators have found correlations between personality characteristics and progression of cancer. Gay (1970) found that personality differences exist between rapidly and slowly progressing cancer patients as measured by the Minnesota Multiphasic Personality Inventory. The Simontons (1975) found that a recent loss of a significant loved one was the single largest predisposing factor for onset of cancer, and that a patient's belief system played a major role in the course of the disease. In another study (Schmale & Iker, 1966), a group of women who were being seen for regular routine Pap smears were given a battery of psychological tests. The researchers were able to predict with a high degree of accuracy which women would contract cervical cancer. The single most important predictor was a "hopelessness-prone personality."

Achterberg (1980) studied the incidence of cancer among retarded and mentally disturbed individuals. She found that only four percent of this population had died of cancer compared to 18 percent of the general population. Within the retarded subgroup, incidence of death due to cancer rose from three to ten percent as IQ rose. Within the mentally disturbed group, catatonic schizophrenics had almost no incidence of cancer while paranoids had an incidence similar to the general population. Achterberg concluded that "tuning out" stress (or shutting out the environment), characteristic of catatonics and severely retarded individuals, might account for the reduced susceptibility to cancer.

Locke (1978) found that stress caused damage to cell immunity in those who coped poorly with stress while those who coped well with stress did not appear to suffer deficits in cell-mediated immunity. His findings, which suggest that certain "susceptible" persons may have decreased immunity to disease during times of high stress, have implications for diseases such as cancer which appear to be linked to a breakdown in cell-mediated immunity.

A study by Achterberg, Lawlis, Simonton, and Simonton (1977) examined the relationships between psychological variables, blood chemistries, and course of disease. They found that: "(1) Blood chemistries tend to reflect ongoing or concurrent disease state, (2) There is a statistical relationship between psychological variables and blood chemistries, and (3) Psychological factors are predictive of <u>subsequent</u> disease state." Among the psychological factors

studied, type of imagery was found to be the most important predictor of subsequent disease state (p. 119).

Although the literature supports the contention that there are correlations between stress, personality variables, and diseases, it is difficult to determine how much of the total predisposing variance is due to stress and psychological factors. The "choice" of disease appears to be an extremely complex phenomena. Weiner (1977) aptly summarizes this point: "Multiple and interrelated predisposing factors operate at the biochemical, immunological, physiological, psychological, and social levels of organization. These factors determine what disease or diseases a person may be predisposed to, but they do not tell us when a person may fall ill or what additional mechanisms, if any, are implicated when the disease is initiated" (p. 8).

In summary, a review of the literature on psychosomatic disorders seems to indicate that certain key personality factors appear to be related to various forms of health and illness. This study will consider the effect of the following personality variables: Type A behavior, life-style habits, and locus of control. These personality variables will be briefly discussed in the next section.

Personality Factors

Type A Behavior

More Americans die of coronary heart disease (CHD) than of any other single cause (Glass, 1977). Coronary heart disease is a disorder of the coronary arteries which often destroys the heart

muscle itself. Atherosclerosis, or hardening of the arteries, is usually the cause of CHD.

Stress has been linked with CHD because stress can cause increased levels of cholesterol in the bloodstream, increased blood pressure, and release of hormones (adrenaline and noradrenaline) which speed up blood clotting and elevate blood pressure. These physiological reactions may be linked to other factors, however, and researchers have been indicated that an association exists between stress, certain behaviors, and an increased incidence of CHD.

Osler (1892) was the first to postulate a link between specific behaviors and CHD. More recently, Friedman and Rosenman (1974) have defined a personality type, referred to as Type A, who is at risk for CHD. A Type A personality is characterized by a constellation of behaviors or traits which include time urgency, impatience, ambitiousness, enhanced competitiveness, hostility, and a high need to control one's environment. A Type B behavior pattern is characterized by little sense of time urgency, noncompetitiveness, lack of aggressive drive, and a more patient and relaxed style.

Although there are no known studies correlating Type A personality traits with mental imagery, it would seem that certain traits--i.e., impatience, polyphasic thinking, time pressure--would interfere with effective mental imagery. These personality factors would appear to hinder relaxed attention and focusing which are thought to be important for forming and holding mental images.

There have been several studies which have provided empirical support for a link between Type A personality traits and CHD. One

study (Rosenman, Jenkins, Brand, Friedman, Straus & Wurm, 1975) examined 3154 males aged 39-59 over an eight-and-a-half year time period and found that Type A men had 2.37 times the incidence of cardiovascular heart disease as Type B men. In addition, Type A subjects with CHD were five times more likely to have a second heart attack as Type B individuals with CHD. Caffrey (1968, 1969) found that among 1500 monks in twenty-six monasteries, those groups having a larger number of Type A individuals also had a higher incidence of CHD.

In addition to Type A characteristics, some studies suggest that life-style factors also play a role in the incidence of CHD. Caffrey (1968, 1969) found that a Type A monastery living situation and a high-fat diet were also associated with a higher incidence of CHD.

A study by Shekelle (1979) emphasized that learning to manage stress may be a factor in preventing heart disease. Shekelle suggests that certain life-style factors, i.e., cigarette smoking, lack of exercise, obesity and poor nutrition, and alcohol abuse, contribute to cardiovascular risk.

In summary, there is some evidence that certain personality traits, e.g., Type A, predispose individuals to CHD. Jenkins, Zyzanski, and Rosenman (1976) found that a test measuring these traits (the Jenkins Activity Survey) was a better predictor of CHD than other variables such as serum cholesterol and number of cigarettes smoked daily. Other studies suggest, however, that certain life-style factors may also contribute to the incidence of

CHD and other illnesses. Some of these life-style factors will be considered next.

Life-style Habits

Individual diffences in susceptibility to illness have been related to the absence or presence of certain life-style behaviors (Pelletier, 1977; Benson, 1975; Ardell, 1979; Shealy, 1977). Some of the behaviors thought to be associated with health are aerobic exercise (Cooper, 1970), relaxation (Benson, 1975), nutrition, and environmental sensitivity (Ardell, 1979).

Travis (1977) has developed a questionnaire, the Wellness Inventory, which measures a large number of these life-style behaviors. The Wellness Inventory consists of 100 questions which are divided into the following ten categories: productivity, care and safety, nutrition, environment, physical, emotions, community, creativity, auto, and parenting. Subscores are computed for each category and then summed for an overall wellness score. Generally, the findings suggest that the more responsibility an individual is willing to take for his/her own health, the greater is the likelihood of good health (Pelletier, 1977; Ardell, 1979).

A personality trait which influences how much responsibility one takes for health-related behaviors is a belief that one has some control over one's own health. This personality trait, which Rotter (1954) defined as locus of control, will be discussed next.

Locus of Control

Locus of control is a personality construct which reflects one's belief about who controls behavior and life events. This internal-external (I-E) dimension was derived from Rotter's social learning theory (Lefcourt, 1976; Phares, 1976; Rotter, 1954; Rotter, Chance & Phares, 1972; Strickland, 1977), and represents an individual's beliefs or expectancies. Beliefs range from "internal," which is a belief that positive and negative events are a consequence of one's actions and efforts, to "external," which is a belief that events are controlled by outside forces such as chance, fate, luck, and powerful persons.

Results of research indicate that one's I-E expectancies are significantly related to health-related behaviors. Internals are more likely to collect information about diseases hazardous to their health (Wallston, Maides & Wallston, 1976; Wallston, Wallston, Kaplan & Maides, 1976). Internals are also more likely to take action to improve their health, such as to quit smoking (Coan, 1973) or to participate in an exercise program (Sonstroem & Walker, 1973). Other studies have shown that externals smoke more and have a higher incidence of coronary heart disease, hypertension and psychological maladjustment.

I-E expectancies also seem to be related to control over physiological responses. Several studies demonstrate that internals are more sensitive to internal cues and are superior to externals in changing specific physiological responses such as increased electroencephalogram alpha responding, lowered galvanic skin response, and

increased heart rate (Ray, 1974; Wagner, Boureois, Levenson & Denton, 1974; Gosling, May, Lavand, Barnes & Carreira, 1974; Johnson & Meyer, 1974).

If mental imagery is defined as a conditioned sensory response, according to a classical conditioning paradigm, it would follow that internals should be capable of experiencing more vivid mental imagery than externals. A study by Gralton, Hayes and Richardson (1979) supports this notion. In their study, "introverts reported more mental imagery and produced superior performance in verbal learning tasks than extraverts" (p. 9). In general, the bulk of research seems to indicate that internals are more likely to engage in health-related behaviors, and that a shift toward an internal orientation could lead to the development of healthier life-style practices (Strickland, 1978).

The Placebo Effect

Related to locus of control is the placebo effect which is also based on what an individual believes. A placebo is "any therapy or component of therapy that is deliberately used for its nonspecific psychological or psychophysiological effect but is without specific activity for the condition being treated" (Shapiro & Morris, 1978, p. 371).

The power of patients' expectancies has been demonstrated experimentally in numerous studies. In one study (Vogyesi, 1954), patients with bleeding peptic ulcers were given water injections. One group was told the injections would cure them. A second group

was told the injections were experimental and might help them. Seventy percent of the first group improved significantly while only 25 percent of the second group showed an improvement. In another study (Beecher, 1961), placebos were thought to produce abnormal numbers of a type of white blood cell in the immune system and to reduce the amount of fat and protein in the blood.

The fact that placebo-induced cures often involve real physical changes has generated speculation about how such physical changes occur. One theory asserts that there are naturally occurring substances in the brain, called endorphins, which are similar to morphine. The placebo effect may allow the brain to secrete endorphins which maximizes the body's ability to respond to a variety of healing techniques (Jaffe, 1980).

Other research suggests that the placebo effect operates in a manner similar to hypnosis. For example, placebo is Latin for "I shall please," and the placebo effect may be partially due to an individual's desire to please another person. Rosenthal (1968) studied the effect of suggestibility and found that subjects had a strong tendency to conform to the expectations of the experimentor (the Pygmalion effect). Another study, however, compared placebo-induced responses to responses to hypnotic suggestion and found that hypnotic analgesia alleviated pain more than placebo pills (McGlashan, Evan & Orne, 1969).

According to Achterberg and Lawlis (1980), imagery is the basis for the placebo effect. Placebos are thought to be effective because they are "products of the imagination." "It is enhanced by

all those factors that contribute to the peculiar contents of the imagination. The hopes and fears, expectancies, the previous learning experiences, an archetypal and current belief systems--all form the basis for the quality and degree of the response" (p. 37).

In most scientific research, placebo effects are considered a confounding variable, and are controlled for by the use of designs where neither the researcher nor the patient knows who received the placebo. The present study is primarily interested in the fact that placebo effects do exist and should be taken into consideration when planning a study and interpreting results. The link between imagery, healing, and the placebo effect will be discussed more fully in the next section.

Imagery

From 1880 to 1910, attempts were made to identify pure imagery types (White, Sheehan & Ashton, 1977). During this period, it became clear that individuals image in one or more distinct modalities. Betts (1909) developed a "Questionnaire upon Mental Imagery" which evaluated imagery in seven sensory modalities: visual, auditory, kinesthetic, cutaneous, gustatory, olfactory, and organic. Bandler and Grinder (1975) suggest that therapists who are very effective tend to identify and utilize their patients' most frequently employed representational systems bylistening to the predicates used to describe an experience. Effective therapists join the patient in their most typically used representational system and

then find a point of overlap between that system and a new one in order to expand and enrich experiencing.

There have also been various attempts to categorize types of images. Samuels and Samuels (1975) provide an overview of classifications which include memory images, eidetic images (sometimes referred to as photographic memory), imagination images, daydreams, fantasies, hypnagogic and hynopompic images (which occur before and after sleep), dreams, hallucinations or visions, and after-images. The relationship of these types of images to perceptual reality varies. Most imagery experiences, however, contain an element(s) of symbolism (with the exception of eidetic imagery). It has been postulated that imagery is effective in conflict resolution and problem solving because it allows one to suspend the constraints of external reality and explore unknown territory which often leads to discovery and creativity.

Other Altered States of Consciousness

Much of the research on the physiological correlates of imagery can be found under other topic areas such as: hypnosis, self-hypnosis, biofeedback, meditation, and altered states of consciousness. There is a vast body of literature which discusses the role of hypnosis (and other altered states of consciousness) in controlling pain and producing marked physiological changes (Hilgard, MacDonald, Marshall & Morgan, 1974; Craves & Barber, 1976). Imagery is usually regarded as a key variable in effecting such changes. Hypnosis, like guided imagery, provides executive and monitoring

functions which produces a readiness for a dissociative experience (Hilgard, 1979).

A survey of experimental literature on physiological correlates of hypnosis is provided by Sarbin and Slagle (1979). Their survey offers evidence that hypnosis/imagery can produce profound changes in physiological processes such as: respiratory, cardiovascular, vasomotor, genitourinary, gastrointenstinal, endocrine, metabolism, cutaneous, and central nervous system functions. Their review also indicates that the more the subject is able to enter into the hypnotic role, the more extensive are the physiological changes.

Applications of Imagery

Psychotherapy. Imagery has been used for a number of different purposes. Psychotherapists use imagery to help patients obtain access to repressed, unconscious experiences, to clarify perceptions of conscious experiences, and to create different realities or perceptions of themselves and their environment. Gendlin (1978) has developed a technique which he calls "focusing," to help clients work through conflicts by using relaxation and imagery to produce a "body shift" which is a physical sensation, release, and step toward change. Gendlin coined the term "felt sense" to describe the body's wisdom, which he believes to be the most important ingredient in change. A number of other psychotherapists have developed techniques based on the theory that imagery opens channels from the unconscious to the conscious mind which are necessary to the healing process (Hilgard, 1977; Jaffe, 1980; Bry, 1979; Samuels & Samuels, 1975; Simonton, Simonton & Creighton, 1978).

Leuner (1969) developed a method called Guided Affective Imagery (G.A.I.) which begins with relaxation exercises similar to Jacobson's progressive relaxation (1938) or Schutz's Autogenic Training Method (1959) and proceeds to imagery. The patient enters an altered state of consciousness similar to a meditative state. Leuner also encourages the use of music with G.A.I.

Music. The first accounts of the healing power of music surfaced during the Renaissance era when music was found to influence physiological functions such as breathing, blood pressure, muscular activity, and digestion. Music has been used in combination with imagery at Royal Victoria Hospital's palliative care program, begun in September of 1977. A pilot study (1978) found music to be useful for decreasing anxiety and for helping patients cope with intractable pain. Music is used to promote muscular relaxation and to break the pain cycle by relieving anxiety and depression and altering patients' perception of pain.

Bonny (1980) combined music with guided imagery to facilitate the action of drugs in LSD psychotherapy. According to Yingling's theory (1962), music affects people in four ways: emotional, sensual, associational, and intellectual. "The therapist must be able to determine the psychological state of the subject and then choose a musical selection to implement the treatment aims" (Bonny, 1980, p. 14). Bonny's research found that "high-expectation" groups preferred unstructured listening where a guide gives a simple relaxation exercise followed by only one suggestion, i.e., "let the music

take you where you need to go." A more structured approach appears to be more effective for persons with a short attention span or high anxiety.

Bonny's research also suggests that the presence of another person or guide is helpful. The guide becomes the contact with reality, allowing the subject to expend less energy on reality and to experience more deeply than would be possible if the subject is alone. Studies of hypnosis effects have also supported the importance of a guide who serves as a replacement for aspects of the subject's reality orientation (Hilgard, 1979).

Imagery and medicine. The use of imagery most relevant to this study is medicine's use of imagery in healing. Philosophers, physicians, and priests of many cultures have recognized the importance of images (Samuels & Samuels, 1975). Ancient healing practices in Egypt and Greece employed the use of imagery. Patients were encouraged to sleep and find relief through dreaming and visualizations, a practice referred to as incubation sleep. Aristotle felt that images were causal factors in producing disease or health. The idea of visualizing perfect health is carried on by certain primitive cultures and vitalistic groups today. The Canadian Eskimo and Navaho Indians use imagery to contact tribal spirits as part of their healing rituals. Mary Baker Eddy, founder of the Christian Science Church, tells her followers to mentally envision harmony and health as a way to overcome disease (1934).

A holistic medical philosophy was replaced, during the Cartesian period, by a mechanistic concept of dualism. The body and the mind were treated separately, and the practice of medicine grew increasingly specialized. Psychosomatic disorders were dissociated from physical processes and viewed as purely psychological. Conversion reactions were referred to as "physical hysteria" and patients were often seen as "malingerers" (McMahon & Hastrup, 1980).

Although a mind/body dualism has persisted in current medical practice, some physicians and clinicians have continued to be interested in the role of imagery in the process of healing. Hartley (1966) was the first post-Cartesian to redirect thinking to the role of imagination in physical disorders. He also advanced the notion of "parallelism" which included both psychological and physiological processes, and which has influenced medicine's approach to psychosomatic disorders during the past half-century (McMahon & Hastrup, 1980).

A more contemporary concept goes beyond parallelism and includes a third phase of existence referred to as a "biotonic phase" of existence (Weiner, 1976). The biotonic phase is believed to be a deeper structure which underlies both mental and physical events. Within this structure, imagery is viewed as a part of the total system. This concept has been supported by a large body of psychophysiological research correlating imagery to central and peripheral nervous system events. For example, research correlating imagery to central nervous system events indicates that imagery and perception evoke the same neurophysiological processes (Perky, 1910; Leuba,

1940; Hebb, 1968; Jacobson, 1931; Penfield, 1954; Davidson & Schwartz, 1977). There is also a considerable body of research demonstrating the effects of imagery on the peripheral nervous system--i.e., changes in muscle tension, salivation, electrodermal activity, and cardiovascular events (McGuigan, 1973; Schwartz, Fair, Salt, Mandel & Klerman, 1976; White, 1978; Yaremko & Butler, 1975; Drummon, White & Ashton, 1978; Furedy & Klajner, 1978). In fact, there is some evidence that an image may have a greater physiological effect than a visual or auditory stimulus (Primakoff & Goldberger, 1976; Waters & McDonald, 1973).

Current uses of imagery in modern medicine. Imagery has been used for healing in two ways: (1) in a general way as in the relaxation response, and (2) in a specific way such as increasing blood flow to one area of the body. Schwartz (1973) reviews examples of how imagery has been used to increase self-control of bodily processes, and suggests that imagery may be a more effective means of self-control than biofeedback. Controlled research data is lacking, however, on this issue (Schwartz, 1973).

One of the most thoroughly researched and widely used of all the visualization techniques which utilizes both general and specific effects is autogenic training. This system was developed in the 1930s by Schultz, a German psychiatrist and neurologist. Autogenic therapy uses a series of six standard, 60-second visualization exercises directed at different parts of the body. Luthe (1969) cites 2400 studies on this approach which have found profound effects

on body physiology. Autogenic training is used in Europe as an adjunct to standard medical procedures to assist with a variety of disorders.

Samuels (1973) recommends the use of imagery in private practice. He distinguishes between two types of imagery: receptive and programmed. Receptive imagery is a "tuning into oneself" process and is used for diagnostic purposes. Programmed visualization involves creating images for the purpose of healing. Samuels uses pictures from medical books, laboratory slides, etc., as sources for images. Swearingen (1978), an orthopedic surgeon, shows pictures of a four-stage healing process to his patients. He believes that patients can understand their injury, and can use imagery to influence the healing process.

Heidt (1978) has developed an "image disease/discomfort" approach which uses imagery in combination with therapeutic touch. In this approach, imagery is thought to serve three functions: (1) to form a close relationship with patients in a short period of time; (2) to facilitate the expression of patients' feelings; and (3) to indicate patients' beliefs about their part in the healing process. Patients listen to a tape in which they are instructed to relax and take an imaginary journey through their body. They are then asked to draw pictures of their disease, their treatment, and how they are overcoming their disease.

A new area of nursing, referred to as "sensory information," tells how to take patients on a fantasy trip which teaches them what their upcoming hospital experience will feel like (Johnson, Rice,

Fuller & Endress, 1978). This new type of patient education goes one step beyond merely describing what is wrong and what procedure(s) will be used. It is based on the belief that recovery is aided by delimiting patients' feelings of helplessness and loss of control by teaching relaxation techniques and setting realistic expectations about the duration of pain. Controlled experiments, using patients undergoing various painful procedures, showed that the "sensory information" group responded better to treatment and required fewer postoperative days in the hospital. The group who received relaxation in addition to sensory information consistently responded better than the other groups. These results suggest that relaxation may also be an important factor in physiological change.

Esdaile (1957), a physician who practiced in India 100 years ago, advanced the idea of hypnoanesthesia in surgery. He observed that his patients manifested little or no shock and healed more rapidly than patients who had been given chemoanesthesics. As a result of his work, Esdaile concluded that hypnoanesthesia raised the pain threshold, it raised patients' ability to withstand shock, and when used in conjunction with chemoanesthesia, it produced neuromuscular relaxation. The discovery of anaesthetics such as nitrous oxide, chloroform, and ether, caused hypnoanesthesia to be discarded. In addition, most physicians do not receive training in hypnosis, and unfortunately for many, hypnosis became associated with entertainment and the performance of theatrical feats (Achterberg & Lawlis, 1980).

The use of imagery to relieve pain has received renewed interest, however (Melzack & Casey, 1968). The three primary physical techniques for relieving pain have been: (1) pharmacological agents which act on the nervous system, (2) anesthetic nerve blocks performed by injection into nerve roots, and (3) surgery at sites along pathways from peripheral receptors to the cortex. According to Melzack and Casey (1968) in a review of pain treatment techniques, none of these methods are totally satisfactory. They state that "the surgical and pharmacological attacks on pain might well profit by redirecting thinking toward the neglected and almost forgotten contribution of motivational and cognitive processes. Pain can be treated by not only trying to cut down sensory input by anesthetic blocks, surgical intervention and the like, but also by influencing the motivation-affective and cognitive factors as well" (p. 435).

Meichenbaum and Turk (1976) likewise recommend that cognitive-motivational factors be considered in the treatment of pain. These factors probably account for the efficacy of placebos and hypnotic analgesia. Turk applied their "stress-inoculation training" procedure to an ischemic (experimentally-induced) pain situation. Imagery was one of three strategies taught to subjects to help them reduce pain. Subjects in the training group reported improved pain tolerance for 15 minutes compared to minimal change in pain tolerance for the control group. Others have also successfully used guided imagery as a treatment for chronic pain (Fuller, 1980; Lane, 1981).

Most important to this study is the work of Simonton and Simonton (1978). Their strong conviction that imagery plays a major role in the causation and course of cancer has led them to develop a comprehensive treatment program for cancer patients with imagery as its cornerstone. At the Cancer and Counseling Research Center in Fort Worth, Texas, the Simontons work with cancer patients who have advanced malignancies. Their six-week program is based on a holisitic approach to recovery. Since they believe that everyone participates in his/her health or sickness, the first step in the program is for patients to identify how they participated in their disease process. Patients are asked to list and discuss the major stresses that have occurred in their lives six to 18 months prior to the onset of their disease. Next, patients are helped to identify some of the "benefits" of their illness. For some, illness may be a way to be taken care of, or to slow down, or to express certain feelings. Alternative ways of meeting these needs are explored. Patients are encouraged to set three month, six month, and one year goals, and these goals are discussed in terms of expectancy, realism, and enjoyment. The Simontons have observed that those who seem to recover dramatically from their illness are physically active, therefore each patient develops a regular exercise program. A healthy diet plan is also instituted. The family atmosphere is seen as crucial to the patient's progress, and family members are helped to understand their feelings about the disease. Counseling is provided so that communication can be more direct, open, and ultimately caring.

In addition to these interventions, patients are taught to relax and visualize recovery. Through relaxation, patients learn how to reduce tension and stress and prepare for the imagery process. The imagery experience helps patients in several ways: to create a positive expectancy, to identify important beliefs that might be hindering recovery, to release hostilities from the past, to communicate with an "inner guide to health," to manage pain, and to aid in self-discovery in other areas of their lives. Patients are educated about how their immune system functions. They see x-rays of their disease state as well as pictures of tumors healing, and these pictures provide a basis for their visualizations. Patients are taught to relax and to visualize their cancer cells. They are asked to visualize their chemotherapy or radiation treatment destroying these cells. Then they are asked to visualize their white blood cells mobilizing to obliterate and carry away the dead cancer cells. Patients are encouraged to practice these visualization exercises three times a day and to draw pictures of their images.

The Simontons noted that some terminal cancer patients have improved against overwhelming odds, and a .78 correlation has been reported between effective imagery and change in symptoms (Achterberg & Lawlis, 1978). They found that 93 percent of those patients scoring one standard deviation above the mean on effective imagery showed no additional tumor growth two months later. Forty-three percent of this group showed no evidence of the disease at all. By contrast, 100 percent of those patients who scored at least one

standard deviation below the mean showed new cancer or had died in the intervening two months.

TABLE 1.--Imagery and Cancer Status.

Imagery Rating	Cancer Status (two months later)
Score of 198 or more	93% showed regression of tumor
($\bar{x}$ = 169, S.D. = 34)	43% showed no evidence of disease
Score of 150 or less	100% showed new cancer growth or had died

Physiological Correlates of Related Techniques

There are numerous religious and secular techniques which have elicited profound physiological changes. Perhaps the best known technique today is the "relaxation response" developed by Benson (1975). Subjects concentrate on a constant stimulus (an object, sound, or phrase) which is repeated again and again. They are told to disregard distracting thoughts and not to worry about how they are doing. Benson found that after 12 minutes of relaxation, oxygen consumption decreased by 13 percent, carbon dioxide production decreased by 12 percent, and respirations decreased from 16 to 11 breaths per minute. Other general effects of relaxation on the body were: decreased blood lactate, lowered blood pressure, slightly increased forearm blood flow, decreased heart rate, and intensification of alpha brain waves.

In the late 1960s, Miller and Dicara (1969) found that rats could alter certain physiological responses--i.e., blood pressure, blood flow, and stomach acidity--in response to reinforcement. They were able to regulate blood flow to specific areas of their bodies. This control has been applied to human beings and labeled biofeedback. Biofeedback research has often included the study of yogis (Boyd, 1976). Green (1972) studied Swami Rama who was able to cause two areas on the palm of his hand to change temperature 10°F in opposite directions. Swami Rama also raised his heartbeat from 70 beats per minute to 300 beats per minute. When asked how such control is achieved, subjects usually report detailed visualizations.

It appears, therefore, that imagery can produce profound physiological changes. Two remaining questions are: (1) what type of imagery is most effective? and (2) how can imagery be measured?

What Type of Imagery is Most Effective?

Lang's (1979) "bio-informational theory of emotional imagery" provides some answers for the first question. According to Lang, imagery is a "conceptual network, controlling specific somatovisceral patterns, and constituting a prototype for overt behavioral expression" (p. 495). Lang (1980) has found that certain types of imagery evoke certain types of physiological responses, and subjects who image more vividly and more actively have greater physiological activity.

Of course, individuals vary in their capacity to image. Hebb (1968) found large individual differences in the ability to

develop vivid visual imagery, and Wolpe (1969) indicated that about 10% of his American and South American clients were unable to obtain sufficiently vivid images for successful desensitization. Psychosomatic patients are often characterized by alexithmyia, an inability to describe feelings, which may include an absence of fantasies regarding feelings, needs, and drives. However, many people can be taught to image more effectively by simply imaginging more active scenes (Lang, 1980). According to Lang, it is possible to evaluate imagery content, and "to analyze the image for perceptual, semantic, and affective response structure, and to explore the impact of training procedures which modify in predictable ways the emotional cognition of normal subjects" (1979, p. 508). Lang's analyses have led him to emphasize active responding in the image script, i.e., to have subjects imagine themselves as personally engaged in the activity "as if" it were really happening. Rather than merely describing a scene, imagery instructions would include active suggestions such as: I ran away from . . . , etc.

How Can Imagery Be Measured?

White, Sheehan, and Ashton (1977) provide a survey of the major imagery self-report measures. They discuss the reliability and validity of the various instruments and the extent to which they measure the same process. Some instruments measure vividness and/or clarity of images while others measure preferred modality and control of imagery. The Betts QMI (Sheehan, 1967), a shortened version of the Betts Questionnaire upon Mental Imagery (1909), is the most widely used measure of imagery vividness.

Ron Pekala (1980), who developed a questionnaire (the Phenomenology of Consciousness Questionnaire) for the purpose of determining the reliability of altered states of consciousness, found internal consistency coefficients of .74. Subjects who were found to be reliabile within a specific state varied when retested, therefore no test-retest reliability was found when measuring states. (Apparently states are not as stable as traits.)

White, Sheehan, and Ashton (1977) report sex and age differences in imagery ability. Females appear to have more visualizing ability than males, and this ability increases with age for both sexes. There are no definitive explanations for these findings, however, it is hypothesized that increased practice with age improves imagery ability.

Few researchers have examined physiological correlates of imagery scores. Two studies found that regular breathing is associated with visual imagery (Chowdhury & Vernon, 1964; Richardson, 1977). The belief that imagery is accompanied by an increase in alpha brain waves has not been supported by E.E.G. studies (Paivio, 1973). However, Achterberg and Lawlis (1978) confirm Brown's idea (1974) that alpha suppression occurs for inexperienced imagers, but sustained alpha occurs for experienced imagers.

Achterberg and Lawlis (1978) have developed an instrument to assess imagery, the IMAGE-CA. The IMAGE-CA was developed to communicate with cancer patients about their disease. The authors managed to formalize imagery drawings and interview sessions in order to make objective scoring procedures possible. (Pekala also found that

states of consciousness could be operationalized according to dimensions.) The relationship between the IMAGE-CA dimensions and disease status were verified in two follow-up validation studies. In the first study, a correlation of .78 (n = 58) was found between ratings of effectiveness of visual imagery and progress change in cancer status as stated earlier. The clinical judgment dimension (highest weight) was the strongest predictor. A second validation study, using a sample of 21 cancer patients of a lower socioeconomic level, substantiated the results of the first study. In the second study, clinical judgment had only a moderate positive loading instead of a high one.

Thus, it appears that imagery dimensions can be operationalized and measured. The success of the IMAGE-CA in predicting future disease status makes this instrument of particular interest in terms of assessing other health conditions. Using this instrument, patients were able to define their health status with more accuracy than by measures of their blood chemistries (Achterberg, Lawlis, Simonton & Simonton, 1977).

In summary, imagery has been used for healing purposes for many centuries (Achterberg & Lawlis, 1980). More recently, the Simontons (1978) have taught cancer patients to imagine that their white blood cells are attacking and killing off their cancer cells. Achterberg and Lawlis (1978) report correlations between effective imagery, as measured by th IMAGE-CA, and remission of tumor growth for these patients.

The present study supports Schwartz's idea (1973) that effective imagers should be able to exercise control over physiological functions. It attempts to provide data on one specific physiological process--white blood cell function.

Immunology

The immunologic system has been divided into two broad components: humoral or antibody-mediated reactions and cell-mediated immunity. This study is interested in cellular immunology, specifically neutrophils, a type of white blood cell. There are five types of leukocytes or white blood cells: lymphocytes, monocytes, and three granulocytes--basophils, eosinophils, and neutrophils. Neutrophils comprise 50 to 70 percent of all leukocytes. The morphological characteristics of neutrophils are as follows: they contain neutral-staining granules within which are enzymes that break down bacteria; they have a polysegmented nucleus; and they are eight to ten microns in diameter.

From a physiological viewpoint, neutrophils are produced in the bone marrow. They circulate in the blood for approximately eight to ten hours, and then leave the blood stream and go into the body tissues where they live for a few more hours. Their principal function is phagocytosis--the eating and digesting of foreign material, especially bacteria and tissue debris that cause infections. Neutrophils have specialized structures in their cytoplasm that contain enzymes which digest the foreign material. They have the ability to sense bacteria and migrate to where they are needed.

They accumulate in large numbers at sites of infection, i.e., pus is made up mostly of neutrophils. In essence, neutrophils are a mobile cell in that they crawl to sites of infection where they perform their phagocytic function. They are capable, then, of directional locomotion, or chemotaxis, and of phagocytosis (Wilkinson, 1974).

In order for neutrophils to perform their phagocytic function, they must be capable of moving from the blood stream into the inflammatory site. When these cells do not migrate, repeated infections may occur (Smith, Hollers, Dupree, Goldman & Lord, 1972; Smith, Dupree & Goldman, 1972; Anderson & Smith, 1981). For example, children whose neutrophils do not migrate to sites of infection often die at young ages (Smith, Hollers, Dupree, Goldman & Lord, 1972). In the process of responding to an infection, three events typically occur: white blood cell count increases, neutrophils become adherent or sticky, and neutrophils change from a round to an elongated shape. They are then ready to squeeze through the blood vessel wall and crawl to the site of the infection.

Procedures to examine these three neutrophil functions have been developed (Smith, Hollers, Patrick & Hassett, 1979). Studies on the mechanisms of the chemotactic responsiveness of neutrophils suggest that their function can be influenced by stress, exercise, and relaxation/imagery. For example, on three separate occasions, three routine blood donors had marked decreases in the adhesiveness of their neutrophils following episodes of emotional stress (Smith, 1979). Specifically, their white blood cell count increased and adherence decreased from a mean of 45 percent to 15 percent.

In another experiment, a subject used two separate conditions to measure pre to post changes in white blood cell function (Schneider & Smith, 1979). In Condition I, the subject had blood samples taken immediately before and after running for 10 minutes (a normal activity for the subject). In Condition II, blood samples were taken before and after a 20 minute self-induced relaxation/imagery session. The imagery focused on increasing the adherence and responsiveness of neutrophils. A third sample was taken 24 hours later.

Results of this n = 1 study are shown in Table 2. Dramatic differences may be seen in white blood cell count (WBC), adherence, and stimulated adherence which are related to the conditions defined. (Adherence refers to the proportion of neutrophils remaining attached to a serum-coated surface; stimulated adherence refers to the adherence of neutrophils that are treated with the chemotactic factor, fMP.) After jogging, the subject's white blood cell count increased from 5,400 to 6,900 cells, and adherence remained unchanged. After the relaxation/imagery session, white blood cell count dropped from 5,800 to 4,300 cells (the decrease in white blood cell count was due primarily to a decrease in the number of neutrophils), and adherence increased from 63 percent to 91 percent adherence. Stimulated adherence increased from 89 percent to 100 percent. Twenty-four hours later, adherence was still elevated to 85 percent and stimulated adherence was still at 100 percent.

Other preliminary experiments have yielded results which correspond to those found in the n = 1 study (Schneider & Smith,

TABLE 2.--Neutrophil Function Changes for One Subject.

Condition	WBC	Adherence	Stimulated Adherence
I: Jogging			
Pre	5400	61%	81%
Post	6900	63%	86%
II: Relaxation/Imagery			
Pre	5800	63%	89%
Post	4300	91%	100%
24 Hour Post	4800	85%	100%

1981). After jogging for 20 minutes, five experienced joggers' white blood cell count increased and adherence remained unchanged (42% to 43%). Following a relaxation/imagery experience, three subjects' white blood cell count showed no change, while adherence increased to a mean of 81 percent. Thus, using pre and post blood samples (20 minutes apart), changes were noted in subjects' white blood cell count, adherence, and stimulated adherence which appeared to correspond to reported images which occurred during the 20 minute session.

In summary, neutrophils were chosen for the present study for three reasons. First, observations have indicated that neutrophils, like other white blood cells, are sensitive to stress factors (Smith, 1979). Second, neutrophils play a critical role in the immune system's responses to bacterial infections and inflammation

(Wilkinson, 1974). Finally, procedures have been developed to reliably determine the behavior of these cells while in the blood stream in ways which can be related to immune system function (Smith, Hollers, Patrick & Hassett, 1979).

HYPOTHESES

In view of the review of the literature, two primary questions were investigated: (1) Will a 20 minute relaxation/imagery experience affect the white blood cell count, adherence, and shape change functions of blood neutrophils? and (2) Will imagery ratings correspond with changes in white blood cell count, adherence, and shape change of neutrophils?

In addition to testing the primary questions of interest, the study will correlate three personality variables, thought to be associated with "health," with changes in the white blood cells. The three personality variables are Type A personality, locus of control, and wellness behaviors.

To investigate these questions, the following primary hypotheses were stated:

1. The total white blood cell count will drop following a 20 minute relaxation/imagery experience.
2. The neutrophils will become more adhesive after a 20 minute relaxation/imagery experience.
3. The neutrophils will change from a circular to a more elongated shape after a 20 minute relaxation/imagery experience.
4. Higher imagery ratings will correspond with greater neutrophil change scores.

To investigate the exploratory questions, the following exploratory hypotheses were tested:

1. Lower Type A scores will correspond with greater neutrophil change scores.
2. Higher Internal Locus of Control scores will correspond with greater neutrophil change scores.
3. Higher Wellness scores will correspond with greater change scores.

SUMMARY

The two primary purposes of the study were to determine the effect of a relaxation/imagery experience on blood neutrophil function, and determine whether imagery ratings would correspond with changes in neutrophil function. A secondary purpose of the study was to see whether specific personality factors would correlate with the blood changes.

The independent variable was a 20 minute relaxation/imagery experience. The dependent variables were the neutrophil function measures and the psychological measures. It was expected that neutrophil functions would change following the 20 minute relaxation/imagery session, and that imagery ratings and personality variables would correspond with blood changes.

CHAPTER II

RESEARCH DESIGN AND PROCEDURES

This chapter is divided into the following sections: the pilot study, the subjects, procedures, measures (neutrophil function measures, psychological measures, and imagery ratings), and the design and statistical analysis.

PILOT STUDY

The present study is based on a pilot study conducted by the investigator at Michigan State University from June to August, 1980. The pilot study involved 22 subjects, which included nine students at Michigan State University, 12 persons from the Lansing community, and one professor at Michigan State University. The sample was comprised of 15 males and seven females, ranging in age from 19 to 48, with a mean age of 31 years. All subjects volunteered to participate in the study in response to a notice posted at the Lansing YMCA and/or direct verbal requests.

Each subject filled out three personality inventories (which will be described in detail later), a consent form, and a demographic data form immediately prior to their participation in an experimental condition. Subjects were randomly assigned to one of four conditions: specific imagery, general imagery, relaxation/biofeedback, and a control condition. For the specific imagery condition, subjects

listened to a 20 minute tape which included instructions to relax and imagine their white blood cells changing shape, getting sticky, and leaving the blood stream. A background sound of a heartbeat ("Ultimate Heartbeat," Environment Records) accompanied the guided imagery instructions. For the general imagery condition, subjects listened to a 20 minute tape instructing them to relax and imagine a pleasant scene on the beach. Sounds of waves rolling in onto the seashore were dubbed in on this tape ("The Psychologically Ultimate Seashore," Environment Records). For the biofeedback condition, the subjects were familiarized with biofeedback techniques by D. R. Vorro (Associate Professor of Anatomy at Michigan State University), and all questions were answered to ensure that they understood the experimental procedure. Levels of relaxation were monitored using standard biofeedback techniques. Specifically, subjects were seated in an isolated room (516 East Fee Hall) and were allowed to view the electrical activity on a CRT (cathode ray tube) and simultaneously listen to the electrical activity from headphones for 20 minutes. Dr. Vorro monitored electrical activity via surface electrodes placed on the subjects' foreheads. The signals were processed by a polygraph enabling Dr. Vorro to evaluate the level of relaxation. For the control condition, subjects read for 20 minutes from one of several books selected for their non-arousing content.

For each of the four conditions, blood samples were taken via venapuncture immediately before and after the 20 minute experimental procedures. No explanation or training about the study was provided. Subjects came for one pre-post session only. No

significant differences were found pre to post in any of the groups. Some subjects showed marked changes in total white blood cell count (WBC) and adherence, but in varying directions. For example, in the specific imagery condition, one subject's WBC dropped 3,000 cells (per milimeter of blood) while another subject's WBC increased 10,000 cells. Several reasons for these findings were postulated, and the present study is an outgrowth of changes that were made based on observations from the pilot study.

To compensate for hypothesized sources of error in the pilot study, the following six changes were made for the present study:

First, experiences known to affect neutrophil function (Riley, 1981) were controlled for, i.e., exercise, caffeine and other drugs, infections, and stress. In the present study, all subjects were screened for any health or emotional irregularities which might affect their blood results. They were informed as to the function of neutrophils, and asked to delay their participation if anything might be currently altering their neutrophil function.

Second, in the pilot study, subjects were randomly assigned to one of four groups. In the present study, subjects were assigned to one condition (specific imagery) which allowed for the use of a smaller sample size. All subjects, then, were able to be tested during one season of the year. The Fall season was chosen to control for seasonal fluctuations in neutrophil function. Blood samples were also taken at the same time of the day for all subjects. Control data was obtained by drawing blood from the subjects twice (with a

20 minute interval) before the experiment began. Any persons who were found to have "abnormal" neutrophil function were excluded from the study.

Third, the pilot study consisted of one session only and did not include a training/practice component. The present study followed, as closely as possible, the steps outlined by Meichenbaum and Turk (1976) in their cognitive/behavioral treatment program for pain control which includes educational, rehearsal, and application phases. Subjects were provided with information about the procedure by the investigator and the functions of the involved bodily mechanisms by Dr. Wayne Smith (Professor of Anatomy at Michigan State University). Opportunities were provided for practicing the relaxation/imagery procedure, and options were given to the subjects as to the kinds of imagery they might choose to use by encouraging them to be playful and creative with their images--i.e., allowing subjects to experiment with any images that came into their minds.

Fourth, in the pilot study, subjects listened to a tape recording for the general and specific imagery conditions. In the present study, the specific imagery instructions were read aloud by the investigator. This change was based on observations made during hypnosis and other altered states of consciousness (Hilgard, 1979; Bonny, 1980) which suggest that the presence of a guide allows subjects to suspend reality functions and enter into a deeper trance state. In addition, the background heartbeat sound used during the specific imagery condition in the pilot study was replaced by sounds of ocean waves pounding on a seashore. Several pilot subjects had

commented that the heartbeats interfered somewhat with their ability to relax, and since a background sound to reduce distractions seemed desirable, a more neutral sound was chosen.

Fifth, pilot subjects were instructed to fill out three personality measures, a demographic data sheet, and permission to participate in the study form. This was done in an office in the Department of Psychiatry at Michigan State University immediately prior to the experimental condition. Since many subjects were from the community and not familiar with the Department or psychological testing, the experience may have been stressful and interfered with relaxation. In the present study, subjects were oriented to the experimental room and procedures in advance.

Finally, in the present study, the placebo effect was not controlled for, but was incorporated into the design of the investigation. Subjects were given information about how others had been able to affect neutrophil function via imagery, and they were encouraged to believe that they might cause changes in their neutrophils.

SUBJECTS

Data was collected on eight male and eight female subjects for a total sample size of 16. Thirteen of the subjects were Michigan State University students--nine were first year medical students, two were counseling psychology students, one was a clinical psychology student, and one was an undergraduate student. A college teacher at Lansing Community College, a geologist, and a marketing manager

with a local paper company comprised the remaining three subjects. The subjects' ages ranged from 21 to 38 with a mean age of 29.4. All subjects were screened over the phone by the investigator who asked them if they had any health or diet irregularities which might affect their blood results, and all were classified as healthy. For example, participation was delayed for any person who had an infection within the past week, had active allergies, or had used certain drugs within three days of a blood sample--i.e., aspirin, alcohol, marijuana, or other mind-altering substances.

Subjects were informed of the intent of the study in advance. Any persons who did not believe in the possibility that they might be able to influence their blood cells were excluded from the study. The total sample, then, was not representative of the general population in that they were believed to be highly motivated, in college or college educated, healthy, and already had a belief in their ability to influence their white blood cells.

PROCEDURES

This investigation took place over an eight-week time period, and each subject attended six sessions. The study was designed to control for daily and seasonal fluctuations in white blood cell function by having blood samples drawn at the same time of the day for all subjects, and having the same amount of time elapse between pre and post blood samples, i.e., seven weeks. This necessitated dividing the 16 subjects into two groups of eight each, labeled Phase 1 and Phase 2, respectively. Phase 1 subjects attended sessions

from October 16, 1980 to November 25, 1980, and Phase 2 subjects participated from October 27, 1980 to December 15, 1980.

During the first session, each subject had blood drawn using a standard venapuncture procedure, signed a consent form explaining the nature and purpose of the study, filled out a demographic data form and three personality inventories, and had blood drawn again 20 minuts after the first sample was taken. (See Appendix A for forms and personality measures.) The investigator conducted all of the sessions except for session two, and Dr. Wayne Smith drew all of the blood samples.

The second visit was a group session conducted by Dr. Smith during which white blood cell function was explained and slides of neutrophils were shown which could later be used as a basis for imagery representations. (See Appendix B for pictures of the slides.)

During the third session, subjects listened to a relaxation/ general imagery tape. (A transcript of the tape is given in Appendix C.) The purpose of this session was to acquaint subjects with the relaxation/imagery process, and to familiarize them with the private office and surroundings in which they would do the final specific imagery experience. Dr. John Schneider, Associate Professor of Psychiatry at Michigan State University, donated his private office which is located in the Department of Psychiatry in East Fee Hall. Because the office afforded privacy and comfort, i.e., subjects were seated in a reclining leather chair, it was well-suited for the imagery experience. In addition to providing practice, this session

also served to attempt to desensitize anyone who might feel anxious relaxing in a psychologist's private office.

The fourth and fifth sessions were group training sessions. Training consisted of the following: explaining the rationale and purpose of the study, describing results of the Simontons' work (1978), explaining the relaxation/imagery procedure and giving suggestions for effective imagery, practicing the imagery procedure as a group, asking subjects to draw pictures of their imagery and rate the pictures according to specified criteria, and answering any questions that arose. Subjects were provided with blank paper and were asked to draw a picture(s) of what their white blood cells had looked like during their imagery experience. They then were asked to evaluate their images, using their pictures, according to seven variables which are described in the subsection entitled "Imagery Ratings." A typical question would be, "How vivid were your white blood cells?" They were also told that these seven variables were thought to be related to changes in white blood cell function, i.e., the more vivid your images are, the more change will occur in your white blood cell function.

The specific imagery procedure was adapted from the imagery instructions given to cancer patients in the Simonton's treatment program (1978). The adapted imagery procedure was designed to help subjects relax and visualize their white blood cells. They were then asked to imagine their white blood cells changing shape, sticking to the vessel wall, passing through the vessel wall, and going to places in the body where "garbage" had collected. The white blood

cells were to be seen as "garbage collectors," picking up "garbage" and dumping it outside the body. The entire procedure lasted approximately 20 minutes. Subjects were encouraged to experiment and be playful with their images and adapt the procedure in any way that made sense for them. Articles clarifying both imagery studies and leukocyte function were distributed, and they were encouraged to read the articles and to practice the technique at home. (See Appendix C for the imagery instructions and Appendix D for the articles.)

Subjects came individually for the sixth session. They were seated in the private office mentioned earlier, blood was drawn by Dr. Smith, the relaxation/specific imagery experience was repeated by the investigator, blood was drawn a fourth and final time, and they drew a picture of their imagery. The procedure was the same as the one used during the training sessions. All subjects were given an opportunity to emerge from their relaxed state at their own rate which took approximately one to five minutes.

Subjects were then asked a series of questions about their imagery by the investigator. (The questions are listed in Appendix E.) The investigator did not draw the blood and was not informed of the blood results until the completion of the study. This recall session was tape recorded. Based on the Achterberg and Lawlis procedure for quantification of anatomical imagery (which is explained in detail in the next section), subjects were later scored independently by three raters for the adequacy of their imagery process. Each of the three raters had familiarized him/herself with the

Achterberg/Lawlis procedure by reading their book, Imagery of Cancer (1978), which explained the procedure in detail. Each rater was also familiar with the nature and purpose of the study. One of the raters was an assistant professor in the Department of Psychiatry at Michigan State University. The second rater was a first year student in Human Medicine at Michigan State University, and the third rater was the investigator. All three volunteered to be raters.

MEASURES

The measures used in this study can be divided into three categories: neutrophil function measures, psychological measures, and imagery ratings.

Neutrophil Function Measures

Blood was obtained on four separate occasions by venapuncture. Ten milimeters (ml) were anticoagulated with heparin, two ml were anticoagulated with EDTA and three ml were allowed to clot in a glass tube. A portion of the serum was stored at -70°C for possible future use. Three neutrophil measures were observed: white blood cell count (WBC), adherence (Ad), and shape change (SC).

White Blood Cell Count

White blood cells are produced in the bone marrow and are found circulating in the blood stream (circulating pool) or attached to the blood vessel walls (marginal pool). Under ordinary circumstances, approximately 50 percent are circulating and 50 percent are

marginal. Changes in white blood cell count are caused by cells shifting from the circulating to the marginal pool and vice versa. Only those cells that are circulating are measured by venapuncture.

A 25 microlitre sample of blood was diluted in white blood cell diluting fluid. The white blood cells were then counted on a Coulter counter. They were counted in triplicate to account for variability. The number of cells were multiplied by 1000 which gives the number of white blood cells per milimeter of blood.

Adherence

Adherence was determined by the ability of cells to stick to protein-coated surfaces. After the neutrophils were isolated, they were injected into a glass chamber and allowed to settle for 500 seconds. The apparatus for measuring adherence is two gaskets and two cover glasses. The chamber is filled with Hanks balanced salt solution (which contains all salts necessary for cell function and approaches a balanced physiologic condition), and the cells are injected into the chamber. Gravity causes the cells to settle. The chamber is flipped over. After 500 seconds, some cells detach, and some cells stick to the upper glass cover. Percent unstimulated adherence represents the percent of isolated neutrophils that remain attached to the glass cover.

$$\frac{\text{adherent}}{\text{total}} \times 100 = \text{percent adherence}$$

The same procedure was repeated for neutrophils that were stimulated by f-Met-Phe (fMP), a synthetic substance and a chemotactic factor

produced by Sigma Chemical Company. F-M-P, which binds to a fairly specific receptor site on the cell, activates shape change and adherence in the cell. If neutrophils are dysfunctional, their percent adherence will not increase when treated with fMP. Percent stimulated adherence represents the percent of neutrophils treated with fMP that remain attached to the glass cover.

Shape Change

One measure of chemotactic response is the ability of cells to assume a bipolar configuration upon exposure to a chemotactic factor. There are five classifications of cell shapes: (1) round, (2) ruffled, (3) bipolar, (4) uropod, and (5) pseudopod. The uropod is the tail of the cell and the pseudopod is the front of the cell. An average cell takes approximately two minutes to change from a round to a uropod shape. Five minutes after chemotactic stimulation, roughly 90 percent of the cells are in the last three classification categories.

The neutrophils are suspended in a Hanks balanced salt solution and fixed with gluteraldehyde, which kills the cell but perserves its morphology. The fixed cells are examined with a "phase contrast" microscope, which allows the examiner to see the cells without staining them. The chemotactic factor, fMP, is added to the sample in a concentration that gives the highest response (10^{-6} molar). In a second round, varied concentrations of fMP are used to determine to what extent the imagery would affect the dose response. The percentage of cells with a bipolar configuration is determined by scoring 100 cells per slide. Shape Index scores are determined

by multiplying the shape change categories by a factor and adding them. The Shape Index, then, is a weighted summary that gives a more sensitive indication of overall change. Scores are reported for unstimulated and stimulated shape change.

All three techniques have been found to be highly reliable, reproducible, and sensitive procedures through repeated samplings. The procedure for adherence and shape change has been used for over 100 subjects, and has been found to be highly reliable. For example, multiple samples taken from single subjects have yielded less than a five percent variation in adherence and less than a two percent variation in shape change (Smith, 1980).

Two other procedures were done as a check on the health of the subjects. Hematocrit is an indication of anemia. Sedimentation rate is an indication of infection. All 16 subjects fell within a normal range.

Psychological Measures

Three psychological inventories were used to measure correlations between personality characteristics and ability to influence neutrophil function. All three measures were paper-and-pencil self-administered questionnaires (see Appendix A).

One of the inventories was a test measuring Type A personality characteristics. Two major approaches have been used to assess Type A behavior. These are the Structured Interview (Rosenman, Friedman, Straus, Wurm, Kositchek, Haan & Werthessen, 1964) and the Jenkins Activity Survey (Jenkins, Rosenman & Friedman,

1967). The present study used the Jenkins Activity Survey (JAS) which is a questionnaire consisting of 44 items of which 16 are scored. The JAS was developed from an item pool derived from the structured interview questions and from clinical experience. Those items that significantly discriminated individuals classified by the interview as Type A were selected for the inventory.

An interjudge agreement of classification of 72 percent was found between the JAS and the Structured Interview (Zyzanski & Jenkins, 1970). The JAS was also found to be significantly related to coronary heart disease in a study known as the Western Collaborative Group Study (Jenkins, Rosenman, and Zyzanski, 1974). Test-retest reliability was 65 percent for both one year and four year intervals.

Most of the present validity data for the JAS has been derived from laboratory studies which used college students as subjects. A number of studies support the concurrent, predictive, and construct validity of the Type A concept and the JAS (Dembrowski, 1978). For example, comparisons with other psychological tests--i.e., the Minnesota Multiphasic Personality Inventory, Rotter's I-E, Thurstone Temperament Scale--yielded significant correlations which supported the validity of a Type A pattern.

Certain Type A behaviors--i.e., time urgency, impatience, polyphasic thinking, and the need to be in control of one's environment--would appear to interfere with one's ability to relax and image effectively, therefore it was postulated that higher Type A scores would be negatively correlated with blood changes.

The Wellness Inventory (Travis, 1977) is a questionnaire which purports to measure degrees of wellness. It consists of 100 questions which are divided into the following ten categories: productivity, care and safety, nutrition, environment, physical, emotions, community, creativity, auto, and parenting. Subscores are computed for each category and summed for an overall wellness score.

There is no normative data for test-retest reliability or validity, therefore interpretation relies primarily on clinical judgment. The questionnaire simply categorizes behavior as opposed to asking for opinions.

Travis reports scores ranging from 65 to 75 for persons participating in his wellness program. In addition, locally, 34 undergraduates in the College of Agriculture participating in a lecture series in Project LEAD at Michigan State University had a mean score of 64.5 with a standard deviation of 8.41 (Schneider, 1980). Another group of 12 male and female white collar workers participating in a stress workshop had a mean score of 71.2 with a standard deviation of 6 (Schneider, 1980).

Since life-style habits have been related to one's physical health and functioning, it was expected that higher wellness scores would be associated with greater blood changes.

The International Opinion Survey, also known as the Internal versus External Control of Reinforcement Scale (Rotter, 1966), measures an individual's beliefs about who controls his/her behavior and life events. The test demonstrates reasonable reliability

based on data obtained in a series of samples (Rotter, 1966). Item analysis and factor anlaysis estimates are fairly high for an additive scale. Test-retest reliability estimates range from .49 to .83, and the test correlates satisfactorily with other scales measuring the same variable--i.e., the Likert scale. Although the test shows reasonable internal consistency, it is limited in its ability to discriminate between individuals. Thus, the test is thought to be more suitable for investigations of group differences than individual differences.

Construct validity of the I-E Scale has been determined by correlations between scores and behavioral criteria, i.e., internals take more steps to improve their environmental situations.

Several studies suggest that better results occur when the type of treatment program is congruent with I-E expectancies (Abramawitz, Abramawitz, Roback & Jackson, 1974). Internals seem to do better in non-directive programs where they have more control, while externals prefer more structured intervention. The present study provided some structure, but attempted to allow for a great deal of flexibility and subject-control, i.e., subjects were encouraged to develop their own personal images. One would expect that internals might respond more creatively to this situation, and creativity is thought to contribute to imagery effectiveness. In summary, internal-external expectancies appear to be related to imagery ability (Gralton, Hayes & Richardson, 1979), therefore it was expected that "internals" would experience more vivid imagery

than "externals," and, thus, manifest greater changes in neutrophil function.

Imagery Ratings

The instrument chosen to assess imagery is an adaptation of the IMAGE-CA (Achterberg & Lawlis, 1978). The IMAGE-CA consists of 14 dimensions which were derived from hundreds of interviews with patients. These dimensions are: vividness, activity, and strength of the cancer cell; vividness and activity of the white blood cell; relative comparison of size and numbers of cancer and white blood cells; strength of white blood cells; vividness and effectiveness of medical treatment; degree of symbolism; overall strength of imagery; regularity of imagery process; and clinical opinion related to prognosis based on combined imagery factors (pp. 27, 28).

Scores for the 14 dimensions are derived from two sources: (1) drawings by the patients, and (2) tape recordings of structured interviews. The 14 dimensions can be divided into four categories: the disease, white blood cell defense system, treatment, and general imagery characteristics. Scoring was based on the following criteria:

1. Vividness of cancer cells: High scores were given for continuous and clear descriptions. This dimension was not strongly related to progress of disease.

2. Activity of cancer cells: This dimension attempted to assess the patient's feeling about growth and spread of malignancy.

3. Strength of cancer cells: High scores were given for weak or fragile images. This dimension was the most important of the three cancer cell dimensions in predicting subsequent disease.

4. Vividness of white blood cells: High scores were given for clear and continuous descriptions.

5. Activity of white blood cells: Higher ratings were given for more detailed, active, complex and self-generated images.

6. Numerosity of white blood cells: Higher scores were given when the number of white blood cells relative to cancer cells was high.

7. Size of white blood cells: Once again, the size of white blood cells relative to cancer cells was of interest. Relative sizes may tell something about a patient's attitude toward sickness and health.

8. Strength of white blood cells: The nature of the interaction of the white blood cells and cancer cells, i.e., strength, was found to be one of the most powerful predictors of short-term disease state. High scores were given if the white blood cells were often winners over the cancer cells.

9. Vividness of treatment: Low scores were given when descriptions were fragmented and difficult to follow.

10. Effectiveness of treatment: High scores were given when patients saw their treatment effectively combating their disease.

11. Symbolism: Higher scores were given for more symbolistic imagery. It is especially important that the white blood cells appear symbolically. The authors suggest that the content of the imagery is important, because symbols often reflect personality dynamics.

12. Overall strength of imagery: This dimension assesses a patient's overall ability to image, and is derived from specific details, emotional intensity, etc.

13. Estimated regularity of imagery: High scores were given for frequent practice of imagery.

14. Clinical judgment: This dimension was found to be the most complex, yet the best predictor of disease status. The power of this dimension is determined by the ability of the rater(s).

Scores ranged from 1 (low) to 5 (high), and raw scores were weighted, summed, and transformed to standard scores (stens). A sten score is descriptive of the normative sample population. A sten score ranges from 1 to 10, with respect to a normal distribution, with a mean of 5.5 and a standard deviation of 2.0. Reliability was measured by interdimensional correlations and interrater correlations. All of the correlations were statistically significant, but had a wide range from .60 to .95. Validity was measured by correlating the scores to objective medical criteria two months later. If a patient scored 140 or above, his prognosis for remission of disease was excellent. If the score was less than 100, the prognosis was poor.

The present study adapted the following variables from the Achterberg and Lawlis IMAGE-CA (1978): vividness, shape change, adherence, leaving the blood stream, strength, general feeling, symbolism, and clinical judgment. In addition, three summary variables were rated: decrease in white blood cell count, shape change, and adherence. At the end of the experimental condition, subjects were asked to draw a picture of their imagery and were asked a series of questions about their images by the investigator (see Appendix E). This recall session was tape recorded.

After two training protocols, the three raters described earlier (who had no knowledge of the blood results) independently

rated the subjects on the 11 variables. The tape recorded sessions and the drawings of the images were used to determine the ratings. Scores ranged from 1 (low) to 5 (high). Each rater took the tape recordings of the sessions home with him/her in order to arrive at independent ratings. Then the three raters met together in Dr. Schneider's office at Michigan State University to compare their ratings. Discrepancies between raters were resolved by re-listening to the tape and then arriving at an averaged score of the three ratings. Interrater reliabilities ranged from .65 to .92.

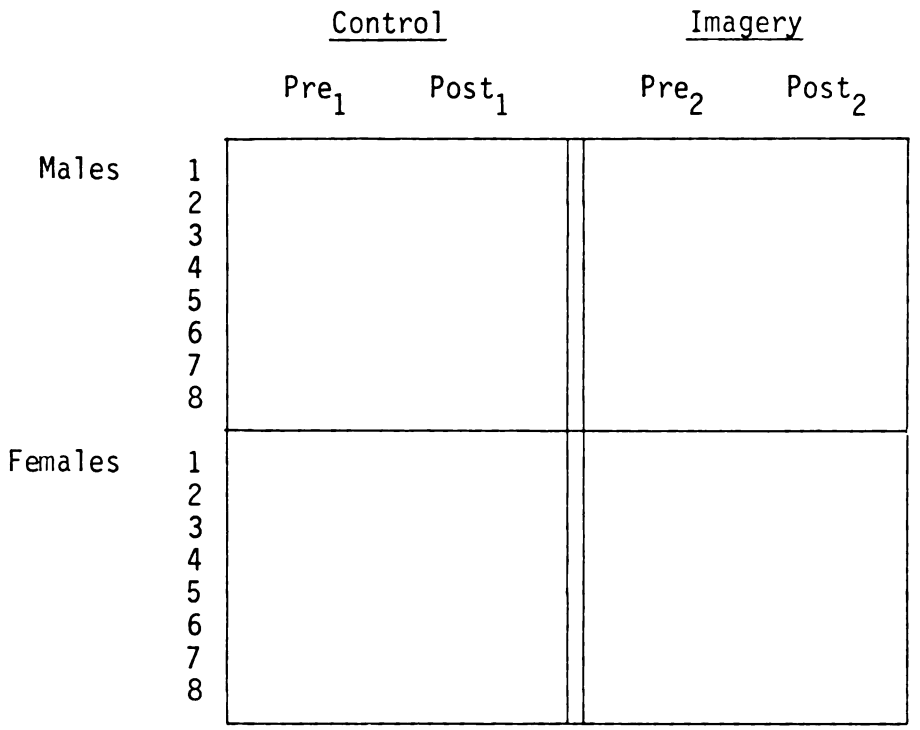
DESIGN AND STATISTICAL ANALYSIS

The study took the form of a quasi-experimental design with the 16 subjects serving as their own control group as shown on the Design Graph. The factor over the subjects was sex and consisted of two levels--male and female. The repeated measures design was a 2 x 2 design where one factor was the time element (pre and post) and the second factor was the treatment factor (control and imagery). The independent variable of interest was a comparison of change of neutrophil functions under the imagery condition and the control condition. The dependent variables associated with this design are the neutrophil functions described earlier.

The other dependent variables were the psychological and imagery measures. These measures were collected to examine their relationship to blood neutrophil function.

The data were analyzed according to five considerations. A repeated measures multivariate analysis of variance (Finn, 1967) was

DESIGN GRAPH



computed for the treatment effect on (1) total white blood cell count, (2) adherence, and (3) cellular shape change. When there were significant differences, the Student t-test was used as a post-hoc comparison procedure. Pearson product moment correlation coefficients were computed to examine the relationship of blood changes to imagery ratings and personality variables.

The primary hypotheses tested were:

Hypothesis 1: There will be changes in peripheral blood neutrophils as a result of a 20 minute relaxation/specific imagery experience. Specifically:
(a) The total white blood cell count will drop following the imagery experience.
(b) The neutrophils will become more adhesive as a result of the imagery experience.

(c) The neutrophils will change from a circular to a more elongated shape as a result of the imagery experience.

Hypothesis 2: Correlation coefficients between imagery ratings and blood neutrophil measures will be greater for subjects who received higher ratings on the adequacy of their imagery process. Specifically:

(a) Higher vividness scores will correspond with greater neutrophil change scores.
(b) Higher leaving-the-blood-stream scores will correspond with greater neutrophil change scores.
(c) Higher strength of white blood cells scores will correspond with greater neutrophil change scores.
(d) Higher overall feeling scores will correspond with greater neutrophil change scores.
(e) Higher symbolism scores will correspond with greater neutrophil change scores.
(f) Higher overall scores will correspond with greater neutrophil change scores.
(g) Higher white blood count scores will correspond with a decrease in white blood cell count.
(h) Higher shape change scores will correspond with a more elongated shape change.
(i) Higher adherence scores will correspond with a greater neutrophil adhesiveness.

Exploratory Hypotheses: Three personality variables will correlate with changes in the white blood cells. Specifically:

(a) Lower Type A scores will correspond with greater neutrophil change scores.
(b) Higher Internal Locus of Control scores will correspond with greater neutrophil change scores.
(c) Higher Wellness scores will correspond with greater neutrophil change scores.

SUMMARY

Sixteen healthy volunteers were trained over an eight week period in a relaxation/imagery procedure. Blood samples were taken

20 minutes apart before the training program began while the subjects filled out three personality inventories--i.e., a blood sample was taken, subjects filled out the personality measure, and a second sample was taken 20 minutes after the first one. Blood samples were taken again prior to and immediately following the 20 minute imagery session. Subjects were then asked a series of questions about their imagery experience. Their responses to these questions were later scored, according to specified criteria, by three raters.

The blood samples were examined for changes associated with motility--i.e., white blood cell count, adhesiveness, and cellular shape. The imagery ratings and the personality inventories were correlated with the blood results.

A repeated measures multivariate analysis of variance was computed for the effect of imagery on white blood cell count, adherence, and shape change. Significant differences were determined by Student t-tests. Correlation coefficients examined the relationships of blood results to imagery ratings and personality factors.

CHAPTER III

ANALYSIS OF DATA

The research hypotheses can be divided into three broad areas of interest: (1) the effect of relaxation and imagery on blood neutrophil function, (2) the correlation between imagery ratings and changes in neutrophil function, and (3) the correlation between personality variables and changes in neutrophil function.

HYPOTHESIS 1: RELAXATION/SPECIFIC IMAGERY AND CHANGES IN NEUTROPHIL FUNCTION

Hypothesis 1 states that there will be changes in peripheral blood neutrophils as a result of a 20 minute relaxation/specific imagery experience. As the probability levels in Table 3 show,

TABLE 3.--Probability Levels for Analysis of Variance of Blood Function Measures.

Source	White Blood Cell Count	Adherence	Shape Change
Sex Effect	.515	.4003	.9726
Repeated Measures Effect	.0001**	.0779*	.0089**
Sex x Repeated Measures Effect	.6628	.4304	.8066

*p < .10

**p < .01

there were no significant p levels for the sex by repeated measures effect and the main effect for sex. There were significant differences for the white blood count and shape change functions. The differences observed for adherence were marginally significant.

The means and standard deviations of the blood variables for each cell in the repeated measures design are reported in Table 4. There was little change in blood function for any of the pre to post control samples. There was, however, a drop in white blood cell count and unstimulated adherence following the imagery condition. Significant shape change occurred but not following the imagery condition. All three variables were then examined separately.

Hypotheses 1a states that the total white blood cell count (WBC) will drop following the specific imagery experience. The raw data for WBC is shown in Figure 1. The mean WBC for the first control blood sample was 7290 cells (per milimeter of blood), and the mean WBC for the second control sample was 7260 cells, showing little change for the control condition. WBC dropped 33 cells for males and 25 cells for females. The mean WBC before imagery was 8168 cells, and the mean WBC after imagery was 6405 cells which represents a 2763 cell drop in total WBC. There was a 1825 WBC drop for males and 1699 WBC drop for females. T-tests were computed showing a probability of $< .0001$ for the imagery difference.

Hypothesis 1b states that the neutrophils will become more adhesive as a result of the imagery experience. The change in adherence (Ad) means is illustrated in Figure 2. Control means for unstimulated adherence dropped from 41 to 38 (a 3 point difference),

TABLE 4.--Means of Blood Function Measures for Control and Imagery Conditions (N = 16).

Blood Function Measures	Control		Imagery	
	Pre	Post	Pre	Post
White Blood Cell Count	7290 (759.31)[a]	7260 (840.90)	8168 (1514.94)	6405 (1275.97)
Adherence, Unstimulated	41 (14.59)	38 (14.49)	45 (23.69)	32 (17.95)
Adherence, Stimulated	69 (12.07)	70 (13.94)	72 (12.11)	73 (19.28)
Shape Change, Unstimulated	36 (24.62)	43 (37.12)	12 (13.06)	11 (13.04)
Shape Change, Stimulated	158 (66.34)	159 (61.05)	184 (40.28)	182 (40.21)

[a]Standard deviations are given in parentheses.

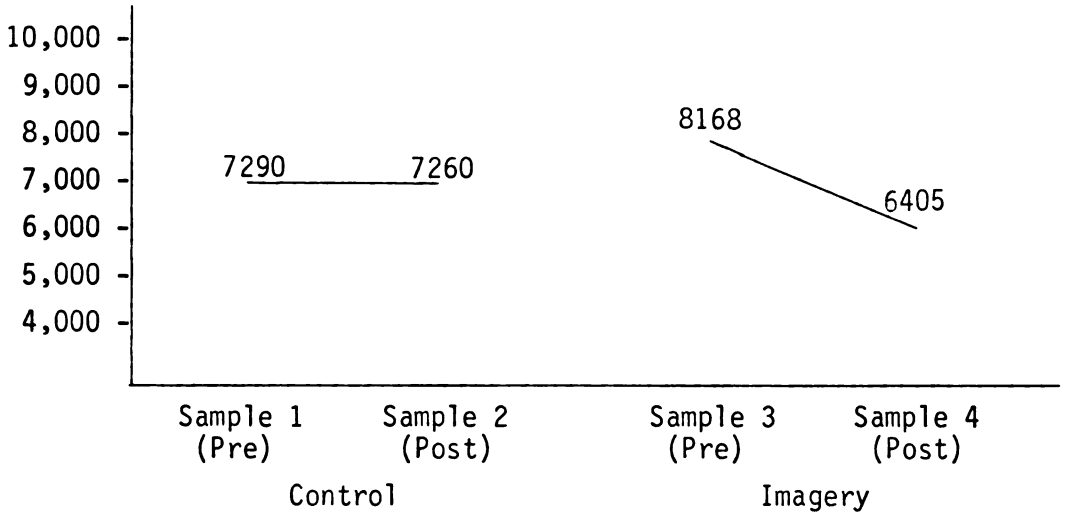
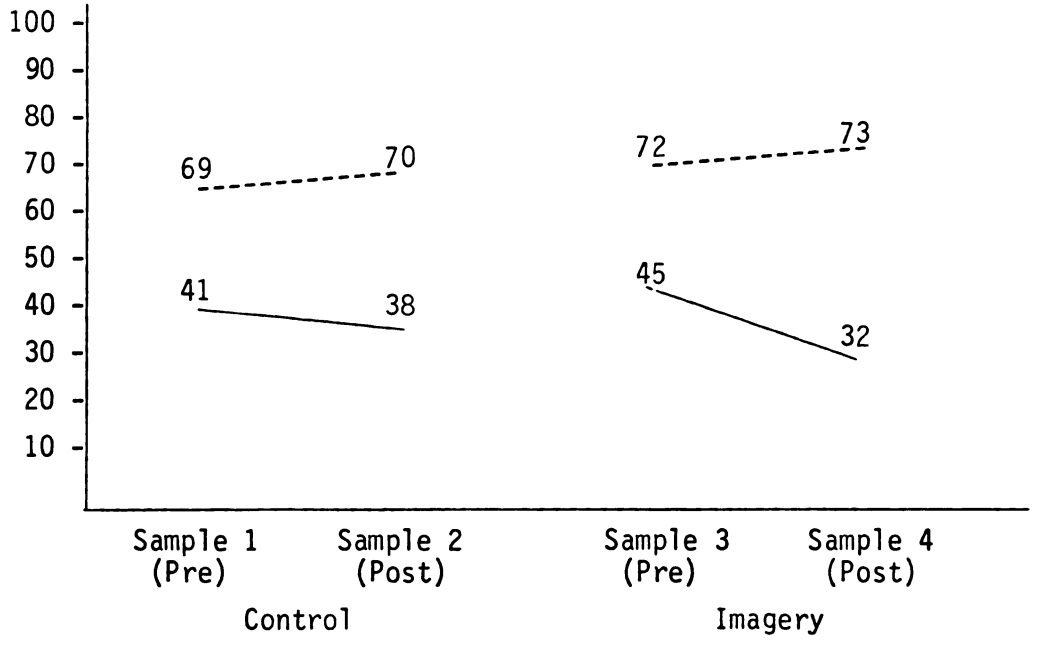


Figure 1.--Pre and Post WBC Means for Control and Imagery Conditions.



Key: ——— = unstimulated adherence

----- = stimulated adherence

Figure 2.--Pre and Post Adherence Means for Control and Imagery Conditions.

and imagery means dropped form 45 to 32 (a 13 point difference). T-tests were computed showing a probability of <.035 for the adherence difference. The means of the stimulated cells are also shown. The drop was caused primarily by changes in females adherence function; unstimulated adherence dropped one point for males and 18 points for females.

Hypothesis 1c states that the neutrophils will change from a circular to a more elongated shape as a result of the imagery experinece. The raw data for shape change (SC), illustrated in Figure 3, shows no significant elongation of the neutrophils ($p < .663$) before or after chemotactic stimulation.

HYPOTHESIS 2: IMAGERY RATINGS AND CHANGES IN NEUTROPHIL FUNCTION

Hypothesis 2 states that subjects who receive higher ratings on the adequacy of their imagery process will have greater changes in blood neutrophil function. Interrater reliabilities, as reported earlier, ranged from .65 to .92. The means, standard deviations, and range for each imagery category is given in Table 5. The total possible range was from 1 (low) to 5 (high).

Pearson product moment correlation coefficients for imagery ratings and blood changes are shown in Table 6 (see Appendix F for all correlations). The blood function measures on the left represent difference scores, i.e., the difference between the pre and post blood samples for each condition. Most of the significant correlations (shape change, adherence, leaving the blood stream, strength, general feeling, clinical judgment, and WBC count) correlate with

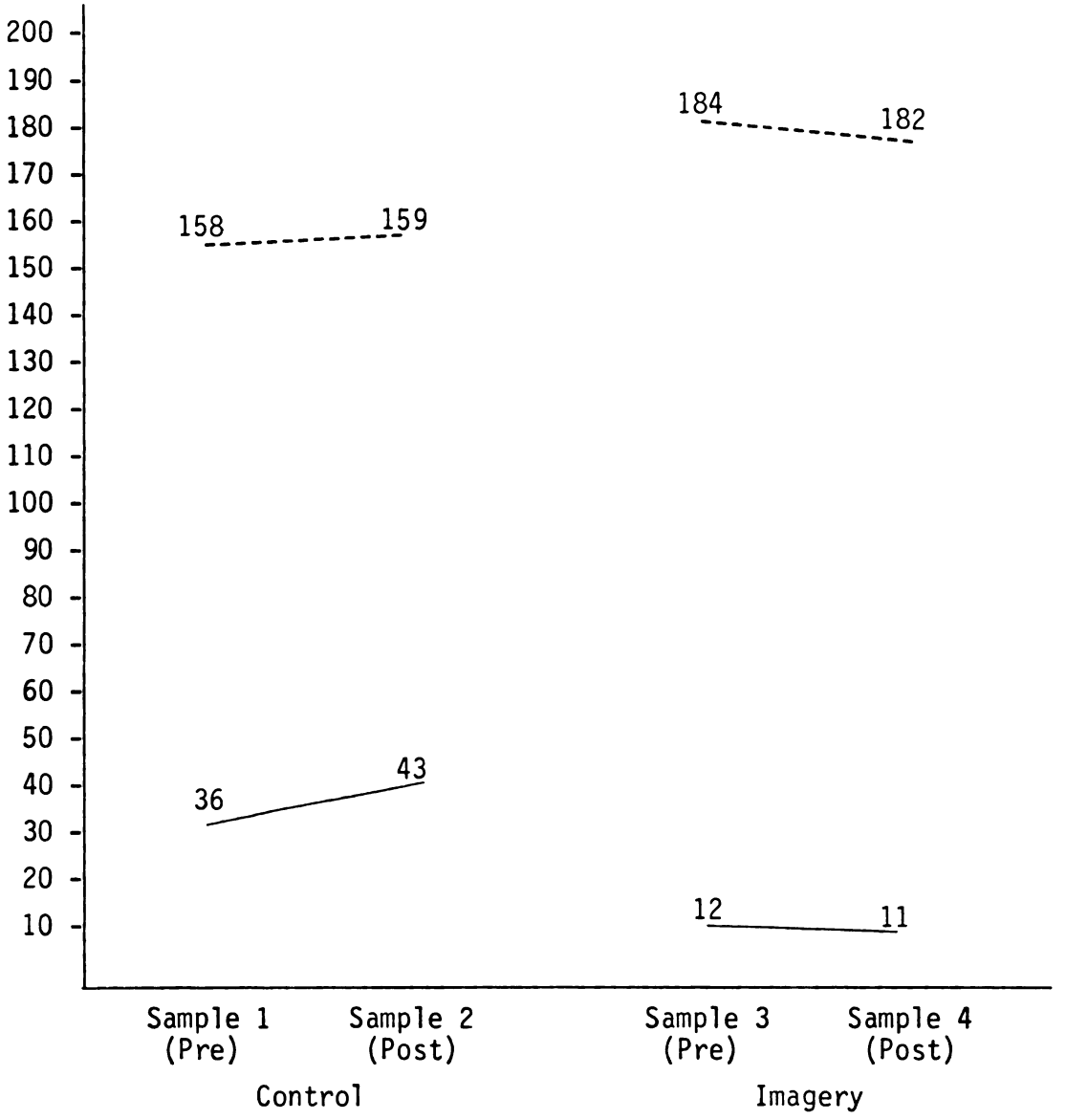


Figure 3.--Pre and Post Shape Change Means for Control and Imagery Conditions.

TABLE 5.--Means and Range of Scores for Imagery Ratings.

Imagery Category	Mean	Range
Vividness	3.656 (.8107)[a]	2 - 5
Shape Change	3.5625 (.8342)	2 - 5
Leaving the Blood Stream	3.78125 (.8944)	2 - 5
Strength	3.03125 (.8360)	1 - 5
Overall Feeling	3.46875 (1.3098)	2 - 5
Symbolism	2.84375 (.8654)	1.5- 5
Clinical Judgment	3.0625 (1.2479)	2 - 5
WBC Change	3.53125 (.8165)	2 - 5
Adherence Change	3.5 (.8845)	2 -5

[a]Standard deviations are given in parentheses.

decreased adherence, which are represented by negative correlations. The highest correlations are for shape change and clinical judgment ratings ($p < .001$). Also the ratings for symbolism ($p < .001$) and white blood cell count ($p < .01$) correlate with changes in white blood cell count.

Tables 7 and 8 illustrate correlations between imagery ratings and blood measures for each pre and post sample, rather than difference scores. Significant correlations between control blood function measures and imagery ratings are shown in Table 7. Most of the significant correlations are clustered in white blood cell count and adherence functions. Since only 17 percent of the

TABLE 6.--Significant Correlations Between Imagery Ratings and Pre to Post Changes in Blood Function (N = 16).

Blood Function Difference Scores	Imagery Ratings								
	Vividness	Shape Change	Adherence	Leaving the Blood Stream	Strength	General Feeling	Symbolism	Clinical Judgment	Decrease in WBC
Control White Blood Count			-.61**						
Imagery White Blood Count							.66***		.55**
Control Adherence, Unstimulated									
Control Adherence, Stimulated			.51*						
Imagery Adherence, Unstimulated					.59**				
Imagery Adherence, Stimulated		-.67***	-.57**	-.52*	-.44*	-.46*		-.71***	-.49*
Control Shape Change, Unstimulated	.53*	.42*		.54*					
Control Shape Change, Stimulated					.47*				
Imagery Shape Change, Unstimulated									.44*
Imagery Shape Change, Stimulated									

*p < .05
**p < .01
***p < .001

TABLE 7.--Significant Correlations Between Control Blood Function Measures and Imagery Ratings (N = 16).

	Imagery Ratings								
Blood Function Measures	Vividness	Shape Change	Adherence	Leaving the Blood Stream	Strength	General Feeling	Symbolism	Clinical Judgment	Decrease in WBC
White Blood Count, Pre	.66**			.51*					
White Blood Count, Post	.65**	.40	.41	.59*					
Adherence, Unstimulated, Pre			.35			.59**			
Adherence, Stimulated, Pre			.38		.36	.63**	.43*	.35	.35
Adherence, Unstimulated, Post									
Adherence, Stimulated, Post									
Shape Change, Unstimulated, Pre									
Shape Change, Stimulated, Pre									
Shape Change, Unstimulated, Post			-.35						
Shape Change, Stimulated, Post									

$p < .10$
$*p < .05$
$**p < .01$
$***p < .001$

TABLE 8.--Significant Correlations Between Imagery Blood Function Measures and Imagery Ratings (N = 16).

Blood Function Measures	Imagery Ratings								
	Vividness	Shape Change	Adherence	Leaving the Blood Stream	Strength	General Feeling	Symbolism	Clinical Judgment	Decrease in WBC
White Blood Count, Pre									
White Blood Count, Post									
Adherence, Unstimulated, Pre			-.34						
Adherence, Stimulated, Pre			-.58**			-.35	-.49*	-.49*	
Adherence, Unstimulated, Post		-.42*		-.43*	-.45*	-.48*	-.42*	-.35	
Adherence, Stimulated, Post		.48*						.37	
Shape Change, Unstimulated, Pre	.48*	.36	.43*	.47*		.52**	.36	.38	.42*
Shape Change, Stimulated, Pre		.40*							
Shape Change, Unstimulated, Post	.46*		.39			.45*			
Shape Change, Stimulated, Post		.40*							

p < .10
*p < .05
**p < .01
***p < .001

correlations were significant, they could have occurred by chance. Table 8 shows the significant correlations between imagery blood function measures and imagery ratings. The highest number of correlations were found in adherence (unstimulated, post) and shape change (unstimulated, pre) functions.

HYPOTHESIS 3: PERSONALITY FACTORS AND CHANGES IN NEUTROPHIL FUNCTION

Three personality variables--Type A, Locus of Control, and Wellness--were correlated with changes in white blood cell function. It was expected that lower Type A scores would correspond with greater neutrophil change scores; higher Internal Locus of Control scores would correspond with greater neutrophil change scores; and higher Wellness scores would correspond with greater neutrophil change scores.

Pearson product moment correlation coefficients for personality factors and blood changes were computed. Few significant correlations were found between Type A personality and Locus of Control scores and blood changes. There were some correlations, however, between Wellness scores and blood changes as illustrated in Tables 9 and 10. (Only the significant correlations are shown.) A few significant correlations were found in all three blood function categories as shown in Table 9. Table 10, which illustrates correlations between each blood function measure and Wellness scores, shows that the highest number of correlations are clustered in productivity and auto safety categories. Significant correlations

TABLE 9.--Significant Correlations Between Wellness Scores and Pre to Post Changes in Blood Function (N = 16).

Blood Function Difference Scores	Wellness Scores										
	Productivity	Personal Care	Nutrition	Environment	Physical	Emotions	Community	Creativity	Auto	Parenting	TOTAL
Control White Blood Count	.56**										
Imagery White Blood Count							.42*				
Control Adherence, Unstimulated											
Control Adherence, Stimulated	.43*										
Imagery Adherence, Unstimulated		.55**	.41*			.42*					.55**
Imagery Adherence, Stimulated											
Control Shape Change, Unstimulated											
Control Shape Change, Stimulated						.52*		.53**			.50*
Imagery Shape Change, Unstimulated											
Imagery Shape Change, Stimulated						-.48*		-.67**			

*p < .05

**p < .01

TABLE 10.--Significant Correlations Between Wellness Scores and Blood Function Measures (N = 16).

Blood Function Measures	Wellness Scores										
	Productivity	Personal Care	Nutrition	Environment	Physical	Emotions	Community	Creativity	Auto	Parenting	TOTAL
Control White Blood Count, Pre			.48*						.66**		
Control White Blood Count, Post			.43*						.55*		
Imagery White Blood Count, Pre											
Imagery White Blood Count, Post											
Control Adherence, Unstimulated, Pre	.46*										
Control Adherence, Stimulated, Pre										. .46*	
Control Adherence, Unstimulated, Post	.43*										
Control Adherence, Stimulated, Post				.45*						.47*	
Imagery Adherence, Unstimulated, Pre			.59**								
Imagery Adherence, Stimulated, Pre	-.54**		.50*				-.43*				
Imagery Adherence, Unstimulated, Post							-.45*		-.48*		-.47*
Imagery Adherence, Stimulated, Post											
Control Shape Change, Unstimulated, Pre											
Control Shape Change, Stimulated, Pre	.52*				.49*				.49*		.56**
Control Shape Change, Unstimulated, Post											
Control Shape Change, Stimulated, Post	.54**				.42*				.46*		
Imagery Shape Change, Unstimulated, Pre											
Imagery Shape Change, Stimulated, Pre					.46*						
Imagery Shape Change, Unstimulated, Post	.44*										
Imagery Shape Change, Stimulated, Post					.43*						

*p < .05
**p < .01

are distributed fairly evenly among the blood function measures (see Appendix F for all correlations).

SUMMARY

The results of the neutrophil function tests, summarized in Table 11, show that significant changes occurred for two of the three blood functions. The total white blood cell count dropped significantly ($p < .0001$) as predicted. This finding is particularly significant when restricted to neutrophils. There was a 38 percent drop in neutrophil count, as compared with a 20 percent drop in total white blood cell count. When neutrophils are removed from the total white blood cell count, there are essentially no differences for other white blood cells. Thus it appears that the imagery experience was highly specific in its effects on only neutrophils, which were the particular white blood cells the subjects were trained to visualize.

The second blood measure, adherence, also dropped significantly ($p < .05$). Subjects were instructed to visualize an increase in adherence, therefore this finding was in the opposite of the expected direction.

The third blood measure, shape change, remained unchanged. Although there is a treatment effect for Measure 1 (Table 3), there was no significant change following the imagery condition.

Despite a relatively small sample size ($n = 16$), significant correlations were found between imagery ratings and changes in blood functions. High correlations (Table 9) were found between ratings

TABLE 11.--Neutrophil Function Test Means Before and After a 20 Minute Relaxation/Imagery Session.

	Imagery	
Blood Function Measures	Pre	Post
White Blood Cell Count	8200 (1500)[a]	6400 (1300)
Neutrophil Count	4900 (650)	3100 (600)
Adherence, Unstimulated	45 (13)	32 (18)
Shape Change, Unstimulated	12 (13)	11 (13)

for symbolism and white blood cell count and changes in white blood cell count. Results were highly significant in the opposite of the expected direction in terms of adherence, however, indicating that imagery effectiveness was related to a decrease in neutrophil adherence.

Finally, some correlations were found between Wellness scores and blood function measures. Few significant correlations were found between Type A and Locus of Control scores and blood changes.

CHAPTER IV

SUMMARY AND CONCLUSIONS

SUMMARY

The purpose of this study was to investigate two primary hypotheses: (1) that white blood cell function could be influenced by a relaxation/imagery experience, and (2) that ratings of imagery effectiveness would correlate with blood changes. Although it is well known that imagery can affect mental and physical functioning (Sarbin & Slagle, 1979; Schwartz, 1973; Benson, 1975), few controlled studies appear in the literature that measure a specific physiological change, such as white blood cell function, resulting from imagery.

Neutrophils are a type of white blood cell which provide a major defense against bacterial infections. In order for neutrophils to carry out their defensive role, they must be capable of motility so that they can emigrate into inflammatory sites. While it appears that alterations in the cells' ability to migrate predisposes individuals to infection (Smith & Hollers, 1980; Jadwin, Smith & Meadows, 1980, Anderson & Smith, 1981), little information is available on endogenous control mechanisms in normal individuals. Procedures to examine the chemotactic responsiveness of neutrophils have been developed to a high degree of reliability (Smith, Hollers, Patrick & Hassett, 1979). These procedures enable the researcher to isolate

neutrophils and examine changes associated with motility, i.e., white blood cell count, adhesiveness, and cellular shape change.

Prolonged stress and certain personality and life-style factors are believed to affect an individual's susceptibility to illness (Friedman & Rosenman, 1979; Pelletier, 1977; Shealy, 1977; Ardell, 1979; Rotter, 1954; Strickland, 1977). Three inventories which measure personality and life-style characteristics thought to be associated with health were used in this study. These inventories are Type A, Locus of Control, and the Wellness Inventory.

Imagery has been used for centuries as a tool in healing (Samuels & Samuels, 1975; Achterberg & Lawlis, 1980). Visual imagery has been used more recently as part of a comprehensive treatment program for cancer patients (Simonton & Simonton, 1978). A study by Achterberg and Lawlis (1978) found a .78 correlation between ratings of effectiveness of visual imagery and progress or remission of cancer growth two months later. Another study (Achterberg, Lawlis, Simonton & Simonton, 1977) examined the relationships between psychological variables, blood chemistries, and course of cancer. They concluded that psychological factors are predictive of subsequent disease state, and among the psychological factors studied, type of imagery was found to be the most important predictor of subsequent disease state. Some preliminary in vitro experiments, using healthy adult donors, have been performed at Michigan State University (Schneider & Smith, 1981). These studies suggest that neutrophil function can be influenced in different directions by factors such as

stress, relaxation, and imagery. These experiments, together with the Achterberg and Lawlis studies (1977, 1978), provide a basis for this study.

In the present study, 16 healthy volunteers were trained over an eight week period in a relaxation/imagery procedure. Blood samples were taken 20 minutes apart before the training program began while the subjects filled out three personality inventories and consent and demographic data forms. Blood samples were taken again prior to and immediately following the 20 minute imagery session. Subjects were then asked a series of questions about their imagery experience. Their responses to these questions were later scored, according to specified criteria, by three raters. The blood samples were examined for changes associated with motility--i.e., white blood cell count, adhesiveness, and cellular shape change. The imagery ratings and the personality inventories were correlated with the blood results. A repeated measures analysis of variance was computed for the effect of imagery on white blood cell count, adherence, and shape change. Significant differences were determined by Student t-tests. Correlation coefficients examined the relationships of blood results to imagery ratings and personality factors.

CONCLUSIONS

The results of the neutrophil function tests, as shown in Table 11, indicate that changes occurred for two of the three neutrophil functions. Following the imagery session, the total white blood cell count dropped significantly ($p < .001$), as did the

neutrophil count ($p < .0001$). Adherence of the neutrophils also dropped significantly ($p < .05$), while shape change remained unchanged.

Some significant correlations were found between imagery ratings and changes in blood function as shown in Table 6. High ratings for symbolism and decrease in white blood cell count correlate with changes in the white blood cell count. High imagery ratings in several categories (shape change, adherence, leaving the blood stream, strength, general feeling, clinical judgment, and WBC count) correlate with decreased adherence.

Of the three personality variables, some significant correlations were found between Wellness scores and the blood measures (see Tables 9 and 10).

DISCUSSION

Blood Measures

The results of this study support the primary hypothesis that a 20 minute relaxation/imagery experience can affect neutrophil function. The results are mixed, however, with white blood cell count being affected in the expected direction, adherence being affected in the opposite of the expected direction, and shape change not being significantly affected.

There was a 20 percent drop in total white blood cell count, as expected, following the imagery session. The drop was even greater (38%) when restricted to neutrophils, the particular white blood cell the subjects were trained to visualize. Thus it appears

that healthy, motivated subjects can be trained to significantly lower their neutrophil count by relaxing for 20 minutes and visualizing their neutrophils leaving the blood stream.

The drop in adherence was in the opposite of the expected direction, since subjects were asked to visualize their neutrophils getting stickier. One possible explanation for this finding is that the most adherent cells were unavailable for sampling by venapuncture because they were part of the 38 percent that had marginated and/or left the blood stream. Thus, the decrease in adherence might be related to the drop in white blood cell count.

There was no significant neutrophil shape change. Again, it is possible that some neutrophils did change shape and left the blood stream, in which case they would be unobtainable for the post-imagery sample. Another explanation is that, biochemically, there are separate pathways that lead to adherence and shape change, so that imagery might affect one function and not the other.

Imagery Ratings

The results support the hypothesis that imagery ratings would correspond with changes in neutrophil function. It appears, therefore, that effective imagery is related to neutrophil function changes. Specifically, ratings of overall effectiveness and of the symbolic nature of the imagery show the strongest relationship to changes in white blood cells. This finding is consistent with the Achterberg and Lawlis study (1978) which found a high correlation between symbolism of imagery and change in cancer status. It would

appear that the more individuals are able to visualize their white blood cells in an abstract and symbolically meaningful manner, the more the blood cells are affected. Perhaps, as the literature suggests, imagery has a healing effect because it integrates left and right brain functions (Bry, 1979; Achterberg & Lawlis, 1980; Jaffe, 1980; Simonton, Simonton & Creighton, 1978). Therefore, subjects who are able to transform factual information (a left brain function) into playful, abstract symbolic images (a right brain function) are able to achieve a greater physiological effect. This interpretation is consistent with contemporary explanations of the imagery experience (Gunnison, 1982). The imagery experience involves both left and right brain functions in a synergistic way so as to alter basic physiological functions. The finding is also supported by the results of Meichenbaum and Turk's "stress-inoculation training" procedure where imagery was the most effective of three strategies taught to subjects for reducing pain (1976).

The correlations between imagery ratings and adherence was in the opposite of the expected direction. Again, as with the drop in adherence of white blood cells, this finding might be explained by the drop in neutrophil count, i.e., the adherent cells either left the blood stream or became marginated, thereby becoming inaccessible to sampling by venapuncture. The results do suggest, however, that effective imagery is related to marked change in adherence of the neutrophils.

One unexpected and surprising finding is the correlations between imagery ratings and control adherence values. Although

these correlations could have occurred by chance, this finding is consistent with the Achterberg and Lawlis study (1978) which found significant correlations between imagery ratings and cancer status two months later. One possible explanation for both findings is that the imagery ratings may reflect a relatively enduring characteristic of the individual, i.e., their capacity for effective imagery. This idea is supported by the nature of the training process which was geared toward helping subjects learn how to image as effectively as possible. All subjects received the same training, yet sizeable differences were obtained.

Personality Measures

Some significant correlations were found between Wellness scores and the blood measures. The highest number of correlations were clustered in the productivity and auto safety categories. The significant correlations were somewhat randomly distributed among the blood function measures, and both positive and negative correlations were found.

The lack of consistent findings might be due to several factors. The sample size was small (n = 16) and restricted in range. All of the subjects were self-selected, educated, and highly motivated. This homogeneous group undoubtedly scored more similarly on the three measures than a more heterogeneous sample would have scored. A second limiting factor is the somewhat low reliability and validity of the measures in terms of individuals. The Internal versus External Control of Reinforcement Scale, for example, has not

demonstrated high discriminant ability for individuals (Rotter, 1966). A larger and more heterogeneous sample, however, might offset this second limitation.

IMPLICATIONS FOR FUTURE RESEARCH

The results of the preliminary investigations and of this study seem significant enough to warrant further investigation. Current research indicates that neutrophils are an important part of the body's defense system. The results of this study suggest that a 20 minute relaxation/imagery experience can alter certain functions of neutrophils. If this is the case, the number of possible implications in terms of healing benefits and increased awareness of mind-body connections is virtually limitless. Further research is necessary, however, before any cause-and-effect relationships can be established.

Future research might include a replication of this study, increasing the power by using a larger sample, and then varying the imagery instructions. Such a study has been conducted at Michigan State University subsequent to this one (Smith, Schneider & Whitcher, 1981). The same 16 subjects plus an additional 16 subjects participated. All conditions were exactly the same except the subjects were asked, during training and the imagery session, to imagine their neutrophils getting stickier but staying in the blood stream. As expected, there was little change in white blood cell count and adherence increased significantly (40-58%). The two studies together suggest that relaxation alone was not responsible for the blood

changes, since by varying one aspect of the imagery procedure, very different results in white blood cell count and adherence of neutrophils were obtained. Apparently the content of the imagery process is an important variable in affecting neutrophil function.

Another interesting finding is that the drop in white blood cell count was highly specific to neutrophils. It is possible that specific types of cells, like neutrophils, could be the focus of an imagery training procedure, and reveal shifts in availability and function as a result. Replications with other types of white blood cells would further understanding of this effect. Other variations of this study might include measuring white blood cell functions at various points in time--i.e., 5, 10, or 15 minutes--or comparing imagery with other altered states of consciousness such as hypnosis.

The correlations between imagery ratings and control blood samples suggest that some persons may be more capable of effective imagery than others. Further studies which examine the nature of these response capabilities would help clarify this question. Such studies might take into account the relationship of factors such as personality characteristics, stress, depression, and creativity to imagery ability.

An unresolved issue is the extent to which the imagery experience or the placebo effect or some combination thereof produced the results of this study. Numerous studies have demonstrated the power of expectancies (Volgyesi, 1954; Beecher, 1961; Jaffe, 1980). Although some believe that imagery is the basis for the placebo effect (Achterberg & Lawlis, 1980), it is possible that the placebo

effect is the basis for guided imagery. It seems probable that both are interrelated factors. This study utilized both the placebo effect and the imagery experience to attempt to produce changes in neutrophil function. Further investigations which control for the placebo effect would help to clarify the contribution of these independent variables. For example, to determine the effect of imagery alone, an investigator might replicate this study without telling subjects what to expect, thereby controlling for the placebo effect.

In addition, the question of generalizability beyond a highly motivated, healthy, educated sample is unanswered. It would be interesting to replicate this study using a larger and more heterogeneous sample. This study may have demonstrated that subjects could self-select for their capacity to engage in this type of imagery, since all 16 subjects achieved a drop in their white blood cell count. The capacity of individuals to realize more of their bodies' potential deserves further study.

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APPENDICES

APPENDIX A

CONSENT FORM, DEMOGRAPHIC DATA FORM, AND PERSONALITY INVENTORIES

Michigan State University

Department of Psychiatry

1. I have freely consented to take part in a scientific study being conducted

   by: Christy Minning

   under the supervision of: John Schneider, Ph.D.

   Academic title: Associate Professor of Psychiatry

2. I agree to donate a maximum of 30 c.c. of whole blood per venapuncture, and no more than 55 c.c. in a 24 hour period for this scientific study. Blood samples will be taken up to a maximum of 5 times.

3. I have no known health problem for which blood donations might be detrimental, and I will report any change in my health, or blood donations given elsewhere before any donation.

4. I understand that in the unlikely event of physical injury resulting from research procedures, Michigan State University, its agents, and employees will assume that responsibility as required by law. Emergency medical treatment for injuries or illness is available where the injury or illness is incurred in the course of an experiment. I have been advised that I should look toward my own health insurance program for payment of said medical expenses.

5. I will not participate in the Exercise Condition unless I have been jogging for a minimum duration of 20 minutes at least three days per week for the previous six months.

6. The study has been explained to me and I understand the explanation that has been given and what my participation will involve.

7. I have not been coerced in any way to participate in this experiment and I understand that I am free to discontinue my participation in the study at any time without penalty.

8. I understand that the results of the study will be treated in strict confidence and that I will remain anonymous. Within these restrictions, results of the study will be made available to me at my request.

9. I understand that my participation in the study does not guarantee any beneficial results to me.

10. I understand that, at my request, I can receive additional explanation of the study after my participation is completed.

Signed _____

Date _____

Demographic Data

1. **Name** _____

2. **Sex** _____M _____F

3. **Age** _____

4. **Occupation** _____

5. **Educational level** _____

6. **What exposure, if any, have you had to wholistic health?**

7. **Why did you volunteer for this research?**

8. **Diet (check one):** _____ organic
   _____ vegetarian
   _____ other **Explain:** _____

   Have you taken any dietary supplements during the past week? (vitamins, etc.) ____
   If so, what? _____ **How much?** _____

9. **Are you currently under much stress?** _____ **Explain:**

10. **Are you taking medication for anything? (includes birth control pills)** _____
    If so, what? _____

11. **Have you consumed any alcohol during the past 24 hours?** _____
    If so, how much? _____

* for college students

THE JENKINS ACTIVITY SURVEY

Form T *

Medical research is trying to track down the causes of several diseases which are attacking increasing numbers of people. This survey is part of such a research effort.

Please answer the questions on the following pages by marking the answers that are true for you. Each person is different, so there are no "right" or "wrong" answers. Of course, all you tell us is strictly confidential—to be seen only by the research team. Do not ask anyone else about how to reply to the items. It is your personal opinion that we want.

Your assistance will be greatly appreciated.

For each of the following items, please circle the number of the ONE best answer:

1. Do you ever have trouble finding time to get your hair cut or styled?

   1. Never 2. Occasionally 3. Almost always

2. Does college "stir you into action"?

   1. Less often than most college students 2. About average
   2. More often than most college students

3. Is your everyday life filled mostly by

   1. Problems needing solution 3. A rather predictable routine of events
   2. Challenges needing to be met 4. Not enough things to keep me interested or busy

4. Some people live a calm, predictable life. Others find themselves often facing unexpected changes, frequent interruptions, inconveniences or "things going wrong". How often are you faced with these minor (or major) annoyances or frustrations?

   1. Several times a day 3. A few times a week 5. Once a month or less
   2. About once a day 4. Once a week

5. When you are under pressure or stress, do you usually:

   1. Do something about it immediately
   2. Plan carefully before taking any action

6. Ordinarily, how rapidly do you eat?

   1. I'm usually the first one finished 3. I eat at about the same speed as most people
   2. I eat a little faster than average 4. I eat more slowly than most people

7. Has your spouse or some friend ever told you that you eat too fast?

   1. Yes, often 2. Yes, once or twice 3. No, no one has told me this

8. How often do you find yourself doing more than one thing at a time, such as working while eating, reading while dressing, figuring out problems while driving?

   1. I do two things at once whenever practical
   2. I do this only when I'm short of time
   3. I rarely or never do more than one thing at a time

For each of the following items, please circle the number of the one best answer:

9. When you listen to someone talking, and this person takes too long to come to the point, do you feel like hurrying him along?

   1. Frequently 2. Occasionally 3. Almost never

10. How often do you actually "put words in his mouth" in order to speed things up?

   1. Frequently 2. Occasionally 3. Almost never

11. If you tell your spouse or a friend that you will meet them somewhere at a definite time, how often do you arrive late?

   1. Once in a while 2. Rarely 3. I am never late

12. Do you find yourself hurrying to get places even when there is plenty of time?

   1. Often 2. Occasionally 3. Rarely or never

13. Suppose you are to meet someone at a public place (street corner, building lobby, restuarant) and the other person is already 10 minutes late. Will you

   1. Sit and wait?
   2. Walk about while waiting?
   3. Usually carry some reading matter or writing paper so you can get something done while waiting?

14. When you have to "wait in line", such as at a restaurant, a store, or the post office, do you

   1. Accept it calmly?
   2. Feel impatient but do not show it?
   3. Feel so impatient that someone watching could tell you were restless?
   4. Refuse to wait in line, and find ways to avoid such delays?

15. When you play games with young children about 10 years old, how often do you purposely let them win?

   1. Most of the time 2. Half the time 3. Only occasionally 4. Never

16. Do most people consider you to be

   1. Definitely hard-driving and competitive?
   2. Probably hard-driving and competitive?
   3. Probably more relaxed and easy going?
   4. Definitely more relaxed and easy going?

17. Nowadays, do you consider yourself to be

   1. Definitely hard-driving and competitive?
   2. Probably hard-driving and competitive?
   3. Probably relaxed and easy going
   4. Definitely more relaxed and easy going?

18. How would your spouse (or closest friend) rate you?

   1. Definitely hard-driving and competitive?
   2. Probably hard-driving and competitive?
   3. Probably more relaxed and easy going?
   4. Definitely more relaxed and easy going?

3

For each of the following items, please circle the number of the ONE best answer:

19. How would your spouse (or best friend) rate your general level of activity?
    1. Too slow. Should be more active
    2. About average. Is busy much of the time.
    3. Too active. Needs to slow down.

20. Would people who know you well agree that you take your work too seriously?
    1. Definitely yes 2. Probably yes 3. Probably no 4. Definitely no

21. Would people who know you well agree that you have less energy than most people?
    1. Definitely yes 2. Probably yes 3. Probably no 4. Definitely no

22. Would people who know you well agree that you tend to get irritated easily?
    1. Definitely yes 2. Probably yes 3. Probably no 4. Definitely no

23. Would people who know you well agree that you tend to do most things in a hurry?
    1. Definitely yes 2. Probably yes 3. Probably no 4. Definitely no

24. Would people who know you well agree that you enjoy "a contest" (competition) and try hard to win?
    1. Definitely yes 2. Probably yes 3. Probably no 4. Definitely no

25. Would people who know you well agree that you get a lot of fun out of your life?
    1. Definitely yes 2. Probably yes 3. Probably no 4. Definitely no

26. How was your "temper" when you were younger?
    1. Fiery and hard to control
    2. Strong, but controllable
    3. No problem
    4. I almost never got angry

27. How is your "temper" nowadays?
    1. Fiery and hard to control
    2. Strong, but controllable
    3. No problem
    4. I almost never get angry

28. When you are in the midst of studying and someone interrupts you, how do you usually feel inside?
    1. I feel O.K. because I work better after an occasional break
    2. I feel only mildly annoyed
    3. I really feel irritated because most such interruptions are unnecessary

29. How often are there deadlines in your courses? (If deadlines occur irregularly, please circle the closest answer below).
    1. Daily or more often
    2. Weekly
    3. Monthly
    4. Never

30. Do these deadlines usually
    1. Carry minor pressure because of their routine nature?
    2. Carry considerable pressure, since delay would upset things a great deal?

31. Do you ever set deadlines or quotas for yourself in courses or other things?
    1. No 2. Yes, but only occasionally 3. Yes, once per week or more

(Remember, the answers on these questionnaires are confidential information and will not be revealed to officials of your university).

32. When you have to work against a deadline, is the quality of your work

1. Better? 2. Worse? 3. The same? (Pressure makes no difference)

33. In school do you ever keep two projects moving forward at the same time by shifting back and forth rapidly from one to the other?

1. No, never 2. Yes, but only in emergencies 3. Yes, regularly

34. Do you maintain a regular study schedule during vacations such as Thanksgiving, Christmas, or Easter?

1. Yes 2. No 3. Sometimes

35. How often do you bring your work home with you at night or study materials relative to your courses?

1. Rarely or never 2. Once a week or less often 3. More than once a week

36. How often do you go the University when it is officially closed (such as night or weekends)? If this is not possible, circle here: 0

1. Rarely or never
2. Occasionally (less than once a week)
3. Once or more a week

37. When you find yourself getting tired while studying, do you usually

1. Slow down for a while until your strength comes back
2. Keep pushing yourself at the same pace in spite of the tiredness

38. When you are in a group, do the other people tend to look to you to provide leadership?

1. Rarely
2. About as often as they look to others
3. More often than they look to others

39. Do you make yourself written lists of "things to do" to help you remember what needs to be done?

1. Never 2. Occasionally 3. Frequently

IN EACH OF THE FOLLOWING QUESTIONS, PLEASE COMPARE YOURSELF WITH THE AVERAGE STUDENT AT THE UNVERISTY. PLEASE CIRCLE THE MOST ACCURATE DESCRIPTION.

40. In amount of effort put forth, I give

Much more effort	A little more effort	A little less effort	Much less effort

41. In sense of responsibility, I am

Much more responsible	A little more responsible	A little less responsible	Much less responsible

-5-

IN EACH OF THE FOLLOWING QUESTIONS, PLEASE COMPARE YOURSELF WITH THE AVERAGE STUDENT AT YOUR UNIVERSITY. PLEASE CIRCLE THE MOST ACCURATE DESCRIPTION.

42. I find it necessary to hurry

Much more of the time	A little more of the time	A little less of the time	Much less of the time

43. In being precise (careful about detail), I am

Much more precise	A little more precise	A little less precise	Much less precise

44. I approach life in general

Much more seriously	A little more seriously	A little less seriously	Much less seriously

Thank you for your cooperation.

* for employed persons

Please answer the questions on the following pages by marking the answers that are true for you. Each person is different, so there is no "right" or "wrong" answer. Of course, all you tell us is strictly confidential—to be seen only by the research team. Do not ask anyone else about how to reply to the items. It is your personal opinion that we want.

Your assistance will be greatly appreciated.

THE JENKINS ACTIVITY SURVEY (FORM T)*

For each of the following items, please circle the number of the ONE best answer:

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   1. Never 2. Occasionally 3. Almost always
2. Does work "stir you into action"?
   1. Less often than most working adults
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   3. More often than most working adults
3. Is your everyday life filled mostly by
   1. Problems needing solution
   2. Challenges needing to be met
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4. Some people live a calm, predictable life. Others find themselves often facing unexpected changes, frequent interruptions, inconveniences or "things going wrong". How often are you faced with these minor (or major) annoyances or frustrations?
   1. Several times a day
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   4. Once a week
   5. Once a month or less
5. When you are under pressure or stress, do you usually
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   1. I'm usually the first one finished
   2. I eat a little faster than average
   3. I eat at about the same speed as most people
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7. Has your spouse or some friend ever told you that you eat too fast?
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12. Do you find yourself hurrying to get places even when there is plenty of time?

   1. Often 2. Occasionally 3. Rarely or never

13. Suppose you are to meet someone at a public place (street corner, building lobby, restaurant) and the other person is already 10 minutes late. Will you

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   2. Walk about while waiting?
   3. Usually carry some reading matter or writing paper so you can get something done while waiting?

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   1. Accept it calmly?
   2. Feel impatient but do not show it?
   3. Feel so impatient that someone watching could tell you were restless?
   4. Refuse to wait in line, and find ways to avoid such delays?

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17. Nowadays, do you consider yourself to be

   1. Definitely hard-driving and competitive? 3. Probably more relaxed and easy-going?
   2. Probably hard-driving and competitive? 4. Definitely more relaxed and easy-going?

18. How would your spouse rate you?

   1. Definitely hard-driving and competitive? 3. Probably relaxed and easy-going?
   2. Probably hard-driving and competitive? 4. Definitely relaxed and easy-going?

For each of the following items, please circle the number of the ONE best answer:

19. How would your spouse rate your general level of activity?
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21. Would people who know you well agree that you have less energy than most people?
    1. Definitely Yes 2. Probably Yes 3. Probably No 4. Definitely No

22. Would people who know you well agree that you tend to get irritated easily?
    1. Definitely Yes 2. Probably Yes 3. Probably No 4. Definitely No

23. Would people who know you well agree that you tend to do most things in a hurry?
    1. Definitely Yes 2. Probably Yes 3. Probably No 4. Definitely No

24. Would people who know you well agree that you enjoy "a contest" (competition) and try hard to win?
    1. Definitely Yes 2. Probably Yes 3. Probably No 4. Definitely No

25. Would people who know you well agree that you get a lot of fun out of your life?
    1. Definitely Yes 2. Probably Yes 3. Probably No 4. Definitely No

26. How was your "temper" when you were younger?
    1. Fiery and hard to control
    2. Strong, but controllable
    3. No problem
    4. I almost never got angry.

27. How is your "temper" nowadays?
    1. Fiery and hard to control
    2. Strong, but controllable
    3. No problem
    4. I almost never get angry

28. When you are in the midst of working and someone interrupts you, how do you usually feel inside?
    1. I feel O.K. because I work better after an occasional break.
    2. I feel only mildly annoyed.
    3. I really feel irritated because most such interruptions are unnecessary.

29. How often are there deadlines in your work? (If deadlines occur irregularly, please circle the closest answer below)
    1. Daily or more often 2. Weekly 3. Monthly 4. Never

30. Do these deadlines usually
    1. Carry minor pressure because of their routine nature?
    2. Carry considerable pressure, since delay would upset things a great deal?

For each of the following items, please circle the number of the ONE best answer:

31. Do you ever set deadlines or quotas for yourself at work or at home?

    1. No 2. Yes, but only occasionally 3. Yes, once per week or more often

32. When you have to work against a deadline, is the quality of your work

    1. Better? 2. Worse? 3. The same? (Pressure makes no difference)

33. At work or at home do you ever keep two projects moving forward at the same time by shifting back and forth rapidly from one to the other?

    1. No, never 2. Yes, but only in emergencies 3. Yes, regularly

34. Do you maintain a regular work schedule during vacations such as Thanksgiving, Christmas, and Easter?

    1. Yes 2. No 3. Sometimes

35. How often do you bring your work home with you at night or study materials related to your work?

    1. Rarely or never 2. Once a week or less often 3. More than once a week

36. How often do you go to your place of employment when it is officially closed (such as nights or weekends)? If this is not possible, circle here: 0

    1. Rarely or never

    2. Occasionally (less than once a week)

    3. Once or more a week

37. When you find yourself getting tired while working, do you usually

    1. Slow down for a while until your strength comes back.

    2. Keep pushing yourself at the same pace in spite of the tiredness.

38. When you are in a group, do the other people tend to look to you to provide leadership?

    1. Rarely

    2. About as often as they look to others

    3. More often than they look to others

39. Do you make yourself written lists of "things to do" to help you remember what needs to be done:

    1. Never 2. Occasionally 3. Frequently

IN EACH OF THE FOLLOWING QUESTIONS, PLEASE COMPARE YOURSELF WITH THE AVERAGE EMPLOYEE AT YOUR PLACE OF EMPLOYMENT. PLEASE CIRCLE THE MOST ACCURATE DESCRIPTION.

40. In amount of effort put forth, I give

Much more effort	A little more effort	A little less effort	Much less effort

41. In sense of responsibility, I am

Much more responsible	A little more responsible	A little less responsible	Much less responsible

IN EACH OF THE FOLLOWING QUESTIONS, PLEASE COMPARE YOURSELF WITH THE AVERAGE EMPLOYEE AT YOUR PLACE OF EMPLOYMENT. PLEASE CIRCLE THE MOST ACCURATE DESCRIPTION.

42. I find it necessary to hurry

Much more of the time	A little more of the time	A little less of the time	Much less of the time

43. In being precise (careful about detail), I am

Much more precise	A little more precise	A little less precise	Much less precise

44. I approach life in general

Much more seriously	A little more seriously	A little less seriously	Much less seriously

International Opinion Survey

Below are a number of statements about various topics. They have been collected from different groups of people and represent a variety of opinions. There are no right or wrong answers to this questionnaire: for every statement there are large numbers of people who agree and disagree. Please indicate whether you agree or disagree by marking an "X" under the agree, or disagree column. If you have no opinion or can't decide, place an "X" in the no opinion column.

When you finish all 59 items, select two statements which you agree with most strongly, and two statements which you disagree with most strongly. Identify these items on the answer sheet by putting the letter "A" next to the two you agree with, and a "D" next to the two you disagree with.

Please read each item carefully and be sure that you indicate the response which most closely corresponds to the way which you personally feel.

1. I think the government owes every citizen a decent living.
2. Most students in school would not cheat even if they were sure of getting away with it.
3. When people are nice to me, it is generally because I have done something to make them that way.
4. I definitely cannot go along with the philosophy of "Eat, drink and be merry for tomorrow, who knows?"
5. What has happened to me in the past is my own fault. No one is responsible but me.
6. A good leader makes it clear to everybody what their jobs are.
7. By taking an active part in political and social affairs, the people can control world events.
8. Most students don't realize the extent to which their grades are influenced by accidental happenings.
9. Capable people who fail to become leaders have not taken advantage of their opportunities.
10. Most repairmen will not overcharge even if they think you are ignorant of their specialty.
11. I believe that the government has been taking over too many of the affairs of private industry.
12. Most parents can be relied upon to carry out their threats of punishment.

13. In the long run, people get the respect they deserve in this world.

14. Many of the unhappy things in people's lives are partly due to bad luck.

15. When people are "mean" to me, it is generally because I have done something to make them that way.

16. Using the Honor System of not having a teacher present during exams would probably result in increased cheating.

17. The average citizen can have an influence on government decisions.

18. The idea that teachers are unfair to students is nonsense.

19. A person can succeed no matter what his previous background is.

20. Most people can be counted on to do what they say they will do.

21. My political views are more liberal than most peoples'.

22. I am not as honest with myself as I should be.

23. When someone gets mad at me, I can usually do something to make him my friend again.

24. Many times we might just as well decide what to do by flipping a coin.

25. It is seldom profitable to try to be friends with someone if he doesn't want to be.

26. This country has a dark future unless we can attract better people into politics.

27. With enough effort, we can wipe out political corruption.

28. In with case of the well prepared student, there is rarely if ever such a thing as an unfair test.

29. A good leader molds the opinions of the group he is leading rather than merely following the wishes of the majority.

30. Most elected public officials are really sincere in their campaign promises.

31. Labor unions have acquired too much power in this country.

32. The United Nations will never be an effective force in keeping world peace.

33. It is hard to know whether or not a person really likes you.

34. I have often found that what is going to happen will happen.

35. Every person should be held accountable for his own actions.

36. Parents usually can be relied upon to keep their promises.

37. In the long run, the people are responsible for bad government on a national as well as a local level.

38. Sometimes I can't understand how teachers arrive at the grades they give.

39. I can seldom make other people do the things I want them to do.

40. Most of the time I can't understand why politicians behave the way they do.

41. One should not attack the political beliefs of other people.

42. If we really knew what was going on in international politics, the public would have more reason to be frightened than they now seem to be.

43. People who can't get others to like them don't understand how to get along with others.

44. I think that life is largely a gamble.

45. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

46. The judiciary is a place where we can all get unbiased treatment.

47. It is difficult for people to have much control over the things politicians do in office.

48. There is a direct connection between how hard I study and the grades I get.

49. When I make plans, I am almost certain that I can make them work.

50. Most people would be horrified if they knew how much news the public hears and see is distorted.

51. Completely free enterprise is the best policy a country can have.

52. Even though we have reports in newspapers, radio and television, it is hard to get objective accounts of public events.

53. When I get into an argument, it is sometimes my fault.

-4-

54. Most people don't realize the extent to which their lives are controlled by accidental happenings.

55. No matter how hard you try some people just don't like you.

56. Most people answer public opinion polls honestly.

57. All wars could be stopped if countries would put forth more effort to prevent them.

58. Many times exam questions tend to be so unrelated to course work that studying is really useless.

59. I can usually influence people to my way of thinking if I wish.

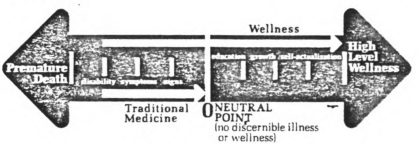
NAME _____

INSTRUCTIONS

Please put a mark in the box before each statement which is true *for you*. Total each section, then copy the subtotals to the back page. Average total scores range from 65 to 75. (If you are answering this questionnaire as part of a wellness evaluation, when the evaluation is completed, this copy of the booklet will be given to you for future reference.)

WHAT IS MEANT BY WELLNESS?

The ideas of measuring wellness and helping people attain high levels of wellness are relatively new. Most of us think in terms of illness and assume that the absence of illness indicates wellness. This is not true. There are many degrees of wellness as there are many degrees of illness. The diagram below is a model used by well medicine.



Moving from the center to the left shows a progressively worsening state of health. Moving to the right of center shows increasing levels of health and well-being. Traditional medicine is oriented towards curing evidence of disease, but usually stops at the midpoint. Well medicine begins at any point on the scale with the goal of helping a person to move as far to the right as possible.

Many people lack physical symptoms but are bored, depressed, tense, anxious or generally unhappy with their lives. These emotional states often lead to physical disease through the lowering of the body's resistance. The same feelings can also lead to abuse of the body through smoking, drinking and overeating. These behaviors are usually substitutes for other more basic human needs such as recognition from others, a stimulating environment, caring and affection from friends, and growth towards higher levels of self-awareness.

Wellness is not a static state. It results when a person begins to see himself as a growing, changing person. High level wellness means giving good care to your physical self, using your mind constructively, expressing your emotions effectively, being creatively involved with those around you, being concerned about your physical and psychological environment and becoming aware of other levels of consciousness.

This questionnaire will help to give you an idea about where you presently are on the wellness scale.

1. PRODUCTIVITY, RELAXATION, SLEEP

00 ☐ I usually enjoy my work.
01 ☐ I seldom feel tired and rundown (except after strenuous work).*
02 ☐ I fall asleep easily at bedtime.
03 ☐ I usually get a full night's sleep.
04 ☐ If awakened, it is usually easy for me to go to sleep again.
05 ☐ I rarely bite or pick at my nails.
06 ☐ Rather than worrying, I can temporarily shelve my problems and enjoy myself at times when I can do nothing about solving them immediately.
07 ☐ I feel financially secure.
08 ☐ I am content with my sexual life.
09 ☐ I meditate or center myself for 15 to 20 minutes at least once a day.*

☐ Total Checked

2. PERSONAL CARE AND HOME SAFETY

10 ☐ I take measures to protect my living space from fire and safety hazards (such as improper sized fuses and storage of volatile chemicals).
11 ☐ I have a dry chemical fire extinguisher in my kitchen and at least one other extinguisher elsewhere in my living quarters. (If very small apartment, kitchen extinguisher alone is adequate).*
12 ☐ I regularly use dental floss and a soft toothbrush.*
13 ☐ I smoke less than one pack of cigarettes or equivalent cigars or pipes *per week.*
14 ☐ I don't smoke at all (if this statement is true, mark item above true as well).
15 ☐ I keep an up-to-date record of my immunizations.
16 ☐ I have fewer than three colds per year.*
17 ☐ I minimize my exposure to sprays, chemical fumes or exhaust gases.*
18 ☐ I avoid extremely noisy areas (or wear protective ear plugs).*
19 ☐ I am aware of changes in my physical or mental state and seek professional advice about any which seem unusual.

WOMEN

100 ☐ I check my breasts for unusual lumps once a month.
101 ☐ I have a pap test annually.

MEN

102 ☐ If uncircumcised, I am aware of the special need for regular cleansing under my foreskin.
103 ☐ If over 45, I have my prostate checked annually.

☐ Total Checked

* An asterisk at the end of a statement indicates that there is a footnote for that statement on the last page.

3. NUTRITIONAL AWARENESS

20 ☐ I eat at least one uncooked fruit or vegetable each day.*
21 ☐ I have fewer than three alcoholic drinks (including beer) per week.
22 ☐ I rarely take medications, including prescription drugs.
23 ☐ I drink fewer than five soft drinks per week.*
24 ☐ I avoid eating refined foods or foods with sugar added.
25 ☐ I add little salt to my food.*
26 ☐ I read the labels for the ingredients of the foods I buy.
27 ☐ I add unprocessed bran to my diet to provide roughage.*
28 ☐ I drink fewer than three cups of coffee or tea (with the exception of herbal teas) a day.*
29 ☐ I have a good appetite and maintain a weight within 15% of my ideal weight.

☐ Total Checked

4. ENVIRONMENTAL AWARENESS*

30 ☐ I use public transportation or car pools when possible.
31 ☐ I turn off unneeded lights or appliances.
32 ☐ I recycle papers, cans, glass, clothing, books and organic waste (mark true if you do at least three of these).
33 ☐ I set my thermostat at 68° or lower in winter.
34 ☐ I use air conditioning only when necessary and keep the thermostat at 76° or higher.
35 ☐ I am conscientious about wasted energy and materials both at home and at work.
36 ☐ I use nonpolluting cleaning agents.
37 ☐ My car gets at least 18 miles per gallon. (If you don't own a car, check this statement as true).
38 ☐ I have storm windows and adequate insulation in attic and walls. (If you don't own your home or live in a mild climate, check this statement as true).
39 ☐ I have a humidifier for use in winter. (If you don't have central heating check this statement as true).*

☐ Total Checked

5. PHYSICAL ACTIVITY

40 ☐ I climb stairs rather than ride elevators.
41 ☐ My daily activities include moderate physical effort (such as rearing young children, gardening, scrubbing floors, or work which involves being on my feet, etc.).
42 ☐ My daily activities include vigorous physical effort (such as heavy construction work, farming, moving heavy objects by hand, etc.).
43 ☐ I run at least one mile twice a week (or equivalent aerobic exercise).*
44 ☐ I run at least one mile four times a week or equivalent (if this statement is true, mark the item above true as well).*
45 ☐ I regularly walk or ride a bike for exercise.
46 ☐ I participate in a strenuous sport at least once a week.
47 ☐ I participate in a strenuous sport more than once a week (if this statement is true, mark the item above true as well).
48 ☐ I do yoga or some form of stretching-limbering exercise for 15 to 20 minutes at least twice per week.*
49 ☐ I do yoga or some form of stretching exercise for 15 to 20 minutes at least four times per week (if this statement is true, mark the item above true as well).

☐ Total Checked

6. EXPRESSION OF EMOTIONS AND FEELINGS

50 ☐ I am frequently happy.
51 ☐ I think it is OK to feel angry, afraid, joyful or sad.*
52 ☐ I do not deny my anger, fear, joy or sadness, but instead find constructive ways to express these feelings most of the time.*
53 ☐ I am able to say "no" to people without feeling guilty.
54 ☐ It is easy for me to laugh.
55 ☐ I like getting compliments and recognition from other people.
56 ☐ I feel OK about crying, and allow myself to do so.*
57 ☐ I listen to and think about constructive criticism rather than react defensively.
58 ☐ I would seek help from friends or professional counselors if needed.
59 ☐ It is easy for me to give other people sincere compliments and recognition.

☐ Total Checked

7. COMMUNITY INVOLVEMENT

60 ☐ I keep informed of local, national and world events.
61 ☐ I vote regularly.
62 ☐ I take interest in community, national and world events and work to support issues and people of my choice. (If this statement is true, mark both items above true as well.)
63 ☐ When I am able, I contribute time or money to worthy causes.
64 ☐ I make an attempt to know my neighbors and be on good terms with them.
65 ☐ If I saw a crime being committed, I would call the police.
66 ☐ If I saw a broken bottle lying in the road or on the sidewalk, I would remove it.
67 ☐ When driving, I am considerate of pedestrians and other drivers.
68 ☐ If I saw a car with faulty lights, leaking gasoline or another dangerous condition, I would attempt to inform the driver.
69 ☐ I am a member of one or more community organizations (social change group, singing group, club, church or political group).

☐ Total Checked

8. CREATIVITY, SELF EXPRESSION

70 ☐ I enjoy expressing myself through art, dance, music, drama, sports, etc.
71 ☐ I enjoy spending some time without planned or structured activities.*
72 ☐ I usually meet several people a month who I would like to get to know better.
73 ☐ I enjoy touching other people.*
74 ☐ I enjoy being touched by other people.*
75 ☐ I have at least five close friends.
76 ☐ At times I like to be alone.
77 ☐ I like myself and look forward to the future.
78 ☐ I look forward to living to be at least 75.*
79 ☐ I find it easy to express concern, love and warmth to those I care about.

☐ Total Checked

9. AUTOMOBILE SAFETY

If you don't own an automobile and ride less than 1,000 miles per year in one, enter 7 points in the box at left and skip the next 10 questions. (If you ride more than 1,000 miles per year but don't own a car, answer as many statements as you can and show this copy to the car's owner.)

80 ☐ I never drink when driving.
81 ☐ I wear a lap safety belt at least 90% of the time that I ride in a car.*
81a ☐ I wear a shoulder-lap belt at least 90% of the time that I ride in a car. (If this statement is true, mark the item above true as well.)*
82 ☐ I stay within 5 mph of the speed limit.
83 ☐ My car has head restraints on the front seats and I keep them adjusted high enough to protect myself and passengers from whiplash injuries.*
84 ☐ I frequently inspect my automobile tires, lights, etc. and have my car serviced regularly.
85 ☐ I have disc brakes on my car.*
86 ☐ I drive on belted radial tires.*
87 ☐ I carry emergency flares or reflectors and a fire extinguisher in my car.
Total Checked ☐ 88 ☐ I stop on yellow when a traffic light is changing.
89 ☐ For every 10 mph of speed, I maintain a car length's distance from the car ahead of me.

10. PARENTING

If you don't have any responsibility for young children, enter 7 in the box at left and skip the next 10 questions. (If some of the questions are not applicable because your children are no longer young, answer them as you would if they were youngsters again.)

90 ☐ When riding in a car, I make certain that any child weighing under 50 pounds is secured in an approved child's safety seat or safety harness similar to those sold by the major auto manufacturers.*
91 ☐ When riding in a car, I make certain that any child weighing over 50 pounds is wearing an adult seat belt/shoulder harness.*
92 ☐ When leaving my child(ren), I make certain that the person in charge has the telephone numbers of my pediatrician or a hospital for emergency use.
93 ☐ I don't let my children ride escalators in bare feet or tennis shoes.*
94 ☐ I do not store cleaning products under the sink or in unlocked cabinets where a child could reach them.
95 ☐ I have a lock on the medicine cabinet or other places where medicines are stored.
96 ☐ I prepare my own baby food with a baby food grinder—thus avoiding commercial foods.*
☐ 97 ☐ I have sought information on parenting and raising children.
Total Checked 98 ☐ I frequently touch or hold my children.
99 ☐ I respect my child as an evolving, growing being.

ENTER SUBTOTALS ON BACK COVER

FOOTNOTES

Numbers before each statement refer to a statement above. Numbers following statements indicate references (next page).

01. Fatigue without apparent cause is not a normal condition and usually indicates illness, stress or denial of emotional expression. (14)
09. Meditation or centering greatly enhances one's sense of well being. (1, 2, 12, 13)
11. Many injuries and much damage can be prevented by putting out fires when they first start. Dry chemical or CO_2 fire extinguishers are necessary for oil, grease and electrical fires.
12. Regular flossing and using a good soft toothbrush with rounded tip bristles prevent the premature loss of teeth in one's 40s and 50s. Be sure to learn the proper techniques of use from a dental hygienist or dentist. (3)
16. If you have more than three colds a year, you may not be getting enough rest, eating a good diet or meeting other energy needs properly. (4)
17. All such toxins have a harmful effect on the liver and other tissues over long periods of time.
18. Very loud noises which leave your ears ringing can cause permanent hearing loss which accumulates and is usually not noticeable until one reaches 40 or 50. Small cushioned ear plugs (not the type designed for swimmers), wax ear plugs and accoustic ear muffs (which look like stereo headphones without wires) can often be purchased in sporting goods stores.
20. Fresh fruits and vegetables provide vitamins, minerals, trace nutrients and roughage which are often lacking in modern diets. (5, 11)
23. Soft drinks are high in refined sugar which provides only "empty" calories and usually replace foods which have more nutritional value. Artificially sweetened soft drinks consumed in excess may have long-range consequences as yet not known. (Both types of soft drinks contain caffeine or other stimulants.)
25. Salting foods during cooking draws many vitamins out of the food and into the water which is usually discarded. Heavy salting of foods at the table may cause a strain on the kidneys and result in high blood pressure. (4)
27. Wheat bran, usually removed in the commercial milling of wheat, is the single best source of dietary fiber available. The use of approximately two tablespoons per day (individual needs vary) can substantially reduce colon cancer, diverticulosis, heart disease and other conditions related to refined food diets.
28. Coffee and tea (other than herbal teas) contain stimulants which, if abused, do not allow one's body to function normally. (4)

ENVIRONMENTAL AWARENESS. Taking care of your environment affects your own wellness as well as everyone else's.

39. Humidified heated air allows one to set the thermostat several degrees lower and still feel as warm as without humidification. It also helps prevent many respiratory ailments. House plants will require less watering and will be happier too.

43, 44. Vigorous aerobic exercise (such as running) must keep the heart rate at 150 beats per minute for 12 to 20 minutes to produce the "training effect." Less vigorous aerobic exercise (lower heart rate) must be maintained for much longer periods to produce the same benefit. The "training effect" is necessary to prepare the heart for meeting extra strain. (6)

48. Such exercise prevents stiffness of joints and musculo-skeletal degeneration. It also promotes a greater feeling of well-being. (7)
51. Basic emotions, if repressed, often cause anxiety, depression, irrational behavior or physical disease. People can relearn to feel and express their emotions with a resulting improvement in their well-being. Some people, however, exaggerate emotions to control and manipulate others; this can be detrimental to their well-being. (8, 9)
52. Learning ways to constructively express these emotions (so that all parties concerned feel better) leads to more satisfying relationships and problem solving. (8, 9)
56. Crying over a loss or sad event is an important discharge of emotional energy. It is, however, sometimes used as a manipulative tool, or as a substitute expression of anger. Many males in particular have been erroneously taught that it is not OK to cry. (8)

FOOTNOTES (cont'd)

71. Spending time spontaneously without relying on an external structure can be self-renewing. (8)
73, 74. Physical touch is important for the maintenance of life for young children and remains important throughout adult life. (10)
78. With proper self care, most individuals can easily reach this age in good health.
81. Shoulder/lap belts are much safer than lap belts alone. (Shoulder belts should never be worn without a lap belt.)
83. Whiplash injuries can be prevented by properly adjusted head restraints. These are required, in the U.S., on the front seats of all autos made since 1968 but are often not raised high enough to protect passengers and driver.
85. Disc brakes provide considerably better braking power than conventional drum brakes.
86. For most cars, radial tires maintain firmer contact with the road and improve braking and handling better than bias ply tires. They also have less rolling friction and give better gas mileage.
90, 91. Over 1,000 young children a year are killed in motor vehicle accidents in the U.S. Many deaths can be prevented by keeping the child from flying about in a car crash. Most car seats do not provide enough protection—as government standards are very low. Check consumer magazines for up-to-date information. Never use an adult seat belt for a child weighing less than 50 pounds.
93. The bare feet of young children are often injured at the end of escalators. Wearing tennis shoes is equally dangerous because their sturdy long laces get pulled into the mechanism and their thin canvas walls offer little protection.
96. Commercial baby foods contain high amounts of sugar, salt, modified starches and preservatives which may adversely affect a baby's future eating habits and health. Federal legislation has been introduced to help correct this problem. Portable baby food grinders and blenders can be used to prepare for an infant the same food as eaten by the rest of the family. Individual servings can be packaged and frozen for future meals.

SCORING

Enter subtotals from each section below and compute your total score.

1	☐	PRODUCTIVITY
2	☐	CARE & SAFETY
3	☐	NUTRITION
4	☐	ENVIRONMENT
5	☐	PHYSICAL
6	☐	EMOTIONS
7	☐	COMMUNITY
8	☐	CREATIVITY
9	☐	AUTO
10	☐	PARENTING

Total _____

REFERENCES

1. *Human Life Styling* - McCamy
2. *Be Here Now* - Ram Dass
3. *The Tooth Trip* - McGuire
4. *Well Body Book* - Samuels and Bennett
5. *Nutrition Against Disease* - Williams
6. *The New Aerobics* and *Aerobics for Women* - Cooper
7. *Fundamentals of Yoga* - Mishra
8. *Born to Win* - James and Jongeward
9. *The Angry Book* - Rubin
10. *Touching* - Montague
11. *Diet for a Small Planet* - Lappe
12. *Center of the Cyclone* - Lilly
13. *The Crack in the Cosmic Egg* - Pearce
14. *Stress* - McQuade & Aiken

Copies available from:
Wellness Resource Center
42 Miller Ave.
Mill Valley, CA 94941
Single copies $1.00
Bulk rates on request.

APPENDIX B

NEUTROPHIL SLIDES

A. Comparison of red blood cells and neutrophils (arrows). The surface of the neutrophil is ruffled compared to the smooth membrane of the red blood cell.

B. A neutrophil 15 seconds after exposure to a chemotactic factor (f-Met-Phe). The ruffling becomes more exaggerated on one side.

C. A neutrophil 30 seconds after exposure to chemotactic factor.

D. A neutrophil 1 minute after exposure to the chemotactic factor. The ruffles are extending at one end (the front of the cell). A smooth tail forms behind (arrow).

Figure 1.--Human Neutrophils as Seen With the Scanning Electron Microscope. The sequence illustrates the shape change most neutrophils undergo when they sense a chemotactic stimulus. The cell develops a structural polarity which indicates the direction it will crawl.

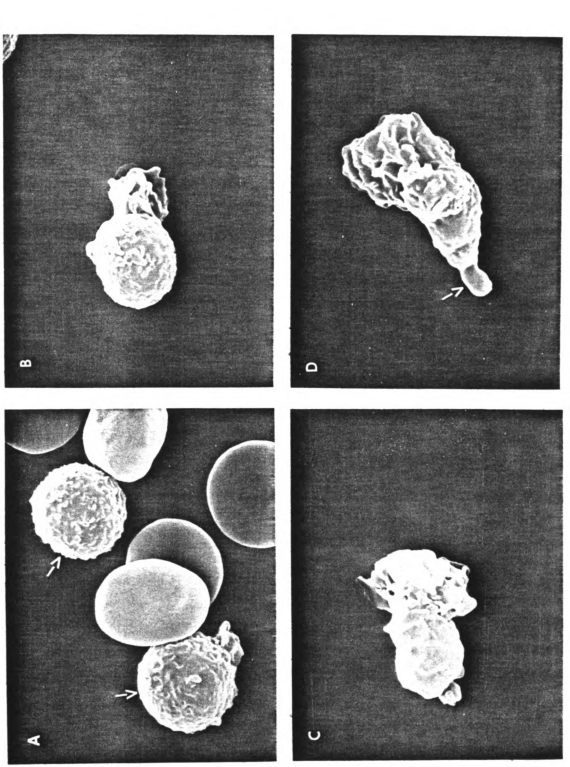


Figure 1

A and B. The structural polarity is evident. The ruffles are at the front (arrows). As the cell moves along, it pulls out small threads of cytoplasm from its tail (small arrows).

C and D. Sometimes it lifts up off the surface as if searching its environment for directional signals. The tail remains attached.

Figure 2.--Human Neutrophils Crawling on a Surface in Tissue Culture. Both Figures 1 and 2 illustrate the shape change involved in cell migration. Figure 2 illustrates the ability of the cell to adhere to a surface. It adheres in the same fashion to the cell's lining in the blood vessels (the endothelial cells).

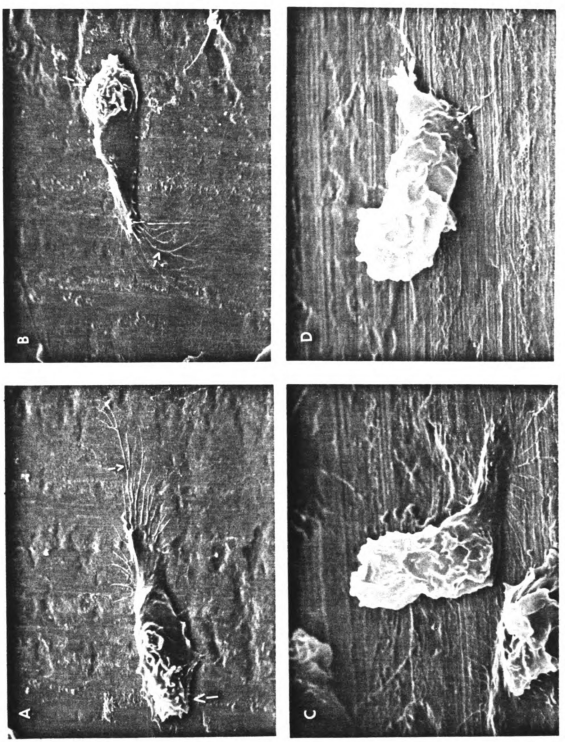


Figure 2

APPENDIX C

IMAGERY INSTRUCTIONS

APPENDIX C

IMAGERY INSTRUCTIONS

General Imagery

This is a tape that will help you relax. All you have to do is just relax and listen to the tape. Don't worry about the time because I will let you know when the time is up. Just relax and listen to the instructions on the tape.

First of all, I would like for you to be sitting in a way that you can be very relaxed and very comfortable. I will give you a few seconds to situate yourself in the chair so that your arms and legs can be relaxed and comfortable and so that your back can be supported. Lean the chair as far back as is comfortable for you.

Now I would like for you to pick a spot on the wall or ceiling, comfortably look at it, and as I count downwards from 10, I want you to continue to stare at the spot, until your eyes become very heavy. 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Now gently close your eyes and just concentrate on my voice. Take some deep breaths, breathing slowly and deeply, letting the air come in and go out. Each time you breathe out, let some of the tension leave your body. Breathe in; breathe out. As you breathe in, say to yourself--I am; as you breathe out, say to yourself--relaxed. Iam--relaxed. (Pause) Let that relaxed feeling spread all over your body. Now, think for a moment about your feet. Let all of the tension flow out of your feet. Let the muscles become

very loose and very smooth; very warm. Imagine the blood warming your feet, making them tingly. (Pause) Think for a moment about your legs, your lower legs, your calves. Let all the tension dissolve out of them, melting away, making them soft and smooth. Your upper legs, your thighs, let them become very warm. Now, at the count of 3, I would like you to be twice as relaxed as you are now. 1, 2, 3. (Pause) In your mind's eye, concentrate for a moment on your hips, letting them come very loose. And now, relax your abdomen. Just let go of all the tension in your abdomen. Let the blood flow through like the wind through the wheat, carrying good oxygen to all of your body. (Pause) Continue to breathe regularly and deeply. (Pause) Think for a moment about the many muscles in your back . . . Mentally, tell them to relax, to let go of all the tension and stress and anxiety that they may be showing. Imagine the tension knots in your back and in your shoulders dissolving, melting, going away. The muscles in your neck, relax - become very soft - just let them go. All up and down the back of your head and the top of your head, let the tension free, flowing out. Allow the tiny muscles around your eyes to relax, around your jaw. Now, if you are still feeling any pain or tension in some part of your body, I'm going to pause for a moment and let you concentrate on that area. (Pause) Just let it relax. (Pause)

Now, while your body is quiet and relaxed, imagine yourself at the seashore. Imagine a quiet, empty beach with waves gently billowing onto the sand. Experience the sand between your toes.

(Pause) the smell and taste of the salt water (Pause) and the sound of the waves as they roll in onto the sand. (Pause)

When you feel yourself very comfortable in this relaxing place, look around for a person or an animal. (Pause) If you don't see it at first, keep looking. (Pause)

When the figure appears, ask it to talk with you. (Pause)

Allow yourself to be with this figure as comfortably as you would be with a friend in your own living room. It is a part of you. It is your own creation. It is benign. It is there to help you. (Pause)

When you feel comfortable and accepting of your adviser, ask it any questions you would like to ask. (Pause)

Then wait patiently and receptively for the answer. (Pause)

If an answer doesn't come immediately, ask your adviser how you can find the answer to your question. (Pause)

Keep asking questions until you have the answers that you have sought. (Long Pause)

DUB OCEAN SOUNDS

When your answers come and you feel satisfied that they are what you sought, thank your advisor and tell it that you will return again to visit with it. (Pause)

Allow yourself to come back into the here and now of outer reality.

Allow yourself to feel good and to feel that you have found out something you wanted to know.

Allow yourself to use the information you have received with wisdom and love.

Allow yourself to return to the relaxing place where you meet with our adviser whenever you feel a need for guidance.

Now, when you're ready, slowly let the muscles in your eyelids lighten up, become ready to open your eyes, and become aware of the room around you.

Specific Imagery

This exercise will help you relax and understand how your body works. Everyone participates in his or her health or illness to some degree. You participate in your health through your beliefs, your feelings and yout attitudes toward life as well as in more direct ways, such as through exercise and diet. Your mind can help create susceptibility to illness but it can also contribute to health. Your white blood cells are a part of your body's natural defense system for controlling and defeating infectious processes such as viruses. We know that white blood cells have as a purpose getting rid of anything they see as not being a part of the self. They remember very well and can combat old forms of illness. White blood cells profit from being exercised and used. We are attempting to study the extent to which you can influence these cells, particularly the shape and movement of your white blood cells simply by visualizing them becoming more flexible and sticky, and being able to leave the blood stream and to go to the parts where they may be needed. During the next few minutes you will have an opportunity to exercise your white blood cells. All you have to do is just relax and listen. Don't worry about the time because I will let you know when the time is up. The entire process will take about 20 minutes. Just relax and listen to the instructions.

First of all I would like for you to be sitting in a way you can be very relaxed and comfortable. I'll give you a few seconds to situate yourself in the chair so that your arms and legs can be relaxed and comfortable, and so that your back and your head are supported. Lean in the chair as far back as is comfortable for you. (Pause) Now I would like for you to pick a spot on the wall or ceiling, comfortably look at it, then kind of let your eyes go soft. Take a deep breath, hold it, and then push it all out. Resume normal breathing, and just notice your breath. As I count downwards from 10, continue to stare at the spot until your eyes become very heavy. Ten, nine, eight, seven, six, five, four, three, two, one. Now gently close your eyes and just concentrate on my voice. Breathe in slowly and deeply. Breathe in warmth and heaviness and comfort. Breathe out any tension. As you breathe in, say to yourself under your breath, "I am," and as you breathe out, say to yourself, "relaxed," "I am . . . relaxed," "I am . . . relaxed." (Pause) Let any kind of thoughts that come into your head just kind of pass through and by, or any noises that you might hear just kind of note them and let them pass through. (Pause) Let your body begin to quiet down. You've let yourself quiet down, and you feel your body getting more and more quiet, and perhaps you can hear and feel your pulse, perhaps in your throat or in some other part of your body. Feel your blood pulsing, carrying warmth and relaxation throughout your body, flowing slowly throughout your body. Feel the kind of strength and power in your blood carrying soothing warmth and relaxation. (Pause) Imagine your white blood cells and feel yourself becoming a part of them. Imagine them moving

around in your blood stream. See if you can imagine your white blood cells becoming more flexible, pliant, changing shape and form, getting longer. Imagine them being able to get more sticky and adhere to various parts of the vessel wall and to each other, getting stickier and stickier so they can attach to the blood vessel wall. (Pause) Imagine the sticky cells beginning to squeeze through the blood vessel walls, going to places in the body where there is garbage collected--old cells, kind of useless, or weak and confused. Imagine your white blood cells, oh, perhaps as garbage collectors of some sort, picking up the garbage in your body and taking it away, dumping it outside your body somewhere. Continue to imagine your white blood cells becoming more flexible and sticky and moving from the blood stream. (Pause)

When you're ready, at your own pace, slowly let the muscles of your eyelids lighten up. Let the muscles of your body kind of come back to life and get light, and wiggle your toes and your fingers. And you can open your eyes and become aware of the room around you.

In a few minutes someone will come in to take another blood sample. Stay relaxed and seated until after the blood sample is taken, then someone else will be coming in to ask you a few questions about what you have been imagining.

Just let yourself relax and feel good about yourself.

APPENDIX D

IMAGERY AND LEUKOCYTE ARTICLES

1
The Mind-Body Connection: A Psychological Approach to Cancer Treatment

Everyone participates in his or her health or illness at all times.

This book will show people with cancer or other serious illnesses how they can participate in getting well again. It will also show those who are not ill how they can participate in maintaining their health.

We use the word *participate* to indicate the vital role you play in creating your own level of health. Most of us assume that healing is something done *to* us, that if we have a medical problem our responsibility is simply to get to a physician who will then heal us. That's true to a degree, but it is only part of the story.

We all participate in our own health through our beliefs, our feelings, and our attitudes toward life, as well as in more direct ways, such as through exercise and diet. In addition, our response to medical treatment is influenced by our beliefs about the effectiveness of the treatment and by the confidence we have in the medical team.

This book in no way minimizes the role of the physician and other health professionals engaged in medical treatment. Rather, *Getting Well Again* will describe what *you* can do in conjunction with medical treatment to gain the health you deserve.

Understanding how much you can participate in your health or illness is a significant first step for everyone in getting well. For many of our patients it is the critically important step. It may well be for you, too.

We are Carl and Stephanie Simonton, and we operate the Cancer Counseling and Research Center in Fort Worth, Texas. Carl, the medical director of the center, is a radiation oncologist, a physician specializing in the treatment of cancer. Stephanie is director of counseling and is trained in psychology.

Most of our patients, who come to us from all over the country, have received a "medically incurable" diagnosis from their doctors. According to national cancer statistics, they have an average life expectancy of one year. When these people believe that only medical treatment can help them — but their physicians have said that medicine is no longer of much avail and that they probably have only a few months to live — they feel doomed, trapped, helpless, and usually fulfill the doctors' expectations. But if patients mobilize their own resources and actively participate in their recovery, they may well exceed their life expectancy and significantly alter the quality of life.

The ideas and techniques described in this book are the approach we employ at our Cancer Counseling and Research Center to show cancer patients how they can participate in getting well again and live a rewarding and fulfilling life.

THE STARTING POINT: THE "WILL TO LIVE"

Why do some patients recover their health and others die, when the diagnosis is the same for both? Carl became interested in this problem while he was completing his residency as a cancer specialist at the University of Oregon Medical School. There he noticed that patients who stated they wanted to live would often act as if they did not. There were lung cancer patients who refused to stop smoking, liver cancer patients who wouldn't cut down on alcohol, and others who wouldn't show up for treatment regularly.

In many cases, these were people whose medical prognosis indicated that, with treatment, they could look forward to many more years of life. Yet while they

affirmed again and again that they had countless reasons to live, these patients showed a greater apathy, depression, and attitude of giving up than did a number of others diagnosed with terminal disease.

In the latter category was a small group of patients who had been sent home after minimal treatment, with little expectation that they would live to see their first follow-up appointment. Yet several years later, they were still arriving for their annual or semiannual examinations, remaining in quite good health, and inexplicably beating the statistics.

When Carl asked them to account for their good health they would frequently give such answers as, "I can't die until my son graduates from college," or "They need me too much at work," or "I won't die until I've solved the problem with my daughter." The common thread running through these replies was the belief that they *exerted some influence over the course of their disease.* The essential difference between these patients and those who would not cooperate was in their attitude toward their disease and their positive stance toward life. The patients who continued to do well, for one reason or another, had a stronger "will to live." This discovery fascinated us.

Stephanie, whose background was in motivational counseling, had an interest in unusual achievers — those people who in business seemed destined to go to the top. She had studied the behavior of exceptional performers and had taught the principles of that behavior to average achievers. It seemed reasonable to study cancer patients in the same way — to learn what those who were doing well had in common, and how they differed from those who were doing poorly.

If the difference between the patient who regains his health and the one who does not is in part a matter of attitude toward the disease and belief that he could somehow influence it, then, we wondered, how could we influence patients' beliefs in that positive direction? Might we be able to apply techniques from motivational psychology to induce and enhance a "will to live?" Beginning in 1969, we began looking at all the possibilities, exploring such diverse psychological

techniques as encounter groups, group therapy, meditation, mental imagery, positive thinking, motivational techniques, "mind development" courses like Silva Mind Control and Mind Dynamics, and biofeedback.

From our study of biofeedback, we learned that certain techniques were enabling people to influence their own internal body processes, such as heart rate and blood pressure. An important aspect of biofeedback, called visual imagery, was also a principal component of other techniques we had studied. The more we learned about the process, the more intrigued we became.

Essentially, the visual imagery process involved a period of relaxation, during which the patient would mentally picture a desired goal or result. With the cancer patient, this would mean his attempting to visualize the cancer, the treatment destroying it and, most importantly, his body's natural defenses helping him recover. After discussions with two leading biofeedback researchers, Drs. Joe Kamiya and Elmer Green, of the Menninger Clinic, we decided to use visual imagery techniques with cancer patients.

THE FIRST PATIENT: A DRAMATIC EXAMPLE

The first patient with whom an attempt was made to apply our developing theories was a sixty-one-year-old man who came to the medical school in 1971 with a form of throat cancer that carried a grave prognosis. He was very weak, his weight had dropped from 130 to 98 pounds, he could barely swallow his own saliva, and was having difficulty breathing. There was less than a 5 percent chance that he would survive five years. Indeed, the medical school doctors had seriously debated whether to treat him at all, since it was distinctly possible that therapy would only make him more miserable without significantly diminishing his cancer.

Carl went into the examining room determined to help this man actively participate in his treatment. This

was a case that justified using exceptional measures. Carl began treating the patient by explaining how the patient himself could influence the course of his own disease. Carl then outlined a program of relaxation and mental imagery based on the research we had been accumulating. The man was to set aside three, five- to fifteen-minute periods during the day — in the morning on arising, at noon after lunch, and at night before going to bed. During these periods he was first to compose himself by sitting quietly and concentrating on the muscles of his body, starting with his head and going all the way to his feet, telling each muscle group to relax. Then, in this more relaxed state, he was to picture himself in a pleasant, quiet place — sitting under a tree, by a creek, or anywhere that suited his fancy, so long as it was pleasurable. Following this he was to imagine his cancer vividly in whatever form it seemed to take.

Next, Carl asked him to picture his treatment, radiation therapy, as consisting of millions of tiny bullets of energy that would hit all the cells, both normal and cancerous, in their path. Because the cancer cells were weaker and more confused than the normal cells, they would not be able to repair the damage, Carl suggested, and so the normal cells would remain healthy while the cancer cells would die.

Carl then asked the patient to form a mental picture of the last and most important step — his body's white blood cells coming in, swarming over the cancer cells, picking up and carrying off the dead and dying ones, flushing them out of his body through his liver and kidneys. In his mind's eye he was to visualize his cancer decreasing in size and his health returning to normal. After he completed each such exercise, he was to go about whatever he had to do the rest of the day.

What happened was beyond any of Carl's previous experience in treating cancer patients with purely physical intervention. The radiation therapy worked exceptionally well, and the man showed almost no negative reaction to the radiation on his skin or in the mucous membranes of his mouth and throat. Halfway through treatment he was able to eat again. He gained

strength and weight. The cancer progressively disappeared.

During the course of treatment — both the radiation therapy and the mental imagery — the patient reported missing only one mental imagery session on a day when he went for a drive with a friend and was caught in a traffic jam. He was most upset, both with himself and with his friend, for in missing just that one session he felt his control over his condition was slipping away.

Treating this patient in this way was very exciting, but it was also somewhat frightening. The possibilities for methods of healing that seemed to be opening up before us went beyond anything that Carl's formal medical education had prepared him for.

The patient continued to progress until finally, two months later, he showed no signs of cancer. The strength of his conviction that he could influence the course of his own illness was evident when, close to the end of his treatment, he said to Carl: "Doctor, in the beginning I needed you in order to get well. Now I think you could disappear and I could still make it on my own."

Following the remission of his cancer, the patient decided on his own to apply the mental imagery technique to alleviate his arthritis, which had troubled him for years. He mentally pictured his white blood cells smoothing over the joint surfaces of his arms and legs, carrying away any debris, until the surfaces became smooth and glistening. His arthritic symptoms progressively decreased, and although they returned from time to time, he was able to diminish them to the point where he could go stream fishing regularly, not an easy sport even without arthritis.

In addition, he decided to use the relaxation and imagery approach to influence his sex life. Although he had suffered from impotence for over twenty years, within a few weeks of practicing the imagery techniques he was able to resume full sexual activity, and his condition in all of these areas has remained healthy for over six years.

It is fortunate that the results of this first case were as dramatic as they were, for as we began to talk openly in medical circles about our experiences and to put forward the idea that patients had a much larger influence over the course of their disease than we gave them credit for, we received strong negative reactions. Indeed, there were many times when we, too, doubted our own conclusions. Like everyone else — and particularly anyone with medical training — we had been taught to see illness as "happening" to people, without any possibility of individual psychological control over its course, or little cause-and-effect relationship between the illness and what was going on in the rest of their lives.

However, we continued to use this new approach to cancer. Although it sometimes made no difference in the illness, in most cases it made significant changes in patients' responses to treatment. Today, in the more than seven years since Carl worked with that first patient, we have evolved a number of other processes in addition to mental imagery that we have used with patients, first at Travis Air Force Base, where Carl was chief of radiation therapy, and now at our center in Fort Worth. These techniques are the basis of "Pathways to Health," Part Two of *Getting Well Again*.

A WHOLE-PERSON APPROACH TO CANCER TREATMENT

Because cancer is such a dread disease, the minute people know someone has cancer, it often becomes the person's defining characteristic. The individual may play numerous other roles — parent, boss, lover — and have numerous valuable personal characteristics — intelligence, charm, a sense of humor — but from that moment on he or she is a "cancer patient." The person's full human identity is lost to his or her cancer identity. All anyone is aware of, often including the physician, is the physical fact of the cancer, and all treatment is aimed at the patient as a body, not as a person.

It is our central premise that an illness is not purely a physical problem but rather a problem of the whole person, that it includes not only body but mind and emotions. We believe that emotional and mental states play a significant role both in *susceptibility* to disease, including cancer, and in *recovery* from all disease. We believe that cancer is often an indication of problems elsewhere in an individual's life, problems aggravated or compounded by a series of stresses six to eighteen months prior to the onset of cancer. The cancer patient has typically responded to these problems and stresses with a deep sense of hopelessness, or "giving up." This emotional response, we believe, in turn triggers a set of physiological responses that suppress the body's natural defenses and make it susceptible to producing abnormal cells.

Assuming our beliefs are essentially accurate — and much of the next seven chapters will show you why we hold them as strongly as we do — then it becomes necessary for patient and physician in working toward recovery to consider not only what is happening on a physical level but, just as importantly, what is going on in the rest of the patient's life. If the total integrated system of mind, body and emotions, which constitutes the whole person, is not working in the direction of health, then purely physical interventions may not succeed. An effective treatment program, then, will deal with the total human being and not focus on the disease alone, for that would be like trying to treat a yellow fever epidemic with sulfa alone, without also draining the ditches in which the sickness-bearing mosquitoes breed.

THE RESULTS OF THIS APPROACH

After three years of teaching patients to use their minds and emotions to alter the course of their malignancies, we decided to conduct a study aimed at distinguishing the effects of emotional and medical treatments to demonstrate scientifically that the emotional treatment was indeed having an effect.

We began studying a group of patients with malignancies deemed medically incurable. Expected survival time for the average patient with such a malignancy is twelve months.

In the past four years, we have treated 159 patients with a diagnosis of medically incurable malignancy. Sixty-three of the patients are alive, with an average survival time of 24.4 months since the diagnosis. Life expectancy for this group, based on national norms, is 12 months. A matched control population is being developed and preliminary results indicate survival comparable with national norms and less than half the survival time of our patients. With the patients in our study who have died, their average survival time was 20.3 months. In other words, the patients in our study who are alive have lived, on the average, two times longer than patients who received medical treatment alone. Even those patients in the study who have died still lived one and one-half times longer than the control group.

As of January 1978, the status of the disease in the patients still living is as follows:

	Number of patients	Percent
No evidence of disease	14	22.2%
Tumor regressing	12	19.1%
Disease stable	17	27.1%
New tumor growth	20	31.8%

Keep in mind that 100 percent of these patients were considered medically incurable.

Of course, duration of life after diagnosis is only one aspect of the disease. Of equal (or perhaps greater) importance is the quality of life while the patient survives. There are few existing objective measures of quality of life; however, one measure we keep is the level of daily activity maintained during and after treatment compared to the level of activity prior to diagnosis. At present, 51 percent of our patients maintain the same level of activity they had prior to the

diagnosis; 76 percent are at least 75 percent as active as they were prior to diagnosis. Based on our clinical experience, this level of activity for "medically incurable" patients is no less than extraordinary.

The results from our approch to cancer treatment make us confident that the conclusions we have drawn are correct — that an active and positive participation can influence the onset of the disease, the outcome of treatment, and the quality of life.

Some people may be concerned that we are offering "false hope," that by suggesting people can influence the course of their disease we are raising unrealistic expectations. It is true that the course of cancer differs so dramatically from person to person that we would not presume to offer guarantees. There is always uncertainty, as there is with standard medical procedures, but hope, we feel, is an appropriate stance to take toward uncertainty.

As we shall see in detail in future chapters, expectancy, either positive or negative, can play a significant role in determining an outcome. A negative expectation will prevent the possibility of disappointment, but it may also contribute to a negative outcome that was not inevitable.

There are no guarantees at this time that a positive expectation of recovery will be realized. But without hope the person has only hopelessness (a feeling that, as we will see, is already too much a part of the cancer patient's life and personality). We do not deny the possibility of death; indeed, we work hard with our patients to help them confront it as a possible outcome. We also work to help them believe that they can influence their condition and that their mind, body, and emotions can work together to create health.

THEORY INTO PRACTICE

Getting Well Again is divided into two major parts. The first describes the theory on which our psychological approach to cancer treatment is based; the second presents a program for recovery for patients and their

families. The chapters in Part One, "The Mind and Cancer," are not an effort to prove the validity of this approach to the scientific community. Rather, they are an effort to provide a simple, straightforward explanation so that you can evaluate for yourself whether our approach is reasonable and whether you wish to use it.

Part Two begins "Pathways to Health," the program we use with our patients at the Cancer Counseling and Research Center in Fort Worth. We urge you to try the specific techniques. Reading about them but not practicing them is no more effective than filling a prescription and not taking the pills. By participating in the program, you will participate in your health.

In the final chapter, we turn to the problems of living with a loved one who has a life-threatening disease. We describe some of the communication problems that occur, the kaleidoscope of feelings, and the possibility of increased closeness and love from the experience. If you have cancer, we not only encourage you to read this chapter but to give it to your spouse, your children, your family, and your close friends.

We invite all our readers to join us in the search for new methods for recovering from illness and maintaining health.

2
The Mysteries of Healing: The Individual and His Beliefs

The awesome technology of modern medicine casts an image of such great potency and knowledge that it is hard to believe our individual resources can make much difference. Of course, no one would responsibly dismiss the advances of medicine in this age. Its accomplishments are among the greatest products of the human mind. In cancer treatment alone, great advances have been made in radiation therapy, in sophisticated procedures for chemotherapy, and in surgical techniques. As a result of this technology, from 30 to 40 percent of all cancer patients will be "cured" of their disease.

Some cancer patients receive their treatment from machines housed in special rooms posted with signs warning of the dangers of radiation. The patients are left alone to wonder why, if the treatment is supposed to do so much good, all the medical staff members avoid it so. Other machines emit such loud noises and whines that the patient must wear earmuffs. The latest diagnostic equipment is so vast that the patient is wheeled into the machine, where scans may be taken of cross sections of the body. Surgical teams use incredibly sophisticated and expensive equipment in hours-long operations involving the most elaborate procedures. The technology is brilliant and powerful. Some cancer therapies are so potent, in fact, that patients fear the side effects of the treatment as much as the disease itself.

So much time, money, and knowledge have gone into our medical technology that it is easy to think of medical science as all-powerful. But when, in spite of everything, people still die, it is illness that seems all-powerful. The glittering machines, the giant laboratories, and the genuine medical accomplishments of our time can cause us to forget that many of the essential ingredients of healing are still mysterious. It is important that we remember the limits of our knowledge.

THE IMPORTANCE OF THE INDIVIDUAL

There is no cancer specialist who has not asked himself why one patient died whereas another, with virtually the same prognosis and the same treatment, recovered. Such a situation occurred with two patients who participated in our program. Each received the best available medical treatment. Each participated in the processes and techniques described in this book. But their responses were very different. Jerry Green and Bill Spinoza (fictitious names) had virtually identical diagnoses of lung cancer, which had also spread to the brain.

The day he received his diagnosis, Jerry resigned from life. He quit his job and, after taking care of his financial affairs, he settled in front of the television set, staring blankly hour after hour. Within twenty-four hours he was experiencing severe pain and lack of energy.

No one was able to get him interested in much of anything. He did remember that he had always wanted to make some bar stools for the house, so for a week or two he worked in his shop, with some signs of increased energy and reduced pain. But as soon as the bar stools were completed, he returned to the TV. His wife reported that he did not really watch it as much as he watched the clock, for fear that he would miss the time for taking his pain medication. Jerry showed no signs of response to radiation therapy, and within

three months he was dead. Jerry's wife later recalled that both his parents and many of his close relatives had died of cancer, and in fact, Jerry had warned her when they were first married that he would die of cancer, too.

Bill Spinoza was also diagnosed with cancer of the lung, which had spread to his brain. The prognosis for his survival and the treatment were nearly identical to Jerry's. But Bill's response to the diagnosis was very different. For one thing, he took the illness as a time to review the priorities of his life. As a traveling sales manager he had been constantly on the go and, he said, had "never taken time to see the trees." Although he continued working, he rearranged his schedule so that he could take more time to do things that were enjoyable to him.

At our clinic, he participated actively in the therapy group and regularly used a mental imagery process he had learned there. He responded favorably to radiation therapy and became virtually symptom free. All the while he remained active. Approximately a year and a half after Bill left our program, he experienced several major emotional blows and, within a short time, he suffered a recurrence and died shortly thereafter.

Both patients had had the same diagnosis, both had received the same treatment. Yet Bill outlived Jerry by more than a year and considerably outlived the medical prognosis for that form of cancer. Furthermore, the *quality* of life that Bill lived was quite different: he was involved in life, active, enjoying his family and friends. Each patient responded to his treatment in ways that are not considered typical. Jerry's decline was more precipitous than would normally be expected. On the other hand, Bill outlived his prognosis by many months.

A MYSTERIOUS RECOVERY

While Bill and Jerry's cases illustrate the differences that the individual's personality can make, the mysteries of recovery are even more dramatically illus-

trated in the case of Bob Gilley, a highly successful insurance executive from Charlotte, North Carolina. Bob had always had near-perfect health and, as a result, had never thought much about illness. For years he had been an avid racquetball player. However, in the months preceding his diagnosis Bob was aware that he was "down" emotionally, feeling discouraged and depressed about some relationships in his life. But when he went in for his annual physical examination in 1973 he was "feeling good" physically: in fact, he had played a rather strenuous hour of racquetball the morning of his exam.

By virtue of his business, Bob was very conscious of the value of regular physical exams, although he usually approached them with boredom since they had rarely turned up any signs of illness. The EKG, the X-rays, the blood work were all normal, but after a thorough examination, a lump was discovered in his groin. A surgical biopsy was scheduled for the following week.

Bob described his experience recently in a presentation to cancer patients and health professionals interested in our approach:

> I was told that there would be a very small cut, perhaps an inch in length, much like the incision in an appendectomy. However, when I woke up several hours after the biopsy, I found that they had opened my whole abdomen, both vertically and horizontally.
>
> When the surgeon arrived, he told me it was very hard to diagnose the particular kind of tissue he had removed. It was some sort of a malignant mass, but I had a good chance of pulling through it. Early the next morning the chance was changed to 50 percent. When my own doctor arrived on the scene, the diagnosis was changed again. I was given a 30 percent chance of survival.
>
> After much debate, the pathologist, the oncologist, and the surgeon finally called it a "secondary undifferentiated carcinoma." The chances for my cure were dropped to less than 1 percent.

Bob was then sent to a very large cancer clinic for chemotherapy treatment:

> It was a bizarre experience. I arrived there very weak from surgery and for an entire day sat in a waiting room with hundreds of other cancer patients. Everyone seemed to be treated very impersonally, but I'm sure it was just because of the incredible case load. I became "Undifferentiated Carcinoma in Room 351-A."
>
> When I was strong enough, I got passes for everything: passes to go for a walk in the park, passes to go to breakfast, lunch, dinner — I even got passes to go to the bathroom at the service station across the street, because it was very important for me to remain a member of the outside world and not become a patient entombed in a cancer hospital. I got more passes than anybody in the history of that clinic. I also ran my office from my hospital bed.
>
> The chemotherapy types and dosages were finally decided upon, and I was introduced to another stressful aspect of cancer. Three-quarters of the time I remained deathly ill. I lost all my hair, my appetite, and a considerable amount of weight. I was constantly nauseated, had diarrhea, burned veins [veins irritated from chemotherapy], mouth blisters, and was pallid and weak. In a very short time I looked like a reject from a concentration camp.
>
> I could tell that in the eyes of all but a few people — a very precious few who mattered — I was a dying man. During my ten months of intense chemotherapy, I was on a miracle chase, working with nutrition, vitamin therapy, faith healers, psychic readers, and so on. Many times I would scream, "Damn you, cancer! Get out of my body!"

Bob made several trips back to the cancer clinic, receiving intensive chemotherapy. At the end of a ten-month period he had reached the point where con-

tinued chemotherapy held little promise and high danger of causing deterioration of the heart muscles. And the mass in his groin had not diminished in size.

Bob heard about our program and attended one of our patient sessions in Fort Worth. Prior to the meeting he was sent some materials describing our work as well as a tape recording that taught him the mental imagery process. Although his initial stay was only for a few days, the first session gave him renewed hope. In Bob's words: "When I got off the plane in Charlotte, my wife said, 'You look different.' And I *was* different. I had hope. I had returned home full of enthusiasm and new direction."

Bob's chemotherapy was discontinued and his local oncologist evaluated him monthly. Bob found the discipline of practicing mental imagery regularly to be difficult but he kept it up. He also began to exercise regularly and soon was able to play twenty minutes of light racquetball. He began to build up slowly, regaining some of his weight. But the spectre of cancer still hung on. As he reported:

> No medical differences showed up for two, three, even four weeks. But I kept holding on to the belief that this system would work. After six weeks, I was examined by my doctor in Charlotte. As he began probing my body, I can't begin to describe the absolute terror that came over me. "Maybe it's spread!" I thought. "Maybe it's five times bigger than it was before." My doctor turned to me in amazement and said with a very tender expression, "It is considerably smaller. As a matter of fact, I would say that it's shrunk 75 percent in mass size." We rejoiced together, but cautiously.
>
> Two weeks later — which was only two months after I had met the Simontons — I was given a gallium scan and various other tests and examinations. There was absolutely no disease present, only a residual scar nodule about the size of a small marble. Within two months of beginning relaxation and imagery, I was cancer-free! My doctors in Charlotte didn't believe it.

Over the next few months Bob's energy and vitality continued to increase, until he felt his energy and vitality were as great as or greater than they had been before his diagnosis.

Bob still had a good deal of work to do. In subsequent sessions with us, he began to resolve many of the personal problems that had caused him to be emotionally "down" before the onset of the cancer. He also worked hard on changing behaviors that were interfering with his relationships. At this writing, he continues to show no evidence of cancer. In fact, he reports that:

> Today my vitality is greater than before the cancer. If I had no medical records, I could pass any insurance exam in America. I don't want to sound overly confident, because I have many down moments. Fears of the disease return when I have abdominal pain from indigestion, for instance. Sometimes I even doubt that all of this is a reality, and my logical mind says, "Maybe it was a delayed effect of the chemotherapy, or maybe it was the vitamins. Maybe there was no cancer there to begin with." But most of the time I feel very confident that this was the way for me, and it can be a way for many, many others.

Bob has done much to educate people in Charlotte about the role patients can play in overcoming cancer and has instituted a cancer counseling service known as Dayspring. He sums up his experience by saying: "I've learned a lot about my responsibility for my disease, my responsibility for healing, and about the techniques for unlocking powers that can be found within all of us."

"SPONTANEOUS" REMISSION AND THE PLACEBO EFFECT

Bob's case is dramatic because he did not appear to respond well to standard medical treatment, yet four years later he continues not to show any sign of cancer.

His turnaround could have been a delayed response to the chemotherapy, although most physicians would not predict or expect such an occurrence. We believe that his recovery had to do with Bob himself. It cannot be attributed to a normal response to medical treatment. This is an apparent case of spontaneous remission; it "just happened."

When a disease does not proceed in ways that can be explained by physical intervention, the result is called "spontaneous." The word covers today's ignorance in much the same way as the term "spontaneous generation" covered medical ignorance during the late Middle Ages. In those times, no explanation was available as to why living organisms, such as maggots, could grow out of nonliving matter, such as spoiled foods, and so it was said they were "spontaneously" generated. (It was not until 1765 that Spallanzani showed that when food was placed in airtight jars the living organisms that normally appeared in spoiled food did not appear. In other words, something in the air carried the larvae. When no air reached the food, there was no "spontaneous generation.") "Spontaneous remission," too, results from processes or mechanisms that are not yet understood.

The number of spontaneous remissions from cancer appears to be small, though all estimates are guesses because we have no idea how many such remissions take place before patients are diagnosed as having the disease. Yet however many cases there are, none of them is "spontaneous." In each case there is some kind of cause-and-effect process. The process by which spontaneous remission takes place is simply beyond our present understanding. It may be that we are unable to recognize the processes because we are not paying sufficient attention to the effect on the body of the mental and emotional aspects of human beings, including their beliefs about their illness, their treatment, and their chances for recovery.

This exclusion of beliefs and feelings from medical practice is unwarranted and in a way, surprising, because it fails to take into account the significance of what many physicians regard as one of their most

powerful drugs, the placebo. Every physician knows the effectiveness of treatments which use only a sugar pill or other medicineless preparation. This is known as the "placebo effect." A patient is told that a prescription will produce a certain beneficial side effect — and it does — even though there is no medication in the pill that could produce it.

A physician may give a placebo either because medicine is not required (for example, to a chronic complainer) or because an appropriate treatment is not available and the doctor does not want the patient to feel abandoned. (For obvious reasons, doctors do not frequently discuss placebos with their patients.) In many cases, the placebo proves to be exceedingly effective in reducing or eliminating physical symptoms, including ailments for which there are no known cures. The only active ingredient in the treatment appears to be the power of the *belief — the positive expectations* — patients have that they have received a helpful treatment. Since they believe the placebo is helpful, because the physician has created *positive expectations* about the results, the treatment does, in fact, help.

A striking illustration of the placebo effect occurred in a research study conducted with two groups of patients who had bleeding ulcers. One group was told by a physician that they were to receive a new drug that would undoubtedly produce relief. The second group was told by nurses that a new experimental drug would be administered, but that little was known about its effects. The same drug was then administered to both groups. Seventy percent of the patients in the first group showed significant improvement in their ulcers; in the second group 25 percent showed significant improvement. The only difference in treatment was the positive expectancy created in the first group by the physician.

Countless other studies have confirmed the results of positive expectancy on treatment.

- Dr. Henry K. Beecher and Dr. Louis Lasagna of Harvard University conducted a study of post-

operative pain. Some patients were given morphine, others placebos. Fifty-two percent of the people who took the morphine reported relief from pain; 40 percent who took the placebos reported relief. In other words, the placebo was more than three-quarters as effective as morphine. In fact, Drs. Beecher and Lasagna discovered that the more severe the pain, the more effective the placebo.

- Eighty-three arthritic patients were given sugar pills instead of their usual medicine, aspirin or cortisone. A second group received their usual medication. The percentage of patients who reported relief was the same among those who received the sugar pills as among those who received conventional medication. In addition, when those patients who received sugar pills but reports no relief were given placebo injections of sterile water, 64 percent reported relief or improvement. (Apparently, injections inspired greater positive expectancy than did pills, regardless of the medical value of either.)

- Medical officials at the National Institute of Geriatrics in Bucharest, Romania, conducted a study of a new drug designed to enhance health and longevity by activating the endocrine system. One hundred fifty patients were divided into three equal groups. The first group received no medication, the second received a placebo, and the third was given the new drug. The three groups were then observed for several years.

  Members of the group that received nothing had similar mortality rates and incidence of illness as people in the same age groups in the patients' geographical areas. The second group, which had received the placebo, showed a substantial improvement in health and a lower death rate than the first group. The third group,

> which had received the drug, showed about the same improvement over the placebo group that the placebo group showed over the first group. Thus, although the drug made an important difference in longevity and health, the placebo effect by itself was able to produce improvements in both the degree of illness and the length of life.

The placebo effect is not limited to the administration of sugar pills. Throughout medical history there have been countless practices, such as "bleeding" the patient (which was common during the Middle Ages), that have no physiological basis for curing but still frequently worked, apparently because everyone — including the physician — believed in their efficacy. Indeed, some surgical procedures that were in vogue during the last fifty years seemed to produce remarkable results even though we now know that, in many cases, there are serious questions about their value. Thus, patients not infrequently reported feeling much better after unnecessary hysterectomies or tonsillectomies were performed. Once again, the results can be attributed largely to the patient's belief that the treatments would work and because of his confidence in the doctor.

The placebo effect may also account for a portion of the benefit received from real medication. The effect is created both by the doctor's manner in administering the drug and also by the process by which drugs are approved by the medical profession. Everyone knows that new drugs must undergo extensive testing by pharmaceutical companies and receive approval by agencies of the federal government. These same federal agencies are also actively involved in attempting to remove harmful foods and drugs from the market, further inspiring public confidence. So when research, testing, and approval by respected federal agencies are combined with a few publicly acclaimed successes, such as the polio vaccine, the ritual for establishing so-

cial belief in medical treatment is complete, and the public comes to believe that a medicine prescribed by a doctor *must* be effective.

A most dramatic case of the placebo effect has been reported by Dr. Bruno Klopfer, a researcher involved in the testing of the drug Krebiozen. In 1950, Krebiozen had received sensational national publicity as a "cure" for cancer and was being tested by the American Medical Association and the U.S. Food and Drug Administration.

One of Dr. Klopfer's patients had lymphosarcoma, a generalized, far-advanced malignancy involving the lymph nodes. The patient had huge tumor masses throughout his body and was in such desperate physical condition that he frequently had to take oxygen by mask, and fluid had to be removed from his chest every two days. When the patient discovered that Dr. Klopfer was involved in research on Krebiozen, he begged to be given Krebiozen treatments. Klopfer did so, and the patient's recovery was startling. Within a short time the tumors had shrunk dramatically, and the patient was able to resume a normal life, including flying his private plane.

Then as AMA and FDA reports of the negative results of Krebiozen started being publicized, the patient took a dramatic turn for the worse. Thinking the circumstances extreme enough to justify unusual measures, Klopfer told his patient that he had obtained a new, superrefined, double-strength Krebiozen that would produce better results. Actually, the injections Klopfer gave were simply sterile water. Yet the patient's recovery was even more remarkable. Once again the tumor masses melted, chest fluid vanished, and he became ambulatory and even went back to flying. The patient remained symptom-free for over two months. The patient's belief alone, independent of the value of the medication, produced his recovery.

Then further stories of the AMA and FDA's tests appeared in the press: "Nationwide tests show Krebiozen to be a worthless drug in the treatment of cancer." Within a few days the patient was dead.

PSYCHOSOMATIC HEALTH

How can the placebo effect be explained? Some will dismiss it by saying the patient's illness was "psychosomatic." It was "all in his head," a figment of his "imagination," and therefore not "real."

But this is a distortion of the meaning of the word *psychosomatic*, which simply means that an illness originated as a result of, or is aggravated by, an individual's psychological processes. It does not mean that the illness is any less real because it is not solely physical in origin — if any illness ever is. An ulcer may have originated as a result of, and be aggravated by, anxiety and tension. This does not make the ulcer any less real.

While almost everyone acknowledges that there are psychosomatic factors in high blood pressure, heart attacks, headaches, and certain skin disorders, the psychosomatic connection with cancer is not generally accepted even though the idea that such connections may exist is not a new or revolutionary one. As early as 1959, Dr. Eugene P. Pendergrass, president of the American Cancer Society, emphasized the necessity of treating the whole patient, not just the physical manifestations of cancer.

> Anyone who has had an extensive experience in the treatment of cancer is aware that there are great differences among patients. . . . I personally have observed cancer patients who have undergone successful treatment and were living and well for years. Then an emotional stress such as the death of a son in World War II, the infidelity of a daughter-in-law, or the burden of long unemployment seems to have been precipitating factors in the reactivation of their disease which resulted in death. . . . There is solid evidence that the course of the disease in general is affected by emotional distress. . . . Thus, we as doctors may begin to emphasize *treatment of the patient as a whole* as well as the disease from which the patient is suffering. We may learn how to influence general body systems and through them modify the neoplasm which resides within the body.

> As we go forward . . . searching for new means of controlling growth both within the cell and through systemic influences it is my sincere hope that we can widen the quest to include the distinct possibility that within one's mind is a power capable of exerting forces which can either enhance or inhibit the progress of this disease. [Emphasis added.]

The importance of Dr. Pendergrass's view is not just that it underscores the role that psychological factors play in aggravating a disease, it also emphasizes the possibility that psychological factors, including the patient's beliefs, may be mobilized to move toward health. Not only can mental and emotional conditions originate or aggravate physical conditions, they can also contribute to health. Just as one can become psychosomatically ill, so one who is ill can move in the other direction and become psychosomatically healthy.

Although at times we may say that someone "wanted" to make himself or herself sick, psychosomatic illness is generally attributed to unconscious processes. Basically our belief has been that the unconscious aspect of psychosomatic illness made it something that was beyond our control, and therefore something that simply "happened" to us. Although the mind might make the body sick, we did not think about the degree to which we might consciously influence the mind to make the body well again.

One of the greatest advances in modern medicine, however, is the new vision that doctors and others are gaining in regard to the amount of control a person may learn to exert over the mental processes that influence a wide variety of physical processes.

BIOFEEDBACK AND THE ABILITY TO INFLUENCE HEALTH

For years Westerners have heard reports about amazing feats of physical control performed most frequently by Indian yogis. They were, it was reported, able to

stick large needles into parts of their bodies and not bleed or experience pain. Others were reported to have been buried in coffins in the ground for extended periods of time and, long after the normal consumption of air should have left them dead, emerged alive and healthy. Still other yogis were reported to be able to walk over burning coals and experience neither pain nor blistering. Most people doubted these reports or dismissed them as magician's tricks. But some researchers had learned from their own work that such reports might be true.

These exotic stories and common individual experiences are part of the impetus to the development of the new science of biofeedback. During the sixties biofeedback studies demonstrated how people could exercise substantial influence over bodily states that were formerly thought not to be subject to conscious control.

Researchers in biofeedback have discovered that it is possible for average people, not just yogis, to learn to control *voluntarily* heart rate, muscle tension, sweat-gland activity, skin temperature, and a wide range of internal physical states normally considered to be under *involuntary* control by the autonomic nervous system. The procedure by which the trainee learns to control these physical states is not very complex. Electrodes are attached to the skin of the person receiving the training so that a biofeedback machine can monitor some of his physiological functions, such as heart rate, brain waves, or muscle tension. The machine gives the trainee visual and/or sound signals that indicate what is happening to the physical function.

If, for example, you were learning how to alter your heart rate, a tone might sound at a higher frequency as the heart rate increased, and at a lower frequency as the heart rate declined. Initially, it might seem to you that the higher and lower frequency sounds were purely random, that there was no connection between what you were thinking and your heart rate. But soon you would become aware that you were experiencing certain thoughts or feelings when your heart rate declined, or that certain physical postures had an effect. Over time you would learn to exercise

sufficient control over the physiological function to raise or lower the sound (and your heart rate) pretty much as you wished.

To date, every physiological function that can be accurately and predictably measured and "fed back" to trainees has been subject to learned control. Using biofeedback, people have been taught to reduce high blood pressure, eliminate migraine headaches, control irregular heartbeats, increase and decrease blood flow, cure insomnia, and control numerous other "involuntary" physiological functions.

Elmer and Alyce Green of the Menninger Clinic, pioneers in the field of biofeedback, have reported experiments in which trainees learned to control through their own volition a single nerve cell. They believe that biofeedback technique has clearly demonstrated the physiological principle that, "Every change in the physiological state is accompanied by an appropriate change in the mental emotional state, conscious or unconscious, and conversely, *every change in the mental emotional state, conscious or unconscious, is accompanied by an appropriate change in the physiological state.*" In other words, mind, body, and emotions are a unitary system — affect one and you affect the others. As Dr. Barbara Brown, another pioneer in biofeedback research, states:

> If some medical researchers are now teaching hearts, or the minds of hearts, to reverse a pathological condition, then medicine must be learning that relationships between mind and body are more powerful than they once thought. The concept of "psychosomatic" is generally accepted as indicating the mental origin of physical pathology; research into biofeedback is the first medically testable indication that the *mind can relieve illnesses as well as create them.* [Emphasis added.]

A SYSTEM CONCEPT OF HEALTH

The results of countless placebo studies and the increasingly sophisticated use of biofeedback technology

have caused the physical orientation of medicine to begin to undergo a change. It is no longer possible to see the body as an object waiting for replacement parts from the factory. Instead we now view the mind and body as an integrated *system*.

In this view, physical treatment remains an integral and essential part of the battle with a life-threatening disease such as cancer. Yet without beliefs — those of the patient and of the medical team — to support the treatment and create an expectancy of health, the physical treatment is incomplete. Recovery is more likely when we mobilize the whole person in the direction of health.

It is this concept, that the whole person be mobilized, that creates — even demands — a role for the patient in overcoming cancer and other diseases. The limits of the patient's responsibility extend far beyond getting himself to a physician who will "fix him up." Each person can assume responsibility for examining, even altering, beliefs and feelings that do not support the treatment, that do not move in the direction of affirming life and health.

Each of the next four chapters deals with one part of this changing conception of our role in illness and health. Each draws together a few more strands that tie the system together. The starting place is a definition of cancer that will be new to many, and an increased appreciation for our own resources to influence the disease.

3
The Search for the Causes of Cancer

Many of our patients come to us puzzling over what cancer is and what causes it. Most of them wonder, "Why me?" While we can offer a definition of the disease and describe the research into its causes, it is the third question — why a particular person contracts cancer — that is the real core of this book. However, we need to deal with the first two questions to set the stage for our evidence on "why you."

WHAT IS CANCER?

Because many people have lost a loved one to cancer or heard of the horrors of cancer, they assume it is a strong and powerful invader capable of ravaging the body. Actually, cellular biology tells us the opposite is true. A cancerous cell is, in fact, a weak and confused cell.

A cancer begins with a cell that contains incorrect genetic information so that it is unable to perform its intended function. This cell may receive the incorrect information because it has been exposed to harmful substances or chemicals or damaged by other external causes, or simply because in the process of constantly reproducing billions of cells the body will occasionally make an imperfect one. If this cell reproduces other cells with the same incorrect genetic makeup, then a

5. Not having to meet their own or others' high expectations.

Now review your own list. Consider what underlying needs were met by your illness: relief from stress, love and attention, an opportunity to renew your energy, and so forth. Next, try to identify the rules or beliefs that limit you from meeting each of these needs when you are well.

One of our patients discovered that she felt a lack of physical closeness from her husband, but it was unthinkable for her simply to ask for affection and caring when she was well. Now she has given herself permission to say to her husband at any time, "I want a hug." She also learned some important things about herself as she looked at why it was so difficult to ask for physical closeness from her husband.

Ask yourself if you have been unable to allow yourself periods of release from tension. What personal beliefs stop you from giving yourself this freedom without needing the illness as justification? You might believe, for example, that it is a "sign of weakness" to give in to pressure or tension, or that it is your duty to put others' needs ahead of your own. Because these rules are mostly unconscious, this self-examination will take effort. But taking preventive action to avoid future illness is worth your time and energy. Once you begin to become aware of your internal rules and are able to see alternative ways of viewing situations, you are on the road to a healthier life.

By using the lessons of illness as a starting point, we can educate ourselves to recognize our needs and take the opportunity to satisfy them. This is the creative use of illness.

11
Learning to Relax and Visualize Recovery

The first step in getting well is to understand how your beliefs and emotional responses have contributed to your illness. The next step is to find ways of influencing those responses in support of your treatment. In this chapter we will tell you about a relaxation process for reducing the effect on your body of stress and tension associated with the onset of cancer and with the fear of the disease, which itself becomes a major source of stress. We will also show you how to use mental imagery, once you are relaxed, to create positive beliefs that will activate your body's defenses against disease.

For many cancer patients, the body has become the enemy. It has betrayed them by getting sick and threatening their lives. They feel alienated from it and mistrust its ability to combat their disease. Learning to relax and influence the body, on the other hand, helps people accept their body once again and their ability to work with it toward health. The body again becomes a source of pleasure and comfort and an important source of feedback on how effectively people are living life.

Relaxation also helps reduce fear, which can become overwhelming at times with a life-threatening disease. Cancer patients are often terrified they will die a prolonged, painful death, impoverishing their families through medical expenses, and doing their children psychological harm by the absence of a parent. Such

fears make it almost impossible for patients to develop a positive expectancy about the outcome of their illness. But learning to relax physically helps them break the cycle of tension and fear. For a few minutes at least, while they are relaxing their bodies, cancer is not the overriding reality of their lives. Many patients report that they have a different perspective and renewed energy after using relaxation techniques. It appears to be a way of recharging their batteries. With the fear reduced, it is easier to develop a more positive expectancy, resulting in a further decrease in fear.

It is important to note that, in clinical terms, relaxation does not mean spending an evening in front of the television, having a few drinks, or talking with friends. Although these certainly can be pleasurable activities, laboratory studies show that such forms of "relaxation" do *not* result in an adequate discharge of the physical effects of stress.

Regular physical exertion is one way of unstressing. Regular exercise acts out the equivalent of the "fight-or-flee" response, which we discussed in Chapter 4, permitting the body to discharge the buildup of tension. It is not accidental, in our opinion, that many patients who have done very well in our program engage in some form of regular physical exercise. Many joggers and runners say that running is their "therapy" and that during the running, they are able to get a perspective on their problems that they cannot get just by thinking about them. (Later in the book we have a chapter devoted to this subject.)

Still, it is not always possible for people to engage in physical activity whenever they feel stressed. Modern life often requires considerable effort to handle all the arrangements necessary for physical activity. Fortunately, researchers have developed a variety of simple relaxation techniques — certain forms of meditation and progressive relaxation, autogenic training, and self-hypnosis, to name a few. Most of these techniques involve some form of mental concentration. People may focus their attention on a symbol or a series of mental images designed to calm the mind, or they may

go through a series of instructions in their mind to relax the body.

Dr. Herbert Benson of Harvard University has documented the positive physical benefits of several of these techniques for reducing stress in his book, *The Relaxation Response*. Although all of the body's physiological responses to these various mental relaxation techniques may not be understood, research has amply demonstrated that the techniques discharge the effects of stress to a much greater degree than do the activities conventionally considered relaxing.

THE RELAXATION TECHNIQUE

The relaxation technique we developed while working with our patients is taken largely from a program devised by Dr. Edmond Jacobson, who calls his technique "progressive relaxation." In practice, we combine this technique with the mental imagery process we describe later in this chapter. However, we have detailed the relaxation process separately here so that you will see its value for use anytime. We recommend to our patients that they complete the combined relaxation/mental imagery activity three times a day for ten to fifteen minutes each time. Most people feel relaxed the first time they use this technique. But since relaxation is something that can be learned and improved upon, you will find that you'll enter into increasingly relaxed states as the process is repeated.

To make the relaxation/mental imagery process easier to learn, we provide our patients with a cassette tape of instructions. You may also find it helpful to have a friend read the following instructions to you or to make a tape recording of them. Allow plenty of time for completing each step in a comfortable, relaxed manner.

1. Go to a quiet room with soft lighting. Shut the door and sit in a comfortable chair, feet flat on the floor, eyes closed.

2. Become aware of your breathing.

3. Take in a few deep breaths, and as you let out each breath, mentally say the word, "relax."

4. Concentrate on your face and feel any tension in your face and eyes. Make a mental picture of this tension — it might be a rope tied in a knot or a clenched fist — and then mentally picture it relaxing and becoming comfortable, like a limp rubber band.

5. Experience your face and eyes becoming relaxed. As they relax, feel a wave of relaxation spreading through your body.

6. Tense your eyes and face, squeezing tightly, then relax them and feel the relaxation spreading throughout your body.

7. Apply the previous instructions to other parts of your body. Move slowly down your body — jaw, neck, shoulders, back, upper and lower arms, hands, chest, abdomen, thighs, calves, ankles, feet, toes — until every part of your body is relaxed. For each part of the body, mentally picture the tension, then picture the tension melting away; tense the area, then relax it.

8. When you have relaxed each part of the body, rest quietly in this comfortable state for two to five minutes.

9. Then let the muscles in your eyelids lighten up, become ready to open your eyes, and become aware of the room.

10. Now let your eyes open, and you are ready to go on with your usual activities.

If you have not already done so, we encourage you to go through this process before reading on. You can find the relaxation it produces pleasurable and energizing.

People sometimes experience difficulty picturing the mental image or keeping their minds from wandering the first few times they try the process. There's no need to feel discouraged. It's very natural and criticizing yourself will only increase your tension. At the end of this chapter, when you are more familiar with relaxation and visualization techniques, we will deal with a few of the common problems patients have with these procedures and suggest how to overcome them.

The next section provides instructions for moving directly from the relaxation process into the mental imagery process. Although the relaxation technique is valuable by itself, as we said earlier, we use it primarily as a prelude to mental imagery, because the physical relaxation reduces tension that could distract from concentrating on the mental imagery. The relaxation technique is also a prelude to mental imagery in another sense: Learning to use mental guidance to produce physical relaxation should help strengthen your belief that you can use your mind in support of your body.

RELAXATION AND MENTAL IMAGERY

Relaxation and mental imagery are among the most valuable tools we have found to help patients learn to believe in their ability to recover from cancer. In fact, we mark as the conception of our present approach the first time Carl used mental imagery with a patient. Since then, we have discovered that mental imagery is not only an effective motivational tool for recovering health, but is also an important tool for self-discovery and for making creative change in other areas of life.

We owe our discovery of the relaxation and mental imagery process to Stephanie's background in motivational psychology. Because of her training, we were

aware that this process for altering expectancies had been used by people in many different disciplines. The common thread running through these disciplines was that people created mental images of desired events. By forming an image, a person makes a clear mental statement of what he or she wants to happen. And, by repeating the statement, he or she soon comes to expect that the desired event will indeed occur. As a result of this positive expectation, the person begins to act in ways consistent with achieving the desired result and, in reality, helps to bring it about. (This is similar to the concept of self-fulfilling prophecy, which we discussed earlier in the book.)

For example, a golfer would visualize a beautiful golf swing with the golf ball going to the desired place. A business person would visualize a successful business meeting. A stage performer would visualize a smooth opening night. A person with a malignancy would picture the tumor shrinking and his body regaining health.

As we were learning of the effectiveness of the relaxation and mental imagery process, we were also learning of the evidence that biofeedback researchers were amassing (described more fully in Chapter 2), that people could learn how to control inner physiological states, such as heart rate, blood pressure, and skin temperature. When interviewed, these people frequently stated that they had not been able to command the body to alter the internal state but instead had learned a visual and symbolic language by which they communicated with the body.

One woman, who had a dangerously irregular heartbeat, created a picture in her mind's eye of a little girl on a swing. She would see the little girl rhythmically swinging back and forth whenever she needed to bring her heartbeat under control. Within a short time, she needed no heart medication and had no more difficulties. Her success and the experiences of thousands of others in using mental imagery to control body states suggested to us that mental imagery — used in conjunction with standard medical treatment — might

be a way cancer patients could influence their immune systems to become more active in fighting their illness.

Carl first used the mental imagery technique in 1971 (as we described in Chapter 1) with a patient whose cancer was considered medically incurable. The patient practiced three times a day visualizing his cancer, his treatment coming in and destroying it, his white blood cells attacking the cancer cells and flushing them out of his body, and finally imagining himself regaining health. The results were spectacular: The "hopeless" patient overcame his disease and is still alive and healthy.

THE MENTAL IMAGERY PROCESS

In this section, we will lead you through the relaxation/mental imagery process, repeating the previous instructions for relaxation. In Chapter 12, we will identify beliefs inherent in mental imagery, provide a list of criteria for creating effective imagery, and analyze examples drawn from our patients' experiences.

You may want to tape-record instructions, as we do for our patients, or have a friend read them to you. If you are reading to someone else, be sure to read slowly. Allow the other person plenty of time to complete each step. Remember that we encourage our patients to take ten to fifteen minutes to complete the entire process and to practice it three times a day.

Even if you do not have cancer, we ask you to go through the cancer visualization once to give you an emotional understanding of this process and insight into how the cancer patient feels.

1. Go to a quiet room with soft lighting. Shut the door, sit in a comfortable chair, feet flat on the floor, eyes closed.

2. Become aware of your breathing.

3. Take in a few deep breaths, and as you let out each breath, mentally say the word, "relax."

4. Concentrate on your face and feel any tension in the muscles of your face and around your eyes. Make a mental picture of this tension — it might be a rope tied in a knot or a clenched fist — and then mentally picture it relaxing and becoming comfortable, like a limp rubber band.

5. Experience the muscles of your face and eyes becoming relaxed. As they relax, feel a wave of relaxation spreading through your body.

6. Tense the muscles of your face and around your eyes, squeezing tightly, then relax them and feel the relaxation spreading through your body.

7. Move slowly down your body — jaw, neck, shoulders, back, upper and lower arms, hands, chest, abdomen, thighs, calves, ankles, feet — until every part of your body is more relaxed. For each part of the body, mentally picture the tension, then picture the tension melting away, allowing relaxation.

8. Now picture yourself in pleasant, natural surroundings — wherever feels comfortable for you. Mentally fill in the details of color, sound, texture.

9. Continue to picture yourself in a very relaxed state in this natural place for two to three minutes.

10. Then mentally picture the cancer in either realistic or symbolic terms. Think of the cancer as consisting of very weak, confused cells. Remember that our bodies destroy cancerous cells thousands of times during a normal lifetime. As you picture your cancer, realize

that your recovery requires that your body's own defenses return to a natural, healthy state.

11. If you are now receiving treatment, picture your treatment coming into your body in a way that you understand. If you are receiving radiation treatment, picture it as a beam of millions of bullets of energy hitting any cells in its path. The normal cells are able to repair any damage that is done, but the cancerous cells cannot because they are weak. (This is one of the basic facts upon which radiation therapy is built.) If you are receiving chemotherapy, picture that drug coming into your body and entering the bloodstream. Picture the drug acting like a poison. The normal cells are intelligent and strong and don't take up the poison so readily. But the cancer cell is a weak cell so it takes very little to kill it. It absorbs the poison, dies, and is flushed out of your body.

12. Picture your body's own white blood cells coming into the area where the cancer is, recognizing the abnormal cells, and destroying them. There is a vast army of white blood cells. They are very strong and aggressive. They are also very smart. There is no contest between them and the cancer cells; they will win the battle.

13. Picture the cancer shrinking. See the dead cells being carried away by the white blood cells and being flushed from your body through the liver and kidneys and eliminated in the urine and stool.

    • This is your expectancy of what you want to happen.

- Continue to see the cancer shrinking, until it is all gone.

- See yourself having more energy and a better appetite and being able to feel comfortable and loved in your family as the cancer shrinks and finally disappears.

14. If you are experiencing pain anywhere in your body, picture the army of white blood cells flowing into that area and soothing the pain. Whatever the problem, give your body the command to heal itself. Visualize your body becoming well.

15. Imagine yourself well, free of disease, full of energy.

16. Picture yourself reaching your goals in life. See your purpose in life being fulfilled, the members of your family doing well, your relationships with people around you becoming more meaningful. Remember that having strong reasons for being well will help you get well, so use this time to focus clearly on your priorities in life.

17. Give yourself a mental pat on the back for participating in your recovery. See yourself doing this mental imagery exercise three times a day, staying awake and alert as you do it.

18. Then let the muscles in your eyelids lighten up, become ready to open your eyes, and become aware of the room.

19. Now let your eyes open, and you are ready to resume your usual activities.

If you have not done so already, please take the time now to go through this mental imagery process. When

you have completed the entire exercise, draw a picture illustrating the images you created, so that you can analyze your imagery in more detail, according to the criteria and examples we will present in Chapter 12.

You needn't worry about not being able to "see" the imagery if you were able to "sense" or "imagine" or "think" it. The word describing what you were doing is much less important than the fact of your doing it. Also, if you found your mind drifting during the process, next time just bring it back gently to the imagery without being harsh on yourself. If you were aware, while going through the process, that you were unable to complete certain of the instructions because you could not believe or accept them, then you have begun to confront your attitudes about cancer and recovery. By now you know how important that recognition is.

MENTAL IMAGERY FOR OTHER ILLNESSES

Since many readers of this book do not have cancer but may want to use mental imagery to help deal with pain and other ailments, here is a short mental imagery process, which can be substituted for steps 10 through 19, the cancer portion of the previous activity.

1. Create a mental picture of any ailment or pain that you have now, visualizing it in a form that makes sense to you.

2. Picture any treatment you are receiving and see it either eliminating the source of the ailment or pain or strengthening your body's ability to heal itself.

3. Picture your body's natural defenses and natural processes eliminating the source of the ailment or pain.

4. Imagine yourself healthy and free of the ailment or pain.

5. See yourself proceeding successfully toward meeting your goals in life.

6. Give yourself a mental pat on the back for participating in your recovery. See yourself doing this relaxation/mental imagery exercise three times a day, staying awake and alert as you do it.

7. Let the muscles in your eyelids lighten up, become ready to open your eyes, and become aware of the room.

8. Now let your eyes open and you are ready to resume your usual activities.

As an example of how you can use mental imagery to deal with an illness other than cancer, if you have an ulcer, your mental picture of the ulcer might be a crater-type sore in the lining of the stomach or intestine, seeing it rough and raw. Picturing the treatment, visualize antacids coating the area, neutralizing the excess acid and having a soothing effect on the ulcer itself. Picture normal cells coming in and doubling, dividing, covering over the raw, ulcerated area. See your body's white blood cells picking up any debris and cleaning the area, making it a pink, healthy lining. The next step is to see yourself free from pain and healthy, able to deal with the stresses of life without producing ulcer symptoms.

If you have high blood pressure, you could use the imagery process to see the problem as little muscles in the walls of the blood vessels tightening down, so that it causes much higher pressure necessary for the blood to be driven through. Now, see the medication relaxing these little muscles in the blood vessels, your heart pumping evenly, with less resistance, and blood flowing smoothly through the vascular channels. See yourself as able to cope with the stresses of life without producing symptoms of tension.

If your illness is arthritis, first picture your joints very irritated and having little granules on the surfaces. Then see your white blood cells coming in, cleaning up the debris, picking up the little granules, and smoothing over the joint surfaces. Then see yourself active, doing what you like to do, free of joint pain.

When you complete one of these mental imagery processes for the first time, draw a picture of your imagery. It will help you identify your attitudes toward participating in your health.

THE VALUE OF RELAXATION AND MENTAL IMAGERY

To give you a better idea of what to expect from these exercises, the list below contains some of the benefits of the relaxation/mental imagery process.

1. The process can decrease fear. Most fear comes from feeling out of control — in the case of cancer, feeling your body is deteriorating and you are powerless. Relaxation and mental imagery help you see your role in regaining health so that you begin to sense your own control.

2. The process can bring about attitude changes and strengthen the "will to live."

3. It can effect physical changes, enhancing the immune system and altering the course of a malignancy. Since mental processes have a direct influence on the immune system and hormonal balances in the body, physical changes can be directly attributed to changes in thought patterns.

4. The process can serve as a method for evaluating current beliefs and altering those beliefs, if

desired. Alterations in the symbols and pictures that you use can dynamically alter beliefs to those more compatible with health.

5. The process can be a tool for communicating with the unconscious — where many of our beliefs are at least partially buried.

6. It can be a general tool for decreasing tension and stress. The process of regular relaxation by itself can decrease tension and stress and have a significant effect on underlying body functions.

7. The process can be used to confront and alter the stance of hopelessness and helplessness. We have seen again and again how this underlying depression is a significant factor in the development of cancer. As people begin to picture their bodies regaining health, their ability to solve the problems that existed prior to the malignancy, they weaken their sense of helplessness and hopelessness. Indeed, as the patients proceed toward health, they gain a sense of confidence and optimism.

OVERCOMING POTENTIAL PROBLEMS WITH THE MENTAL IMAGERY PROCESS

Some people are more visual than others; they think in images. Some people tend to sense things. Others feel things. Some think in words. Because of these individual differences, we have found that when we use the word "see" in our instructions to the mental imagery process, some people might instead "feel" what it is like to be well. When we would say, "See yourself becoming well," they might have the "sensation" of energy and health. It has become increasingly clear to us that a person should stay with the process or way of thinking that he or she is most comfortable with, rather

than trying to become primarily visual. In the long run, all types of thinking tend to intertwine. A person who is mostly visual will begin to become more feeling, and a person who is more feeling will begin to become more visual. Permit yourself to operate first in the sense that is most natural to you.

Another problem we have found to be very common during mental imagery is the tendency for a person's mind to wander. This often represents a lack of concentration, which can be aggravated by certain medications, by pain, or fear. From time to time it is a problem that affects everyone using the process regularly. One of the most effective ways for dealing with distraction is to stop the process and ask yourself what is going on: "Why is my mind wandering?" Pursue that line of thought for a short time, perhaps five minutes. Then focus back on the exercise and go through it with whatever degree of success you can attain.

A third difficulty is the feeling that saying the cancer is "shrinking" is actually lying to yourself. We've heard statements such as, "I've got a cancer growing on my shoulder, I can feel it, it's not possible for me to see it shrinking when I know it's growing bigger." The problem here is a confusion about the purpose of the mental imagery process. We are attempting to help the patient visualize the *desired outcome*, not what may be happening at the time. It is possible to picture the cancer shrinking even when in reality it may be growing; you are picturing in your mind what you want to come about. Understanding this distinction is very important. Mental imagery is not a method of self-deception; it is a method for self-direction.

Now that you know the basic relaxation/mental imagery process, the next chapter will help you interpret and develop specific mental images so that you can understand your underlying beliefs about cancer and create a more positive expectancy for recovery.

12
The Value of Positive Mental Images

We first began using mental imagery to motivate patients and provide them with a tool for influencing their immune systems, but we soon discovered that the activity revealed extremely important information about patients' beliefs. This discovery was somewhat accidental. When we first began assigning the mental imagery process, we would ask our patients whether they were practicing it regularly, but we did not try to ascertain *what* their imagery was. However, when one patient's condition went steadily downhill, even though he steadfastly maintained he was using the process three times a day, we asked him specifically to describe the content of his imagery.

His answer confirmed our fears. When asked what his cancer looked like, he said, "It looks like a big black rat." When asked how he envisioned his treatment, which consisted of chemotherapy in the form of small yellow pills, he replied, "I see the little yellow pills going into my bloodstream, and once in a while the rat eats one of these pills." Asked what happened when the rat ate the pills, he said, "Well, he's sick for a while, but he always gets better, and then he bites me all the harder." When we asked about his white blood cell imagery, he replied, "They look like eggs in an incubator. You know how eggs sit under the warm light? Well, they're incubating in there, and one day they're going to hatch."

The imagery paralleled his deteriorating condition. First of all, the cancer was strong and powerful — a "big black rat." The treatment was weak and impotent, "tiny pills" that the rat ate only occasionally and that had only a temporary effect on him. Finally, the white blood cells, the representatives of the body's natural defenses, were completely immobile. Our patient had created an almost perfect image of total suppression of the immune system and had been faithfully repeating this imagery three times a day.

We soon discovered that other patients also showed strongly negative expectancies in their imagery. One patient reported that, "I visualize my cancer as a big rock. Every once in a while, these little scrub brushes come to clean up around the edges of the rock, but they can't do much good." Again, the cancer appeared strong and impregnable while the body's defenses were puny and impotent, unable to "do much good."

Another patient reported that he saw his white blood cells "as a snowstorm that sweeps over my whole body and obliterates most of the cancer cells in a single pass, but a few pop back." Here the body's defenses appeared to be more potent, but they did not really destroy the cancer cells, they only glossed over them. Moreover, since snowflakes have no directionality or intelligence, this imagery revealed that the patient did not see his body's defenses as actually recognizing and destroying the cells: their impact was by sheer numbers.

These experiences made us realize how important it was to examine the contents of our patients' imagery closely to see what expectancies were being communicated. Since then, we have used the significance of the imagery to determine whether patients show a general pattern of glossing over, or trying to hide, negative feelings or otherwise impede their treatments.

We have also discovered that the content of the imagery varies with the patient's psychological state at a particular time. For instance, the scientist John Browning, whose case was reported in Chapter 10, had developed a strong mental image for his white blood cells

(see Figure 3), visualizing them as a vast army of white knights on white horses who would line up, their lances gleaming in the sunlight, and charge through the landscape killing the cancer cells, which were small, slow-moving creatures.

But just prior to his two recurrences, John found his imagery changing. Sometimes he visualized black knights in the ranks of his army, which he took to mean enemy knights. At other times he imagined his knights' lances bent and limp, as if made of rubber, so that clearly they could do no damage. Or the knights' horses would be the size of dogs, so that they were ungainly and ineffective. We were soon able to observe a correlation between the imagery and events in John's life, and we realized that the imagery could be used as general feedback on his psychological progress.

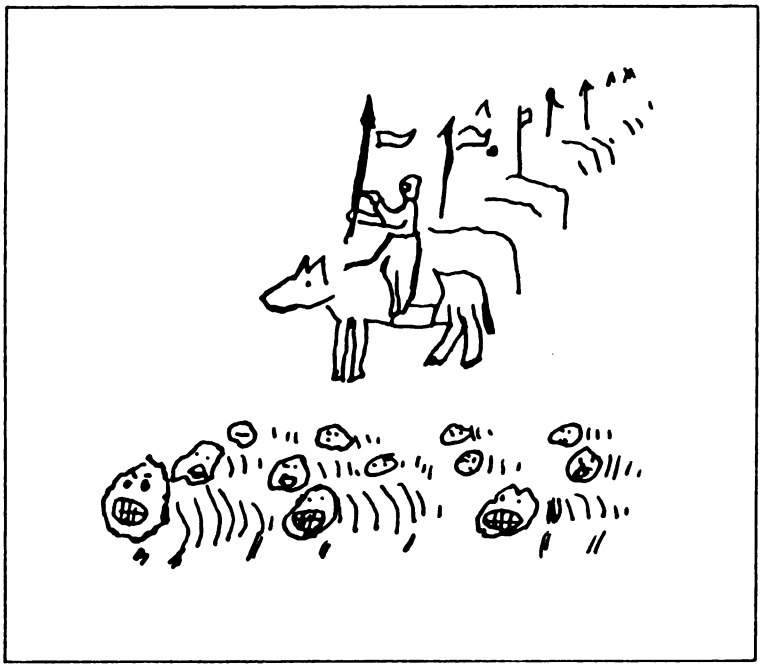


Figure 3. John Browning's Mental Imagery: White Knights, on White Horses.

THE CRITERIA FOR EFFECTIVE IMAGERY

With the assistance of Dr. Jean Achterberg-Lawlis, a research psychologist, we have developed a list of tentative criteria that can be used to evaluate the content of one's mental imagery. In our treatment center, patients use the criteria to analyze each other's imagery and to suggest alternatives that contain more positive expectancies. Representing cancer cells as ants, for instance, we have found is generally a negative symbol. Have you ever been able to get rid of the ants at a picnic? Crabs, the traditional symbol for cancer, and other crustaceans are also negative symbols. These beasts are tenacious, they hang on. They also have hard shells, making them relatively impregnable, and most people are afraid of them — the crab symbolizes the potency and the fear of the disease.

Interpreting mental imagery is similar to interpreting dreams: It involves a highly personal, symbolic language. To translate the beliefs inherent in an image, then, you must "try on" the image internally, identifying the meaning of its characteristics for you. The emotional meaning of a particular symbol may vary greatly for different individuals, so that a symbol that means strength and power to you may mean anger and hostility to someone else. Thus, you should not automatically accept anyone else's interpretation of your symbols. And, of course, your imagery need not be literally correct: there are no ants, crabs, white knights, or black rats crawling around in your body. Whatever the image, its importance lies in the meaning it holds for you, a meaning which, in this circumstance, it is up to you to recognize. Our experience has been that patients have a good feel for this kind of interpretation.

Despite all the potential for individual variations, our research indicates that effective images generally contain the features listed below. But because imagery is highly individual, what we are pointing out are the significant *qualities* of the symbols, not the symbols themselves. We will deal with problems related to effective mental imagery in the next section.

1. **The cancer cells are weak and confused.** It is important to depict your cancer cells as anything soft that can be broken down, like hamburger meat or fish eggs.

2. **The treatment is strong and powerful.** Your imagery should communicate the belief that the treatment is clearly capable of destroying the cancer. The imagery is strengthened if there is ample interaction between the treatment and the cancer, so that the impact of the treatment on the cancer is visible and understandable.

   For example, if the cancer is pictured as a gray glob of cells, the treatment might be a yellowish or greenish fluid that flows over the cancer, breaking it down and making it shrink so that the white blood cells can easily destroy it.

3. **The healthy cells have no difficulty repairing any slight damage the treatment might do.** Since the treatment usually touches all cells, not just the cancerous cells, you should visualize your normal, healthy cells as being strong enough so that the treatment does little damage to them, and they are capable of repairing any minimal damage. The cancerous cells are destroyed by the treatment because they are weak and confused.

4. **The army of white blood cells is vast and overwhelms the cancer cells.** The white blood cells are a symbol of your body's natural healing process, so your imagery should reflect vast numbers of these cells and great strength. The victory of the white cells over the cancer should be seen as inevitable.

5. **The white blood cells are aggressive, eager for battle, quick to seek out the cancer cells and destroy them.** Again, the white blood cells are a symbol of your own defenses — that part of

you that will help you recover — so make them intelligent, capable, strong. Visualize your white blood cells overwhelming the cancer cells, leaving no doubt about which cells are stronger.

6. **The dead cancer cells are flushed from the body normally and naturally.** Flushing dead cells from the body is a wholly natural process, requiring no special effort or magic. By imagining this process, you are communicating your confidence in your body's normal functioning.

7. **By the end of the imagery, you are healthy and free of cancer.** This image represents your desire for the final outcome: it is important that you see your body clearly as healthy, vital, and energetic.

8. **You see yourself reaching your goals in life, fulfilling your life's purpose.** This imagery communicates the fact that you have powerful reasons for living. You are confirming your confidence that you can recover and your commitment to living.

Our experience indicates that people who do very well in our program have developed imagery that matches these criteria. Yet none of our patients have started out with imagery containing all these elements. You may need to experiment before you find strong enough images to capture your new positive expectancy. Use the criteria to help you identify images that need strengthening or changing. Although it is not possible to provide a medically correct "prescription" of images, it is essential that you see your body's natural defenses triumphing over the disease. Strong images represent a strong belief in recovery.

It is important that in your imagery the most potent factor in overcoming your malignancy be your white blood cells, rather than, for example, chemotherapy.

Patients often have reported seeing the white blood cells coming in and attacking but leaving behind some cancerous cells for the chemotherapy to eliminate. This indicates a basic belief that the medicine will get them well. While we in cancer therapy appreciate that medicine can do a great deal, we believe that the body's basic defenses eliminating the cancerous cells is the essential aspect in regaining health.

OVERCOMING PROBLEMS IN YOUR MENTAL IMAGERY

Now that you are familiar with the criteria for creating effective mental imagery, let's take a closer look at the mental imagery activity you just completed, the possible beliefs inherent in those images, some of the common problems patients face in creating such images, and some of the ways they have gone about overcoming the problems.

Imagery of the Cancer Cells

If you had difficulty visualizing the cancer, this may represent a strong fear of the disease and is often accompanied by a lack of confidence that your body can naturally and normally defend against the cancer. If you had difficulty seeing the cancerous cells as weak and confused, and instead saw them as strong — like stones or a predatory animal — or if you saw the cancer more vividly than other symbols in your imagery, you may have a much stronger belief in the potency of the disease than in the potency of treatment or of your body's defenses.

It is common to have difficulty picturing the cancer. If you are having trouble with this, picture a mass of gray cells wherever you know (or believe) the cancer to be in your body. Black and red are two very common colors that people use to describe their cancer, but these colors tend to have strong emotional connotations. Gray is a much more neutral color, and part of our approach is an attempt to neutralize the feelings about cancer.

Thus, we would suggest using gray rather than a stronger color. Or, you might picture the cancer as broken up hamburger meat and your white blood cells as large numbers of white dogs coming in to devour the hamburger, licking the surrounding areas clean and going on to patrol the other parts of your body. The basic image of the cancer cells should be that they are neutral, weak, and disorganized.

Imagery of the Treatment

It is important to visualize your treatment as a friend and ally. Our patients frequently report reduced side effects to treatment as a result of changing their attitudes in positive, supportive directions. For instance, one patient who had feared his treatment began calling the machine giving him radiation "George," and holding mental conversations with "George" about all the good things the treatment was going to do for him. In addition, the patient made efforts to engage the doctor and nurses in friendly conversations, which included thanking them for their efforts. Shortly after this change in attitude, he began to experience fewer and fewer side effects from the radiation. Personalize your treatment, make it a helpful friend who is working with you to overcome the disease.

Imagery of the White Blood Cells

This, we believe, is the most crucial symbol of the imagery process because it represents your beliefs about the body's natural defenses. The essential relationship between the white blood cells and the cancer is the strength and number of the white blood cells relative to the cancerous cells. The healthiest images are those in which the cancer is significantly outnumbered and overpowered by the white blood cells.

One way to strengthen the imagery of your white blood cells is to do the following: Assume your images of your white blood cells are fish swimming in and eating up the grayish cancer cells. Project this image as if it were on a screen that you're viewing in your mind's eye. When you have that image very clear, then *become* one of the fish and lead the rest of the pack into

the attack. Feel yourself as the fish eating the cancer cells, destroying them, cleaning up any remaining debris. Hear the sounds and feel the emotions that are appropriate to the situation.

Again, the vividness of the imagery is important. Do you see the imagery of your white blood cells with the same or greater clarity than you see the cancer? Or do you see the cancer with greater vividness and clarity? If the cancer is more vivid, then, as previously mentioned, you probably have a greater belief in the power of the cancer than you do in the potency of your body's defenses, and so you will need to consciously strengthen the imagery representing your white blood cells.

In addition, the traits you attribute to the white blood cells often describe significant psychological issues you are facing. For example, patients who do not see the white blood cells attacking or destroying the cancer cells usually have difficulty expressing anger and hostility and have a strong need to impress others. These problems may have contributed to the onset of the disease and are standing in the way of recovery.

With this in mind, think of the white cell as having those characteristics that you consider most admirable and strong in yourself.

Imagery of Flushing Out Dead Cells

As we have said, how you see the dead and dying cells flushed from the body by natural and normal processes indicates your confidence in your body's natural functioning. Some of our patients include in their imagery some form of magic or divine intervention to get the cancer cells out of the body. This is another representation of their belief in the power of cancer — that is, even when the cancer cells are dead, they are still so powerful that it takes a special intervention to rid the body of them.

Imagery of a Healthy Self

Since this is the desired outcome, how you visualize yourself regaining health, vitality, and energy is impor-

tant. If you can see the battle, the cancer, the treatment, and the white blood cells but have great difficulty seeing yourself regaining health, you are quite possibly having difficulties believing you can recover. Try visualizing yourself engaging in activities you would pursue if you were healthy or having the overall feelings you would have if you were well. Picture yourself at the healthiest time in your life and create images of the present, feeling just that way.

Imagery of Your Goals
Goal setting (discussed in detail in Chapter 14) is a highly significant phase of the visualization process. If you have difficulty seeing yourself as healthy and well and engaged in happy pursuits, this may suggest you doubt your ability to recover. Try to see yourself reaching your goals and enjoying the satisfaction of having done so.

DRAWINGS AND INTERPRETATIONS OF OUR PATIENTS' MENTAL IMAGERY

We asked you to draw a sketch of your mental imagery for a simple reason. The drawing documents your beliefs at a particular time so you can later compare how your beliefs have evolved. In our program, we ask our patients to draw such pictures every three months and then to describe them aloud to us. By comparing their drawings from the initial session with the drawings from follow-up sessions, we are able to see how the patients are dealing with the cancer and how their beliefs are changing. Here are four case histories showing how imagery and beliefs changed over time.

Betty
Betty, thirty-five, was first diagnosed with breast cancer in 1973 and had one breast removed surgically. Later she had a second cancer requiring that her other breast be removed. When she began working with us in Fort Worth, she was receiving chemotherapy.

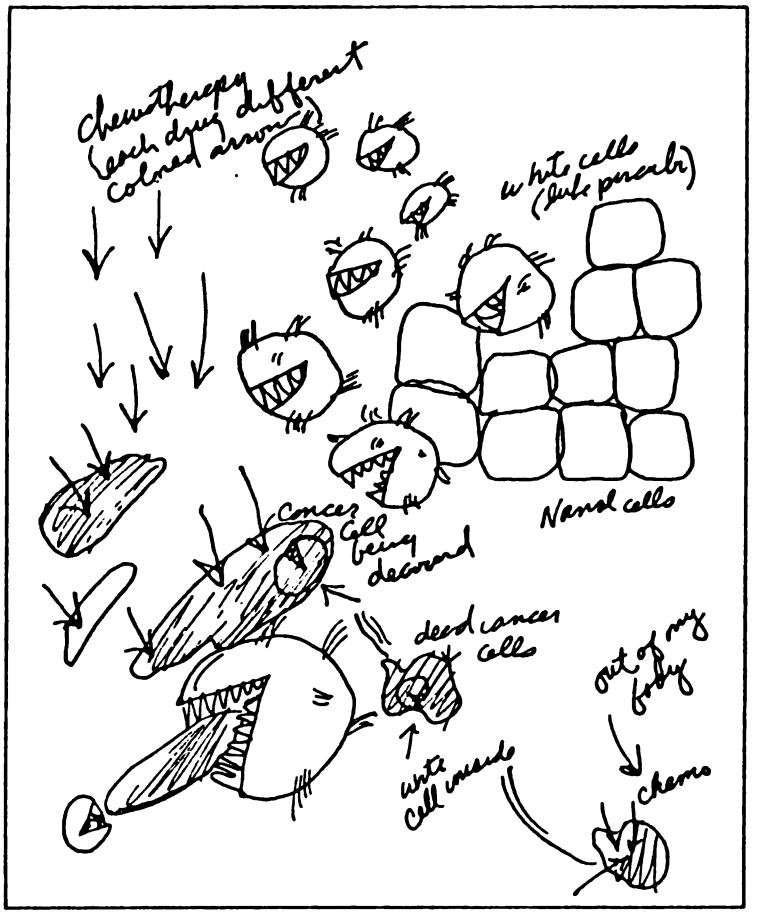


Figure 4. Betty's Initial Imagery, Showing Anger and, Hostility.

Betty's initial imagery (Figure 4) left little doubt that the white blood cells were going to win. Her first drawing showed ferocious-looking white blood cells with sharp, aggressive teeth. She noted that they were "like piranha," the voracious fish of South American rivers. Our experience tells us that such sharp teeth often indicate strong anger and hostility, and during her first session with us Betty did express much anger and hostility. Over the short term this works for her in her im-

agery; because of the potency of the symbol, there is little doubt that the white blood cells will win.

There are two other elements in the drawings we see as less positive. First, the cancer cells are either quite large or the cancer is drawn as a cluster of cells. It is good if patients are able to see the individual cancer cells. Those who do not visualize the individual cells often have difficulty looking at the component parts of a problem and instead are overwhelmed by the whole.

The second problem in Betty's imagery is that the chemotherapy is represented by sharp, pointed arrows. This is a very common symbol, but it often represents a fear of the treatment and a belief that the chemotherapy will have a detrimental effect on normal cells as well as cancerous ones. While such a belief has a basis in the experience of many patients, it is possible that the side effects will be reduced if another symbol for the treatment, such as an individual rubbing "chemotherapy ointment" on cancerous cells, is pictured.

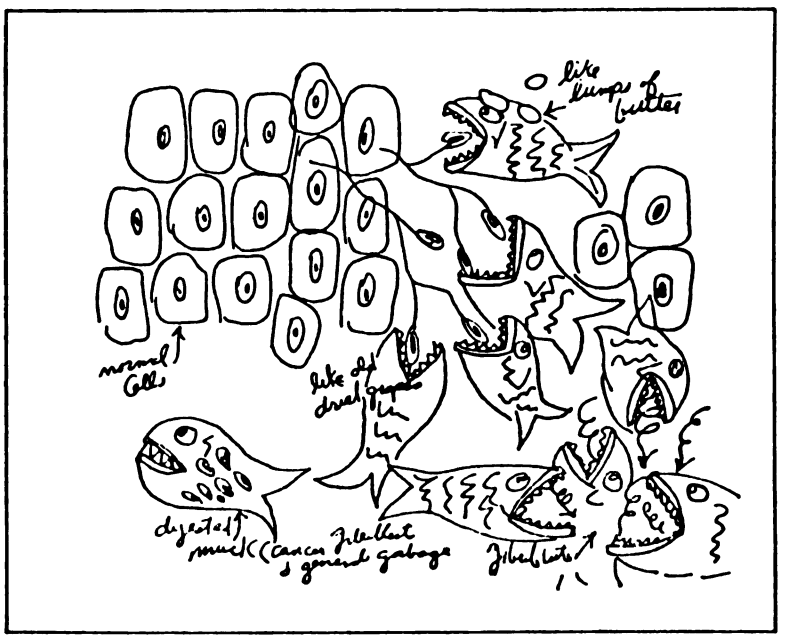


Figure 5. Betty's Imagery Six Months Later.

In Betty's second drawing six months later (Figure 5), the piranhas (white blood cells) were still there, but the teeth were less pronounced — though still quite effective — and now there were prominent eyes in the fish, indicating alertness and purposeful direction. At this meeting, Betty seemed considerably less angry and told the group that she had spent a great deal of time working on that aspect of her life.

Now, the cancerous cells were depicted as small and grapelike, and entwined with the normal cells. She associated this image with a great deal of fear which she had been experiencing recently. (We have often observed that vinelike, entangling symbols and fingerlike projections generally represent fear.) In working with Betty, it became clear to us that in addition to being more aware of her fear of dying, and particularly of dying alone, she was also afraid of getting well and facing the problems that she had suspended during her illness.

Betty had also picked up some erroneous information about precancerous cells, and in this drawing she portrayed them as corkscrewlike cells that at times almost appear to be attacking the white blood cells. These precancerous cells, she thought, were actually capable of penetrating normal cells, which is medically incorrect.

Betty is now doing quite well, both physically and mentally, and receives her primary counseling in her hometown.

Jennifer

Jennifer, thirty years old, had advanced ovarian cancer, and presented herself as a shy woman who had difficulty asserting herself so that she could meet her own emotional needs.

When given the assignment of drawing her mental imagery, Jennifer drew two different pictures. In the first (Figure 6), she showed her cancer as a cube of ice and her white blood cells as the sun, melting the ice. Her chemotherapy was depicted as white dust sprin-

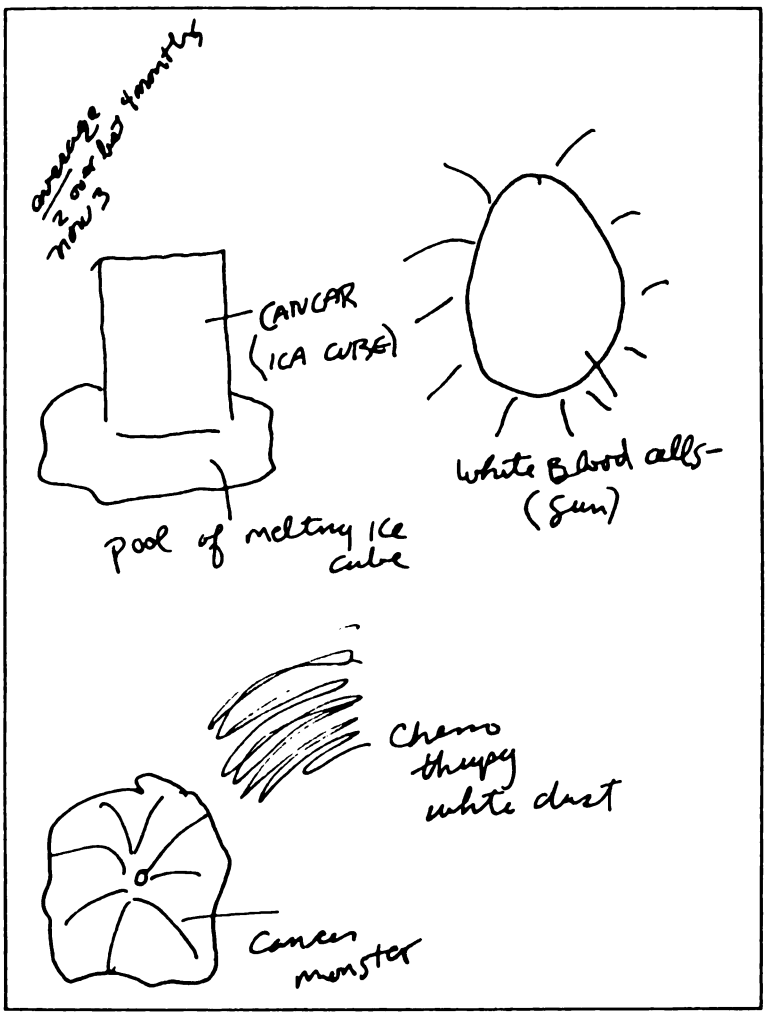


Figure 6. Jennifer's Mental Imagery; First Visit.

kled over her cancer, which she had labeled the "cancer monster." Obviously, the word *monster* captured her dread and fear of the cancer, as well as her sense of its strength and ferocity. Her image for the chemotherapy was weak: dust is hardly a match for a monster. Although the sun (her white blood cells)

could melt her cancer ice cube, it is a rather passive symbol with little direction or intentionality; that is, while the sun is shining, it incidentally melts the cancer.

Her second drawing (Figure 7) presented her as being in an even more hopeless position. Her cancer was portrayed as logs in a logjam, and one single man, representing a white blood cell, was shown trying to unjam the logs. Only if he succeeded could the logs be

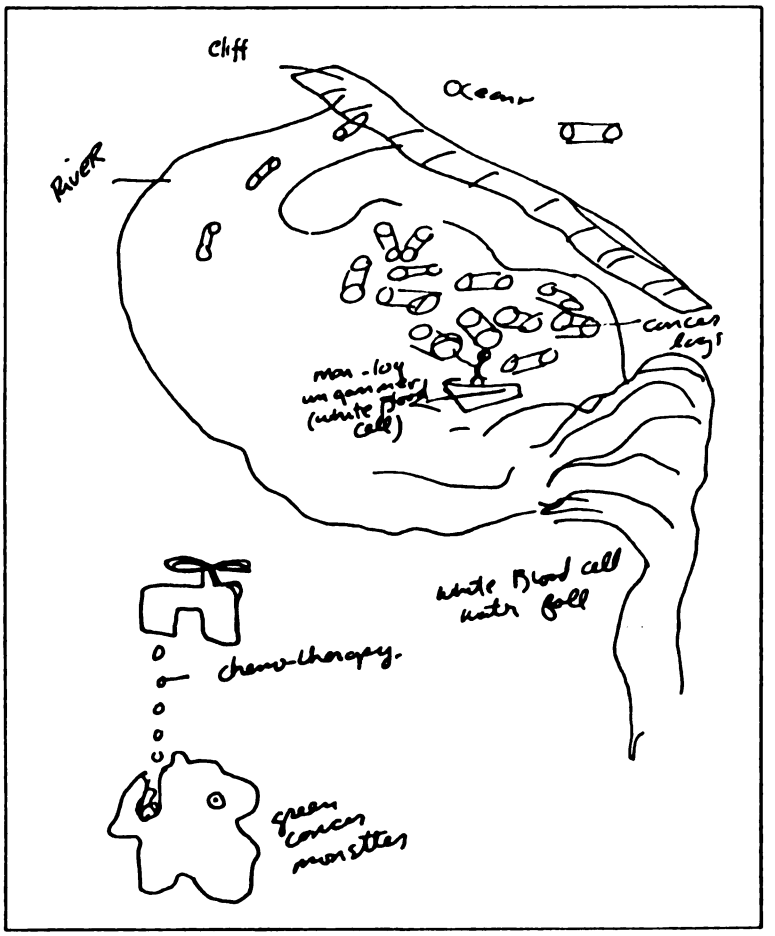


Figure 7. Jennifer's Mental Imagery; First Visit.

floated away, and even then they would remain unchanged; that is, they would still be cancer logs, and it is certainly undesirable to have cancer logs floating around in the body. With only one white blood cell against the entire jam of logs, Jennifer's odds did not look good.

The drawing also showed a lack of assertiveness and power — the kind of energy that might be able to break up the logjam in her life. (People who draw only one image of the white blood cells tend to have a feeling that if anything gets done in their lives, they have to do it all by themselves with no outside help. This feeling intensifies their sense of helplessness and hopelessness.)

The image of her chemotherapy was still weak. It appeared to be dripping some kind of poison into the cancer, again labeled "cancer monster," but did not seem to affect it greatly. In fact, the monster seemed to have a humanoid face, an eye and mouth, indicating intelligence and alertness with which it could defend itself.

Taken together, Jennifer's first drawings indicate a confusion, an inability to stay with one image, and little belief that either her chemotherapy or her body's defenses could significantly influence the cancer.

Six months later, Jennifer's drawing (Figure 8) showed definite improvement. Her white blood cells were now depicted as white sharks with angry, pointed teeth. For Jennifer to show signs of anger or aggression, and sharks are certainly aggressive, was a major step forward. The cancer cells were also far smaller and less malevolent. Unfortunately, there was no interaction between the sharks and the cancer cells; in fact, the sharks seemed to be aiming their aggressiveness toward the chemotherapy (which looked remarkably like the "cancer logs" in her earlier picture).

These images correlated closely with what was going on in her life: Her anger at the chemotherapy was surfacing. Though the sharks symbolized that part of herself that would help her get well, their aggressiveness needed to be aimed at the source of her problem, not

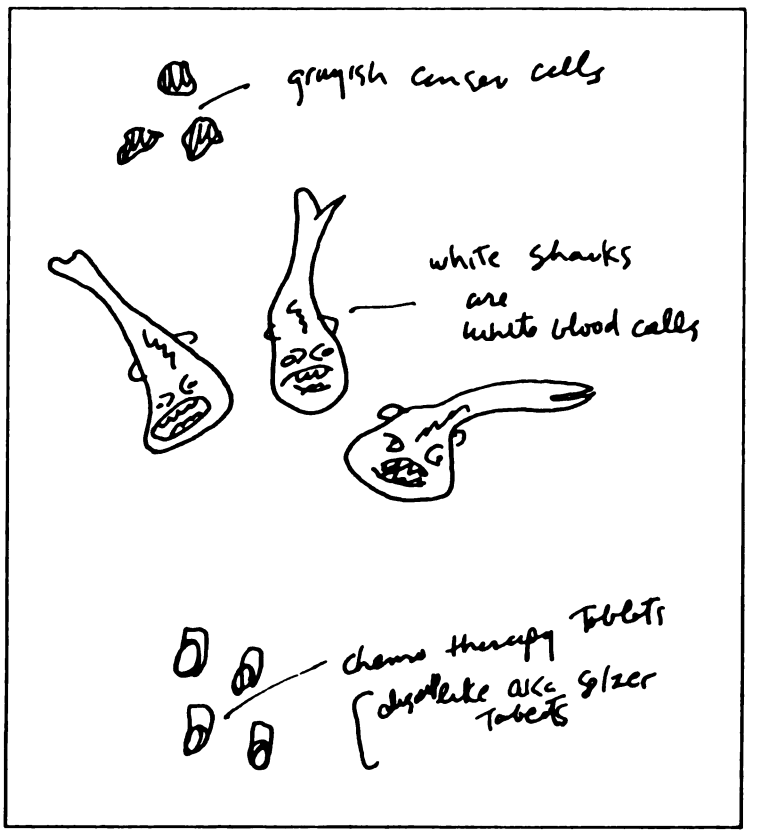


Figure 8. Jennifer's Mental Imagery, Six Months Later.

at her treatment. Despite her anger at the chemotherapy, her symbol of the chemical was not very strong: She associated it with Alka Seltzer tablets, certainly not a very potent drug, suggesting only a weak belief in the potency of her treatment. Moreover, though the tablets apparently dissolved in the bloodstream, again no interaction was shown between the chemotherapy and the cancer.

Jennifer was showing signs of progress, but her newly discovered assertive energy was, at that point, still not focused on the problem. Over the past two years, however, she has steadily improved.

Glenn

Glenn, a fifty-year-old clinical psychologist, has cancer of the kidney that metastasized to his lung, and he has remained stable for four years. Therefore, no treatment was being given, since chemotherapy was considered inappropriate for his disease.

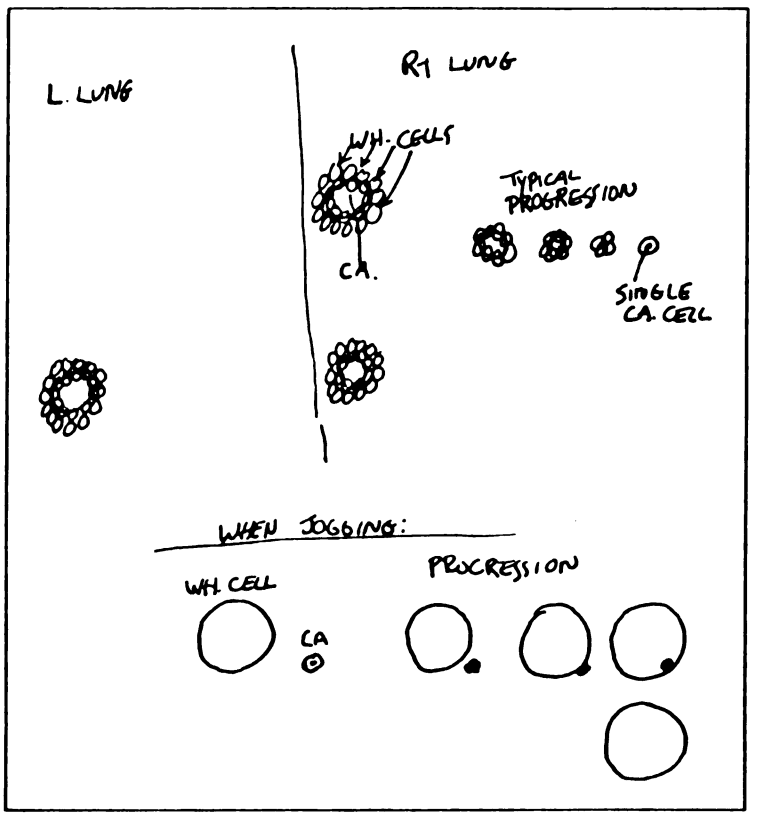


Figure 9. Glenn's Initial Mental Imagery.

In his first drawing (Figure 9), Glenn showed his cancer surrounded by white cells and the cancer mass gradually being reduced to a single cell. During his relaxation/mental imagery activity, he had difficulty eliminating the last cell, but he found when he was

jogging that he could see the final cancer cell being absorbed by a giant white cell and disappearing.

Although in the drawing he does finally succeed in eliminating the cancer, there were some weaknesses in the imagery. The white blood cells seemed to work around the periphery of the cancer; there was little interaction, and they met the cancer only on the surface. (This desire to stay on the surface of the problem sometimes indicates an unwillingness to investigate the details of why one has developed cancer.) Also, destroying the last cancer cell required a tremendous effort on Glenn's part: He had to be jogging before it could occur. There appeared to be something almost magical about that last cell, almost a hanging on to the disease and an indication that it would take a very large white cell and an extraordinary event finally to get rid of the cancer.

Six months later, his drawing (Figure 10) showed more interaction between the white blood cells and the

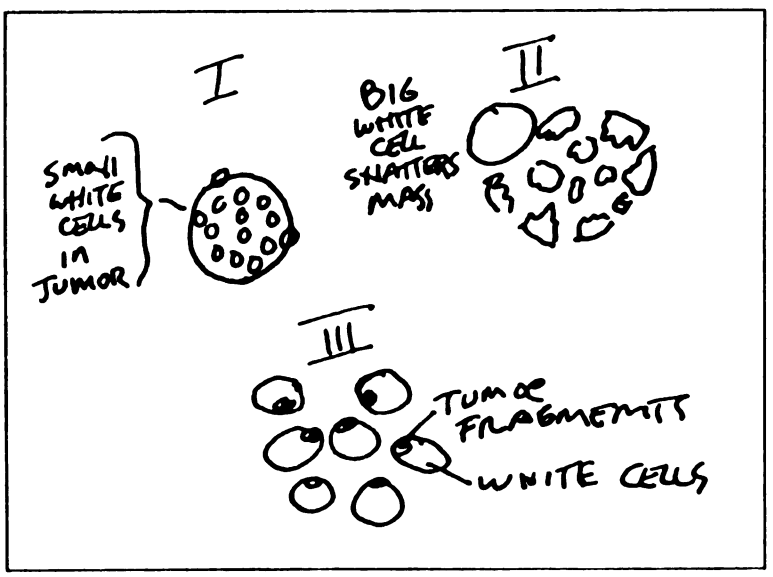


Figure 10. Glenn's Mental Imagery Six Months Later.

cancer, yet the size of the tumor relative to the size of the white cells did not suggest overwhelming strength on the part of the body's defenses. A single, large white cell was shown suddenly appearing and shattering the tumor mass, and the tumor fragments were then absorbed by the ordinary white cells. Again, the drawing showed that an extraordinary event was required, and that until this magical event occurred, the cancer would remain intact. To us, Glenn's picture illustrated an unwillingness to deal with small component problems and a tendency to wait for the one event that would explain and remedy everything.

Similar to his imagery, Glenn's cancer has not regressed, though his general health is superb and he continues as professor and long-distance runner.

Charles

Charles was a successful businessman who, shortly after his retirement at sixty-two developed multiple myeloma, a cancer of the bone marrow. Although the disease showed up in laboratory studies, Charles was free of symptoms, so his doctor decided to wait before beginning chemotherapy. Now, three years later, his lab reports show less disease than when he was diagnosed, and he has still not received any chemotherapy. In addition to participating in our program, Charles has also had several years of private psychotherapy in which one of the problems dealt with was his difficulty expressing anger.

There were strong similarities between Charles's two pictures (Figures 11 and 12), drawn almost a year apart. Both showed a positive expectancy, in that the white blood cells (the sharks or large fish) were clearly overwhelming the cancer. The most dramatic difference between the two drawings was in their size: the first drawing filled almost the entire page, the second occupied a much smaller space. The second indicated how much smaller a part the cancer occupies in Charles's life, for at that point his blood chemistry showed the cancer decreasing, he had no physical

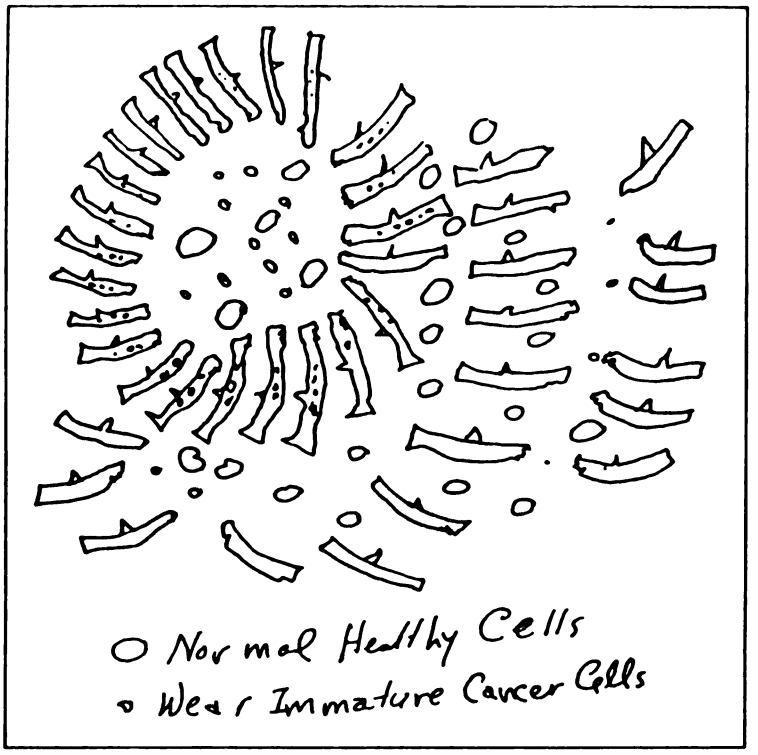


Figure 11. Charles' Initial Mental Imagery.

symptoms, and his physical condition had remained excellent — regularly beating the authors at tennis at the age of sixty-five.

Another sign of progress was that in the first picture, the cancer was shown as being largely surrounded in a highly organized manner by white blood cells; in effect, the cancer was walled-off, much as Charles had walled off problems in his life. By the second drawing, there was much less organization. We correlated these images with less need on Charles's part to protect himself emotionally and a greater willingness to interact openly with the problems in his life.

One difficulty was suggested by the lack of definition of the mouths — the major weapon — of the sharks or fish in the second drawing. During the

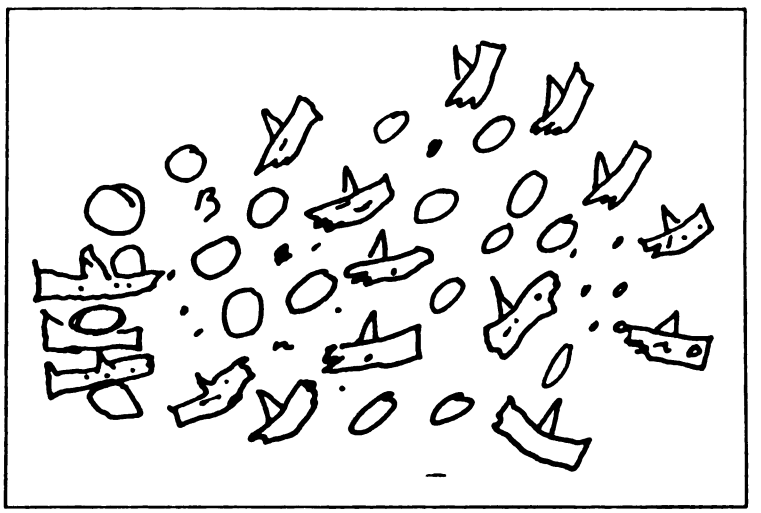


Figure 12. Charles' Mental Imagery One Year Later.

period of the first drawing, Charles was very angry about the death of a close friend, and the anger showed up in the sharp, aggressive teeth. By the time of the second drawing, he was expressing much less anger about problems in his life, an issue we explored with him again.

IMAGERY AS A DESCRIPTION OF SELF

These interpretations of our patients' drawings take into account as much as possible all the significant problems and psychological issues they are facing. We come to understand the drawing within the context of what we know of the patient's personality and life situation. Thus, it represented progress for Betty to tone down the anger and hostility expressed in her piranhalike fish, while it represented progress for Jennifer to portray her defenses as sharks. In one case, Betty's anger and hostility were causing her to reject the acceptance, approval, and recognition she desperately wanted and now had some hope of getting; in the

other, Jennifer, a passive person, desperately needed the energizing that anger often accomplishes, even though she still had to learn how to use the anger effectively.

We are often able to use the imagery not just as an indicator of patients' beliefs about cancer but also as a description of their situations in life. In making this interpretation, we see the symbols of the cancer as the part of the person that wants to die or that is killing him or her, and the white blood cells as the part of the person that wants to live or that will help him or her get well.

The disease becomes a physical manifestation of the battle being waged between two parts of the self: the toxic or self-destructive parts and the nurturing or life-sustaining parts. The symbolic potency of the cancer in relation to the body's defenses is not just a measure of the patient's beliefs about the disease but is also an indicator of how strongly the patient wants to live or die.

Our patients go through the drawing procedure every three months when they return to Fort Worth for a follow-up visit. Even though they are fully aware of the use of this procedure, they still generate revealing imagery.

We encourage them to use the whole process, including their attitudes toward mental imagery and changes in their imagery, as an important guide to their psychological states. When they learn to ask, "Why are these images coming to me now? What changes in beliefs do these images indicate? Why am I choosing to see things in this light at this particular time?" they are participating in the process of expectancy and taking a measure of control over it.

Use relaxation/mental imagery time as an opportunity to work on other issues in your life. During the first weeks and months, the necessary emphasis is on getting well. Obviously, without health your ability to concentrate on other problems is limited. But as you begin to regain health, we urge you to seek ways to apply the process to a wide variety of life's problems.

As we have stated, the imagery of positive expectancies, which is also the principle of the self-fulfilling prophecy, can help you succeed in a limitless number of ways.

Sticking and emigration of leucocytes

...model
...emigrating from the vessel,
...through opened junctions
...wall
...neutrophil has reshaped itself
...the blood vessel.

One of the most striking phenomena observable in living blood vessels in the early stages of acute inflammation is that the white blood cells cease to float freely in the blood stream keeping pace with the red cells as they pass along the venules but adhere closely to the endothelium. Furthermore, the leucocytes not only stick to the endothelium but also to each other. All the granulocytic cells are involved—particularly the polymorphonuclears and also the monocytes, and platelets *(Figs. 21, 23)*. The small lymphocytes are the notable exceptions.

Since there is increased permeability to plasma proteins where sticking is not observed and in other vessels sticking where there is no evidence of increased permeability to colloids, these two processes seem to be brought about by different mediators.

Sticking and phagocytosis

Whatever the mechanism of sticking, the phenomenon seems in some way to be associated with phagocytosis. For example, if leucocytes are allowed to phagocytize pneumococci *in vitro*, they stick to each other and form tightly adherent clumps. F. Allison and M. G. Lancaster have studied this phenomenon using both rabbit and human white cells. They found that if the medium was deionized by various means, both phenomena were inhibited. But they could be restored by the addition of either calcium or magnesium ions. Of the two, magnesium was the more effective. Since both Ca^{++} and Mg^{++} were divalent, they tested the efficacy of other divalent cations and found that both manganese and nickel were very potent for this purpose. Cadmium and lead were moderately effective and

Figure 23
An electron micrograph of a sticking polymorph shows the plasma membrane of the polymorph flattened against the luminal surfaces of two endothelial cells, whose junction it covers. The very narrow space between the blood cell and the endothelial wall may be an artifact.

so was trivalent iron. Divalent iron and other monovalent and trivalent metals had little activity. The fact that other divalent ions were as effective as calcium or more so seemed to rule out any close relationship to fibrin formation.

The possibility of the participation of an enzyme in this phenomenon was also considered, and the effect of various enzymes and enzyme inhibitors was tried. Because both phagocytosis and clumping were almost completely inhibited by epsilon-amino-caproic acid, a known inhibitor of proteolytic enzymes, and for other reasons, Allison and Lancaster felt that possibly a proteolytic enzyme was involved. Such an enzyme might act on a protein that in some way alters the cell surface.

The behavior of both rabbit and human leucocytes was essentially the same. The experimental procedures usually affected phagocytosis and clumping of leucocytes equally, but there were some slight differences so that the processes though closely related may not be identical. Since leucocytes tend to stick to each other as well as to the endothelial cells, it is probable that whatever causes the phenomenon acts on both types of cells.

Emigration

Very soon after sticking is observed, the leucocytes are seen to work their way through the endothelium and perivascular structures into the tissue spaces. Electron micrographic studies indicate that this is accomplished by their insinuating a pseudopod into an intercellular junction of the endothelial cells, enlarging this opening somewhat and eventually squeezing through it *(Figs. 22, 24, 25)*. Only granulocytes and monocytes actively work their way out of the vessels but it would appear that a few red cells and lymphocytes may take advantage of the holes they create and emerge without any preliminary sticking *(Fig. 26)*.

Mediators of emigration

While substances known to promote vascular permeability often occasion some emigration of leucocytes, the response is usually delayed and weak. A great many substances produce such responses, for example, plasma. It is possible that any agent producing vascular permeability might cause mild delayed emigration of leucocytes because of the extravasated plasma.

Extracts of burned skin, J. V. Hurley found, produced a prompt and very intense emigration of leucocytes. This is the type of response that would be expected from a specific mediator of this phenomenon. It was also found that leu-

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A neutrophil, in this electron micrograph, is passing through an endothelial gap. As the leading edge advances it is notably empty of granules, which will flow back into it later on. In the lumen a platelet adheres to the neutrophil and a portion of a second neutrophil may be glimpsed, adhering to the first one and to the endothelium.

cocytes extracted with saline produced an intense migration of leucocytes. To ascertain whether or not it was the leucocytes in the burned skin that produced the response, rats were treated with nitrogen mustard to the point that they were devoid of leucocytes and burned. An extract of their burned skin was made and tested. It produced an intense response even though the skin was almost devoid of white cells. The inciting material was then sought in serum, but serum by itself produced little response. When, however, serum was incubated with white cells or minced tissue of various kinds, potent materials were produced. The active substance was nondialyzable, stable when heated to 60°C for 30 minutes, but destroyed if kept at this temperature for one hour. It was destroyed by trypsin. Its action was not prevented by the prior administration of antihistamines, amine oxidase inhibitors, quinine or salicylate.

It was hypothesized that some factor in serum was acted on by a substance present in injured tissue; this factor would then produce the active mediator of leucocyte emigration.

To test the possible relation between chemotaxis and leucocyte emigration, the various extracts were tested for chemotatic activity in a modified Boyden chamber, and it was found that their ability to induce emigration of leucocytes and their chemotactic activity were parallel. It appears, therefore, that there is an endogenous material that can be produced by injury that is capable of inducing migration of leucocytes and possibly attracting them to the site of injury.

There is obviously a relationship between sticking of leucocytes, their emigration, chemotaxis and phagocytosis since, in a sense, they are all stages in the process that gets the phagocytic cells to the material to be phagocytized. It would not be surprising therefore if the same substance mediated more than one of these stages.

Whether or not this material described by Hurley is also the substance responsible for the preliminary sticking of the white cells to the endothelium and each other and also probably involved in phagocytosis remains to be shown.

A complex of three components of complement C_5, C_6, and C_7 seems to be highly chemotactic for polymorphonuclear neutrophils and eosinophils, particularly when it has been fixed in an antigen-antibody reaction. Mononuclears are also attracted by components of complement but different ones from those attracting granulocytes.

. 20

A monocyte is beginning the journey through an endothelial gap by pushing a pseudopod into the opening. At right, an eosinophil, already outside the vessel, partially blocks the emerging monocyte.

Erythrocytes are passive cells. Here an erythrocyte has probably been washed into an already existing endothelial gap and because of its extreme plasticity it will be squeezed through it.

Chemotaxis

While a straight forward enough phenomenon *in vitro*, chemotaxis has not been satisfactorily demonstrated *in vivo*. In fact, Sumner Wood, Jr. using a cinematographic method has plotted in detail the peregrinations of a single polymorphonuclear leucocyte. The movements were active but there was no indication that it had any tendency to move toward an area of injury or a highly chemotactic substance. It moved quite as often away from as toward the chemotactic material. Why the highly chemotactic materials failed to attract the polymorphs *in vivo* remains to be explained.

Most tests made for chemotaxis in recent years have been made in the Boyden chamber, two shallow compartments separated by a millipore filter. The chemotactic substance is placed in one compartment and leucocytes in the other. The pores of the filter are so small that leucocytes can only get through by ameboid movement. In so confined a space, chance alone would bring many cells to the membrane. Perhaps only then does the attractant stimulate the cells to penetrate it. In other words, the attraction of the chemotactic substance might actually act only over a very short distance. Consequently, the demonstration of chemotaxis by this means does not necessitate that the leucocyte be able to follow a concentration gradient toward the substance for any great distance, but rather that coming close to it by chance it remains and attempts to engulf it.

Lymphocytes

One cell that is always present in a normal inflammatory exudate and which arrives there fairly early in the course of the process is the lymphocyte. This cell has not been observed by the electronmicroscopists to leave normal small blood vessels via the intercellular junctions unless it is washed through a hole left by a polymorph or monocyte. It has, however, been seen to leave the vessels in lymph nodes by piercing the endothelial cytoplasm. Furthermore, according to the work of A. R. Page the substances that induce the emigration of leucocytes do not induce the emigration of lymphocytes; an entirely different mediator seems involved. In the first place, a prior emigration of neutrophils seems to be required, because in neutropenic animals the lymphocyte response is either prevented or greatly delayed. Apparently this agent is an inducer of new protein synthesis in the lymphocyte, since the response is prevented by drugs that interfere with protein synthesis.

Leukocytic Infiltration

Figure 27. Acute inflammatory infiltrate (muscular fascia)
Note venule nearly filled with leukocytes (H & E stain).

When we look at a piece of inflamed tissue under a microscope, the most striking and characteristic thing we see – the "pathognomonic" feature – is the presence of leukocytes (Figures 27, 28). These cells come from the blood; they first stick to the walls of the blood vessels, then emigrate outward into the tissues (Figures 29-31), and crawl towards whatever might have provoked the inflammatory response – perhaps a clump of bacteria, or perhaps a group of damaged cells. This process of directional locomotion is called *chemotaxis*. The leukocytes then do their best to eat up and digest the offending agent – *phagocytosis*.

Leukocytic Sticking

In animals without blood vessels, mobile mesodermal cells accumulate at sites of injury or around bits of foreign material. These mobile cells are analogous to mammalian leukocytes, except that the latter are enclosed within the bloodstream. The first step in getting mammalian leukocytes out into the tissues where they are needed (in an inflammatory response) is to have them stick to the vessel walls in the appropriate area. This is obviously a crucial event in inflammation, but we know remarkably little about how it occurs. It does not seem to be a nonspecific result of increased vascular permeability. If histamine is injected into the skin, the leukocytic infiltration is slight. On the other hand, if bacteria are present or if there is tissue damage, then we see massive sticking (and emigration) of leukocytes. Probably the bacteria and the damaged tissue liberate factors that somehow alter the endothelial lining of the blood vessels so that it becomes sticky for leukocytes. Cohnheim envisaged "a molecular change in the vessel walls," but its nature remains a mystery.

It was once thought that a "glue" forms on the luminal surfaces of the endothelial cells, particularly in the venules, where most of the sticking occurs. Using special staining techniques (ruthenium red, colloidal iron), electron microscopy has revealed the presence of an amorphous "cell coat" material on the endothelial surface of normal blood vessels. But, somewhat disappointingly, there does not seem to be any change in this layer in inflammation; at least there is no alteration that can be detected morphologically. Another idea is that the attachment is due to the formation of ionic bridges, eg, with Ca^{++}, between the leukocyte and the endothelial cell sur-

Figure 29. Scanning electron micrograph (SEM) showing leukocytes in inflamed tissue

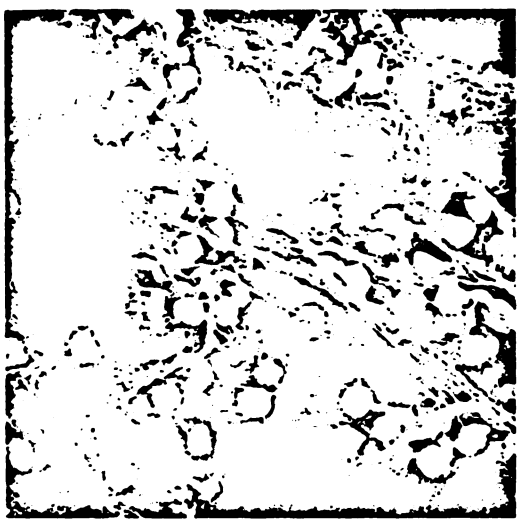
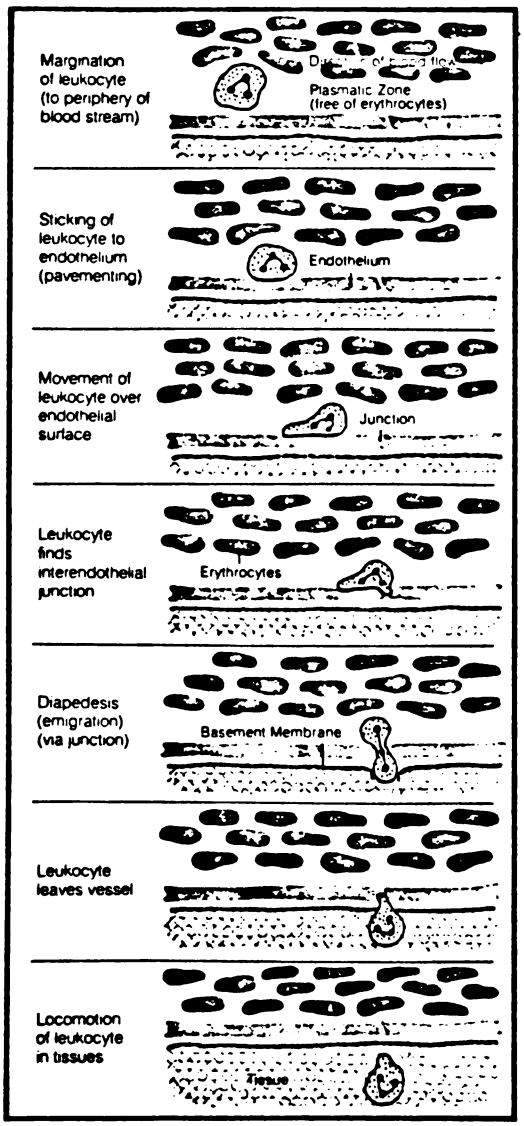


Figure 28. Leukocytes stuck to the wall of a venule in an inflamed tissue (SEM)

Figure 30. A leukocyte stuck to a venular wall and probably preparing to crawl through it (see Figure 31) to reach the tissue (SEM)

Figure 31. A leukocyte crawling through a venular wall (SEM)

Figure 32. Schema of diapedesis of leukocytes



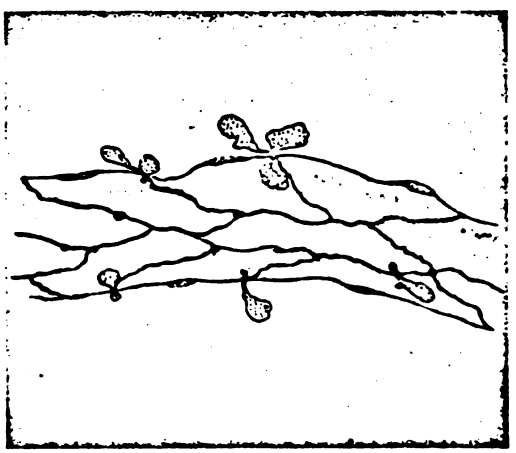
face. However, both the leukocyte and the endothelial cell are negatively charged, so it is difficult to see how they could get close enough to form such bridges. It is possible that inflammation induces an appropriate change in the endothelial surface (perhaps a change in charge) that allows closer cell-to-cell contact, but this is obviously a difficult concept to test. However, there seems little doubt that divalent ions such as Ca^{++} play a part in the process. This has been shown in experiments in which sticking was inhibited in animals treated with EDTA (ethylene-diaminotetraacetate), a chelating agent that removes free calcium ions from the blood. This inhibition was shown by direct observation of inflamed blood vessels in the rabbit ear chamber, in the cheek pouch of the hamster, and in the mouse mesentery. Local anesthetic drugs also inhibit leukocytic sticking in experimental animals; the mechanism is obscure, but it is known that such agents can displace Ca^{++} from binding sites in membranes.

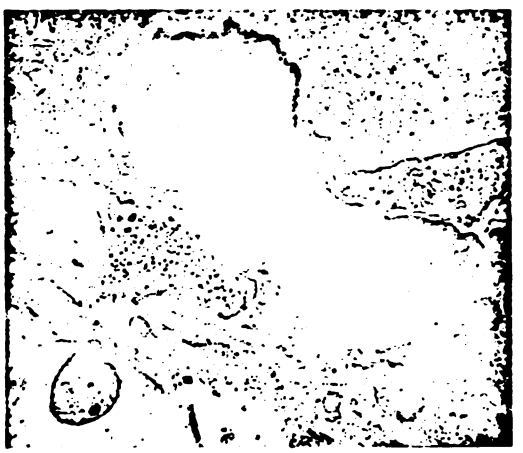
Leukocytic Emigration (Diapedesis)

In acute inflammation, diapedesis of leukocytes across the venular wall occurs via the interendothelial junctions (Figure 32). This fact was recorded in the drawings of Arnold in 1875 (Figure 33), and was confirmed by electron microscopy, more than a century later, by Vincent Marchesi and Sir Howard (later Lord) Florey at Oxford. We can see this process in Figures 34-36. Individual leukocytes usually take from 2 to 12 minutes to get completely across the vessel wall.

Perhaps some of the leukocytes sneak out through gaps prepared for them by histamine-type mediators (this is not well established). However, it is certain that they do not *need* such preformed gaps, because it is possible to produce diapedesis without an accompanying increase in permeability. Nor does diapedesis cause vascular leakage, which shows how tightly the leukocytes must squeeze themselves between the endothelial cells. Here is the experiment: in the rat, a subcutaneous injection of serum produces a lively inflammatory response (with the rapid onset of increased vascular permeability). Four hours later, vascular leakage has subsided, whereas diapedesis is at its peak. India ink, injected intravenously at this stage, does not cause "carbon labelling" of the vessels because the endothelium closes up immediately behind the emigrating leukocytes.

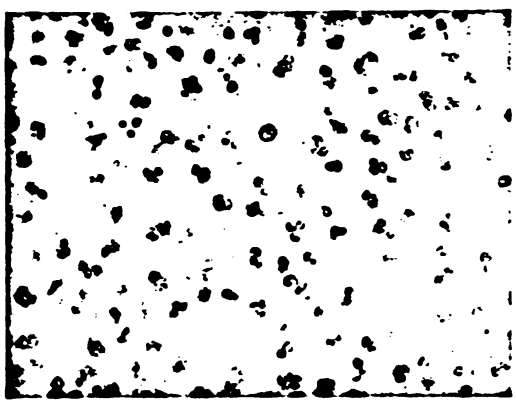
Figure 33. Leukocytes emigrating from a small inflamed vessel in frog mesentery, as observed by Julius Arnold and reported in Virchow's *Archiv für pathologische Anatomie* (1875)





Figures 34, 35, 36. Three phases of diapedesis (in inflamed rat mesentery). *34* (above) A leukocyte adhering to the endothelium. *35* (top right) Another leukocyte going through the endothelium. *36* (bottom right) A third leukocyte that is already outside the endothelium.

Figure 37 Histologic section of gonococcal pus mostly polymorphs, cell debris and a few erythrocytes.



Although the emigrating leukocytes may not cause leaks in the endothelium, they temporarily tear apart the basement membrane around the vessel. They probably have no alternative. A simple experiment devised by John Hurley to prove this point is to cause vascular labelling by injecting India ink intravenously immediately after injecting histamine into the skin. If this area of skin already shows active diapedesis (for example, in response to an injection of serum four hours earlier), the labelled venules spill their carbon out into the tissue spaces through holes punched in the basement membrane by the escaping leukocytes.

We do not know what stimulates the leukocytes to emigrate. It is possible that chemotactic agents released in the tissues might seep into the junctions and attract the pavemented leukocytes out of the vessel, but there is no evidence to support this theory, nor do we know how the leukocyte traverses the basement membrane – whether by pure mechanical force, by enzymatic lysis, or by some other process.

Before leaving this topic, let us mention a minor controversy concerning another sort of leukocytic emigration. It has been claimed that lymphocytes cross venular walls in lymph nodes by passing through the cytoplasm of the endothelial cells. However, in more recent studies using careful serial sectioning techniques, Gutta Schoefl demonstrated that, here too, emigration occurs through the junctions.

What Kinds of Leukocytes Emigrate in Acute Inflammation – and When?

In the early stages of the acute inflammatory response, the predominant cell infiltrating the tissues is the *neutrophil polymorphonuclear leukocyte*. After a day or so, as the intensity of the response subsides, the predominant cell is the *mononuclear phagocyte* (usually called a *macrophage* when found in the tissues); this cell is derived from the blood monocyte.

If the tissue is infected with pyogenic (pus-producing) bacteria, the influx of neutrophils is greatly enhanced and sustained. If the bacteria survive long enough they can provoke the formation of abscesses. These are *newly formed cavities that contain pus*. Pus consists of myriads of neutrophils in various stages of degeneration, floating in exudate fluid (Figure 37).

The time sequence for leukocytic emigration has been worked out experimentally by collecting and counting exudate cells at various times after injecting phlogistic agents (an old-fashioned term for inflammatory agents) into the pleural or peritoneal cavity of rats. A typical experiment is shown in Figure 38; this depicts the numbers of neutrophils and mononuclear phagocytes found in the pleural cavity of rats sacrificed at various times after injecting rat serum. Clearly, the peak polymorph emigration occurs within the first 6 hours, whereas the peak mononuclear phagocyte emigration is delayed another 6 hours or so. The mononuclear cells predominate after 12 hours, and by 48 hours they are virtually the only cells found in the exudate. In striking contrast is the pattern seen after the injection of living *Klebsiella pneumoniae* organisms into the pleural cavity of rats (Figure 39). In this situation, enormous numbers of neutrophils continually pour into the cavity while mononuclear emigration remains relatively insignificant.

It is not understood why the major infiltration of mononuclear phagocytes occurs after the neutrophil peak. Some investigators have attributed it to a combination of two factors: first, the locomotion of the macrophages is relatively sluggish, and secondly, macrophages can live for days or months, whereas neutrophils only last for a matter of hours after emigration. This hypothesis may be a partial explanation for the findings, at least for the precipitous fall in neutrophil numbers after the peak is reached compared with the much slower decline in

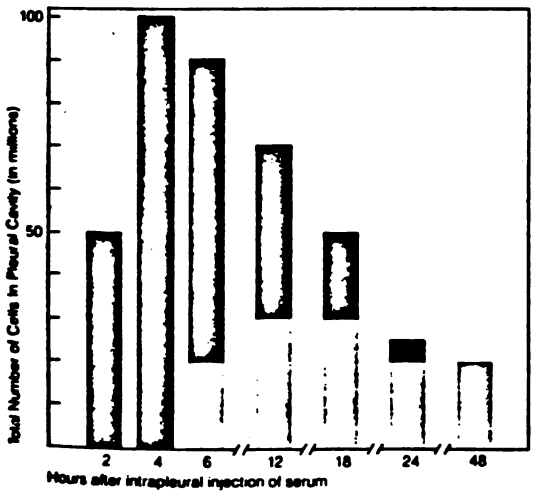
numbers of mononuclear cells. However, from experiments such as those shown in Figure 38, it is apparent that proportionally more neutrophils emigrate into the inflammatory focus in the early stages, whereas more monocytes enter the lesion later. This biphasic response could result from the sequential action of specific chemical mediators. In other words, there may be a mediator that causes neutrophil emigration, followed by a mediator that causes monocyte emigration. In recent years, it has been demonstrated that certain chemotactic agents may specifically attract certain kinds of leukocytes. In the present context, the most relevant of these specific agents is one described as a monocyte chemotactic factor released from neutrophils.

Chemotaxis

Chemotaxis – the attraction of cells towards chemical substances – is a subject that has fascinated biologists for nearly 100 years. The term was originally used by Pfeffer in 1884 to describe the attraction of spermatozoids of certain ferns toward malic acid. In 1888, Leber was the first to observe chemotactically directed movement of leukocytes. He injected guinea pig corneas with molds or with products of putrefied rabbit muscle and then, after waiting for several hours until the corneas were in-

Figure 38. (below left) Graph showing numbers of neutrophils and mononuclear phagocytes entering an inflamed area at various intervals (following an injection of serum into rat pleural cavity)

Figure 39. (below) Graph showing continued influx of neutrophils following an intrapleural injection of living *Klebsiella pneumoniae* organisms into a rat pleural cavity



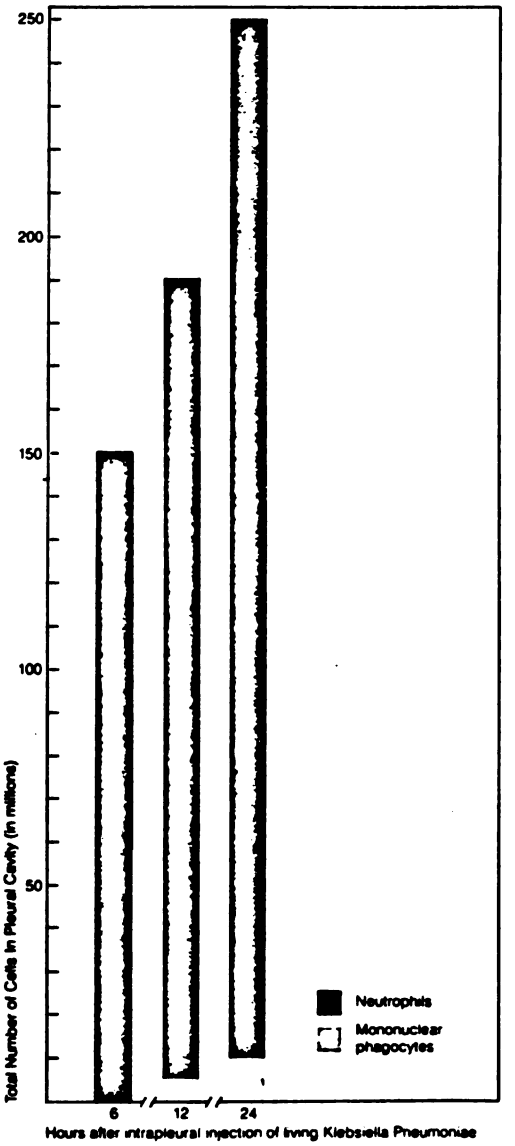


Figure 40. Dark field micrographs showing the tracks produced by human neutrophils crawling on a slide (single 15-minute exposure of photographic frame) *Top* cells crawling at random, in relation to a piece of fibrin (right) *Bottom* cells crawling towards a clump of living *Staphylococcus epidermidis* organisms (right) — chemotactic locomotion

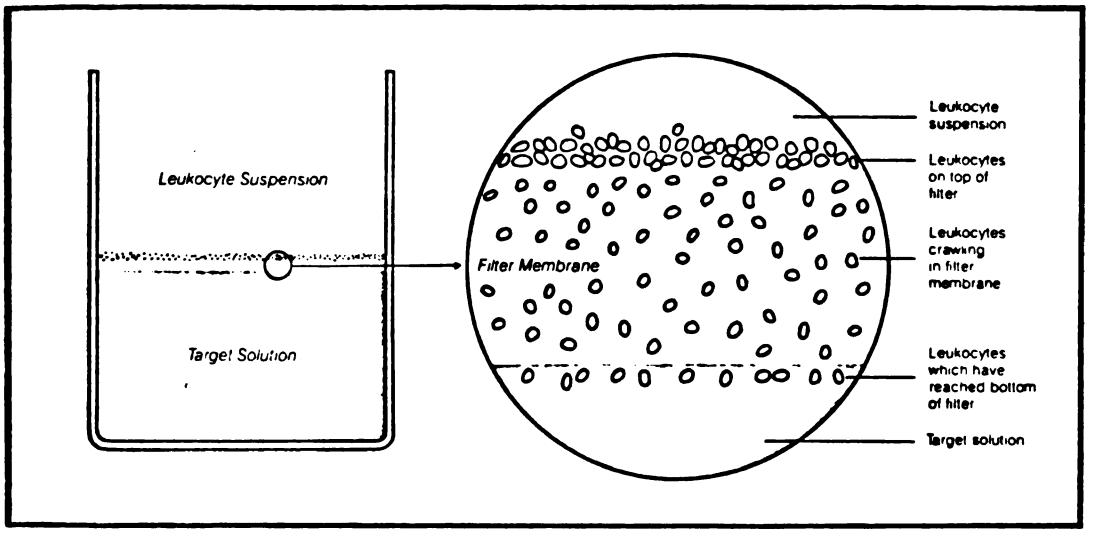
filtrated with leukocytes, he removed the corneas and examined them under the microscope. He observed the leukocytes moving directly towards the injection sites. Over the next 50 years, chemotaxis was studied by many workers using a wide variety of methods. By the 1940s it was generally believed that neutrophils were attracted by bacteria and their products, as well as by factors released during tissue breakdown.

However, at Oxford in the early 1950s, Henry Harris proposed that much of the data concerning leukocyte chemotaxis were obtained from experiments that were badly controlled. He attacked the common assumption that accumulation of leukocytes at a particular site necessarily meant that the cells had been attracted there chemotactically. He pointed out that such a finding could just as easily be explained by a local, nonspecific trapping of randomly moving cells. Harris particularly stressed that chemotaxis can only be assessed if directional locomotion of the cells is directly observed or recorded. He devised a simple but elegant system in which neutrophils were incorporated into a film of clotted plasma between a slide and a coverslip. Using dark field microscopy (in which cells show up as white blobs on a black background), the paths traced by the cells could be recorded by making long exposures of a single photographic frame (Figure 40). Using this technique, Harris confirmed that clumps of various bacteria were chemotactic but found no polarization of the tracks towards fragments of injured or autolysed tissue (we shall reexamine this result in a moment).

The next important development occurred in Australia in 1962, when Stephen Boyden introduced a new assay system for chemotaxis. This system consists essentially of a chamber with two compartments separated by a horizontal filter membrane (Figure 41). Leukocytes placed in the upper compartment crawl through the pores of the filter (Figure 41) when a chemotactic solution is placed in the lower compartment. The chemotactic activity of the fluid in the lower compartment is evaluated by counting the number of cells on the lower side of the filter (or the extent of penetration of cells into the filter) at the end of a certain period of time.

As a technique, Boyden's system has enjoyed wide popularity. It is simple, it can be conveniently used to assess the chemotactic activity of substances in solution, and it allows some degree of quantitative comparison of different test substances. However, it has been recognized recently that, as ordinarily used, the system may not distinguish between accelerated random locomotion of cells and true chemotaxis. Thus, the test substance may simply stimulate the cells to crawl around faster, and this would result in larger numbers of cells reaching further into the filter, independent of specific chemotactically directed locomotion. Boyden also recognized this problem and performed control experiments in which the chemotactically active solution was placed with the cells in the upper compartment of the chamber. In such cases, the cells showed less tendency to crawl into the

Figure 47. The Boyden chemotactic system
Leukocytes are placed in the top compartment of the chamber and crawl into a porous filter towards the target solution in the bottom compartment. Cells are counted either on the bottom of the filter or in the filter itself (x cells per high power field)



filter than if the solution were placed only in the lower compartment. This was interpreted as evidence that accelerated random locomotion was not involved in a positive result. Recently, however, it has been shown by Sally Zigmond and James Hirsch that a given substance may stimulate random locomotion at low concentrations (such as might develop with slow diffusion of molecules through the filter), but may actually inhibit locomotion at higher concentrations (such as when the test solution is placed directly with the cells in the upper compartment). Because of this problem, Hirsch has urged that data obtained with such indirect techniques as the Boyden system should be checked by direct microscopic observation of leukocytes crawling in thin preparations (such as in the slide-coverslip system used by Harris).

Now that we have described and evaluated the technique, let us return to Boyden's original observations. They are most interesting. He discovered that chemotactic activity (for neutrophils) was generated if serum was incubated with antigen-antibody precipitates. He proposed that such precipitates interact with the serum complement system to liberate chemotactic factors. John Hurley soon adopted the same technique to show that serum incubated with minced tissues also became chemotactic. Ryan and Hurley then used Harris' slide-coverslip technique to directly demonstrate that neutrophils crawled towards tissue fragments that had been previously incubated with fresh serum. These findings not only reinstated the view that chemotactic factors can be released during tissue damage, but also established a new concept: *chemotactic factors can be derived from an interaction between tissue products and serum substrates.* Later, in the section on Mediators, we discuss how this work has been extended, pinpointing the key role of serum complement components in the production of endogenous chemotactic factors, such as C3 fragments and C5 fragments.

There is also evidence that serum-independent chemotactic factors can be released from certain cells. For example, damaged or phagocytizing neutrophils probably release chemotactic molecules – rather like ants releasing "alarm pheromones," thereby calling their colleagues to help them attack a foreign insect invader. From studies of blood cells in slide-coverslip preparations, Marcel Bessis gives the following colorful description of such a process – he calls it "necrotaxis."

Figure 42 A human neutrophil crawling across a glass surface from left to right (SEM)

"On a cellular level, the phenomenon calls to mind large sharks swimming without paying attention to each other, to fasten upon one of their number which has blood escaping from a wound. It can sometimes be observed that after ingesting part of a dead cell, leukocytes abandon a piece of the corpse; this piece does not attract another cell, even if it is near to it."

Bessis makes the point here that such chemotactic factors are only released while the cell is in the process of dying and not at later stages.

Mechanisms Involved in Leukocyte Chemotaxis

First, how does the cell detect a gradient of chemotactic molecules so that it knows which way to crawl? Secondly, how does sensing of the gradient actually cause the cell to crawl in the right direction? These are challenging questions of broad biologic interest. It is likely that attractants are detected primarily by specific chemoreceptors on the surface of cells. This certainly seems to be true for bacterial cells that respond chemotactically (*Escherichia coli* has receptors for galactose, glucose, ribose, aspartate and serine). A gradient could be detected by a) a "temporal" mechanism whereby the cell "sniffs the air" (available chemotactic molecules bind to the surface receptor sites) at separate time intervals, or b) a "spatial" mechanism whereby the cell compares the concentration of the attractant at two or more separate locations on its surface at the same time. For bacteria, it seems that a temporal mechanism is involved (implying that individual cells can possess some sort of "memory" system) because sudden decreases in attractant concentrations cause *Salmonella typhimurium* organisms to show uncoordinated tumbling, whereas sudden increases in concentration induce smoother, "super-coordinated," straight-line motion for several minutes. This behavior could result in a directional response along a gradient. On the other hand, the available evidence suggests that a spatial mechanism is more likely to be involved in leukocyte chemotaxis. Sally Zigmond has shown in slide-coverslip preparations that stationary neutrophils exposed to a chemotactic gradient make their first movement towards the chemotactic source, indicating that a leukocyte can sense a difference in the number of chemotactic molecules across its own dimensions – no mean feat! However, we are still far from understanding how sensing of such a gradient can lead to directional movement: in other words, how the actin-myosin contractile machinery of the leukocyte is triggered and coordinated to produce the appropriate response (Figure 42).

The literature is full of studies claiming that chemotaxis (in the Boyden system) is inhibited or enhanced with one treatment or another. For instance, inhibition has been reported with drugs that increase intracellular cyclic AMP. However, it is likely that most of these results are due to inhibition or enhancement of cellular motility and not true effects on chemotactic responsiveness.

Years ago, it was thought that leukocytes were repelled by certain materials, eg, kaolin. This was called *negative chemotaxis*. The evidence for this phenomenon, however, was always rather weak and has not been confirmed in more recent studies.

Chemotaxis *In Vivo*

In rabbit ear chambers, early experiments demonstrated that leukocytes wandered about randomly in injured areas. This was interpreted to mean that chemotaxis was simply an *in vitro* curiosity. This pessimistic view was challenged by Ian Buckley, who proposed that random motility in such studies occurred because the injury was too widespread to allow gradients to develop within the field of the chamber. To examine the point more precisely, Buckley induced a very small focus of heat injury in an ear chamber. He then observed that neutrophils emigrated from the surrounding blood vessels and then crawled directly towards the site of injury.

APPENDIX E

QUESTIONS USED FOR IMAGERY RATINGS

APPENDIX E

QUESTIONS USED FOR IMAGERY RATINGS

Specific Imagery Questions

Score: 1 - no visualization
5 - high visualization

		SCORE
*1.	Describe how your white blood cells looked. (Score on vividness, clarity, continuity of description.)	_____
2.	Did you see them changing shape? What shape? How many?	_____
3.	Did you see them sticking to the blood vessel wall? How? How many?	_____
*4.	Did you see them leave the blood stream? How many?	_____
*5.	Could you tell anything about their strength?	_____
*6.	How do you feel about this experience?	_____
7.	Any other observations or comments?	_____
*8.	How symbolistic vs. how concrete is the visualization?	_____
*9.	Clinical judgment--overall strength of imagery?	_____

Summary Variables:

*White blood cell count change	_____
*Shape change	_____
*Adherence change	_____

*Variables correlated with the blood measures.

APPENDIX F

CORRELATIONS BETWEEN IMAGERY RATINGS, PERSONALITY FACTORS, AND BLOOD MEASURES

APPENDIX F.1.--Correlations Between Imagery Ratings and Pre to Post Changes in Blood Function (N = 16).

Blood Function Difference Scores	Imagery Ratings								
	Vividness	Shape Change	Adherence	Leaving the Blood Stream	Strength	General Feeling	Symbolism	Clinical Judgment	Decrease in WBC
Control White Blood Count	-.19	-.31	-.61*	-.45	-.01	-.08	.10	-.06	-.27
Imagery White Blood Count	.32	.40	.29	.35	.33	.33	.66***	.27	.55**
Control Adherence, Unstimulated	-.25	-.22	-.05	-.31	-.33	-.07	-.28	-.12	-.09
Control Adherence, Stimulated	.15	.15	.51*	.14	.04	.22	.14	.31	.11
Imagery Adherence, Unstimulated	.38	.37	.05	.27	.59**	.10	.36	.24	.25
Imagery Adherence, Stimulated	-.26	-.67***	-.57**	-.52*	-.44*	-.46*	-.31	-.71***	-.49*
Control Shape Change, Unstimulated	.53*	.42*	.19	.54*	.16	.11	.16	.33	.36
Control Shape Change, Stimulated	.16	.19	.09	-.02	.47*	.11	.07	.14	-.11
Imagery Shape Change, Unstimulated	.03	.38	.07	.38	.00	.14	.19	.27	.44*
Imagery Shape Change, Stimulated	-.01	.03	.05	-.11	-.25	.10	-.04	-.06	-.02

*p < .05
**p < .01
***p < .001

APPENDIX F.2.--Correlations Between Imagery Ratings and Blood Function Measures (N = 16).

Blood Function Measures	Imagery Ratings								
	Vividness	Shape Change	Adherence	Leaving the Blood Stream	Strength	Overall Feeling	Symbolism	Clinical Judgment	Decrease in White Blood Count
Control White Blood Count, Pre	.66**	.35	.26	.51*	.25	-.19	.13	.23	.33
Control White Blood Count, Post	.65**	.40	.41	.59*	.23	-.15	.09	.22	.38
Imagery White Blood Count, Pre	.25	.04	.09	.20	.16	.35	.35	.05	.32
Imagery White Blood Count, Post	.12	-.18	-.06	.05	.01	.23	.03	-.10	.07
Control Adherence, Unstimulated, Pre	.13	.18	.35	.14	.21	.59**	.29	.29	.31
Control Adherence, Stimulated, Pre	-.06	-.15	.02	.04	-.22	.18	.02	-.09	.14
Control Adherence, Unstimulated, Post	.25	.28	.38	.29	.36	.63**	.43*	.35	.35
Control Adherence, Stimulated, Post	-.11	-.19	-.18	-.02	-.21	.08	-.03	-.19	.08
Imagery Adherence, Unstimulated, Pre	.09	-.11	-.34	-.27	.12	.06	-.21	-.28	-.17
Imagery Adherence, Stimulated, Pre	-.11	-.26	-.58**	-.33	-.25	-.35	-.49*	-.49*	-.25
Imagery Adherence, Unstimulated, Post	-.28	-.42*	-.28	-.43*	-.45*	-.04	-.48*	-.42*	-.35
Imagery Adherence, Stimulated, Post	.18	.48*	.18	.29	.26	.21	-.02	.37	.31
Control Shape Change, Unstimulated, Pre	.23	.02	.10	.02	-.02	.25	.12	.04	-.05
Control Shape Change, Stimulated, Pre	-.13	.06	-.11	-.26	-.01	-.11	.03	-.05	-.15
Control Shape Change, Unstimulated, Post	-.20	-.27	-.06	-.35	-.12	.10	-.03	-.19	-.27
Control Shape Change, Stimulated, Post	-.19	-.00	-.15	-.28	-.17	-.15	.01	-.10	-.12
Imagery Shape Change, Unstimulated, Pre	.48*	.36	.43*	.47*	.08	.52*	.36	.39	.42*
Imagery Shape Change, Stimulated, Pre	-.00	.40	.01	-.05	.02	.22	-.06	.24	.12
Imagery Shape Change, Unstimulated, Post	.46*	.17	.39	.08	.o8	.45*	.26	.24	.19
Imagery Shape Change, Stimulated, Post	.00	.40*	.02	-102	.09	.20	-.05	.25	.13

*p < .05
**p < .01
***p < .001

APPENDIX F.3.--Correlations Between Wellness Scores and Pre to Post Changes in Blood Function (N = 16).

Blood Function Difference Scores	Wellness Scores										
	Productivity	Personal Care	Nutrition	Environment	Physical	Emotions	Community	Creativity	Auto	Parenting	TOTAL
Control White Blood Count	.56**	.18	.00	.19	-.16	.16	.30	.06	.18	-.05	.24
Imagery White Blood Count	.01	-.14	.21	.18	-.15	.28	.42*	.25	.31	.24	.31
Control Adherence, Unstimulated	.07	.01	.17	-.35	.05	-.13	-.40	.12	-.19	.18	-.13
Control Adherence, Stimulated	.43*	-.08	-.21	-.29	.12	-.13	.08	.09	.03	-.20	-.01
Imagery Adherence, Unstimulated	-.02	.55**	.41*	.35	.08	.42*	.29	.20	.37	.06	.55**
Imagery Adherence, Stimulated	-.20	-.14	-.00	.39	-.23	.04	.13	-.18	.09	.28	.03
Control Shape Change, Unstimulated	-.19	.18	.07	.11	.06	-.20	-.25	-.16	-.23	-.13	-.14
Control Shape Change, Stimulated	.07	.38	.21	.10	.34	.52*	.28	.53**	.22	-.18	.50*
Imagery Shape Change, Unstimulated	-.21	-.05	-.11	-.03	-.03	.04	-.25	-.15	-.08	.23	-.18
Imagery Shape Change, Stimulated	.23	-.14	-.05	-.10	.14	-.48*	-.14	-.67**	-.21	-.05	-.24

*$p < .05$

**$p < .01$

APPENDIX F.4.--Correlations Between Wellness Scores and Blood Function Measures (N = 16).

Blood Function Measures	Wellness Scores										
	Productivity	Personal Care	Nutrition	Environment	Physical	Emotions	Community	Creativity	Auto	Parenting	TOTAL
Control White Blood Count, Pre	.05	.36	.48*	.20	-.01	.15	-.07	.35	.66**	-.16	.39
Control White Blood Count, Post	-.12	.28	.43*	.12	.04	.09	-.15	.30	.55**	-.13	.29
Imagery White Blood Count, Pre	.19	-.05	.35	.28	-.24	-.04	-.06	-.22	.11	.34	.11
Imagery White Blood Count, Post	.22	.02	.30	.23	-.20	-.21	-.32	-.40	-.05	.26	-.05
Control Adherence, Unstimulated, Pre	.46*	.26	.22	.02	.17	.14	-.24	-.18	-.19	.27	.14
Control Adherence, Stimulated, Pre	.21	.05	.20	.39	.14	.02	-.39	-.37	.00	.46	.12
Control Adherence, Unstimulated, Post	.43*	.25	.14	.19	-.15	.21	-.06	-.24	-.11	.19	.21
Control Adherence, Stimulated, Post	.02	.07	.25	.45*	.08	.07	-.37	-.35	-.01	.47*	.10
Imagery Adherence, Unstimulated, Pre	-.21	.16	.59**	-.01	.01	.03	-.26	.12	-.20	.03	.05
Imagery Adherence, Stimulated, Pre	-.54**	.03	.50*	-.09	-.07	-.21	-.43*	.06	-.18	-.04	-.19
Imagery Adherence, Unstimulated, Post	-.13	-.38	.05	-.33	-.07	-.35	-.45*	-.09	-.48*	-.03	-.47*
Imagery Adherence, Stimulated, Post	-.14	.15	.31	-.43	.18	-.17	-.39	.21	-.20	-.29	-.14
Control Shape Change, Unstimulated, Pre	.40	.15	-.18	.09	.04	.35	.03	.03	.10	-.22	.15
Control Shape Change, Stimulated, Pre	.52*	.10	.12	.28	.49*	.31	.33	.10	.49*	-.28	.56**
Control Shape Change, Unstimulated, Post	.39	-.02	-.16	-.01	-.01	.36	.18	.12	.22	-.06	.19
Control Shape Change, Stimulated, Post	.54**	-.02	.06	.27	.42*	.17	.27	-.07	.46*	-.25	.44
Imagery Shape Change, Unstimulated, Pre	.33	-.18	-.16	.32	.09	-.03	-.29	-.44	-.14	.16	-.07
Imagery Shape Change, Stimulated, Pre	.25	.09	.21	-.31	.46*	.06	-.31	.12	-.13	-.38	.04
Imagery Shape Change, Unstimulated, Post	.44*	-.15	-.10	.34	.11	-.05	-.16	-.36	-.10	.15	.03
Imagery Shape Change, Stimulated, Post	.19	.13	.23	-.29	.43*	.20	-.27	.31	-.07	-.37	.11

*$p < .05$
**$p < .01$

APPENDIX F.5.--Correlations Between Type A Scores, Locus of Control (Internal) Scores and Pre to Post Changes in Blood Function (N = 16).

Blood Function Difference Scores	Type A and Locus of Control (Internal) Scores								
	Type A	Luck/Fate	Academics	Miscellaneous	Leadership	Politics	Respect	Interpersonal Trust	Overall Internal Score
Control White Blood Count	-.38	.40	.37	.54*	.07	-.29	.05	.23	.29
Imagery White Blood Count	-.03	-.07	-.01	.22	.12	-.17	-.29	.05	-.00
Control Adherence, Unstimulated	-.34	-.26	-.12	-.32	.04	-.40	-.61**	-.18	-.37
Control Adherence, Stimulated	-.23	-.30	-.26	-.03	.10	.15	-.28	.01	-.09
Imagery Adherence, Unstimulated	.36	-.12	.19	.01	-.13	.07	.16	.05	.03
Imagery Adherence, Stimulated	-.16	.46*	-.01	-.13	-.32	.22	-.08	.21	.12
Control Shape Change, Unstimulated	-.06	-.10	.14	.10	.22	.04	.31	.14	.17
Control Shape Change, Stimulated	.18	-.04	.26	.08	.06	.30	.14	.03	.16
Imagery Shape Change, Unstimulated	.20	-.19	.11	.02	.23	-.24	.30	-.16	-.05
Imagery Shape Change, Stimulated	.04	.02	-.39	-.50	-.47	.05	-.20	-.44*	-.45*

*$p < .05$

**$p < .01$

APPENDIX F.6.--Correlations Between Type A Scores, Locus of Control (Internal) Scores and Blood Function Measures (N = 16).

Blood Function Measures	Type A and Locus of Control (Internal) Scores								
	Type A	Luck/Fate	Academics	Miscellaneous	Leadership	Politics	Respect	Interpersonal Trust	Overall Internal Scores
Control White Blood Count, Pre	-.18	-.27	.18	-.23	.01	.32	-.11	-.00	-.02
Control White Blood Count, Post	-.06	-.36	.06	-.36	-.01	.37	-.11	-.07	-.10
Imagery White Blood Count, Pre	.23	.10	.16	.27	-.10	-.07	-.04	-.06	.04
Imagery White Blood Count, Post	.25	.16	.19	.19	-.19	.01	.12	-.10	.05
Control Adherence, Unstimulated, Pre	.35	-.32	.13	.02	.06	-.09	-.13	-.15	-.12
Control Adherence, Stimulated, Pre	.31	-.03	.16	-.03	-.10	.09	.18	-.07	.01
Control Adherence, Unstimulated, Post	.51*	-.20	.19	.17	.04	.09	.15	-.07	.05
Control Adherence, Stimulated, Post	.36	.09	.24	-.01	-.13	.02	.26	-.07	.04
Imagery Adherence, Unstimulated, Pre	.17	.23	.34	-.10	-.10	-.10	-.17	-.25	-.08
Imagery Adherence, Stimulated, Pre	.04	.28	.26	-.31	-.10	-.20	-.10	-.24	-.13
Imagery Adherence, Unstimulated, Post	-.21	.27	.07	-.08	.04	-.14	-.26	-.22	-.08
Imagery Adherence, Stimulated, Post	.18	-.26	.18	-.07	.25	-.33	.01	-.35	-.19
Control Shape Change, Unstimulated, Pre	-.10	.11	.32	.16	.11	.49*	.19	-.05	.25
Control Shape Change, Stimulated, Pre	.23	.11	.17	-.31	-.18	.34	.11	-.17	-.03
Control Shape Change, Unstimulated, Post	-.11	.14	.12	.04	-.07	.30	-.08	-.13	.05
Control Shape Change, Stimulated, Post	.19	.13	.10	-.36	-.22	.27	.08	-.20	-.08
Imagery Shape Change, Unstimulated, Pre	.01	-.18	.01	.14	.03	.28	.23	-.12	.05
Imagery Shape Change, Stimulated, Pre	.08	-.15	.26	-.32	.13	-.18	-.07	-.58*	-.29
Imagery Shape Change, Unstimulated, Post	-.10	-.08	-.05	.13	-.09	.41	.08	-.03	.07
Imagery Shape Change, Stimulated, Post	.07	-.15	.37	-.17	.27	-.20	-.01	-.45	-.17

*p < .05