1991

Perceptual and Cognitive Abnormality Model of Hypochondriasis: Psychological Correlates of Amplification and Misinterpretation

James R. Craft

College of Humanities and Sciences

Virginia Commonwealth University

This is to certify that the thesis prepared by James R. Craft entitled "Perceptual and Cognitive Abnormality Model of Hypochondriasis: Psychophysiological Correlates of Amplification and Misinterpretation" has been approved by his committee as satisfactory completion of the thesis requirement for the degree of Master of Science.

[redacted]

Sandra E. Gramling, Ph.D., Director of Thesis

[redacted]

Stephen W. Harkins, Ph.D., Committee Member

[redacted]

Timothy R. Elliott, Ph.D., Committee Member

[redacted]

Joseph P. Bush, Ph.D., Director of Graduate Studies

[redacted]

Elske v.P. Smith, Ph.D., Dean,
College of Humanities and Sciences

April 1, 1991
Date

Perceptual and Cognitive Abnormality Model of Hypochondriasis: Psychophysiological Correlates of Amplification and Misinterpretation

A thesis submitted in partial fulfillment
of the requirements for the degree of Master of Science at
Virginia Commonwealth University

By
James Randolph Craft
Bachelor of Science
Virginia Commonwealth University
1978

Director: Sandra E. Gramling, Ph.D.
Assistant Professor of Psychology

Virginia Commonwealth University
Richmond, Virginia
August, 1990

Acknowledgements

I would first like to extend my deepest gratitude to my advisor and committee chairperson, Dr. Sandra E. Gramling. Her ceaseless efforts and generosity on my behalf have made this project come to fruition. It is very much appreciated. I would also like to thank Dr. Steve Harkins for his generous donation of time, equipment, space to run this study, as well as all his help with graphs and suggestions. Thanks go as well to Dr. Tim Elliott for serving on my committee.

There were many people who helped with this study who also deserve thanks. First, my project coordinator, Lori Howell, who had a thankless task and did a first-rate job with it. Thank you for all your help keeping everything in order and running smoothly. I would also like to thank my three research assistants, Betsy Rogan, Hiliary Guess, and Christine Case, for all those late Friday afternoons and early Saturday mornings when it was so nice outside, Thanks as well for scoring all those forms. Also to Monte Thomas and Tineka Archer thanks for checking the data one more time.

I would also like to thank Ben Holland and Spotland Productions of Nashville, Tennessee for their invaluable assistance in producing the pre-recorded audiotape instructions for this project. Thanks as well Ben for being my friend for over twenty years.

I would like to thank all those professors who let me come into their class and make my pitch. Thanks to Kristen Knoebber for commiserating and to Chiara Nuzzo for being that last data point. Finally, thanks to all those women who participated in the study and put their foot in that cold water. I really appreciate that.

Dedication

This project is dedicated to my lovely wife Debbie. You have worked just as hard on this project as I have. Thank you for all your help typing, scoring, entering, organizing, retyping, listening, staying up late, waiting, caring, pushing, not pushing, being there. Without your MRS I would never have gotten my MS. Thank you for being who you are and for being my wife. One day I hope to come through for you the way you have for me.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

LIST OF ABBREVIATIONS

HR	Heart Rate
MMPI	Minnesota Multiphasic Personality Inventory
MPD	Myofascial Pain Dysfunction
MPQ	McGill-Melzack Pain Questionnaire
RR	Interbeat Interval
UCS	Unconditioned Stimulus
VAS	Visual Analogue Scale
YELP	Your Everyday Life Pressures

Abstract

Hypochondriasis is a disorder that may affect ten percent of all individuals seeking medical care. This places a great burden on the health care resources that are currently available. Unfortunately, very few of these individuals come to the attention of mental health professionals.

Various models have attempted to conceptualize hypochondriasis. These include the psychiatric model, the psychodynamic model, the social learning and the perceptual or cognitive abnormality model.

The perceptual or cognitive abnormality model suggests that individuals who are hypochondriacal misinterpret and/or amplify normal bodily sensations. These processes lead the individuals to believe they are suffering from a serious disease. Few empirical studies have been conducted to confirm this model, and no research has been conducted testing this model using psychophysiological measures to test whether or not these indices are indeed different for non-hypochondriacal persons.

Pain is a symptom often reported by hypochondriacs and this is what usually brings them into contact with the health care system. Being able to measure how hypochondriacs react to the experience of pain would give insight into whether or not they react more strongly to pain than do non-hypochondriacal persons. Although the objective measurement of pain has been considered difficult in the past, recent work by researchers using visual analogue scales have shown them to be valid and reliable instruments for measuring both the sensory and affective dimensions of the pain experience.

The present study tested the perceptual and cognitive abnormality model of hypochondriasis using painful physical stimuli (heat stimulation and a cold pressor task) to measure subjects' pain tolerance and to rate their experience of pain. Subjects rated their pain experience on both sensory (intensity) and affective (unpleasantness) dimensions using visual analogue scales. The model was also tested using a psychological stressor, a visualization task which incorporated everyday life events. The psychophysiological measure heart rate was continuously recorded to assess subjects' physiological activity to stress. It was hypothesized that hypochondriacal individuals would withdraw their feet from the cold water bath, before being instructed to, at a significantly higher rate than the control group. It was also hypothesized that visual analogue scale ratings of intensity and unpleasantness would be significantly higher for the hypochondriacal group than for the control group for both cold pressor and thermal radiant heat. Further, it was hypothesized that the hypochondriacal group would exhibit increased heart rate, as well as a longer return to baseline time compared to the control group.

In general, the data offered little support for the hypotheses used to test the amplification/misinterpretation components of the perceptual and cognitive abnormality model. Methodological problems with the study were discussed and improvements suggested. Also, problems and advantages of the present model were noted.

Introduction

Almost everyone is familiar with hypochondriasis. We have been exposed to it through family lore or the stereotypes portrayed on television and in the movies. For example the person who complains constantly about various aches and pains or a character such as that played by Woody Allen who is sure that every sniffle means he's contracted pneumonia. While these caricatures have provided entertainment, hypochondriasis is no laughing matter.

Hypochondriacal individuals are tenacious in their search for a cure and validation of their illness. It is not uncommon for hypochondriacs to "doctor shop" trying to obtain a diagnosis they believe justifies their condition. Frequently, the relationship between clinician and patient is unsatisfying to both parties and breaks down. At this point the hypochondriacal person typically seeks out a new relationship with another clinician (Barsky & Klerman, 1983).

Hypochondriasis has a substantial impact on the general practice of medicine. Estimates are that between 30 - 80% of patients seeking care from a physician have functional complaints (i.e. physical complaints with no organic basis) (Lowy, 1975). Even the most conservative estimates place the number at 10% of the medical population (Ford, 1986). It has also been estimated that the "worried well" account for 50% of the cost of adult ambulatory medical care (Barsky & Klerman, 1983). As the "baby boomer" population moves toward a time of needing increasing medical care, the strain placed on services and finances for that care could be severely hampered by the high prevalence of hypochondriasis.

An understanding of hypochondriasis has been slow to develop for several reasons. Based on the statistics cited above, it would appear that physicians see many patients with functional somatic complaints, yet few empirical articles appear in the medical journals. Reports in the literature suggest that physicians experience these patients with chronic functional complaints as "vexing and perplexing" (Kaplan, Lipkin, & Gordon, 1988). Though some of these patients would clearly meet diagnostic criteria for DSM-III R, mental health professionals do not often encounter this population, perhaps explaining the paucity of data regarding these patients. When they do, it is generally in an inpatient setting where the person has been admitted for another psychiatric disorder (Barsky and Klerman, 1983). There has also been difficulty in establishing clear and reliable diagnostic criteria for hypochondriasis. These factors have led to a lack of scientific research on this subject, which is necessary to improve our understanding of hypochondriasis.

Conceptualization and Diagnosis of Hypochondriasis

Hypochondriasis has been conceptualized in a number of different ways. It has been viewed as a psychiatric disorder, a condition arising from intrapsychic and unconscious emotional forces (psychodynamic model), a learned social behavior, or as a cognitive or perceptual abnormality (Barsky & Klerman, 1983). Although there is some overlap in these models, the unique aspects of each merit separate consideration.

The Psychiatric Model of Hypochondriasis

The psychiatric model views hypochondriasis as a psychopathological condition which is chronic in nature. The hypochondriacal person has an unrealistic fear that they have a serious disease (Barsky & Klerman, 1983). The psychiatric model includes classification of the psychopathological disorder. Currently this classification is provided by the Diagnostic and Statistical Manual (Third Edition - Revised) (APA, 1987). The manual lists the following diagnostic criteria for hypochondriasis: (A) Preoccupation with the fear of having, or the belief that one has, a serious disease, based on the person's interpretation of physical signs or sensations as evidence of physical illness. (B) Appropriate physical evaluation does not support the diagnosis of any physical disorder that can account for the physical signs or sensations or the person's unwarranted interpretation of them, and the symptoms in A are not just symptoms of panic attacks. (C) The fear of having, or belief that one has, a disease persists despite medical reassurance. (D) Duration of the disturbance is at least six months. (E) The belief in A is not of delusional intensity as in Delusional Disorder, Somatic Type (i.e., the person can acknowledge the possibility that his or her fear of having, or belief that he or she has, a serious disease is unfounded (APA, 1987, p. 261).

Hypochondriacal individuals generally report pain as their major complaint (Barsky & Klerman, 1983). However, many other bodily complaints may be noted involving every organ system in the body, either alone or in combination (Kenyon, 1976). These individuals are unable to dispel their belief about their illness despite objective testing or medical reassurances about their health. Also, these individuals are only satisfied with a medical diagnosis and reject any suggestion of a psychological etiology for their symptoms (Barsky & Klerman, 1983).

There is also a preoccupation and fascination with bodily function and sensation. Their disease state becomes their life, coloring every part of their lives, including interpersonal relationships. These individuals respond to life events, particularly crises and stress, with bodily symptoms not
emotional manifestations (Barsky & Klerman, 1983). While some of the above symptoms do overlap with other models, they are always found in the psychiatric model and can best be conceptualized within this model.

The Psychodynamic Model of Hypochondriasis

Hypochondriasis has also been conceptualized from a psychodynamic point of view. Freud viewed hypochondriasis as a manifestation of redirected sexual libido into narcissistic libido (Freud, 1914). Other psychodynamic writers (Vaillant, 1977; Brown & Vaillant, 1981) have viewed hypochondriacal behavior as a transformation of hostile and aggressive tendencies toward others. Hypochondriacal persons are thought to redirect their anger by appealing to others for help and then rejecting that help. This view is consistent with evidence suggesting that inhibition of anger is a component of hypochondriasis (Bianchi,1971).

Some psychodynamic theorists have conceptualized hypochondriacal behavior as an intrapsychic defense mechanism (e.g. Nemiah, 1980). The symptoms are a defense against feelings of worthlessness and inadequacy. It is better for the body to be sick instead of one's self esteem (Barsky & Klerman, 1983). This conceptualization is closely related to the concepts of primary and secondary gain. Primary gain results mostly from the reduction of intrapsychic conflict and the partial drive gratification which comes from the defensive operation. Secondary gain is accomplished in being able to avoid responsibilities and obligations, as well as gain sympathy, attention and possibly financial support (Wahl, 1963).

The Social Learning Model of Hypochondriasis

A third way that hypochondriasis has been conceptualized is as a learned social behavior or social communication. With respect to learned social behavior, persons often go to physicians because they are the individuals with the power to validate and therefore legitimize the illness condition. In terms of a social communication, the person is saying, with their body, that they need to be taken care of, that they are hurt. This role will excuse them from duties and responsibilities or challenges and brings the benefits of sympathy, attention and support, both personal and financial. (Barsky & Klerman, 1983).

These individuals are not consciously or maliciously attempting to adopt the sick role. They are merely repeating behaviors which they learned in the past brought them the care, sympathy, nurturing, and other benefits of the sick role. This behavior is ultimately counterproductive in the patient-physician interaction. The patient cannot respond to the treatment and be cured because then the caretaking would stop. Physicians, who are trained to cure, become frustrated, often feeling that their expertise is not needed. Frequently, this relationship ends and a new one begins with another physician who is unaware of the patient's past history (Barsky & Klerman, 1983).

Support for this model has also been demonstrated. Patients with chronic illness behavior have variable pain tolerance which can be verbally influenced by reinforcement and reassurance (Wooley, Epps, & Blackwell, 1975). Behavioral modeling can also influence pain tolerance and reactivity (Craig & Neidermayer, 1974). Also, psychosomatically ill patients value care-taking behaviors more than achievement, sociability, or communication behaviors. Hypochondriacal individuals will reward and thereby reinforce those individuals that give them care. This reinforcement may possibly shape those care givers behaviors to treat hypochondriacs as being in the sick role thereby perpetuating the problem (Wooley & Blackwell, 1975).

The Perceptual and Cognitive Abnormality Model of Hypochondriasis

A fourth conceptualization of hypochondriasis suggests that these individuals may suffer from a perceptual or cognitive abnormality. Barsky & Klerman (1983) describe several ways this abnormality may be expressed. Hypochondriacal individuals may amplify normal bodily sensation (i.e. experience stimuli as more noxious or intense than non-hypochondriacal persons) and/or misinterpret the bodily sensations which accompany emotional arousal (e.g. anxiety) or normal bodily functioning (e.g. indigestion; Barsky and Klerman, 1983).

In this conceptualization, the perceptual or cognitive defect is considered the primary source of the problem. The hypochondriacal behavior is considered a natural consequence of the hypochondriac's abnormal bodily perceptions (Barsky & Klerman, 1983). The bodily sensations that hypochondriacs experience also occur in normal individuals, particularly when under stress. Individuals not physiologically predisposed to amplify their somatic sensations consider these sensations as normal or trivial (Barsky & Klerman, 1983). Hypochondriacal individuals who amplify and/or misinterpret bodily symptoms have a more difficult time normalizing these sensations because to them these sensations are more intense and/or have different meaning than those of non-hypochondriacal individuals.

Amplification. The amplification hypothesis suggests that the hypochondriac experiences normal bodily sensations as more intense and more noxious than non-hypochondriacal persons. This view suggests that hypochondriacal persons express more physical symptoms than others because they have lower thresholds and tolerance for physical discomfort.

In discussing heightened perceptual sensitivity to bodily sensations Hanback & Revelle (1978) suggest that hypochondriasis is the result of a predisposing hypochondriacal personality. The development of the hypochondriacal personality depends upon both psychological and physiological factors. Hanback and Revelle stress the physiological aspects of this development. The hypochondriacal individual has an innate tendency to experience (perceive) more bodily sensations than other individuals. This leads to health concerns due to this heightened arousal and increased sensitivity to stimulation (Hanback & Revelle, 1978).

Using a two-flash fusion procedure, they were able to provide support for this conceptualization. This procedure involves flashing two lights at a subject and measuring the minimum time needed between the two flashes to distinguish them as two separate flashes. This is known as two-flash fusion sensitivity. They found that those scoring high on a hypochondriasis scale had significantly greater two-flash sensitivity. Also in this experiment absolute auditory sensitivity measures were obtained. In this procedure auditory tones were presented in a random order for three different intensities. Blanks (i.e. no tones) were also administered as part of this random order. Subjects had to indicate after a given trial whether or not a tone had been presented. The results of this auditory measure were in the predicted direction (high hypochondriasis scorers mean = 8.38 db, low hypochondriasis scorers mean = 10.58 db), though the differences were not quite significant ($p < .06$; Hanback & Revelle, 1978).

Also, using cluster analysis on a scale measuring hypochondriasis, Hanback & Revelle (1978) found a cluster of items which were related to a concept of "arousal-induced" hypochondriasis. Individuals with this form of hypochondriasis report more symptoms because of greater sensitivity to bodily functions, as well as being more concerned and anxious about their health. The cluster analysis revealed three sub-clusters which support this. The first of these is body awareness. These individuals were more aware and sensitized to sensations in their own bodies. They also tended to report more aches and pains and to have more general and specific somatic complaints. The second sub-cluster was introverted concern about health. This involved being concerned about their health, but not being concerned about other peoples' reactions to their health or complaints about it. The third sub-cluster was physical symptoms of anxiety. There were more symptoms reported that are physical and clinical signs of anxiety. These included such symptoms as headaches, chest pains, and sleep disturbance. Finally, Hanback and Revelle (1978) found that those subjects who had scored high on the arousal hypochondriacal scale also had greater two-flash sensitivity compared to those who scored low on this scale (Hanback & Revelle, 1978). This was added evidence for their concept of arousal-induced hypochondriasis.

Misinterpretation. A second aspect of the perceptual/cognitive deficit conceptualization of hypochondriasis is that hypochondriacal individuals misinterpret normal bodily sensations (Barsky & Klerman, 1983). They take a normal, trivial, or transient symptom and misattribute it to serious disease.
This can more readily occur when the part of the body the person is experiencing difficulty with is not directly observable, such as an internal organ, or the symptoms are ambiguous or common. This may explain why hypochondriacal persons often report symptoms such as pain, weakness, fatigue, and nausea. Once the individual has interpreted the sensations as pathological symptoms, this interpretation tends to be used again and again leading to perpetuation and self-validation of the pathological nature of the symptoms (Barsky & Klerman, 1983).

Support for this has been demonstrated. Manipulating a subject's idea about the causes of their discomfort can alter his or her perception of the unpleasantness of the sensation (Rodin, 1978). It has also been found that normal subjects scoring highest on a hypochondriacal scale had health concerns due to misinterpretation of normal sensations (Barsky & Klerman, 1983).

Summary of Conceptual Models. There have been several models of hypochondriasis presented, each viewing the concept from a different perspective. The psychiatric model views hypochondriasis as a psychopathological condition which is chronic in nature. The psychodynamic model conceptualizes hypochondriasis as an intrapsychic defense mechanism. The social learning model contends that hypochondriasis is a learned social behavior or social communication. The perceptual and cognitive abnormality model suggests that hypochondriacal persons express more physical symptoms than others because they have lower thresholds and tolerance for physical discomfort. Unlike the other models hypochondriacal behavior per se is considered a natural consequence of the underlying perceptual/cognitive abnormality. Each model has produced research findings which tend to support their respective viewpoints. However the research for each model tends to be scant.

More research in this area is needed in order to better understand the processes underlying the expression of hypochondriacal behavior. The perceptual abnormality model is one which seems to lend itself to straightforward testing and has important implications for the management of this "vexing and perplexing" population. Relative to other models of hypochondriasis, the perceptual/cognitive abnormality model predicts differences at the lowest levels of information processing (i.e. differences in sensory and pain thresholds). The measurement of pain perception and tolerance coupled with measures of subjects' physiological reactivity would be a direct and straightforward way to obtain information relevant to this hypothesis. Since pain complaints are often the reason hypochondriacs come to the attention of health care providers, information regarding their pain perception is of both clinical and theoretical concern.

Pain and Hypochondriasis

Pain has been called "perhaps the most universal form of stress" (Turk, Meichenbaum, & Genest, 1983, p. 73). Over 70 million office visits to physicians representing over 6% of all visits in 1980-1981 were for pain as the chief complaint according to a 1984 report by the National Center for Health Statistics. It has been estimated (Bonica, 1980) that almost 35% of the American population suffers from some form of chronic pain. Over 50 million Americans are disabled to some degree by pain at a cost of over 60 billion dollars a year (Bonica, 1980). Given that the most common complaint reported by persons diagnosed as hypochondriacal is pain, some percentage of those pain patients must be hypochondriacs. It would seem then, that an examination of variables associated with pain expression would be useful in enhancing our understanding of hypochondriasis. Since Melzack & Wall's (1965) seminal work on the gate control theory of pain, the experience of pain has been viewed as a complex phenomenon stemming from an interaction between cognitive, motivational, and sensory components. Some individuals such as Fordyce (1976) assert that it is futile to attempt to measure pain since it is a subjective experience. If it could be shown that the experience of pain is not simply subjective, but has objective quantifiable components, the understanding of the experience of pain would be vastly improved.

Pain Measurement

Individuals have attempted to establish criteria for pain measurement for as long as they have been attempting to measure pain. The establishment of these criteria is important in order to construct a viable pain measure. Price, McGrath, Rafii, & Buckingham (1983) have listed several criteria by which to evaluate a pain measurement procedure. First, the measure should be valid. The instrument should be able to accurately measure what it purports to measure. Second, the measure should be reliable. The measurements should be consistent over time, regardless of who administers the instrument. Third, the measure should be versatile. The instrument should be easy to use in a variety of settings, relatively easy to score, and not unduly disrupt the procedure for which it is being used. Price and Harkins (1987) also state that pain measurement should provide ratio scale measurement, measures for separate dimensions of pain (e.g., sensory-intensive vs. affective -motivational), and a measure of pain intensity that is applied consistently across different types of pain. There are a few instruments which attempt to meet these criteria. Two of these are the McGill-Melzack Pain Questionnaire and visual analogue scales (VASs).

McGill-Melzack Pain Questionnaire. One instrument which might be used to evaluate pain is the McGill-Melzack Pain Questionnaire (MPQ). This questionnaire is based on Melzack's work on pain, and provides a subjective report of pain (Melzack, 1975). The pain is categorized in terms of three separate dimensions: (1) the sensory quality of the pain experience, (2) the affective dimension of the pain experience, and (3) the evaluative dimension of the pain experience.

The MPQ consists of four parts. The first part consists of a drawing (front and back) of the human body. The subject is supposed to mark on the drawing where the pain is occurring and indicate whether it is external, internal, or both. The second part of the questionnaire asks the subject to circle descriptive words which best describe the pain (e.g. flickering, terrifying, nagging). The third part of the questionnaire asks the subject to evaluate how the pain changes with time. The subject is given three sets of words to describe the pattern of pain occurrence (e.g. continuous, rhythmic, transient). The subject is asked to circle all words that describe the pattern. They are also asked what kinds of things relieve or increase their pain. The fourth part of the questionnaire asks the subject to rate the strength of the pain by answering six questions (e.g. Which word describes your pain right now?) using one of five descriptive words ranging from mild (1) to excruciating (5). This yields a Present Pain Intensity score (Melzack, 1975).

The MPQ attempts to measure the sensory and affective dimensions of pain, but in practice fails to do so. Turk, Rudy, & Salovey (1985) point out that the sensory, affective, and cognitive responses on the MPQ are highly correlated so they do not have discriminative validity. Price, Harkins, & Baker (1987) suggest that the type of descriptor word (sensory or affective) that a person uses may not be related to magnitudes of unpleasantness as compared to sensation.

Clinicians often use the MPQ as though it were a self-administered instrument, which it is not designed to be. The MPQ is unreliable when used in this manner. This is due in part to its sometimes difficult vocabulary and lack of a standardized scoring format. Melzack (1975) states that it is important for the subject to understand the vocabulary and that some of the words may be beyond the subject's understanding and may need to be explained. A subject's present pain intensity is based on the selection of one number-word (e.g. 1-mild, 2-discomforting). Melzack discusses the fact that what is a 1-mild for one patient may be a 2-discomforting for another patient. This brings into question if the pain experience is being reliably measured with this instrument. It is also too involved to use within a short time frame. This shortcoming affects the versatility of the MPQ. There are other measures which allow the subject to respond to the pain experience in a multi-dimensional fashion. Perhaps the one which provides accurate information and is more easily administered is the visual analogue scale.

Visual Analogue Scales. The VAS is a scale which allows meaningful, quantifiable comparisons of pain ratings and easy administration. The VAS consists of a line either horizontal or vertical in orientation. It is anchored at either end with an absolute description (i.e. no pain relief or complete pain relief). The line does not have to be of any particular length, but lengths of 10 cm or 15 cm have been used (Huskisson, 1983). Huskisson (1983), in a review of VASs, refers to the scales as "a simple, robust, sensitive, and reproducible instrument that enables a patient to express the severity of his pain in such a way that it can be given a numerical value" (p. 33). These scales have been criticized because they ignore the multi-dimensionality of pain since they measure only the sensation severity of the pain.

This limitation has been addressed by Price et al. (1983) and Price & Harkins (1987). These studies have demonstrated that separate VASs can be used to independently evaluate the sensory and affective dimensions of the pain experience. Though these two measures are usually highly correlated, numerous studies have demonstrated that these measures are non-redundant. In a study testing fentanyl's effects on clinical and experimental pain, Price, Harkins, Rafii, and Price (1986) were able to show that the drug affected both the sensory and affective dimensions of pain. In this study VAS-affective ratings of clinical pain were reduced compared to VAS-sensory ratings of clinical pain. This provides evidence that VAS measurement of these two dimensions is not entirely redundant. It was shown that low to moderate doses of opiates reduced both the sensory and affective dimensions of pain. Their study strongly suggested that reduction in pain affect was directly related to reduction in pain sensation intensity.

Price et al. (1983) also demonstrated that VASs could be used as ratio scale measures of pain. This is an important and valuable finding because it allows for the determination of the percentage of pain increase or reduction that the person is experiencing. Price & Harkins (1987) have also shown similar nociceptive stimulus - VAS response functions in the rating of experimental and clinical pain, demonstrating that the intensities of different types of pain can be meaningfully compared. Pain is often considered a very subjective experience, which does not lend itself well to measurement. It has been demonstrated that VASs can be used with different populations of clinical pain patients, myofascial pain dysfunction (MPD) and chronic low back pain, as well as an experimental pain group using healthy volunteers (Price & Harkins, 1987). All populations used the scales in an internally consistent manner (Price & Harkins, 1987). To determine this, pain patients were asked to rate their clinical pain using VASs to describe their minimum, usual, and maximum pain intensity levels experienced during the last week. They were then asked to rate the intensity of experimentally induced pain (using thermal pulses) with VASs. The clinical pain subjects assigned specific temperatures to different pain intensity levels of minimum, usual, and maximum. The pain subjects were also asked to match the experimental pain levels to their own levels of clinical pain. It was found that the MPD pain subjects rated experimental pain at the same intensity levels as their clinical pain. This demonstrates an internal consistency in the subjects' rating of different types of pain. Normal subjects were also given experimental pain stimuli and asked to rate the intensity levels of their pain using VASs. It was found that MPD subjects, low back pain subjects (from a previous study), and pain-free volunteers did not differ in their VAS ratings to temperature. It was also demonstrated that MPD and lower back pain subjects responded similarly when matching clinical pain to temperature levels. The triangulation procedure used by Price & Harkins (1987) represents the most elegant demonstration to date that VAS scales are used in a internally consistent manner across different subject populations and under differing pain conditions. Given its validity, reliability, and versatility, the VAS appears to be the measurement instrument of choice in differentiating painful experiences.

Pain as a Measurable Stressor

Review of the VAS literature suggests that pain can be objectively quantified and comparisons can be made between and within different pain populations. Measurement models of pain are available which would allow a direct test of the amplification process thought to underlie the perceptual defect or abnormality in hypochondriasis. Similarly, measurement procedures are available to test for the putative misinterpretative process thought to underlie hypochondriasis. Specifically, physiological reactivity to pain and other stressors are thought by some to reflect the evaluative process regarding potential threat relevant stimuli such as fight or flight situations, mental work, active or passive coping, and uncontrollable aversive stimuli (Williams, 1986). As such, measures of physiological reactivity in response to stress may be a useful test of the amplification hypothesis. Moreover, some researchers (e.g. Feuerstein, Labbe, & Kuczmierczyk, 1986) have specifically suggested that tests of physiological reactivity among hypochondriacal individuals may prove to be our most enlightening test to date of the misinterpretation hypothesis.

Physiological Reactivity and Hypochondriasis

Physiological reactivity is one of the most researched topics in Behavioral Medicine/Health Psychology today. Apparent relevance in the etiology of coronary heart disease led to an explosion of research in this field. These techniques, however, have not been applied to the hypochondriacal population despite their apparent relevance in testing the misinterpretation hypothesis.

One of the physiological parameters that can measure the body's response to stressful situations, such as pain, is a measure of cardiovascular reactivity. Pain is a powerful stressor and can be useful in helping to determine how a person responds to stressors. Many stressors will produce a physiological reaction and this reaction may be altered by changing the situations in which the stressor is introduced. After discussing some more general reactivity responses, we will look at the cardiovascular response in more detail.

Physiological Reactivity to Stressors

Stimulus events which elicit physiological reactivity can be classified as either psychological or physical stressors. Psychological stress has been defined as "an internal state of the individual who perceives threats to his/or her physical and/or psychic well being" (Krantz, Manuck, & Wing, 1986, p. 86). Physical stressors involve the subject reacting to such things as pain, noise, or electric shock (Krantz et al., 1986).

Several different types of tasks can be used as stressors. The first type are considered active tasks which actively engage the subject's participation. These are tasks such as: mental arithmetic, reaction-time tasks, vigilance tasks, imagery tasks, or exercise. The other group of tasks are considered passive tasks. Here, the subject passively participates in tasks such as viewing a stressful or pornographic film, watching slides, or a physical stressor such as the cold pressor task or electric shock (Krantz et al., 1986).

There are several contingencies which can be intentionally or inadvertently used to affect a subject's physiological responses. Among these are: increasing or decreasing positive or negative incentives for task performance, increasing the level of challenge in task instructions (high challenge or low challenge), and increasing a subject's level of engagement in the task. The predictability of a stressor and the subject's perception about controllability of the stressor also can affect responses (Krantz et al., 1986). Unpredictable and uncontrollable stressors have been shown to heighten physiological responses (Seligman, 1975).

Two Views of Cardiovascular Reactivity

There are two major views of cardiovascular reactivity in stressful situations. The earliest theory is that of John and Beatrice Lacey. This view is contrasted with that of Paul Obrist, a former student of John Lacey. The first of these views to be discussed will be the work of the Laceys.

The Lacey Theory. The work of the Laceys is based upon earlier work by Darrow (1929). Using two types of stimuli, ideational and sensory, Darrow was able to show two distinct physiological patterns. Ideational stimuli consisted of either disturbing words (e.g. toilet) or pictures (e.g. men's and women's underwear), or neutral stimuli, such as the words apple, table, and paper. Sensory stimuli were also of both types (disturbing or neutral) and consisting of either pulling a subject's hair, slapping him in the face (disturbing) or ringing a bell (neutral). Blood pressure and heart rate increases were found with the disturbing ideational stimuli as opposed to the sensory stimuli. Sometimes there would be decreases in blood pressure and heart rate observed with sensory stimuli (Darrow, 1929).

Building on the work of Darrow, the Laceys (1959) called attention to phenomena of "directional fractionation" of responses. When this occurs, physiological systems do not covary in a general arousal-like fashion. In cases of "environmental intake" (subject's attention is directed outward) heart rate decreased, while in cases of "environmental rejection" (subject's attention is directed inward) heart rate is increased.

When solving mental arithmetic problems, subjects exhibited increased heart rate and skin conductance. This is the pattern one would normally expect to see with arousal. However, when these same individuals listened to a series of tones they demonstrated heart rate decreases and skin conductance increases. This was evidence of directional fractionation due to the fact that the subjects were aroused but the expected pattern of physiological arousal was not exhibited (Lacey, 1959).

In another series of experiments using four different stimuli (visual attention, empathic listening, thinking, and withstanding pain) Lacey found that palmar conductance always increased, while heart rate would either accelerate (thinking and withstanding pain) or decelerate (visual attention and empathic listening; Lacey, 1959). Lacey (1959) went on to state "an increase in heart rate or blood pressure, then, is very likely to lead to *inhibitory* (italics his) effects on cortical activity, and on motor activity" (p. 199). He felt this followed from evidence that baroreceptors in the carotid sinus had been found to exercise tonic inhibitory control of cortical activity. This was called stimulus stereotyping which is defined by Lacey as "consistent differences in the modal or average response pattern produced by different objective stimulus conditions" (Lacey, Kagan, Lacey, & Moss, 1963, p. 163).

The Laceys proposed the concept of environmental rejection and environmental intake to clarify Darrow's ideational and sensory stimuli. They classified ideational stimuli as environmental rejection and sensory stimuli as environmental intake. They found that performing mental arithmetic problems, which they termed environmental rejection, led to phasic heart rate increases. In situations where subjects had to note varying light flashes for color and pattern or listen to a dramatic reading (environmental intake), phase heart rate decelerations were found (Lacey et al., 1963).

In 1967, Lacey postulated that an afferent feedback loop to the central nervous system was responsible for the phasic heart rate changes produced by situation stereotyping. Situation stereotyping is the production of specific patterns of somatic responses that are reliably produced by different stimuli. The responses are different and specific for each stimuli. This feedback is provided by baroreceptors in the aortic arch and carotid sinus which decrease the activity of the brain.

The Obrist Theory. The other view of cardiac reactivity is provided by Paul Obrist. This view (Obrist, Webb, Sutterer, & Howard, 1970) stresses cardiac-somatic coupling as the major determinant in cardiovascular functioning. Using a more common sense and biologically based line of reasoning, Obrist argued that one of the cardiovascular system's basic purposes was to provide adequate blood supply to the musculature and that heart rate changes as a result of striate muscle activity (Obrist, et al., 1970).

Obrist et al. (1970) used a reaction time task and the anticipation of an aversive unconditioned stimulus (UCS) in a classical conditioning procedure to test his hypothesis. He found cardiac deceleration in relation to decreased somatic activity either in preparation for the reaction time tasks or in anticipation of the aversive UCS. He described the decrease in somatic activity as "...quite extensive and is like a momentary state of suspended animation" (Obrist, et al., 1970, p. 571). It would appear that the cessation of somatic activity is complete and total, at least for a small amount of time. Obrist suggests that heart rate is more an index of striate muscle activity than part of an afferent feedback system. He also reports that the interrelationship between heart rate and striate muscle activity is governed by a central nervous system mechanism. When the heart decelerates as is seen in Lacey's environmental intake, it is because the person is in a preparatory state; they have stopped unnecessary movement in order to better attend to the environmental cues. Because they have stopped moving, blood demand is not as great in the striate musculature, so the heart does not have to work as much pumping blood to that working musculature. When heart rate increases during environmental rejection, Obrist believes it is simply because a person tenses their muscles while concentrating on a task such as solving mental arithmetic problems. In an experiment, Obrist & Webb (1967) were able to demonstrate that when dogs were trained first to increase somatic activity and then decrease somatic activity for a food reward, the heart rate showed parallel activity.

Obrist also differentiates between active and passive coping in a series of experiments involving either active coping tasks (reaction time task) or passive coping (viewing of a pornographic film or a cold pressor task) (Obrist, 1976). These studies found that passive coping with the environment brought the heart under the control of the vagus nerve and cardiac-somatic coupling is manifested. Active coping brings the heart under the control of the sympathetic nervous system and you see large heart rate increases that are not coupled with somatic activity (Obrist, 1976). Cardiac-somatic coupling seems to make the most sense biologically because it follows from established functioning of the heart and central nervous system. The physiological reactivity observed is consistent across conditions which makes a stronger empirical case for Obrist's theory.

Heart Rate

A useful and frequently used measure of reactivity to stress is heart rate (HR). HR can be measured either tonically or phasically. Tonic measurement involves counting the beats over relatively long periods of time (a minute or longer). Phasic measurement involves measuring the interbeat interval (RR). A cyclic variation in RR is normal, which is partially modulated by breathing patterns (Schneiderman and Pickering, 1986).

Heart rate is regulated by opposing influences of the sympathetic and parasympathetic systems on the sinus node. The parasympathetic system predominates at rest. Research has indicated that parasympathetic influences on the heart can produce more abrupt changes in rate than the sympathetic system (Jose and Collison, 1970). It has been suggested that any sudden changes which occur during psychophysiological testing are the result of parasympathetic influences (Schneiderman and Pickering, 1986). Obrist, Black, Brener, and DiCara (1974) have demonstrated however that it is possible to uncouple heart rate from somatic measures under conditions of "active" coping where the individual must be more involved in the coping procedure such as when performing a reaction time task to avoid shock. Under these conditions the heart comes under the control of the sympathetic nervous system rather than the parasympathetic nervous system. Sympathetic nervous system influences are also seen on cardiac contractility (Lawler & Obrist, 1974).

Rationale For The Present Experiment

One of the prominent models of hypochondriasis suggests that hypochondriacal behavior may be primarily due to a perceptual defect and that the illness behavior associated with hypochondriasis is an inevitable sequelae of this primary perceptual defect. The specific processes which have been suggested are amplification of bodily sensations (Feuerstein, Labbe, & Kuczmierczyk, 1986; Barsky & Klerman, 1983) and misinterpretation (Barsky & Klerman, 1983). There has been little research on this model of hypochondriasis and none on the psychophysiological correlates of these putative processes. The goal of this investigation was to provide additional information on the processes of amplification and misinterpretation, by measuring pain thresholds and physiological reactivity in subjects scoring high on a paper and pencil measure of hypochondriasis.

In terms of physiological reactivity it was hypothesized that hypochondriacal persons would be more reactive to physical and psychological stressors. Heart rate should have been higher in the hypochondriacal group. There should also have been a longer recovery time (return to baseline levels) indicating an increased time for the system to reestablish equilibrium.

An individual who amplified sensations presumably experienced those sensations as more noxious and intense than those who did not amplify (Barsky & Klerman, 1983; Hanback & Revelle, 1986). This was assessed by comparing pain threshold levels between hypochondriacal individuals and non-hypochondriacal controls. One way this was accomplished was by utilizing the cold pressor task. Here, a person was timed from the beginning of foot immersion to the time they withdrew their foot. Tolerance was measured by timing the length of foot immersion in the cold water bath. Typically, the maximum time allowed for foot immersion was 3 minutes. VAS ratings of the sensory-intensive (intensity) dimension and affective-motivational (unpleasantness) dimension of pain were also used to assess this hypothesis. Individuals who amplified sensations should presumably rated the intensity of the stimuli to be greater than those who did not amplify.

The misinterpretation hypothesis of hypochondriasis was evaluated by measuring the subject's psychophysiological reactivity to stress. Reactivity has been shown to be a reflection of a cognitive appraisal process, as well as an interpretive process (Williams, 1986). Presumably, there would have been autonomic changes produced in the body due to these cognitive processes, which could be measured using psychophysiological recording methods. The reactivity measured in this study was elicited using physical (heat and cold) and psychological stimuli. The subjects also used VASs to rate the intensity (sensory-intensive) and unpleasantness (affective-motivational) components of the sensations. Other studies have indicated that VAS affective-motivational ratings are more related to interpretive processes than are the sensory-intensive dimensions of VAS ratings (Price, Barrell, & Gracely, 1980).

Many different stressors have been used in research, encompassing many dimensions (e.g. Krantz et al., 1986; Williams, 1986). Pain is one of the symptoms most often expressed by hypochondriacal patients. It was hoped that this would give the study greater validity and clinical relevance.

Obrist et al. (1974) and others (Allen, Sherwood, & Obrist, 1986; Light, Obrist, James, & Strogatz, 1987) have developed the concept of "active" and "passive" coping. When a person is faced with a passive coping task he or she has little control over the stressful event or stimulus (e.g. cold pressor or heat pulse stimulator). The person can do little in these circumstances to alter the presentation of the stimulus. With an active coping task the person must be constantly engaged with the stimulus and must be actively involved in coping with the task requirements. An active avoidance task, such as having to respond quickly to a series of tones in order to avoid a painful thermal pulse, is a task which would require active coping. These types of active coping tasks have been shown to cause greater cardiovascular reactivity when compared to passive coping tasks (Obrist et al., 1974).

Data indicating heightened physiological reactivity and/or lowered sensory threshold in persons who score high on hypochondriacal scales would support a cognitive/perceptual abnormality model of hypochondriasis. Using VAS data, it may be possible to get a clearer picture of the differences between amplification and misinterpretation. The VAS allows for the separation of the subjects' sensory and affective dimensions in their response to pain. Using a VAS it is also possible to quantify these dimensions, allowing for comparisons within and across subjects with different painful stimuli and responses (Price, Harkins, & Baker, 1987; Price & Harkins, 1987; Price, 1988). Elevation of both VAS dimensions relative to controls would suggest a response bias that may be mediated by the putative perceptual and cognitive abnormality in hypochondriasis.

The independent measurement of the two pain dimensions, sensory-intensive and affective motivational, may be useful in drawing conclusions regarding the importance of amplification or misinterpretation as a process in hypochondriasis. The sensory-intensive dimension of the pain report should be more affected than the affective-motivational dimension if an amplification process is occurring. However, if a misinterpretational process is occurring, then the affective-motivational should be the more affected dimension. Elevation of both VAS dimensions relative to controls would support the perceptual and cognitive abnormality hypothesis, but it would not provide differential support for the amplification versus misinterpretation hypothesis.

There have been no empirical studies published in the literature testing pain thresholds and assessing physiological reactivity to test the amplification and misinterpretation processes which may be occurring in hypochondriasis. One study (Hanback & Revelle, 1978) has used a student population and found lower sensory thresholds among students scoring high relative to low on a hypochondriacal scale. The present study attempted to test the amplification/misinterpretation hypothesis with the more sophisticated procedures outlined above with an analogue population similar to Hanback and Reveille's. If differences were found in this population, then this would have made a stronger case for the perceptual abnormality conceptualization of hypochondriasis. It would also have provided strong preliminary data for an investigation with clinically diagnosed hypochondriacal individuals.

Methods

Subjects

Volunteer subjects were recruited from undergraduate psychology courses and received class credit for participating. Potential subjects (N = 300) were screened with a paper and pencil measure of hypochondriasis (i.e. MMPI hypochondriasis scale). One group of eighteen subjects was selected from those subjects scoring high on this measure (1.5 SD above the mean). Another group of eighteen students was selected from those subjects scoring in the normal range (+/- .5 SD from the mean). This second group served as the control group. Other criteria for selection included gender (female) and ethnicity (white). All subjects were fully informed about the procedure and gave their written consent before participating in the study. Subjects who were currently receiving treatment for a medical or psychiatric problem were excluded from the testing.

Environment

With the exception of pre-experiment screening to determine a score on the hypochondriasis measure, all parts of the procedure were conducted in the psychophysiological laboratory of the Department of Gerontology located on the medical campus of Virginia Commonwealth University. The stress tasks were administered in a specially constructed isolation chamber. Other aspects of the experiment including electrode preparation and placement were performed in an adjacent lab and office space.

Equipment

The thermal stimulator was used to assess pain threshold levels in one of the tasks. This stimulator was custom built by the VCU Department of Biomedical Engineering. It had a hand-held contact thermode with a surface area of 1 centimeter. The heat stimuli delivered by the stimulator were at six pre-set levels (43, 45, 47, 48, 49, & 51 degrees Celsius) which could be delivered in any order, and were under push-button control. The stimuli were programmed to be presented for five seconds and to rise to the predetermined temperature from a baseline of 35 degrees Celsius. The thermode itself had an active heating element with an approximate rise time of 17 degrees/second.

The cold pressor tank consisted of a styrofoam tank approximately 35 cm x 35 cm x 38 cm. The tank was divided in the center by a wire mesh screen which allowed for crushed ice in one compartment and ice-free water in the other (Spanos, Ollerhead, & Gwynn, 1986). A thermometer attached to the tank allowed for continuous monitoring of water temperature which was maintained at 2-4 degrees Celsius. An 8 channel Grass Instruments Model 8 polygraph was used to record the physiological measures.

Dependent Measures

Heart Rate Heart rate was recorded using a Grass 7p-6 preamplifier and a 7p44 cardiotachometer. Electrodes (Ag/AgCl) were utilized in a Lead III configuration (Erb's point, just under the floating rib on the left side of the body, left forearm as ground). Heart rate was recorded as beats per minute. There were 3 three minute periods analyzed (the YELP stressor however was only two minutes in length). The first period ended the fourteen minute baseline period. The second followed the onset of each stressor. The final period consisted of the first three minutes of each recovery phase. These periods were broken into one minute intervals and mean heart rates were obtained for these intervals.

Pain Tolerance Pain tolerance was assessed via the cold pressor task with the time from foot immersion to the time of foot withdrawal (maximum time = 3 minutes) serving as the dependent measure.

Visual Analogue Scales During both the cold pressor and heat stimulator tasks, VASs were used to assess the subject's response to the experimental pain. The two scales consisted of a 150 mm line anchored at each end with a descriptive phrase. One scale assessed the sensory-intensive dimension of pain and the other assessed the affective-motivational dimension of pain. The sensory scale was anchored by the phrases "no sensation" and "the most intense sensation imaginable." The affective scale was anchored by the phrases "not at all unpleasant" and "the most unpleasant feeling imaginable" (see appendix). During the experimental procedures subjects were asked to make a mark on the line indicating the intensity and unpleasantness of the sensation, respectively. The distance of the subject's mark from the left hand edge of the line was measured to the nearest millimeter. In the heat stimulator task, subjects were exposed to a broad range of heat pulses (35 degrees Celsius to 51 degrees Celsius) and asked to rate both the intensity and unpleasantness of the pain.

Procedures

Phase I

Subjects were pre-screened and selected on the basis of their scores on a paper and pencil measure of hypochondriasis. An undergraduate student served as project coordinator. All screening packets were returned to the coordinator, who scored the questionnaires to determine who qualified for the study. This was done to keep the experimenter blind to the subjects' scores on the screening instrument. Qualified subjects were contacted by the coordinator by telephone to set up a time for participation. During this initial contact potential subjects were told that they would be exposed to mild physical and psychological stressors. They were also informed that the procedure would take approximately one and one-half hours. In addition, individuals were told not to smoke or ingest caffeine for eight hours prior to their participation in the study. The coordinator set up an appointment at this time and placed subjects randomly into one of the six experimental conditions.

Phase II

When selected subjects first arrived at the testing site, they read the consent form and after any questions or concerns were addressed they were asked to sign if they wished to participate. Subjects were assured that they were free to withdraw at any time during the experiment without penalty. Once informed consent was given, several pre-test paper and pencil measures were administered. The subjects first filled out a medical questionnaire requesting information about physical or mental conditions which might prevent them from participating in the study. Information was also requested about menses, prescription and non-prescription medication, and whether or not the subject had smoked or ingested caffeine in the past eight hours.

If the subjects had no physical or mental conditions and had not smoked or consumed caffeine in eight hours several other self-report questionnaires were administered. Subjects who did not meet these criteria were excluded from the study.

The expression of pain can be influenced or altered by several factors other than the painful stimuli itself. These include anxiety (Pennebaker, 1982), neuroticism (Costa & McCrae, 1985), and contextual/environmental factors (Beecher, 1956). Because of this, these factors were assessed for all subjects. The specific instruments included the State-Trait Anxiety Inventory (Spielberger, Gorush, & Lushene, 1970), the Eysenck Personality Inventory (Eysenck & Eysenck, 1964), the Inventory to Diagnose Depression (Zimmerman & Coryell, 1987), the Brief Symptom Index, Miller Behavioral Style Scale (Miller, 1987), and the Perceived Impact Questionnaire. The Perceived Impact Questionnaire developed by Dr. Steve Harkins measures 18 different mood states using VASs.

Phase III

After completion of the paper and pencil measures, the subjects were taken to a private section of the laboratory where the electrodes were placed on the subjects by a female assistant. After all electrode leads had been properly connected the subjects were asked to perform a Valsalver's maneuver in order to calibrate the physiograph for each subject's individual readings. A Valsalver maneuver consists of having the subjects take a deep breath and hold it. While holding their breath, the subjects are then asked to pretend they are blowing up a balloon, without releasing any air. The effect of this is to produce maximal physiological readings so that the physiograph operator can make sure all readings remain on their proper scale. After the subjects were properly fitted with the equipment, tape recorded instructions were played for the subjects which had been taken from the literature (Harkins, Price, & Martelli, 1986) concerning the use of VASs to record the intensity and unpleasantness of the painful stimuli. Tape recorded instructions were used because physiological and self-report responses to stressors can be altered depending on the instructions given to the subject (e.g., Seligman, 1975). With the completion of these instructions, a 14 minute adaptation period ensued wherein physiological functioning was recorded while the subjects sat alone in the isolation chamber. Subjects were instructed to simply relax and get used to the chamber. The last three minutes of this adaptational period was used to calculate baseline heart rate. After baseline measurements were taken the subjects were exposed to one of three "passive" coping tasks (Obrist et al., 1974). These tasks were counterbalanced in their presentation to prevent bias from order effects. The tasks were the cold pressor task, the thermal stimulator task, and the visualization stressor task.

Cold Pressor Task The cold pressor task consisted of having the subjects submerge their non-dominant foot, up to the ankle, into a cold water bath which was maintained at 2-4 degrees Celsius. Subjects were told to leave their foot in the cold water bath until they were instructed to take it out or until they "absolutely couldn't stand it any longer." The subjects were informed that at certain time intervals (every 15 seconds for 3 minutes) they would be asked to rate first the intensity and then the unpleasantness of the sensation they were experiencing using the VASs. The subjects were not aware of the interval length nor the total time length of the stressor. The subjects were instructed when to make their ratings by the experimenter. This continued for 3 minutes or until voluntary termination by the subject.

Heat Stimulator Tasks This task consisted of applying different heat pulses to a subject's non-dominant ventral forearm using a hand-held contact thermode. Before engaging in the tasks all subjects were assured that while the temperature may get rather hot, no actual tissue damage could occur. As a further assurance the experimenter applied the highest level heat pulse to his forearm to demonstrate the device's safety. It was explained that the subject would be asked to rate the intensity and unpleasantness of the sensations they were experiencing using VASs. Once the subjects had been reassured and permission to go forward had been obtained, the subjects were first exposed to all heat stimuli in ascending order (43, 45, 47, 48, 49, & 51 degrees Celsius). After this initial exposure the subjects were then administered a series of discrete heat pulses according to one of two counterbalanced schedules. Subjects were exposed to two identical series of heat pulses. During the first exposure, the subjects were instructed to record a rating of the intensity of the sensation they experienced. During the second exposure, the subjects were instructed to record a rating of the unpleasantness of the sensation they experienced. This continued until completion of the schedule or voluntary termination by the subject.

Visualization Stressor Task This task involved having the subjects visualize a stressful event. The event was one selected from a group called Your Everyday Life Pressures (YELP) (Rosenthal et al., 1989). In this procedure, the subjects were read a card which contained a script describing a stressful event. The description went as follows:

> "You see two teenagers knock a lady to the ground, snatch her purse, and run off. You go to help her and tell her you had a good look at the thieves. Later on they are caught and you must be a witness to the trial. You have to come on quite a few days because they keep postponing the case. Finally, the judge lets the thieves off with a slap on the wrist since they are underage and don't have police records."

The subjects were asked to close their eyes and visualize what it would be like to be in that situation, making their experiences as vivid as possible, like they were really there. The subjects were told to think about what they might see and hear and what individuals would look like and to concentrate on this situation until the experimenter asked them to stop. At the end of two minutes the subjects were asked to open their eyes and the final five minute recovery period began. Heart rate only was recorded during this task.

Phase IV

At the end of the final recovery period, the experimenter returned to the chamber and the subjects were informed about the nature of the experiment. The subjects were told that the study involved looking at individuals' physiological responses to stressful events and comparing these responses to the information obtained on the questionnaires they had filled out earlier to see what the questionnaire data might be able to tell us about individuals' responses to stress. After the nature of the experiment had been discussed with the subjects and questions answered, they were disconnected from the electrode connection posts and escorted from the chamber. Once outside the chamber, the subjects were seated and the electrodes were removed by a female assistant. At this time the subjects were informed that there were two final questionnaires to be filled out and the procedure would be complete. When the electrodes had been removed, the subjects were escorted back into the outer waiting area of the laboratory for the completion of the questionnaires.

Post Questionnaires and Debriefing At this point, the subject completed a post-test Perceived Impact Questionnaire to assess their mood after the testing procedures and the 63 item Ways of Coping questionnaire (Folkman and Lazarus, 1985). After completion of the Ways of Coping questionnaire, the subjects were thanked for their participation and were informed that their instructor would receive a list of the names of everyone from that class that participated in the study so that they would receive their extra credit. This ended the subjects' participation in the experiment.

Listed below is a schematic time line representing the course of the procedures. The times where data was measured for analysis are also indicated. See table 1 for the procedures and their counterbalanced orders.

|------14 minutes-------|--------Variable--------|------5 minutes-----|

Baseline	Stressor	Recovery
Final 3 minutes used for data analysis	First 2 or 3 minutes used for data analysis	First 3 minutes used for data analysis

Table 1

Stressor Presentation Order

Order 1	Order 2	Order 3	Order 4	Order 5	Order 6
1	1	2	2	3	3
2	3	1	3	1	2
3	2	3	1	2	1

Note. 1 - cold pressor task 2 - YELP visualization stressor 3 - heat stimulator task. The stressors within each order were presented in descending order.

Hypotheses

1.) It was hypothesized that foot withdrawal from the cold water bath prior to instructions to terminate the task would occur with significantly higher frequency in the hypochondriacal group relative to the control group.

2.) It was hypothesized that increased heart rate as well a longer time to return to baseline line levels after the application of each stressor, would be exhibited in the hypochondriacal group relative to the control group.

3.) It was hypothesized that the visual analogue scale ratings of both intensity and unpleasantness of cold pressor and heat pain would be significantly higher in the hypochondriacal group relative to the control group.

Results

SUBJECT VARIABLES

A. Hypochondriasis scores - The original criteria for selection into the groups were based on scores on the MMPI hypochondriasis scale (scale 3) for the original screening population (N = 155). Scores falling 1.5 standard deviations or more above the mean for the high group and ± .5 standard deviations around the mean for the normal (low) group were used for selection. The mean for the screening questionnaire (N=155) was 9.27, with a SD = 5.28. This resulted in original criterion scores of 18 or above for the high group and 7 - 12 for the low group. Later in the experiment the criteria were expanded to 1 standard deviation above the mean for inclusion in the high group, and 1 standard deviation below the mean for the low group in order to facilitate subject recruitment. This resulted in a range of scores for the high group (n=18) being 14 - 28 (mean = 17.22, SD = 3.75), while the range for the low group (n=18) was 4 - 8 (mean = 6.28, SD = 1.64).

B. Mood and Personality variables - To insure that the groups did not differ on other variables which might affect the outcome of the dependent measures, separate analyses were performed on reported state variables of mood and personality. Several mood variables, such as state anxiety, are known to affect the report of pain sensitivity. A

MANOVA was performed using the 18 state items from the Perceived Impact Questionnaire, the global symptom index score from the Brief Symptom Inventory and the state score of the State-Trait Anxiety Inventory. There were no significant differences between the groups ($F(1,34) = 1.32$ $p > .29$). This indicated that the two groups did not vary in terms of their mood states.

Another MANOVA was run on personality variables which may have altered the subject's report of pain sensitivity. These variables were the neuroticism and extroversion scores from the Eysenck Personality Inventory, the total score from the Inventory to Diagnose Depression, trait score from the State-Trait Anxiety Inventory, and the score of the difference of the monitor and blunter scores on the Miller's Behavioral Style Scale. There was no significant difference between the groups. This shows that overall there were no trait personality differences between the two groups. However, the univariate F-tests revealed several significant variables known to be associated with hypochondriasis. The first was the neuroticism score ($F(1,34) = 6.85$ $p < .013$) and the second was the depression score ($F(1,34) = 5.42$ $p < .026$). This is consistent with hypochondriasis and indicated that the hypochondriacal group reported more neurotic symptoms and were more depressed than the control group. See table 2 for the means and standard deviations for each variable in this and all other analyses reported in this study.

<u>Order Effects</u> - The stressors were presented in 6 different counterbalanced orders (see table 1). This was done in an attempt to

Table 2

Mood and Personality Variable Scores

Variable	Group High M	Group High SD	Group Low M	Group Low SD
Depression[a]	16.14	15.71	13.01	17.65
Anxiety[a]	35.57	24.27	24.70	14.85
Frustration[a]*	25.87	24.73	10.65	15.66
Anger[a]	9.02	14.10	7.05	14.40
Fear[a]	16.92	17.62	11.05	10.69
Excitement[a]	21.83	17.37	18.83	21.47
Arousal[a]	18.89	15.41	19.87	22.98
Astonished[a]	5.70	8.10	12.21	18.50
Happy[a]	46.70	20.02	44.55	27.76
Tired[a]*	55.18	24.66	33.20	27.77
Bored[a]	26.59	19.93	16.75	19.23
Calm[a]	56.83	26.37	41.05	23.15
Drousy[a]	37.54	23.84	25.92	25.39
Distressed[a]	19.71	20.30	13.91	14.69
At Ease[a]	45.27	26.43	58.12	21.17
Tense[a]	33.99	25.14	23.56	18.26
Relaxed[a]	47.50	23.08	53.34	23.75
Annoyed[a]	14.86	22.32	7.59	10.88
Global Symptom Index[b]	39.44	11.47	41.67	17.78
Somatization[b]	38.72	21.03	30.56	22.49
Obsessive-Compulsive[b]	44.33	11.84	37.28	17.73
Insecurity[b]	40.28	15.27	27.72	23.05
Depression-BSI[b]	29.89	19.17	22.56	20.96
Anxiety-BSI[b]	40.17	11.22	32.56	18.24
Hostility[b]	46.06	18.37	33.39	22.37
Phobia[b]	17.06	23.99	18.50	23.53
Paranoia[b]	33.11	24.03	23.44	24.24
Psychoticism[b]	30.61	22.52	15.06	21.72
Neuroticism[c]*	14.06	5.01	9.72	4.92
Extraversion[c]	13.33	3.56	11.22	4.82
Barsky & Klerman	9.72	2.47	9.50	2.66
Monitor[d]	10.89	2.95	9.17	4.15
Blunter[d]	4.44	2.23	3.94	2.65
Depression Total[e]*	17.06	9.82	10.17	7.82
State Anxiety[f]	35.94	12.91	33.00	11.06
Trait Anxiety[f]	42.72	11.93	36.44	15.19

Note. n = 18 for both groups. Data are expressed as mean and standard deviation, as derived from personality and mood questionnaires. [a] = Perceived Impact Questionnaire. [b] = Brief Symptom Index. [c] = Eysenck Personality Inv. [d] = Miller Behavioral Style Scale. [e] = Inventory to Diagnose Depression. [f] = State-Trait Anxiety Inv. * = $p < .05$ for entire sample means.

counteract any effects which might arise due to stressor presentation order. SPF-ANOVAs were performed for heart rate data for each of the 3 stressors, as well as report of sensory intensity and unpleasantness for both the cold pressor and heat stimulator tasks.

The main effect for order was not significant in any of these analyses. For the heart rate data the results were: (1) cold pressor $F\ (5,19) = 1.59\ p > .2$ (2) heat stimulator $F\ (5,30) = .82\ p > .5$ (3) YELP $F\ (5,30) = 1.37\ p > .25$. The VAS heat data yielded an $F\ (5,30) = 1.08\ p > .39$, while VAS response to the cold pressor task were similarly unaffected by order of stimulus presentation, $F\ (5,17) = 1.17\ p > .36$. These results showed that regardless of which order the stressors were presented there were no significant differences in either heart rate or VAS ratings of heat or cold pain.

Hypothesis 1 - This hypothesis concerned foot withdrawal from the cold water bath prior to termination of the task. It was hypothesized that the hypochondriacal group would withdraw their feet at a significantly higher rate than the control group. A chi-square procedure was used to assess the significance. This hypothesis was not supported by the results of this analysis which were $X^2\ (1,\ N = 36) = 2.09,\ p > .14$. This indicated that both groups were able to tolerate the cold water bath equally well. Surprisingly, the group trend was in the opposite direction predicted with three of the highs and eight of the lows terminating prior to the three minute maximum.

Hypothesis 2 - Hypothesis 2 predicted increased heart rate as well as longer times to return to baseline level for the hypochondriacal group after the application of each stressor. A preliminary SPF-ANOVA revealed no significant differences between the two groups, (F (1,33) = 1.47 p >.23), on baseline heart rate (see table 3). This suggested that hypochondriacal individuals were not more physiologically active before the introduction of a stressor. Because of the absence of baseline differences between groups, subsequent analyses were performed on raw scores rather than difference scores.

For the heat stimulator task, a repeated measures ANOVA with one grouping factor (high or low hypochondriasis scores) and two within subject factors was performed. The within subject variables consisted of three levels of condition (baseline, stressor, and recovery) and three levels of time (three one minute intervals within each condition). The main effect for condition approached, but did not reach significance, F (2,64) = 2.91, p = .062 indicating that heart rate tended to vary as a function of condition (i.e. baseline, stressor, recovery). The SPF-ANOVA for the heat stimulator revealed a significant main effect for time. As can be seen in figure 1, heart rate tended to decrease during the stressor phase relative to baseline and recovery phases. The significance level was F (2,64) = 11.9, p <.001. There was no group effect indicating that overall, the highs and lows did not exhibit differences in heart rate on this task. No other significant effects were demonstrated on the heart rate data.

The analysis of the heart rate data in the cold pressor task included only those individuals who completed the task, in order to control for the length of exposure to the stressor. A repeated measures

Table 3

Heart Rate Measurement for All Stressors by Group

Measurement Period	Minute	High M	High SD	Low M	Low SD
		Group			
Baseline	1	79.06	9.39 (18)	82.25	10.38 (18)
	2	77.00	9.46	81.25	11.33
	3	79.17	9.24	81.81	8.76
Cold Pressor Task	1	85.93	10.27 (15)	93.10	10.42 (10)
	2	86.50	11.41	89.50	10.82
	3	85.86	11.79	92.40	11.21
Cold Pressor Recovery	1	82.64	12.00	88.70	11.58
	2	79.21	11.24	73.50	23.33
	3	77.43	10.60	70.80	22.64
Heat Stimulator Task	1	77.67	12.04 (18)	74.31	18.87 (16)
	2	77.11	8.72	73.31	18.51
	3	76.72	10.11	73.00	18.88
Heat Stimulator Recovery	1	82.33	9.13	80.62	20.78
	2	79.78	20.48	78.44	20.48
	3	79.11	10.58	78.12	20.01
YELP Task	1	78.06	10.03 (18)	76.12	19.02 (17)
	2	77.78	9.77	76.18	19.86
YELP Recovery	1	80.28	9.59	78.00	21.38
	2	77.28	10.10	77.59	20.56

Note. Data are expressed as mean and standard deviation. Numbers in parentheses indicate the number of subjects completing each task.

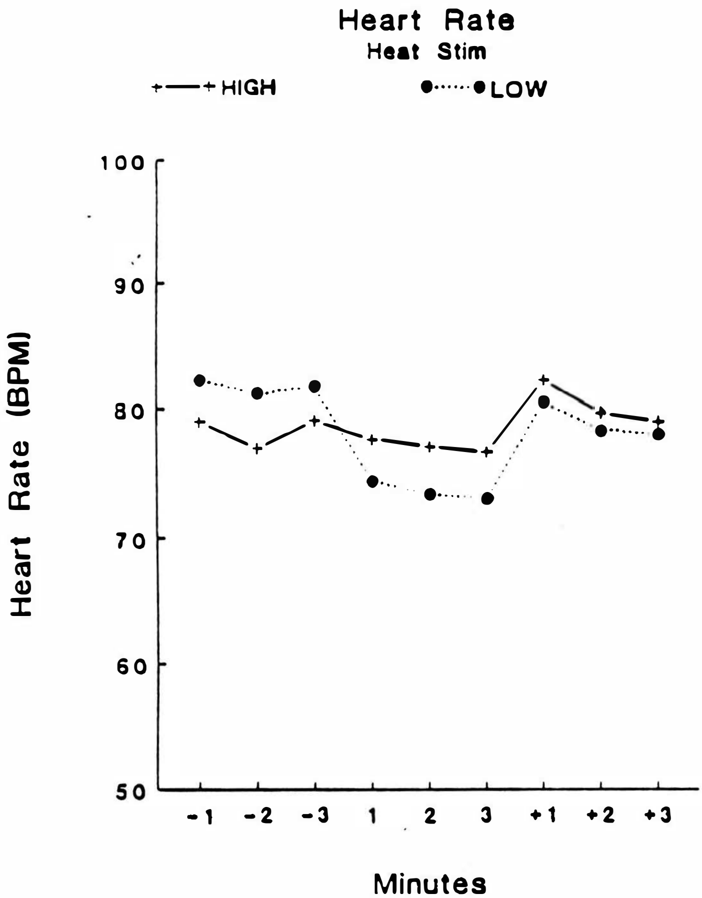

Figure 1. Mean heart rate for the heat stimulator task by group. Heart rate is expressed in beats per minute. Minutes expressed as baseline (-1, -2, -3), stressor (1, 2, 3), and recovery (+1, +2, +3).

ANOVA with one grouping factor (high or low hypochondriasis scores) and two within subject factors was performed. The within subject factors included three levels of condition which reflected baseline, stressor, and recovery as well as three levels of time (three one minute intervals within each condition). Several significant results were obtained, though again, no main effect for group was obtained. The main effect for condition ($F(2,44) = 15.21$, $p < .001$) was significant, indicating that heart rate differed as a function of baseline - stress - recovery conditions. Figure 2 illustrates that this main effect is likely due to the increase in heart rate observed in the stress condition relative to the other two conditions. The second main effect was for time. Here there were differences in heart rate depending on the level of time (1 minute, 2 minutes, or 3 minutes) with an $F(2,44) = 9.62$, $p < .001$. This effect is probably accounted for by the relatively higher heart rates observed during the first minute each level of condition.

There were also several two-way interaction effects which proved to be significant. The first of these was the group by time interaction, $F(2,44) = 3.62$, $p < .05$. This indicated that the differences in heart rate observed at intervals of 1 minute, 2 minutes, and 3 minutes differed according to group membership. Visual inspection of figure 2 suggests that this interaction is largely attributable to the more rapid recovery in heart rate in the low relative to the high hypochondriacal group. A second two-way interaction was significant, the condition by time interaction, ($F(2,44) = 4.84$, $p < .001$). Here heart rates observed at intervals of 1 minute, 2 minutes, and 3 minutes differed according to the stress interval condition of baseline,

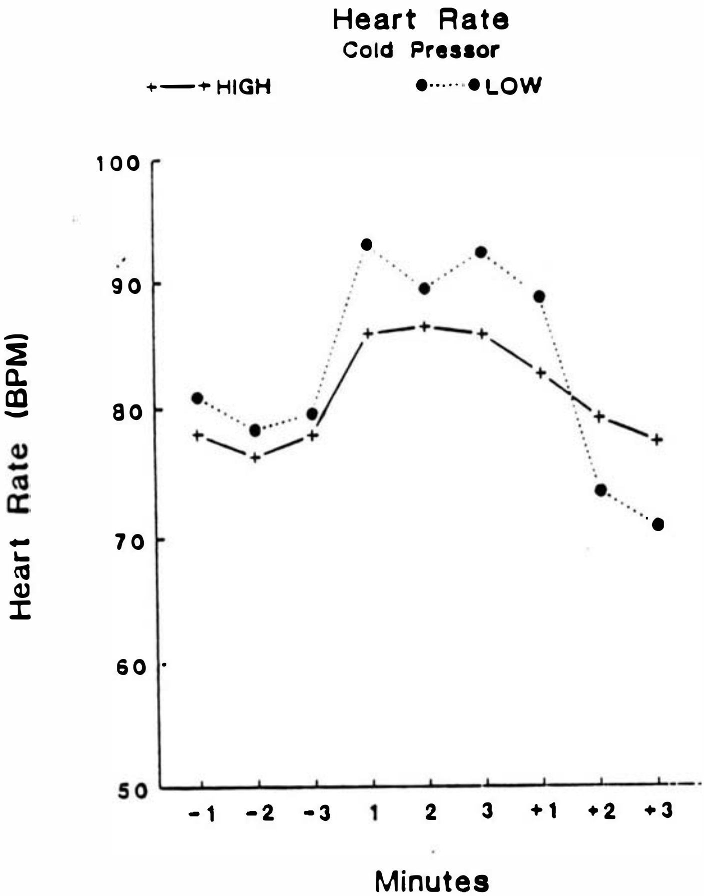

Figure 2. Mean heart rate for the cold pressor task by group. Heart rate is expressed in beats per minute. Minutes expressed as baseline (-1, -2, -3), stressor (1, 2, 3), and recovery (+1, +2, +3).

stressor, or recovery. Figure 2 illustrates that the pattern of decreases in heart rate, in recovery, differed from the pattern observed during the other two conditions. There were no other significant effects for the cold pressor task. There were also no significant between or within subjects differences on the heart rate data for the YELP stressor.

Hypothesis 3 - This hypothesis stated that visual analogue scale ratings of both intensity and unpleasantness for the cold pressor and heat stimulator tasks would be significantly higher in the hypochondriacal group relative to the control group. Repeated measures ANOVAs were used to assess the overall significance of this hypothesis for each stressor.

For the cold pressor stressor, hypochondriacal scores were again used to delineate groups. The repeated measures design used two levels of pain quality (intensity and unpleasantness) and thirteen levels of time (fifteen second intervals for three minutes plus an initial baseline) (see table 4). The analysis revealed one significant main effect. The main effect was for time with an $F(12,276) = 56.48$, $p < .001$ and is illustrated in figure 3. The time effect is largely attributable to the dramatic increase in VAS scores obtained at times 2 - 13 relative to time 1. There was also an interaction effect which was significant. This was the quality by time interaction, $F(12,276) = 2.17$, $p = .013$. This indicated that quality ratings differed the longer the subject was exposed to the stressor. Figure 4 illustrates the interaction with sensory intensity ratings being greater than unpleasantness ratings initially, but unpleasantness ratings become

Table 4

Visual Analogue Scale Ratings for Cold Pressor Task by Group

Group: High (n=15)

Time	Sensory Intensity *M*	Sensory Intensity *SD*	Unpleasantness *M*	Unpleasantness *SD*
1	12.26	14.29	5.60	7.13
2	65.56	23.89	66.28	28.90
3	71.19	21.13	70.57	24.15
4	73.63	21.86	75.79	22.13
5	76.46	20.68	77.72	20.16
6	74.97	18.98	76.46	19.65
7	74.53	19.16	77.74	19.11
8	71.96	20.65	76.98	19.18
9	68.21	22.75	75.43	20.83
10	68.05	22.35	73.64	22.50
11	65.97	23.58	69.16	25.62
12	64.93	21.93	71.95	18.94
13	67.34	19.44	70.52	20.79

Group: Low (n=10)

Time	Sensory Intensity *M*	Sensory Intensity *SD*	Unpleasantness *M*	Unpleasantness *SD*
1	13.24	15.28	2.20	2.35
2	65.64	22.07	61.43	26.86
3	68.85	22.82	66.82	25.08
4	73.54	19.23	70.09	25.37
5	77.85	15.18	74.32	24.38
6	75.50	16.17	74.26	23.69
7	75.41	15.84	75.17	22.45
8	78.24	14.75	75.41	21.76
9	74.55	17.49	74.65	22.12
10	77.40	15.30	73.56	23.01
11	71.61	21.86	70.66	25.80
12	78.67	16.98	75.73	22.87
13	78.79	15.02	75.51	22.96

Note. Data are expressed as mean and standard deviation. Unequal n's reflect the differing number of finishers in each group. Group membership is determined by score on the MMPI scale 3.

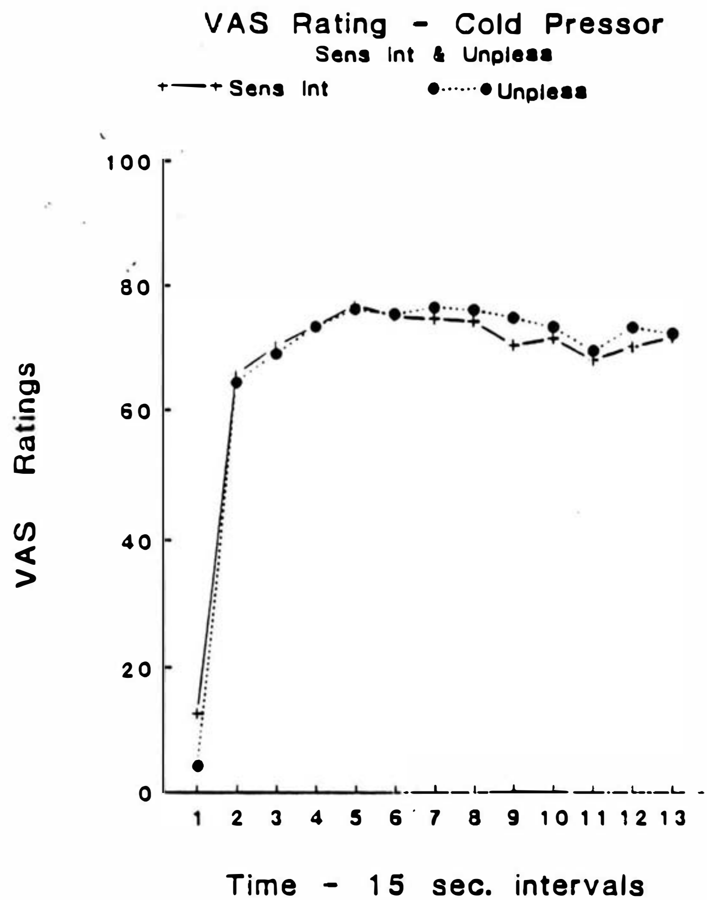

Figure 3. Mean VAS ratings for sensory intensity and unpleasantness for the cold pressor task for entire sample. VAS ratings made at 15 second intervals.

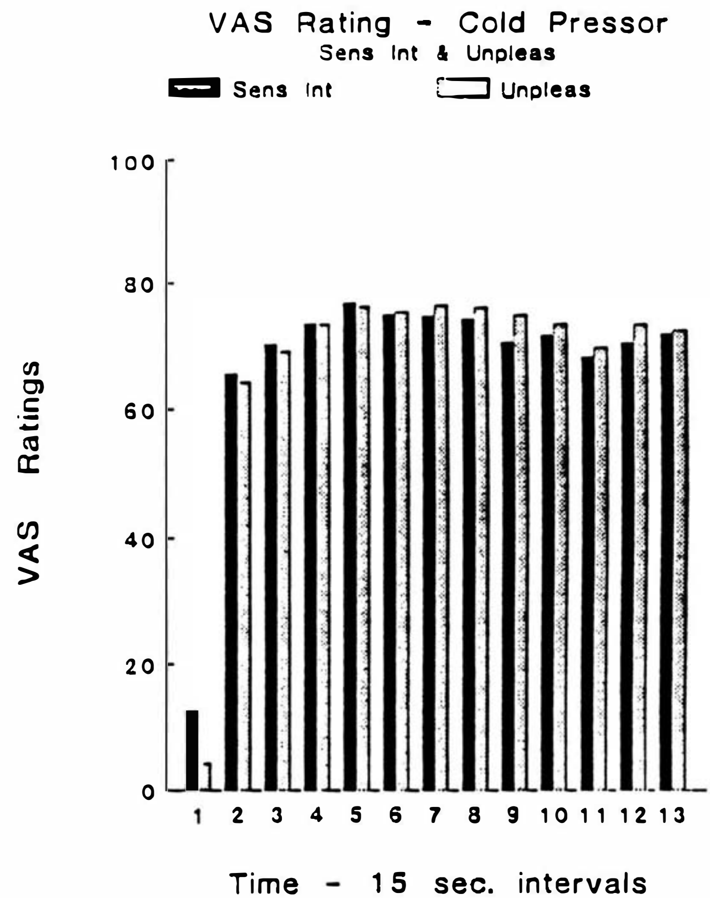

Figure 4. Mean VAS ratings for sensory intensity and unpleasantness for the cold pressor task for entire sample. VAS ratings made at 15 second intervals.

greater as exposure to the stressor continues. No other effects were significant for this analysis.

The repeated measures analysis for the heat stimulator used the same group variable and quality variable as the cold pressor. The design also used seven levels of temperature (35, 43, 45, 47, 48, 49, and 51 degrees Celsius) (see table 5). There were two significant main effects as well as two significant interaction effects in this analysis. The first main effect was for temperature {$F(6,204) = 159.53$, $p < .001$}. This effect is illustrated in figure 5, indicating that the higher the temperature, the higher the VAS ratings. The second main effect was for quality, $F(1,34) = 14.31$, $p < .001$. There were significant differences between the reports of sensory intensity and unpleasantness for the subjects, with sensory intensity being generally higher than unpleasantness (see figures 6 and 7, and table 6). The first significant interaction was a two-way interaction of group by quality, $F(1,34) = 4.55$, $p < .04$. Here report of pain quality differed significantly according to group membership. The second interaction was a three-way interaction of group by quality by temperature. In this interaction, $F(6,204) = 2.71$, $p < .015$. Figures 6 and 7 illustrate that while intensity ratings are consistently higher than unpleasantness in the high hypochondriacal group, the pattern differs for the low group. There were no other significant effects in this analysis.

Table 5

Visual Analogue Scale Ratings for Heat Stimulator Task

Temperature	M	SD
	Sensory Intensity (N=36)	
35	16.09	15.48
43	29.19	14.67
45	29.38	13.99
47	50.86	17.46
48	48.36	17.41
49	58.65	16.77
51	70.63	14.90
	Unpleasantness (N=36)	
35	8.16	10.51
43	18.29	12.49
45	23.64	11.92
47	50.26	17.97
48	42.36	16.23
49	53.92	20.33
51	62.71	19.48

Note. Data are expressed as mean and standard deviation. The N of 36 reflects total subject number. Temperature is expressed in degrees Celsius.

Table 6

Visual Analogue Scale Ratings for Heat Stimulator Task by Group

	Group			
	High (n=18)		Low (n=18)	
Temperature	M	SD	M	SD
	Sensory intensity ratings			
35	18.07	18.03	14.11	12.65
43	28.35	14.76	30.03	14.95
45	31.80	15.94	26.96	11.67
47	56.35	16.47	45.38	17.11
48	54.82	20.84	41.90	10.09
49	57.99	19.21	59.31	14.46
51	70.78	17.79	70.47	11.86
	Unpleasantness ratings			
35	10.54	13.31	5.78	6.18
43	19.88	13.42	16.70	11.65
45	24.90	13.40	22.37	10.46
47	46.45	18.75	54.08	16.82
48	39.21	15.23	45.51	17.00
49	49.43	22.86	58.41	16.91
51	59.22	22.60	66.21	15.64

Note. Data are expressed as mean and standard deviation. Group membership is determined by score on the MMPI scale 3. Temperature is expressed in degrees Celsius.

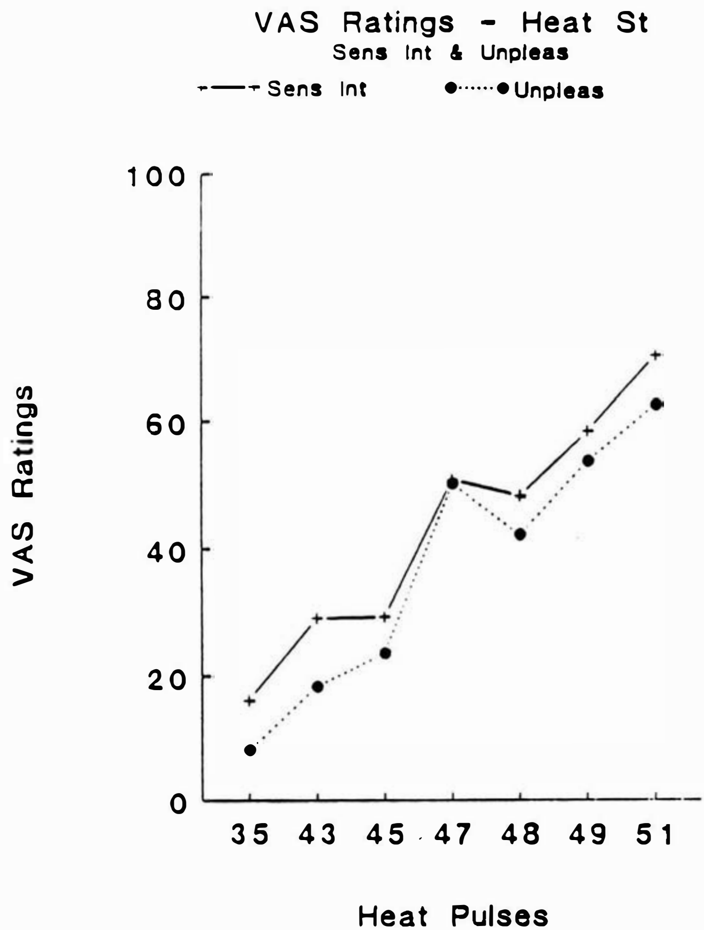

Figure 5. Mean VAS ratings for sensory intensity and unpleasantness for the heat stimulator task for entire sample. Heat pulses are expressed in degrees Celsius.

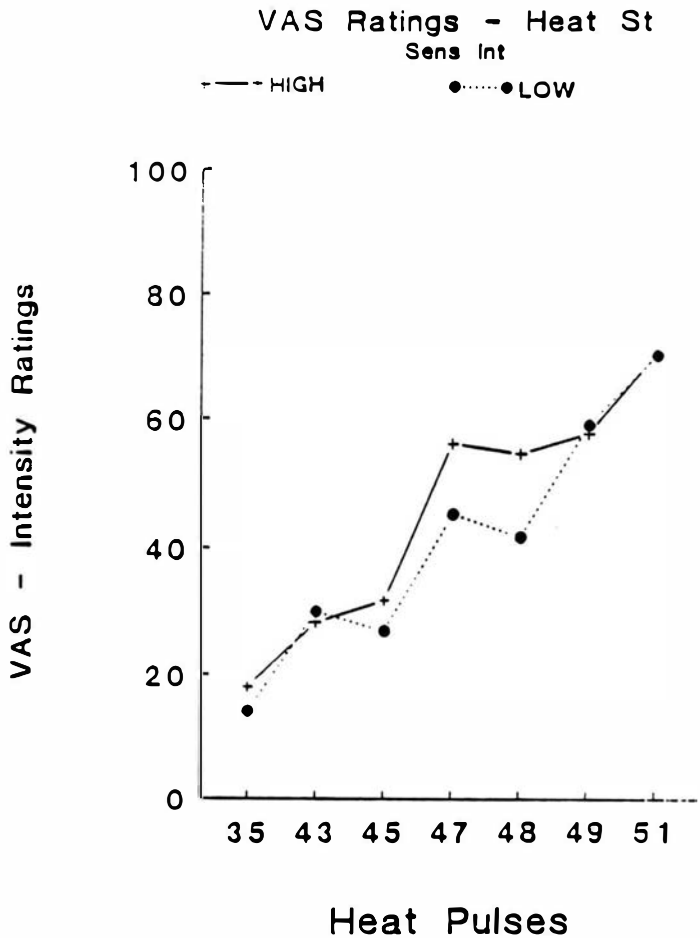

Figure 6. Mean VAS ratings for sensory intensity for the heat stimulator task by group. Heat pulses are expressed in degrees Celsius.

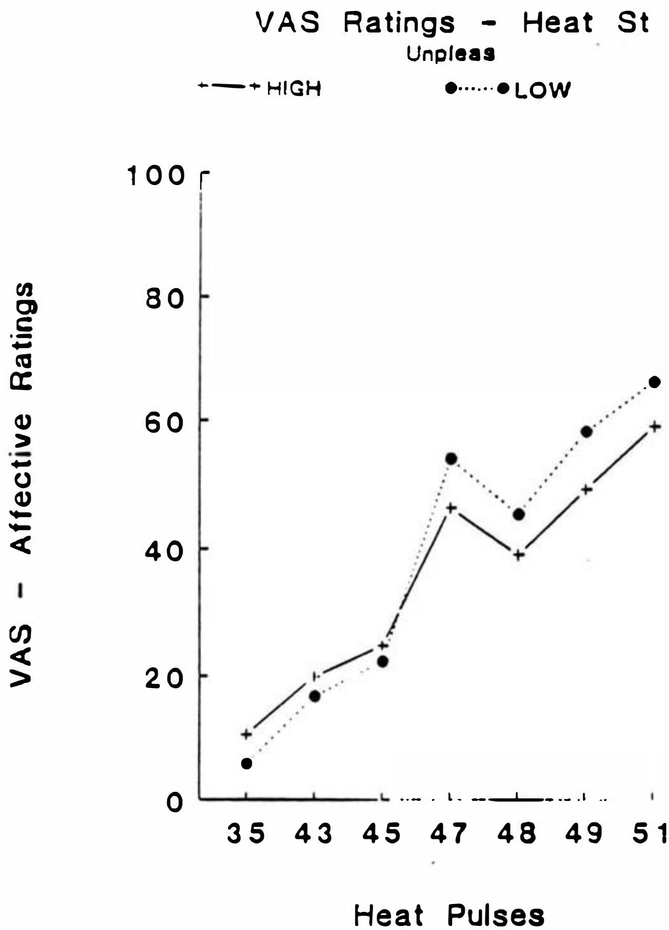

Figure 7. Mean VAS ratings for unpleasantness for the heat stimulator task by group. Heat pulses are expressed in degrees Celsius.

Discussion

The procedures employed in the present experiment produced a number of reliable results consistent with findings in previous experiments. This experiment attempted to test several hypotheses which might confirm that hypochondriacal persons amplify or misinterpret normal bodily sensations. This model is called the perceptual and cognitive abnormality model (Barsky and Klerman, 1983). In this model, a perceptual or cognitive defect is considered the primary source of the problem. Hypochondriacal behavior is considered a natural consequence of the individual's abnormal bodily perceptions. These abnormal sensations are presumed to occur because the person amplifies normal bodily sensations, experiencing them as more noxious or intense than normal individuals, or they may misinterpret normal bodily sensations which accompany emotional arousal or normal bodily functioning. In general, the data offered little support for the hypotheses used to test the amplification/misinterpretation components of the perceptual and cognitive abnormality model. The results will be discussed in the context of each of the hypotheses tested.

Hypothesis 1

The first hypothesis was concerned with pain tolerance. An individual who amplifies sensations presumably is experiencing those sensations as more noxious and intense than those who do not amplify.

This would seem to lead to lower pain tolerance. It was hypothesized that foot withdrawal from the cold water bath prior to instructions to terminate the task would occur with significantly higher frequency in the hypochondriacal group relative to the control group. In the cold pressor task, about one-third of the subjects failed to complete the task. However, high hypochondriacal scores did not appear to have any significant effect on foot withdrawal behavior. Both high and low scorers tolerated the bath equally well as a group. While not statistically significant, results were in the opposite direction of that predicted, with more low scorers failing to finish (n = 8) than high scorers (n = 3). This suggests that pain tolerance may not be a function of hypochondriasis.

Hypothesis 2

The second hypothesis dealt with physiological reactivity. Here the misinterpretation component of the model was being evaluated. Reactivity has been shown to reflect cognitive appraisal and interpretive processes. Presumably, there would be autonomic changes produced in the body due to these cognitive processes which would be reflected in increased physiological reactivity. It was hypothesized that increased heart rate as well as a longer return to baseline levels after the application of each stressor would be exhibited in the hypochondriacal group relative to the control group.

The heart rate changes seen during the cold pressor task suggest accurate recording, since similar patterns have been reported. The cold pressor data showed a significant interaction effect for group and time.

High scorers took longer returning to baseline heart rate levels than low scorers. This supports a hypothesis of greater reactivity among hypochondriacs which in turn supports the misinterpretation aspect of the model. Results relevant to the hypothesis in general, however, were not obtained. Few analyses on the heart rate data for the heat stimulator and YELP tasks were not significant and will not be discussed. The cold pressor task results were consistent with the literature, showing a marked increase in the heart rate during the task (Geden, Beck, Hauge, and Pohlman, 1984). There was a rapid rise in heart rate at the initial immersion of the foot with the rate leveling off as exposure continued. There was partial support for the hypothesis obtained using the cold pressor task. During this task the high group had a slower return to baseline heart rate than the low group. This provides good support for the amplification hypothesis as this indicates an increased time for the system to reestablish equilibrium. A person who is amplifying sensations might take longer to reestablish equilibrium because cognitive decision making about the severity of the sensation should increase the time taken to return to equilibrium. Normal individuals would not go through this process and so return more quickly. The reason there were no group differences obtained may have to do with the severity of the stressor. In this case there may have been a ceiling effect where both groups reached a maximum rate. This was probably not the case since heart rates did not exceed ninety beats per minute even during the first minute of the cold pressor task (see table 3).

The heat stimulator task did not produce significant results on the heart rate data. One explanation for the lack of significance might be attributed to the severity of the stressor. The discrete pulses of the heat stimulator may not have been of sufficient duration to produce stress-related changes between the groups. However, heart rate responds rapidly to stress and the high group was supposed to be amplifying sensations which suggests more rapid responding . Also, since differences approached significance for condition (baseline, stressor, recovery) this suggests that the stressor had an effect.

There are two theories which could be used to explain the heart rate results seen in the heat stimulator task. The first of these theories was proposed by John Lacey.

The key point of Lacey's theory of psychophysiological reactivity has to do with what he calls "environmental intake" or "environmental rejection." These concepts are part of Lacey's refutation of a theory of general physiological arousal. With environmental intake, an individual is engaging in attentive observation of the external environment and wants to accept environmental impacts (Lacey, et al., 1963). When the individual is involved with environmental rejection, one of two things may be happening. First, the individual may be involved in some type of mental work, such as solving arithmetic problems, or other problem solving activities. In this case the person wants to "reject" information from the environment in order to better concentrate on the cognitive activity required in problem solving. Lacey contends that cardiovascular activity can help in this regard (Lacey, 1959). This occurs due to the pressure sensitive receptors in the carotid sinus. These receptors exhibit tonic inhibitory control over cortical electrical activity. According to Lacey, an increase in heart rate is likely to have inhibitory effects on both cortical and motor activity. He asserts that these changes may lead to inhibitory effects on sensory and perceptual events. When cardiac deceleration occurs the person is attempting to take in environmental information. Changes in baroreceptors would cause faster cortical electrical activity and motor control due to a lack of inhibition. Lacey states,

> In a sense, then, the acceleration or deceleration of the heart could be considered to be something like an instrumental act of the organism leading either to increased ease of "environmental intake" or to a form of "rejection of the environment" (Lacey, 1959, p. 199).

The other theory which could be used to explain the results of the study is what might be called the somatic activity theory. This theory is the product of research by Paul Obrist, a former student of Lacey's.

Obrist's theory states that heart rate is directly linked to somatic activity, more specifically, the striate musculature (Obrist, et al., 1970). Obrist states,

> One of the metabolic functions of the cardiovascular system is to provide adequate blood flow for the working muscles. In the intact human and dog, evidence indicates that alteration in heart rate is one of the primary ways that cardiac output, i.e. the amount of blood available to the musculature, can be altered with rate having a direct relationship to output (Obrist, et al., p. 570).

Whenever somatic activity is modified, the heart must respond to this activity and so the heart rate will be altered.

Obrist believes that whenever individuals are involved in what Lacey would call "environmental intake" what is really happening is that they are becoming more somatically quiet (Obrist et al., 1970). They simply aren't moving around as much when they are sitting quietly attending to the environment. With less movement comes less need for blood to the striate musculature, which is manifested in cardiac deceleration. When an individual is involved in "environmental rejection" such as with mental arithmetic or with an aversive stimulus, Obrist believes they are tensing their muscles more. This increased tension causes the need for more blood to the striate musculature which results in cardiac acceleration (Obrist et al., 1970).

It is my belief that Lacey's theory best accounts for the cardiac changes seen in this study. There are several reasons for this. First is the fact that our subjects did not somatically exert themselves anymore in the stressor phase of the heat stimulator task than in the baseline or recovery phases.

The subjects were all seated in a straight backed chair during all phases of the heat stimulator task. The positions of the subjects remained relatively the same during all phases. The one exception was that during the stressor phase subjects were asked to expose their ventral forearms so that the heat stimuli could be placed there. Their arm was supported by the arm of the chair, but there may have been some increased tension in the arm due to the unnatural position. If Obrist's theory is correct, increased tension should have led to cardiac acceleration, rather than the deceleration seen (see figure 1).

The second piece of supporting evidence for the Lacey theory has to do with the instructions the subjects were given for the heat stimulator task. The subjects were told to pay attention to each individual stimulus as they were going to have to compare it with all previous stimuli they had been exposed to in order to rate the intensity and unpleasantness of that stimulus. These instructions asked the subjects to attend to the environment carefully.

Our instructions and stimuli were similar to a study conducted by Lacey which he called "Flash" (Lacey et al., 1963). The stimulus was one of several Lacey was using to study directional fractionation and environmental intake and rejection. During this experiment, subjects were stimulated by flashes at 10 cycles per second by a Grass Photostimulator. Subjects were given instructions to note and detect the varying colors and patterns produced. The subjects were also told they would be asked at the end of the experiment to describe what they saw. The subjects produced cardiac deceleration with heart rate levels going below resting levels (Lacey et al., 1963).

Our subjects were also asked to note the stimuli, as they would have to report on them later. If Obrist were correct, cardiac acceleration should have occurred due to increased demands on the musculature. Subjects were required to mark a response on a visual analogue scale after each stimulus. This required a subject to pick up a pencil, change position slightly, and make the mark. More movement was required than in the baseline state so deceleration should not be seen.

In our study, another stressor task was called "YELP", in which the subjects were read a short description of an incident where the subjects witness a purse snatching. The subject must identify the person from a lineup, and go to court many times. After the description is read, the subject was asked to mentally place themselves in that situation and to try to imagine really being there. The visualization lasted two minutes. There was no change in heart rate from baseline to stressor (see figure 5). It may be that the subjects first attended to the stimulus by listening to the description. This would have led to cardiac deceleration. Next the subjects were concentrating on the situation and rejecting the environment. This would lead to cardiac acceleration. The mean effect would have been no change. Lacey found similar results when he used stimuli which required both attention and rejection (Lacey et al., 1963). It would seem that if the Obrist theory were correct we should have seen either the acceleration caused by the tensing of muscles during "mental work" or the deceleration produced by sitting quietly (Obrist et al., 1970). Interbeat interval recording would shed more light on cardiac reactivity.

In the final stressor, the cold pressor task, cardiac acceleration was seen (see figure 2). Both theories would predict this. Lacey would say the rejection of the aversive stimuli was causing the acceleration, while Obrist would contend it is due to the tensing of the muscles which occurs when someone is exposed to an aversive stressor. In order to answer this question it would be necessary to look at EMG readings for the subjects. These readings would be helpful in providing more definitive answers for all stressor conditions.

It is not possible to definitively conclude which theory best explains the results obtained in this study. More information is needed for this, particularly EMG readings. However it does not seem possible to explain the results obtained in the heat stimulator task using the Obrist theory. While it is speculative, the Lacey theory seems to provide an explanation which best fits the data obtained.

As with the heat stimulator, the YELP stressor did not produce significant heart rate results. This may have been related to differences in the use of the stressor between this experiment and the original study. In the original study which used this task (Rosenthal et al., 1989) the female subjects had a mean heart rate change of 15.60 beats per minute compared to a 3.00 beats per minute change for the subjects in our study. In the first study the subjects were exposed to three different YELP stressors for a total of six minutes, while the subjects in the present experiment were exposed to one stressor for a total of two minutes. The additional exposures may have made the experience more stressful. The stressor chosen for this experiment was one of the three judged in the original study as being the most noxious out of a group of seven stressful scenarios. The scene for this study was chosen for its relevance to a college population. It seemed likely that on an urban campus, the subjects would have concerns about witnessing a scene involving an assault and robbery and would be more likely to find this scene realistic. Perhaps witnessing a purse snatching and subsequent court appearances was not as relevant to a young college population as assumed. It may have improved response if we had used a more personally relevant stressor. Individuals in this study may not have good visualization skills. No pre-screen for visualization skills was used to test the subjects ability as was done in the original study. It was also impossible to monitor a subjects performance on this task. The subjects may not have been performing the task, or may not have been performing it with the intensity and consistency needed to produce a stressful response. Having their eyes closed and being quiet may have served to have the opposite effect on the subjects than the one desired.

Hypothesis 3

This hypothesis stated that the visual analogue scale ratings of both intensity and unpleasantness of cold pressor and heat pain would be significantly higher in the hypochondriacal group relative to the control group. This hypothesis was concerned with attempting to clarify differences between amplification and misinterpretation. If the person was amplifying sensations then the sensory-intensive dimension of the pain report should be more affected than the affective-motivational dimension. A misinterpretational process should yield opposite results, with the affective-motivational dimension being higher than the sensory-intensive. This is because the person experiences normal sensations but draws erroneous conclusions about their severity. An alternate explanation may be that an individual simply has a bias toward higher scoring on the VAS scales. If this is the case, our hypothesis would not explain this.

This hypothesis was not strongly supported by the data since the between-group difference appeared as an interaction of group and condition and it was only on the heat stimulator task. The lack of a between-group main effect might be explained again by the severity of the stressor. Generally, hypochondriacal individuals report pain that is diffuse or in areas where it is difficult to describe the nature of the pain (Barsky & Klerman, 1983) . It may be that the cold pressor task is so severe that it focuses the attention of the hypochondriacal person not allowing the misinterpretation to occur. In this case, the individual can clearly describe the pain and the source of that pain. This would allows normal interpretation to occur. This explanation seems somewhat implausible and a more parsimonious explanation would be that there are no group differences.

For the heat stimulator task, the generally increased affective ratings of the low group at the higher temperatures was surprising. This was unexpected, since the hypothesis predicted higher affective ratings for the high group. This would have supported the misinterpretation part of the hypochondriasis concept. The higher affective ratings of the high group at the lower temperatures (35, 43, 45) support the hypothesis, however the absence of the effect at the higher temperatures (48, 49, 51) would seem to be inconsistent. A possible explanation of this phenomenon may be that hypochondriacal individuals have adapted to higher levels of pain and do not experience them as aversely as normal individuals. The amplification may make lower levels seem more unpleasant, but the higher levels may bring out the adaptational coping strategy. This does not really make sense however, since amplification should amplify all the sensations making them more unpleasant.

While it was not statistically significant, in general, the sensory intensive ratings of the high group were higher than those of the low group. This is suggestive of support for the amplification portion of the hypothesis. The marked jump of both the intensity and unpleasantness ratings for both groups at 47 degrees is thought to be spurious, due to miscalibration of the thermal stimulator, particularly since the ratings decline at the next highest temperature.

Methodological Considerations

Instrumentation. There were other factors which may have improved this study, allowing for greater support of the amplification/ misinterpretation hypothesis. Perhaps the hypochondriasis scale (scale one) of the MMPI was not the proper screening instrument to use to delineate the groups. The amplification/misinterpretation process may not be tapped by the factors measured by the hypochondriasis scale. Kellner (1986) asserts that the hypochondriasis scale of the MMPI consists largely of somatic symptoms and does not measure hypochondriacal beliefs and attitudes. He also believes that the hypochondriasis scale is predominantly a state measure. Amplification is considered to be more of a trait characteristic and so high scores on the hypochondriasis scale may not accurately measure long standing characteristics. While the scale does discriminate between groups of hypochondriacal and non-hypochondriacal persons, there is a large overlap in individuals' scores (Kellner, 1986).

The possibility of overlap is even greater in the instrument used in this study due to the lack of K correction. The K scale consists of thirty items interspersed throughout the MMPI and is designed as a measure of defensiveness toward answering the test items. A percentage of the K scale score is added to several other MMPI scale scores to correct for defensiveness (Meehl & Hathaway, 1956). This leads the K scale score items to act as a suppressor variable. The hypochondriasis scale is one of the scales to which the K score is added. In order to correct for defensiveness, one-half the total K raw score is added to the hypochondriasis scale score. In the present experiment we were unable to add any K correction to the scale score. This could lead to an underestimation of hypochondriasis among our analog population. To be considered clinically hypochondriacal, a person must obtain a T score of 70 on an MMPI scale. This translates to a raw score of 20 if K-correction is used based on norms obtained for North Carolina college freshmen (Greene, 1980).

In order to examine our classification and therefore to know whether our sample could be considered hypochondriacal, K-correction must be added. Greene (1977) states that for college students, K scale scores of 55 to 70 should be considered average. Using those college students' norms a T score of 62 for K (midway between 55 and 70) translates to a raw score of 19. This might be considered an average raw score for K among college freshmen. Since one-half the total K score is added to the hypochondriacal scale this would mean that 10 raw score points should be added to our samples' scores in order to assess their level of hypochondriasis in the manner recommended by the inventory. By using an average K score and adding it to the scores of our sample, all 18 subjects classified as high hypochondriacal would still be correctly classified from a clinical definition.

The difficulty here is in applying an "average" score. The K scale is a measure of defensiveness. It would be very difficult to know how individuals would respond to the entire K scale. It may be that some individuals who would be classified as hypochondriacal using MMPI criteria might be quite willing to admit to psychological or physiological weaknesses as would be indicated by low K scores (Meyer, 1983). Admission of such weaknesses might be the person's way of seeking validation for their symptoms. However, it might also be the case that certain individuals who would be considered hypochondriacal are unwilling to admit to psychological or physiological weaknesses. They may believe that people will try to tell them it's all in their head when they are convinced it is not. These individuals may believe it is in their best interest not to admit to a great deal of psychological or physical distress. These are the people the scale was designed to correct for. Given the possibility of these two different types of responding, it would not be meaningful to add an average score to every subject's score in our sample. This being the case, it is necessary to examine the sample's classification without K-correction.

In order to obtain a T score of 70 without K-correction it is necessary to obtain a raw score of 18 on the hypochondriasis scale (Greene, 1980). In examining the raw scores of the sample classified as hypochondriacal using the statistical method, it is found that 12 of the 18 individuals failed to obtain a raw score of 18 or better. This means that two-thirds of the hypochondriacal sample would not be considered clinically hypochondriacal. This may explain, in part, the failure of this study to obtain stronger results. The analog subjects used in this study were not clinically hypochondriacal. They were therefore probably a non-representative sample and so not appropriate to test hypotheses regarding hypochondriasis.

Barsky, Goodson, Lane, and Cleary (1988) produced a screening instrument which was supposed to measure amplification in individuals. The questionnaire consists of five self-report items. Patients were asked to rate how characteristic each of the items was for them on a five-point scale from 0, "not at all" to 4, "extremely" for questions relating to unpleasant bodily states. The mean score on the questionnaire was 8.9 with a standard deviation of 4.3 and was found to have a .85 test-retest reliability over a period of 1.5 to 5 weeks. The Cronbach's alpha of the scale was .72. In this study, amplification, as measured by the scale, was significantly correlated ($r = .49$ $p < .0001$) with the report of discomfort. This instrument was also used in the present study and several analyses were run using the amplification score as the grouping variable. Individuals with a score of less than nine were classified as lows, and those with scores greater than ten were classified as highs (mean = 9.6 SD = 2.5 min = 5 max = 16). The two groups divided using the amplification scale scores did not differ significantly on their MMPI hypochondriasis scores (low group - M = 11.33 SD = 5.01 high group - M = 12.69 SD = 6.5). This supports the possibility that the MMPI hypochondriasis scale does not properly assess amplification in individuals. However, the groups did not differ on their VAS ratings for the heat stimulator task. This is puzzling since the Barsky study found that amplification was correlated with report of discomfort.

Subject Selection. Another possible problem may have been in using an analog population. Hanback and Revelle (1978) used a student population to test heightened perceptual sensitivity and achieved mixed results. It may be that the phenomenon is not strong enough in this population, but needs to be tested in a clinical population where they are more likely to be seen. A student population also generally has younger people comprising it. Age may be a factor that is relevant to this concept. Increased pain as a function of aging may exacerbate the tendency to amplify or misinterpret. Having a wider range of ages particularly older individuals may help answer this question. Another possible way to improve selection might be having individuals identified by medical personnel as meeting the criteria for hypochondriasis as they would be familiar with the person's medical history and health care utilization.

Measurement. Failure to observe group differences in this study may be related to the use of insensitive measures and/or failure to operationalize the amplification model properly. There are other measures that could be taken as well. Physiologically, electrodermal response would certainly be another way to look at reactivity as well as electromyography and respiration. Perhaps a better test might involve measuring physiological sensitivity in a different way. Hanback and Revelle (1978) had success using visual two-flash fusion sensitivity. Their basis for physiologically based hypochondriasis was a tendency for the hypochondriacal individual to perceive more bodily sensations than normal. They believed that heightened arousal lead to greater sensitivity to stimulation. It might be useful to determine sensory thresholds across a variety of modalities including auditory and pricking pain as a way to improve measurement.

Stressors. The YELP stressor did not appear to be stressful enough. Other stressors produce stronger effects. Mental arithmetic or reciting a personally embarrassing event might produce a more marked physiological effect than the one produced with the YELP stressor. Mental arithmetic or a personally embarrassing event produce a strong physiological reaction and are considered to be quite stressful by the participant. The response is however ideographic in nature. The primary reason for using the YELP stressor in this study was to get a standardized stressor. Expansion of the number of YELP stressors may have improved physiological response. Perhaps better use of the cold water bath may have improved results. The water may not have been cold enough or perhaps circulating the water might have helped.

Better dependent measures may have improved results, but perhaps the measures taken were not the best in terms of testing the model. The measures may not have operationalized the amplification/misinterpretation model properly. The use of the measure of pain tolerance, visual analogue scale ratings, and measurement of heart rate may not be the best way to support our hypotheses. It may be that individuals who amplify do not experience the amplified sensations as more noxious, or that this noxiousness does not result in lower pain tolerance.

Problems with the Model

There are methodological changes that could have been made to improve the study, but it may be that the perceptual and cognitive abnormality model is not the best one to explain hypochondriasis. In this study no strong support was found for physiological sensitivity.

Even if this was only a partial explanation for hypochondriasis, this should have been observed in the measures taken in the present experiment. If there is a predisposition for physiological sensitivity will this knowledge improve the treatment of hypochondriasis? You cannot change your genetics, only your behavior. Knowing you are predisposed to a behavior does not of itself change that behavior. Barsky and Klerman (1983) also assert that hypochondriacal behavior is the inevitable and normal consequence of a perceptual and cognitive abnormality. Why it is inevitable is not clear and Barsky and Klerman do not elaborate on their reasons or offer alternative explanations.

It may be however that a physiological explanation is an important part of an overall conceptualization of hypochondriasis. Knowing that a predisposition exists could lead to better behavioral management of the condition. Also, a documented physiological predisposition could help remove part of the stigma attached to hypochondriasis and lead to better treatment for the condition.

Conclusion

Further research is needed in order to better clarify the amplification/misinterpretation hypothesis. While the results of this study do not fully support the hypothesis, they cannot rule it out either. This is the first study to use physiological measures in an attempt to demonstrate differences between normals and hypochondriacal individuals who may be amplifying or misinterpreting their bodily sensations. This still provides the most basic evidence for amplification and misinterpretation. Improved techniques and better population selection are needed before definitive answers may be reached.

List of References

List of References

Allen, M. T., Sherwood, A., & Obrist, P. A. (1986). Interactions of respiratory and cardiovascular adjustments to behavioral stressors. Psychophysiology, 23, 532-541.

American Psychiatric Association. (1987). Diagnostic and statistical manual of mental disorders (3rd-revised ed.). Washington,DC: Author.

Barsky, A.J., Goodson, J.D., Lane, R.S., & Cleary, P.D. (1988). The amplification of somatic symptoms. Psychosomatic Medicine, 50, 510-519.

Barsky, A. J., & Klerman, G. L. (1983). Overview: Hypochondriasis, bodily complaints, and somatic styles. American Journal of Psychiatry, 140, 273-283.

Beecher, H. K. (1956). The subjective response and reaction to sensation. American Journal of Medicine, 20, 107-113.

Bianchi, G. N. (1971). Origins of disease phobia. Australian and New Zealand Journal of Psychiatry, 5, 241-257.

Bonica, J. J. (Ed.). (1980). Pain. New York: Raven Press.

Brown, H. N., & Vaillant, G. E. (1981). Hypochondriasis. Archives of Internal Medicine, 141, 723-726.

Costa, P. T., & McCrae, R. R. (1985). Hypochondriasis, neuroticism, and aging. American Psychologist, 40, 19-28.

Craig, K. D., & Neidermayer, H. (1974). Autonomic correlates of pain thresholds influenced through social modeling. Journal of Personality and Social Psychology, 29, 246-252.

Darrow, C. W. (1929). Electrical and circulatory responses to brief sensory and ideational stimuli. Journal of Experimental Psychology, 12, 267-300.

Eysenck, H. J. & Eysenck, S. G. B. (1964). Manual of the Eysenck personality inventory. London: University of London Press.

Feurstein, M., Labbe, E. E., & Kuczmierczyk, A. R. (1986). Health Psychology: A psychobiological perspective. New York: Plenum Press.

Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. Journal of Personality and Social Psychology, 48, 150-170.

Ford, C. V. (1986). The somatizing disorders. Psychosomatics, 27, 327-337.

Fordyce, W. E. (1976). Behavioral methods for chronic pain and illness. St. Louis: C.V. Mosby.

Freud, S. (1914). Complete Psychological Works, On narcissism: An introduction (standard ed., Vol. 14). London: Hogarth Press.

Geden, E., Beck, N., Hauge, G., & Pohlman, S. (1984). Self-report and psychophysiological effects of five pain-coping strategies. Nursing Research, 33, 260-265.

Greene, R. L. (1977). The MMPI: A practical guide. New York: Oxford University.

Greene, R. L. (1980). The MMPI: An interpretive manual. New York: Greene and Stratton.

Hanback, J., & Revelle, W. (1978). Arousal and perceptual sensitivity in hypochondriacs. Journal of Abnormal Psychology, 87, 523-530.

Harkins. S.W., Price, D.D., & Martelli, M. (1986). Effects of age on pain perceptions: Thermonociception. Journal of Gerontology, 41, 58-63.

Huskisson, E. C. (1983). Pain measurement and assessment. New York: Raven Press.

Jose, A. D., & Collison, D. (1970). The normal range and determinants of the intrinsic heart rate in man. Cardiovascular Research, 4, 160-167.

Kaplan, C., Lipkin, M., & Gordon, G. H. (1988). Somatization in primary care: Patients with unexplained and vexing medical complaints. Journal of General Internal Medicine, 3, 177-190.

Kellner, R. (1986). Somatization and hypochondriasis. New York: Praeger.

Kenyon, F. E. (1976). Hypochondriasis: a clinical study. British Journal of Psychiatry, 129, 1-14.

Krantz, D. S., Manuck, S. B., & Wing, R. R. (1986). Psychological stressors and task variables as elicitors of reactivity. In K. A. Matthews, S. M. Weiss, T. Detre, T. M. Dembroski, B. Falkner, S. B. Manuck, & R. B. Williams Jr. (Eds.), Handbook of stress, reactivity, and cardiovascular disease (pp. 127-144). New York: John Wiley & Sons.

Lacey, J. I. (1959). Psychophysiological approaches to the evaluation of psychotherapeutic process and outcome. In E. A. Rubinstein & M. B. Parloff (Eds.), Research in psychotherapy (pp. 160-208). Washington, DC: American Psychological Association.

Lacey, J. I. (1967). Somatic response patterning and stress: Some revisions of activation theory. In M. H. Appley & R. Trumbull (Eds.), Psychological stress (pp. 14-42). New York: Appleton Century-Crofts.

Lacey, J. I., Kagan, J., Lacey, B. C., & Moss, H. A. (1963). The visceral level: Situational determinants and behavioral correlates of autonomic response patterns. In P. H. Knapp (Ed.), Expression of the emotions in man (pp. 161-196). New York: International Universities Press.

Lawler, J. E., & Obrist, P. A. (1974). Indirect indices of contractile force. In P. A. Obrist, A. H. Black, J. Brener, & L. DiCara (Eds.), Cardiovascular psychophysiology-Current issues in response mechanisms, biofeedback and methodology (pp. 85-92). Chicago: Aldine.

Light, K. C., Obrist, P. A., James, S. A., & Strogatz, D. S. (1987). Cardiovascular responses to stress: II. Relationships to aerobic exercise patterns. Psychophysiology, 24, 79-87.

Lowy, F. H. (1975). Management of the persistent somatizer. International Journal of Psychiatric Medicine, 6, 227-239.

Meehl, P. E., & Hathaway, S. R. (1956). The K factor as a suppressor variable in the MMPI. In G. S. Welsh, & W. G. Dahlstrom (Eds.), Basic readings on the MMPI in psychology and medicine (pp. 12-40). Minneapolis: University of Minnesota.

Melzack, R. (1975). The McGill pain questionnaire: Major properties and scoring methods. Pain, 1, 277-299.

Melzack, R., & Wall, P. D. (1965). Pain mechanisms: A new theory. Science, 150, 971-979.

Meyer, R. G. (1983). The clinician's handbook: The psychopathology of adulthood and late adolescence. Boston: Allyn and Bacon.

Miller, S. M. (1987). Monitoring and blunting: Validation of a questionnaire to assess styles of information seeking under threat. Journal of Personality and Social psychology, 52, 345-353.

Nemiah, J. C. (1980). Somatization disorder. In H.I. Kaplan, A.M. Friedman, & B. J. Sadock (Eds.), Comprehensive textbook of psychiatry (3rd ed., Vol.2). Baltimore: Williams & Wilkins.

Obrist, P. A. (1976). The cardiovascular-behavioral interaction - as it appears today. Psychophysiology, 13, 95-107.

Obrist, P. A., Black, A. H., Brener, J., & DiCara, L. V. (Eds.). (1974). Cardiovascular Psychophysiology. Chicago: Aldine.

Obrist, P. A., Webb, P. A., Sutterer, J. R., & Howard, J. L. (1970). The cardiac-somatic relationship: Some reformulations. Psychophysiology, 6, 569-587.

Obrist, P. A., & Webb, R. A. (1967). Heart rate during conditioning in dogs: Relationship to somatic-motor activity. Psychophysiology, 4, 7-34.

Pennebaker, J. W. (1982). The psychology of physical symptoms. New York: Springer.

Price, D. D. (1988). Psychological and neural mechanisms of pain. New York: Raven Press.

Price, D. D., Barrell, S J., & Gracely, R. H. (1980). A psychophysical analysis of experimental factors that selectively influence the affective dimension of pain. Pain, 8, 137-149.

Price, D. D., & Harkins, S. W. (1987). Combined use of experimental pain and visual analogue scales in providing standardized measurement of pain. Clinical Pain, 3, 1-8.

Price, D. D., Harkins, S. W., & Baker, C. (1987). Sensory-affective relationships among different types of clinical and experimental pain. Pain, 28, 297-307.

Price, D. D., Harkins, S. W., Rafii, A., & Price, C. (1986). A simultaneous comparison of fentanyl's analgesic effects on experimental and clinical pain. Pain, 24, 197-203.

Price, D. D., McGrath, P. A., Rafii, A., & Buckingham, B. (1983). The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. Pain, 17, 45-56.

Rodin, J. (1978). Somatopsychics and attribution. Personality and Social Psychology Bulletin, 4, 531-540.

Rosenthal, T. L., Montgomery, L. M., Shadish, W. R. Edwards, N. B. Hutcherson, H. W., Follette, W. C., & Lichstein, K.L. (1989). Two new, brief, practical stressor tasks for research purposes. Behavior Therapy, 20, 545-562.

Schneiderman, N., & Pickering, T. G. (1986). Cardiovascular measure of physiologic reactivity. In K. A. Matthews, S. M. Weiss, T. Detre, T. M. Dembroski, B. Falkner, S. B. Manuck, & R. B. Williams Jr. (Eds.), Handbook of stress, reactivity, and cardiovascular disease (pp. 145-186). New York: John Wiley & Sons.

Seligman, M.E.P. (1975). Helplessness: On depression, development, and death. San Francisco: W. H. Freeman.

Spanos, N. P., Ollerhead, V. G., & Gwynn, M. I. (1985). The effects of three instructional treatments on pain magnitude theories of hypnotic analgesia. Imagination, Cognition, and Personality, 5, 321-337.

Spielberger, C.D., Forush, R., & Lushene, R.L. (1970). Manual for the state-trait anxiety inventory. Palo Alto: Consulting Psychologist Press.

Turk, D. C., Meichenbaum, D., & Genest, M. (1983). Pain and behavioral medicine: A cognitive-behavioral perspective. New York: Guilford.

Turk, D. C., Rudy, T. E., & Salovey, P. (1985). The McGill pain questionnaire in the clinical assessment of pain. Pain, 21, 385-397.

Vaillant, G. E. (1977). Adaptation to life. Boston: Little, Brown, and Co.

Wahl, C. W. (1963). Unconscious factors in the psychodynamics of the hypochondriacal patient. Psychosomatics, 4, 9-14.

Williams, R. B. (1986). Patterns of reactivity and stress. In K. A. Matthews, S. M. Weiss, T. Detre, T. M. Dembroski, B. Falkner, S. B. Manuck, & R. B. Williams Jr. (Eds.), Handbook of stress, reactivity, and cardiovascular disease (pp. 109-126). New York: John Wiley & Sons.

Wooley, S. C., & Blackwell, B. (1975). A behavioral probe into social contingencies on a psychosomatic ward. Journal of Applied Behavior Analysis, 8, 337-339.

Wooley, S.C., Epps, B., & Blackwell,B. (1975). Pain tolerance in chronic illness behavior. Psychosomatic Medicine, 37, 98.

Zimmerman, M., & Coryell, W. (1987). The inventory to diagnose depression (IDD): A self-report scale to diagnose major depressive disorder. Journal of Consulting and Clinical Psychology, 55, 55-59.

APPENDIX A

Consent Forms, Medical Checklist, and Screening Questionnaire

Informed Consent

This questionnaire is a prescreening instrument only. No credit will be given for the completion of this questionnaire alone. However if you are contacted later and complete the study, you will earn credit for participation in two research projects.

The questionnaires can be returned to Dr. Gramling's mailbox at 808 West Franklin Street. Or if you picked up a questionnaire in class, someone will be there the following class day to pick them up. Please sign and date the statement below.

I understand that the filling out of this questionnaire is completely voluntary, and that all results are strictly confidential.

Name ______________________________

Signature ______________________________

Phone Number ______________________________

Consent Form

Title of research: Physiological reactivity and sensitivity to physical and psychological stress.

Investigator: Sandy E. Gramling, Ph.D.
Assistant Professor in Clinical Psychology

1. Introduction. Research has shown that there is a link between stress and physical illness. However, more research is needed to understand how the physiological reaction to stress differs across different people. Specifically, some people may be more sensitive to stress and their body may respond more strongly than others to physical (painful) and psychological stressors. Therefore, this study has been designed to study the effects of mild psychological and physical stressors (e.g., remembering a stressful event; putting your foot in ice water) on measures of autonomic reactivity (e.g., perspiration of the skin measured by skin conductance level; quickness of breath measured by respiration).

If you choose to participate in this study you will be asked to fill out several questionnaires. Participants will be contacted by the investigator and invited to participate in a psychophysiological assessment session at a mutually convenient time. During the psychophysiological assessment phase of the study, standard psychophysiological recording procedures will be used to monitor your body's responses to several mild psychological and physical stressors including thinking about an unpleasant event, putting your foot in ice water, and having your skin touched by a hot thermal probe. The thermal probe is constructed with special safety features to prevent an accidental burn even if something were to cause the probe to malfunction. The effects of these stressors are transitory, though they will cause some discomfort when administered. The experimenter will demonstrate each of these stressors on himself/herself prior to the start of the experiment.

2. Benefits. This study does not provide any direct benefits for the individual participants. However, the results of this study will further our understanding of the relationship between stress, physical illness and autonomic reactivity. Further scientific investigations in this area may have beneficial effects for society as our understanding in this area continues to increase.

3. Risks, Inconvenience, Discomfort. You may experience some temporary psychological distress (e.g., anxiety, frustration) and physical discomfort as a function of the laboratory tasks used in this study. You may also experience some mild temporary physical discomfort (skin irritation) for the skin cleaning procedure at some of the recording sites.

4. Cost of Participation. There are no monetary costs associated with this study. Your participation will, however, require a total of about one and one-half hours of your time.

5. Research Related Injury. To participate in this, and all studies conducted at Virginia Commonwealth University, you must read and agree to the following:

"I understand that in the event of any physical and/or mental injury resulting from my participation in this research project, Virginia Commonwealth University will not offer compensation."

6. Confidentiality of Records. The results of this participation will be confidential and will not be released unless required by law. No identifying information will recorded on any of the forms you fill out, and the videotapes will be erased at the completion of the study. Any presentation or publication of the results of this study will be presented as group means, thereby insuring that the identity and responses of individual participants are completely obscured.

7. Withdrawal. Participants are free to withdraw from this study at any time without penalty. Any questions regarding this study will be answered by the investigator.

I have read and understood the information given above. The nature and purpose of this research project has been satisfactorily explained to me. By signing below I consent to participate in this study and acknowledge that my participation is entirely voluntary. A copy of this form will be provided at my request. If any questions or concerns related to this study arise in the future I may call Sandy Gramling, Ph.D. at 804-367-8795.

______________________________ ____________________

Signature of Subject Date

______________________________ ____________________

Witness Date

Medical Checklist

The following medical conditions listed below are ones which would preclude your participation in this study. While the stressors are not harmful to most individuals, for your safety and comfort, we are asking people with certain conditions not to participate. Please check any below that apply.

---- Heart condition
---- Hypertension
---- Diabetes
---- Reynaud's Disease
---- Pregnancy
---- Currently under a physician's care
Please explain

---- Currently under a mental health professional's care
Please explain

---- Peripheral Neuropathy

Are you currently in menses? ---- yes ---- no If no, how many days has it been since your last period? ______________________

Please list any prescription medications you are currently taking ________

____

Please list any non-prescription medications you are currently taking _____

____

Have you smoked in the last eight hours? ---- yes ---- no

Have you consumed caffeine in the last eight hours? ---- yes ---- no

Please list the food you have consumed in the last eight hours ____________

____

Stress and Physical Disorders Questionnaire

Please circle true or false to each question.

T F 1. I am bothered by acid stomach several times a week.

T F 2. Parts of my body often having feelings like burning, tingling, crawling or like "going to sleep."

T F 3. I have had no difficulty in starting or holding my bowel movement.

T F 4. I am troubled by attacks of nausea and vomiting.

T F 5. I am troubled by discomfort in the pit of my stomach every few days or oftener.

T F 6. I have a good appetite.

T F 7. My sleep is fitful and disturbed.

T F 8. I have numbness in one or more regions of my skin.

T F 9. I wake up fresh and rested most mornings.

T F 10. My hands and feet are usually warm enough.

T F 11. I hardly ever feel pain in the back of the neck.

T F 12. I have never vomited blood or coughed up blood.

T F 13. I have little or no trouble with my muscles twitching or jumping.

T F 14. I do not tire quickly.

T F 15. I feel weak all over much of the time.

T F 16. I am neither gaining nor losing weight.

T F 17. My eyesight is as good as it has been for years.

T F 18. I do not often notice my ears ringing or buzzing.

T F 19. I am very seldom troubled by constipation.

T F 20. I am in just as good physical health as most of my friends.

T F 21. Often I feel as if there were a tight band about my head.

T F 22. I have very few headaches.

T F 23. During the past few years I have been well most of the time.

T F 24. I have a great deal of stomach trouble.

T F 25. I can read a long while without tiring my eyes.

T F 26. There seems to be a fullness in my head or nose most of the time.

T F 27. I have few or no pains.

T F 28. I seldom or never have dizzy spells.

T F 29. I am almost never bothered by pains over the heart or in my chest.

T F 30. I have had no difficulty in keeping my balance in walking.

T F 31. The top of my head sometimes feels tender.

T F 32. I am about as able to work as I ever was.

T F 33. I hardly ever notice my heart pounding and I am seldom short of breath.

APPENDIX B

Personality and Mood Questionnaires

Directions

Please read each item below. For each item please circle the number that best indicates how characteristic or descriptive the item is of YOU.

1. Sudden loud noises really disturb me

0	1	2	3	4
Not at All	Somewhat	Moderately	Very Much	Extremely

2. I'm very uncomfortable when I'm in a place that is too hot or too cold

0	1	2	3	4
Not at All	Somewhat	Moderately	Very Much	Extremely

3. I can't stand pain as well as most people can

0	1	2	3	4
Not at All	Somewhat	Moderately	Very Much	Extremely

4. I find I'm often aware of various things happening in my body

0	1	2	3	4
Not at All	Somewhat	Moderately	Very Much	Extremely

5. I'm quick to sense the hunger contractions in my stomach

0	1	2	3	4
Not at All	Somewhat	Moderately	Very Much	Extremely

When you have completed the questionnaire, please copy your answers onto a coding sheet. In column one of the coding sheet, darken in the number that corresponds to your answer for item one. Then do the same thing for the rest of the items.

1. Do you often long for excitement? . . . . Yes No

2. Do you often need understanding friends to cheer you up? . . . . Yes No

3. Are you usually carefree? . . . . Yes No

4. Do you find it very hard to take no for an answer? . . . Yes No

5. Do you stop and think things over before doing anything? . . . . Yes No

6. If you say you will do something do you always keep your promises, no matter how inconvenient it might be to do so? . . . . Yes No

7. Does your mood often go up and down? . . . . Yes No

8. Do you generally do and say things quickly without stopping to think? . . . . Yes No

9. Do you ever feel "just miserable" for no good reason? Yes No

10. Would you do almost anything for a dare? . . . . Yes No

11. Do you suddenly feel shy when you want to talk to an attractive stranger? . . . . Yes No

12. Once in a while do you lose your temper and get angry? . . . . Yes No

13. Do you often do things on the spur of the moment? . . . Yes No

14. Do you often worry about things you should not have done or said? . . . . Yes No

15. Generally do you prefer reading to meeting people? . . Yes No

16. Are your feelings rather easily hurt? . . . . Yes No

17. Do you like going out a lot? . . . . Yes No

18. Do you occasionally have thoughts and ideas that you would not like other people to know about? . . . . Yes No

19. Are you sometimes bubbling over with energy and sometimes very sluggish? . . . . Yes No

20. Do you prefer to have few but special friends? . . . . . Yes No

21. Do you daydream a lot? . . . . Yes No

22. When people shout at you, do you shout back? . . . . Yes No

23. Are you often troubled about feelings of guilt? . . . . . . Yes No

24. Are all your habits good and desirable ones? . . . . Yes No

25. Can you usually let yourself go and enjoy yourself a lot at a gay party? . . . . Yes No

26. Would you call yourself tense or "highly-strung"? . . . Yes No

27. Do other people think of you as being very lively? . . . Yes No

28. After you have done something important, do you often come away feeling you could have done better? . . . . . Yes No

29. Are you mostly quiet when you are with other people? Yes No

30. Do you sometimes gossip? . . . . Yes No

31. Do ideas run through your head so that you cannot sleep? . . . . Yes No

32. If there is something you want to know about, would you rather look it up in a book than talk to someone about it? . . . . Yes No

33. Do you get palpitations or thumping in your heart? . . . Yes No

34. Do you like the kind of work that you need to pay close attention to? . . . . Yes No

35. Do you get attacks of shaking or trembling? . . . . Yes No

36. Would you always declare everything at the customs, even if you knew that you could never be found out? . . Yes No

37. Do you hate being with a crowd who play jokes on one another? . . . . Yes No

38. Are you an irritable person? . . . . Yes No

39. Do you like doing things in which you have to act quickly? . . . . Yes No

40. Do you worry about awful things that might happen? . . Yes No

41. Are you slow and unhurried in the way you move? . . . Yes No

42. Have you ever been late for an appointment or work? . Yes No

43. Do you have many nightmares? . . . . Yes No

44. Do you like talking to people so much that you would never miss a chance of talking to a stranger? . . . . . . Yes No

45. Are you troubled by aches and pains? . . . . Yes No

46. Would you be very unhappy if you could not see lots of people most of the time? . . . . Yes No

47. Would you call yourself a nervous person? . . . . Yes No

48. Of all the people you know are there some whom you definitely do not like? . . . . Yes No

49. Would you say you were fairly self-confident? . . . . . Yes No

50. Are you easily hurt when people find fault with you or your work? . . . . Yes No

51. Do you find it hard to really enjoy yourself at a lively party? . . . . Yes No

52. Are you troubled with feelings of inferiority? . . . . . . Yes No

53. Can you easily get some life into a rather dull party? Yes No

54. Do you sometimes talk about things you know nothing about? . . . . Yes No

55. Do you worry about your health? . . . . Yes No

56. Do you like playing pranks on others? . . . . Yes No

57. Do you suffer from sleeplessness? . . . . Yes No

PLEASE CHECK TO SEE THAT YOU HAVE ANSWERED ALL THE QUESTIONS.

SELF-EVALUATION QUESTIONNAIRE

Developed by C. D. Spielberger, R. L. Gorsuch and R. Lushene

STAI FORM X-1

NAME ______________________________ DATE ______________

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *feel* right now, that is, *at this moment.* There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	①	②	③	④
2. I feel secure	①	②	③	④
3. I am tense	①	②	③	④
4. I am regretful	①	②	③	④
5. I feel at ease	①	②	③	④
6. I feel upset	①	②	③	④
7. I am presently worrying over possible misfortunes	①	②	③	④
8. I feel rested	①	②	③	④
9. I feel anxious	①	②	③	④
10. I feel comfortable	①	②	③	④
11. I feel self-confident	①	②	③	④
12. I feel nervous	①	②	③	④
13. I am jittery	①	②	③	④
14. I feel "high strung"	①	②	③	④
15. I am relaxed	①	②	③	④
16. I feel content	①	②	③	④
17. I am worried	①	②	③	④
18. I feel over-excited and "rattled"	①	②	③	④
19. I feel joyful	①	②	③	④
20. I feel pleasant	①	②	③	④

CONSULTING PSYCHOLOGISTS PRESS
577 College Avenue, Palo Alto, California 94306

SELF-EVALUATION QUESTIONNAIRE

STAI FORM X-2

NAME ______________________________ DATE ______________

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	①	②	③	④
22. I tire quickly	①	②	③	④
23. I feel like crying	①	②	③	④
24. I wish I could be as happy as others seem to be	①	②	③	④
25. I am losing out on things because I can't make up my mind soon enough	①	②	③	④
26. I feel rested	①	②	③	④
27. I am "calm, cool, and collected"	①	②	③	④
28. I feel that difficulties are piling up so that I cannot overcome them	①	②	③	④
29. I worry too much over something that really doesn't matter	①	②	③	④
30. I am happy	①	②	③	④
31. I am inclined to take things hard	①	②	③	④
32. I lack self-confidence	①	②	③	④
33. I feel secure	①	②	③	④
34. I try to avoid facing a crisis or difficulty	①	②	③	④
35. I feel blue	①	②	③	④
36. I am content	①	②	③	④
37. Some unimportant thought runs through my mind and bothers me	①	②	③	④
38. I take disappointments so keenly that I can't put them out of my mind	①	②	③	④
39. I am a steady person	①	②	③	④
40. I get in a state of tension or turmoil as I think over my recent concerns and interests	①	②	③	④

PAST WEEK

Name: ____________

Subject #: ______

Date: ___/___/___

INSTRUCTIONS

1. On this questionnaire are groups of 5 statements.

2. Read each group of statements carefully. Then pick out the one statement in each group that best describes the way you have been feeling the PAST WEEK. Circle the number next to the statement you picked.

3. For every group in which you circled #1,2,3 or 4 answer the follow-up question as to whether you have been feeling that way for more or less than 2 weeks.

1) 0 I do not feel sad or depressed.
1 I occasionally feel sad or down.
2 I feel sad most of the time, but I can snap out of it.
3 I feel sad all the time, and I can't snap out of it.
4 I am so sad or unhappy that I can't stand it.

*** If you circled #1, 2, 3 or 4: Have you been feeling sad or down for more or less than 2 weeks? more less

---

2) 0 My energy level is normal.
1 My energy level is occasionally a little lower than normal.
2 I get tired more easily or have less energy than usual.
3 I get tired from doing almost anything.
4 I feel tired or exhausted almost all of the time.

*** If you circled #1, 2, 3 or 4: Has your energy level been lower than usual for more or less than 2 weeks? more less

---

3) 0 I have not been feeling more restless and fidgety than usual.
1 I feel a little more restless or fidgety than usual.
2 I have been very fidgety, and I have some difficulty sitting still in a chair.
3 I have been extremely fidgety, and I have been pacing a little bit almost every day.
4 I have been pacing more than an hour per day, and I can't sit still.

*** If you circled #1, 2, 3 or 4: Have you felt restless and fidgety for more or less than 2 weeks? more less

---

4) 0 I have not been talking or moving more slowly than usual.
1 I am talking a little slower than usual.
2 I am speaking slower than usual, and it takes me longer to respond to questions, but I can still carry on a normal conversation.
3 Normal conversations are difficult because it is hard to start talking.
4 I feel extremely slowed down physically, like I am stuck in mud.

*** If you circled #1, 2, 3 or 4: Have you felt slowed down for more or less than 2 weeks? more less

---

5) 0 I have not lost interest in my usual activities.
1 I am a little less interested in 1 or 2 of my usual activities.
2 I am less interested in several of my usual activities.
3 I have lost most of my interest in almost all of my usual activities.
4 I have lost all interest in all of my usual activities.

*** If you circled #1, 2, 3 or 4: Has your interest in your usual activities been low for more or less than 2 weeks? more less

6) 0 I get as much pleasure out of my usual activities as usual.
1 I get a little less pleasure from 1 or 2 of my usual activities.
2 I get less pleasure from several of my usual activities.
3 I get almost no pleasure from most of the activities which I usually enjoy.
4 I get no pleasure from any of the activities which I usually enjoy.

*** If you circled #1, 2, 3 or 4: Has your enjoyment in your usual activities been low for more or less than 2 weeks? more less

---

7) 0 I have not noticed any recent change in my interest in sex.
1 I am only slightly less interested in sex than usual.
2 There is a noticeable decrease in my interest in sex.
3 I am much less interested in sex now.
4 I have lost all interest in sex.

*** If you circled #1, 2, 3 or 4: Has your interest in sex been low for more or less than 2 weeks? more less

---

8) 0 I have not been feeling guilty.
1 I occasionally feel a little guilty.
2 I often feel guilty.
3 I feel quite guilty most of the time.
4 I feel extremely guilty most of the time.

*** If you circled #1, 2, 3 or 4: Have you had guilt feelings for more or less than 2 weeks? more less

---

9) 0 I do not feel like a failure.
1 My opinion of myself is occasionally a little low.
2 I feel I am inferior to most people.
3 I feel like a failure.
4 I feel I am a totally worthless person.

*** If you circled #1, 2, 3 or 4: Have you been down on yourself for more or less than 2 weeks? more less

---

10) 0 I haven't had any thoughts of death or suicide.
1 I occasionally think life is not worth living.
2 I frequently think of dying in passive ways (such as going to sleep and not waking up), or that I'd be better off dead.
3 I have frequent thoughts of killing myself, but I would not carry them out.
4 I would kill myself if I had the chance.

*** If you circled #1, 2, 3 or 4: Have you been thinking about dying or killing yourself for more or less than 2 weeks? more less

0 I can concentrate as well as usual.
1 My ability to concentrate is slightly worse than usual.
2 My attention span is not as good as usual and I am having difficulty collecting my thoughts, but this hasn't caused any problems.
3 My ability to read or hold a conversation is not as good as it usually is.
4 I cannot read, watch TV, or have a conversation without great difficulty.

** If you circled #1, 2, 3 or 4: Have you had problems concentrating for more or less than 2 weeks? more less

---

0 I make decisions as well as I usually do.
1 Decision making is slightly more difficult than usual.
2 It is harder and takes longer to make decisions, but I do make them.
3 I am unable to make some decisions.
4 I can't make any decisions at all.

* If you circled #1, 2, 3 or 4: Have you had problems making decisions for more or less than 2 weeks? more less

---

0 My appetite is not less than normal.
1 My appetite is slightly worse than usual.
2 My appetite is clearly not as good as usual, but I still eat.
3 My appetite is much worse now.
4 I have no appetite at all, and I have to force myself to eat even a little.

* If you circled #1, 2, 3 or 4: Has your appetite been decreased for more or less than 2 weeks? more less

---

0 I haven't lost any weight.
1 I've lost less than 5 pounds.
2 I've lost between 5-10 pounds.
3 I've lost between 11-25 pounds.
4 I've lost more than 25 pounds.

you circled #1, 2, 3 or 4: Have you been dieting and deliberately trying to lose weight? Y or N

If you circled #1, 2, 3 or 4: Have you been losing weight for more or less than 2 weeks? more less

---

0 My appetite is not greater than normal.
1 My appetite is slightly greater than usual.
2 My appetite is clearly greater than usual.
3 My appetite is much greater than usual.
4 I feel hungry all the time.

If you circled #1, 2, 3 or 4: Has your appetite been increased for more or less than 2 weeks? more less

---

0 I haven't gained any weight.
1 I've gained less than 5 pounds.
2 I've gained between 5-10 pounds.
3 I've gained between 11-25 pounds.
4 I've gained more than 25 pounds.

If you circled #1, 2, 3 or 4: Have you been gaining weight for more or less than 2 weeks? more less

---

17) 0 I am not sleeping less than normal.
1 I occasionally have slight difficulty sleeping.
2 I clearly don't sleep as well as usual.
3 I sleep about half my normal amount of time.
4 I sleep less than 2 hours per night.

If you circled #1, 2, 3 or 4: Which of these sleep problems have you experienced? (circle all which apply)
1 I have difficulty falling asleep.
2 My sleep is fitful and restless in the middle of the night.
3 I wake up earlier than usual and cannot fall back to sleep.

*** If you circled #1, 2, 3 or 4: Have you been having sleep problems for more or less than 2 weeks? more less

---

18) 0 I am not sleeping more than normal.
1 I occasionally sleep more than usual.
2 I frequently sleep at least 1 hour more than usual.
3 I frequently sleep at least 2 hours more than usual.
4 I frequently sleep at least 3 hours more than usual.

*** If you circled #1, 2, 3 or 4: Have you been sleeping extra for more or less than 2 weeks? more less

---

19) 0 I do not feel anxious, nervous or tense.
1 I occasionally feel a little anxious.
2 I often feel anxious.
3 I feel very anxious most of the time.
4 I feel terrified and near panic.

*** If you circled #1, 2, 3 or 4: Have you been feeling anxious, nervous or tense for more or less than 2 weeks? more less

---

20) 0 I do not feel discouraged about the future.
1 I occasionally feel a little discouraged about the future.
2 I often feel discouraged about the future.
3 I feel very discouraged about the future most of the time.
4 I feel that the future is hopeless and that things will never improve.

*** If you circled #1, 2, 3 or 4: Have you been feeling discouraged for more or less than 2 weeks? more less

---

21) 0 I do not feel irritated or annoyed.
1 I occasionally get a little more irritated than usual.
2 I get irritated or annoyed by things that usually don't bother me.
3 I feel irritated or annoyed almost all the time.
4 I feel so depressed that I don't get irritated at all by things that used to bother me.

*** If you circled #1, 2, 3 or 4: Have you been feeling more irritable than usual for more or less than 2 weeks? more less

---

22) 0 I am not worried about my physical health.
1 I am occasionally concerned about bodily aches and pains.
2 I am worried about my physical health.
3 I am very worried about my physical health.
4 I am so worried about my physical health that I cannot think about anything else.

*** If you circled #1, 2, 3 or 4: Have you been worried about your physical health for more or less than 2 weeks? more less

23) Circle the statement that best describes how your mood varies during the course of the day:

0 I clearly feel the most depressed in the morning.
1 I clearly feel the most depressed in the afternoon.
2 I clearly feel the most depressed in the evening.
3 I do not feel consistently more depressed during any particular part of the day.

24) Do you feel any better when something pleasant happens or someone tries to cheer you up?

0 Yes, I feel almost normal for a short time.
1 I feel a little better, but I still feel somewhat depressed.
2 No, I don't feel any better.

25) How does the feeling of depression or sadness compare with the depression you would feel after someone close to you died?
(If the 2 types of depression differ ONLY in severity circle #0)

0 There is no difference between the two types of depression.
1 There is a definite difference between the two.

BSI

SIDE 1

INSTRUCTIONS:

Below is a list of problems people sometimes have. Please read each one carefully, and circle the number to the right that best describes HOW MUCH THAT PROBLEM HAS DISTRESSED OR BOTHERED YOU DURING THE PAST 7 DAYS INCLUDING TODAY. Circle only one number for each problem and do not skip any items. If you change your mind, erase your first mark carefully. Read the example below before beginning, and if you have any questions please ask about them.

SEX

MALE ○

FEMALE ○

NAME: ______

LOCATION: ______

EDUCATION: ______

MARITAL STATUS: MAR ___ SEP ___ DIV ___ WID ___ SING ___

DATE		
MO	DAY	YEAR

ID. NUMBER

AGE

VISIT NUMBER: ______

EXAMPLE

HOW MUCH WERE YOU DISTRESSED BY:	NOT AT ALL	A LITTLE BIT	MODERATELY	QUITE A BIT	EXTREMELY
1. Bodyaches	0	1	2	(3)	4

HOW MUCH WERE YOU DISTRESSED BY:		NOT AT ALL	A LITTLE BIT	MODERATELY	QUITE A BIT	EXTREMELY
1. Nervousness or shakiness inside	1	0	1	2	3	4
2. Faintness or dizziness	2	0	1	2	3	4
3. The idea that someone else can control your thoughts	3	0	1	2	3	4
4. Feeling others are to blame for most of your troubles	4	0	1	2	3	4
5. Trouble remembering things	5	0	1	2	3	4
6. Feeling easily annoyed or irritated	6	0	1	2	3	4
7. Pains in heart or chest	7	0	1	2	3	4
8. Feeling afraid in open spaces	8	0	1	2	3	4
9. Thoughts of ending your life	9	0	1	2	3	4
10. Feeling that most people cannot be trusted	10	0	1	2	3	4
11. Poor appetite	11	0	1	2	3	4
12. Suddenly scared for no reason	12	0	1	2	3	4
13. Temper outbursts that you could not control	13	0	1	2	3	4
14. Feeling lonely even when you are with people	14	0	1	2	3	4
15. Feeling blocked in getting things done	15	0	1	2	3	4
16. Feeling lonely	16	0	1	2	3	4
17. Feeling blue	17	0	1	2	3	4
18. Feeling no interest in things	18	0	1	2	3	4
19. Feeling fearful	19	0	1	2	3	4
20. Your feelings being easily hurt	20	0	1	2	3	4
21. Feeling that people are unfriendly or dislike you	21	0	1	2	3	4
22. Feeling inferior to others	22	0	1	2	3	4
23. Nausea or upset stomach	23	0	1	2	3	4
24. Feeling that you are watched or talked about by others	24	0	1	2	3	4
25. Trouble falling asleep	25	0	1	2	3	4
26. Having to check and double check what you do	26	0	1	2	3	4
27. Difficulty making decisions	27	0	1	2	3	4
28. Feeling afraid to travel on buses, subways, or trains	28	0	1	2	3	4
29. Trouble getting your breath	29	0	1	2	3	4
30. Hot or cold spells	30	0	1	2	3	4
31. Having to avoid certain things, places, or activities because they frighten you	31	0	1	2	3	4
32. Your mind going blank	32	0	1	2	3	4
33. Numbness or tingling in parts of your body	33	0	1	2	3	4
34. The idea that you should be punished for your sins	34	0	1	2	3	4
35. Feeling hopeless about the future	35	0	1	2	3	4

Please continue on the following page

BSI

SIDE 2

HOW MUCH WERE YOU DISTRESSED BY:		NOT AT ALL	A LITTLE BIT	MODERATELY	QUITE A BIT	EXTREMELY
36. Trouble concentrating	36	0	1	2	3	4
37. Feeling weak in parts of your body	37	0	1	2	3	4
38. Feeling tense or keyed up	38	0	1	2	3	4
39. Thoughts of death or dying	39	0	1	2	3	4
40. Having urges to beat, injure, or harm someone	40	0	1	2	3	4
41. Having urges to break or smash things	41	0	1	2	3	4
42. Feeling very self-conscious with others	42	0	1	2	3	4
43. Feeling uneasy in crowds	43	0	1	2	3	4
44. Never feeling close to another person	44	0	1	2	3	4
45. Spells of terror or panic	45	0	1	2	3	4
46. Getting into frequent arguments	46	0	1	2	3	4
47. Feeling nervous when you are left alone	47	0	1	2	3	4
48. Others not giving you proper credit for your achievements	48	0	1	2	3	4
49. Feeling so restless you couldn't sit still	49	0	1	2	3	4
50. Feelings of worthlessness	50	0	1	2	3	4
51. Feeling that people will take advantage of you if you let them	51	0	1	2	3	4
52. Feelings of guilt	52	0	1	2	3	4
53. The idea that something is wrong with your mind	53	0	1	2	3	4

MILLER BEHAVIORAL STYLE SCALE

1. Vividly imagine that you are afraid of the dentist and have to get some dental work done. Which of the following would you do? Check all of the statements that might apply to you.

____ I would ask the dentist exactly what he was going to do.

____ I would take a tranquilizer or have a drink before going.

____ I would try to think about pleasant memories.

____ I would want the dentist to tell me when I would feel pain.

____ I would try to sleep.

____ I would watch all the dentist's movements and listen for the sound of his drill.

____ I would watch the flow of water from my mouth to see if it contained blood.

____ I would do mental puzzles in my mind.

2. Vividly imagine that you are being held hostage by a group of armed terrorists in a public building. Which of the following would you do? Check all of the statements that might apply to you.

____ I would sit by myself and have as many daydreams and fantasies as I could.

____ I would stay alert and try to keep myself from falling asleep.

____ I would exchange life stories with the other hostages.

____ If there was a radio present, I would stay near it and listen to the bulletins about what the police were doing.

____ I would watch every movement of my captors and keep an eye on their weapons.

____ I would try to sleep as much as possible.

____ I would think about how nice it's going to be when I get home.

____ I would talk to the passenger beside me about what might be wrong.

Race ____________ Age ________ Sex ________

ID# ____________

3. Vividly imagine that, due to a large drop in sales, it is rumored that several people in your department at work will be laid off. Your supervisor has turned in an evaluation of your work for the past year. The decision about lay-offs has been made and will be announced in several days. Check <u>all</u> of the statements that might apply to you.

____ I would talk to my fellow workers to see if they knew anything about what the supervisor's evaluation of me said.

____ I would review the list of duties for my present job and try to figure out if I had fulfilled them all.

____ I would go to the movies to take my mind off of things.

____ I would try to remember any arguments or disagreements I might have had with the supervisor that would have lowered his opinion of me.

____ I would push all thoughts of being laid off out of my mind.

____ I would tell my spouse that I'd rather not discuss my chances of being laid off.

____ I would try to think which employees in my department the supervisor might have thought had done the worst job.

____ I would continue doing my work as if nothing special was happening.

4. Vividly imagine that you are on an airplane, thirty minutes from your destination, when the plan unexpectedly goes into a deep dive and then suddenly levels off. After a short time, the pilot announces that nothing is wrong, although the rest of the ride may be rough. You, however, are not convinced that all is well. Check <u>all</u> of the statements that might apply to you.

____ I would carefully read the information provided about safety features in the plane and make sure I knew where the emergency exits were.

____ I would make small talk with the passenger beside me.

____ I would watch the end of the movie, even if I had seen it before.

____ I would call for the stewardess and ask her exactly what the problem was.

____ I would order a drink or tranquilizer from the stewardess.

____ I would listen carefully to the engines for unusual noises and would watch the crew to see if their behavior was out of the ordinary.

____ I would talk to the passenger beside me about what might be wrong.

____ I would settle down and read a book or magazine or write a letter.

PERCEIVED IMPACT QUESTIONNAIRE (STATE FORM 7/87)

It is not unusual to perceive or have emotions regarding participation in activites in such as this experiment. According to the strength of your feelings right now about this experiment, mark the scales below to reflect the INTESNITY of your emotions. If a word or phrase below does describe how you are feeling at this moment you would place a mark somewhere along the appropriate line: THE STRONGER YOUR FEELING, THE FATHER THE MARK WOULD BE TO THE RIGHT. If the word or phrase does not apply to you at this moment then you would put a mark on the far left of the line to indicate no feeling of that type of ZERO INTENSITY. In turn, if you feel the emotion is perticularly strong or intense your mark woudl be placed closer to the right side of the scale. We only ask that you mark the line so that your marks represent the STRENGTH or the INTENSITY of the emotions you are feeling at this moment about the experiment. There are no right or wrong answers.

The scale below is an example of how someone might feel and respond on this type of questionnaire:

EXAMPLE:

(NONE OR 0%) (EXTREME OR 100%)

A. Do you feel SECURE:

(A) (B) (C)

Not Secure ____ Extremely Secure

The first mark (A) would be for someone who is feeling quite insecure. The second mark, (B) in the middle of the line, would be for the same person or another person feeling more secure but still somewhat insecure. The last mark (C) over to the far right would be for showing almost complete security concerning the present situation.

PLEASE DO NOT HESITATE TO ASK ANY QUESTIONS AT THIS TIME. ALSO FEEL FREE TO ASK QUESTIOSN THAT MIGHT COME UP AS YOU COMLETE THE ITEMS ON THE FOLLOWING PAGES.

Remember, we want you to use the scales that follow to mark the INTENSITY of your feelings or emotions at this time as they relate specifically to the experiment that you are participating in.

Perceived Impact Questionnaire (VAS-7/87)
Visual analogue scales: for PIQ-STAT

NONE (0%)		THE STRONGEST IMAGINABLE (100%)

1. How "DEPRESSED" are you feeling right now?

No Depression ______________________________ Extreme Depression

2. How "ANXIOUS" are you feeling right now?

No Anxiety ______________________________ Extreme Anxiety

3. How "FRUSTRATED" are you feeling right now?

No Frustration ______________________________ Extreme Frustration

4. How "ANGRY" are you feeling right now?

No Anger ______________________________ Extreme Anger

5. How "FEARFUL" are you feeling right now?

No Fear ______________________________ Extreme Fear

6. How "EXCITED" are you feeling right now?

No Excitement ______________________________ Extreme Excitement

7. How "AROUSED" are you feeling right now?

No Arousal ______________________________ Extreme Arousal

8. How "ASTONISHED" are you feeling right now?

No Astonishment ______________________________ Extreme Astonishment

NONE (0%) | THE STRONGEST IMAGINABLE (100%)

9. How "HAPPY" are you feeling right now?

No Happiness — Extreme Happiness

10. How "TIRED" are you feeling right now?

No Ti — reme Tiredness

11. How "BORED" are you feeling right now?

No Boredom — Extreme Boredom

12. How "CALM" are you feeling right now?

Not C — treme Calm

13. How "DROWSY" are you feeling right now?

Not Drowsy — Extreme Drowsy

14. How "DISTRESSED" are you feeling right now?

No Distress — Extreme Distress

15. How "AT EASE" are you feeling right now?

Not "At Ease" — Extreme "At Ease"

16. How "TENSE" are you feeling -ight now?

Not Tense — Extreme Tense

NONE

(0%)

THE STRONGEST IMAGINABLE (100%)

17. How "RELAXED" are you feeling right now?

Not Relaxed ______________________________ Extremely Relaxed

18. How "ANNOYED" are you feeling right now?

Not Annoyed ______________________________ Extremely Annoyed

END (VAS-STAT 7/87: ling to instructioen PIQ-STAT 7/87

WOC (R)

Below is a list of ways people cope with a wide variety of stressful events. Please indicate by circling the appropriate number the strategies you are using in dealing with__ ________________________________.

	Does not apply	Not used	Used somewhat	Used quite a bit	Used a great deal
1. Just concentrate on what I have to do next -- the next step.	NA	0	1	2	3
2. I try to analyze the problem in order to understand it better.	NA	0	1	2	3
3. Turn to work or substitute activity to take my mind off things.	NA	0	1	2	3
4. I feel that time will make a difference -- the only thing to do is to wait.	NA	0	1	2	3
5. Bargin or compromize to get something positive from the situation.	NA	0	1	2	3
6. I'm doing something which I don't think will work, but at least I'm doing something.	NA	0	1	2	3
7. Try to get the person responsible to change his or her mind.	NA	0	1	2	3
8. Talk to someone to find out more about the situation.	NA	0	1	2	3
9. Criticize or lecture myself.	NA	0	1	2	3
10. Try not to burn my bridges but leave things open somewhat.	NA	0	1	2	3
11. Hope a miracle will happen.	NA	0	1	2	3
12. Go along with fate; sometimes I just have bad luck.	NA	0	1	2	3
13. Go on as if nothing is happening.	NA	0	1	2	3
14. I try to keep my feeling to myself.	NA	0	1	2	3
15. Look for the silver lining, so to speak; try to look on the bright side of things.	NA	0	1	2	3

		Does not apply	Not used	Used somewhat	Used quite a bit	Used a great deal
16.	Sleep more than usual.	NA	0	1	2	3
17.	I express anger to the person(s) who caused the problems.	NA	0	1	2	3
18.	Accept sympathy and understanding from someone.	NA	0	1	2	3
19.	I tell myself things that help me feel better.	NA	0	1	2	3
20.	I am inspired to do something creative.	NA	0	1	2	3
21.	Try to forget the whole thing.	NA	0	1	2	3
22.	I'm getting professional help.	NA	0	1	2	3
23.	I'm changing or growing as a person in a good way.	NA	0	1	2	3
24.	I'm waiting to see what will happen before doing anything.	NA	0	1	2	3
25.	Apologize or do something to make up.	NA	0	1	2	3
26.	I'm making a plan of action and following it.	NA	0	1	2	3
27.	I accept the next best thing to what I want.	NA	0	1	2	3
28.	I let my feelings out somehow.	NA	0	1	2	3
29.	Realize I brought the problem on myself.	NA	0	1	2	3
30.	I'll come out of the experience better than when I went in.	NA	0	1	2	3
31.	Talk to someone who can do something concrete about the problem.	NA	0	1	2	[illegible]
32.	Get away from it for a while; try to rest or take a vacation.	NA	0	1	2	3
33.	Try to make myself feel better by eating, drinking, smoking, using drugs or medication, etc.	NA	0	1	2	[illegible]

	Does not apply	Not used	Used somewhat	Used quite abit	Used a great deal
34. Take a big chance or do something risky.	NA	0	1	2	3
35. I try not to act too hastily or follow my first hunch.	NA	0	1	2	3
36. Find new faith.	NA	0	1	2	3
37. Maintain my pride and keep a stiff upper lip.	NA	0	1	2	3
38. Rediscover what is important in life.	NA	0	1	2	3
39. Change something so things will turn out all right.	NA	0	1	2	3
40. Avoid being with people in general.	NA	0	1	2	3
41. Don't let it get to me; refuse to think too much about it.	NA	0	1	2	3
42. Ask a relative or friend I respect for advice.	NA	0	1	2	3
43. Keep others from knowing how bad things are.	NA	0	1	2	3
44. Make light of the situation; refuse to get too serious about it.	NA	0	1	2	3
45. Talk to someone about how I am feeling.	NA	0	1	2	3
46. Stand my ground and fight for what I want.	NA	0	1	2	3
47. Take it out on other people.	NA	0	1	2	3
48. Draw on my past experience; I was in a similar situation before.	NA	0	1	2	3
49. I know what has to be done, so I am doubling my efforts to make things work.	NA	0	1	2	3
50. Refuse to believe it will happen.	NA	0	1	2	3
51. Make a promise to myself that things will be different next time.	NA	0	1	2	3
52. Come up with a couple of different solutions to the problem.	NA	0	1	2	3

	Does not apply	Not used	Used somewhat	Used quite a bit	Used a great deal
53. Accept it, since nothing can be done.	NA	0	1	2	3
54. I try to keep my feelings from interfering with other things too much.	NA	0	1	2	3
55. Wish that I can change what is happening or how I feel.	NA	0	1	2	3
56. Change something about myself.	NA	0	1	2	3
57. I daydream or imagine a better time or place than the one I am in.	NA	0	1	2	3
58. Wish that the situation would go away or somehow be over with.	NA	0	1	2	3
59. Have fantasies or wishes about how things might turn out.	NA	0	1	2	3
60. I pray.	NA	0	1	2	3
61. I prepare myself for the worst.	NA	0	1	2	3
62. I go over in my mind what I will say or do.	NA	0	1	2	3
63. I think about how a person I admire would handle this situation and use that as a model.	NA	0	1	2	3
64. I try to see things from the other person's point of view.	NA	0	1	2	3
65. I remind myself how much worse things could be.	NA	0	1	2	3
66. I jog or exercise.	NA	0	1	2	3

67. I try something entirely different from any of the above. (Please describe)

____

____

____

APPENDIX C

Visual Analogue Scales

VISUAL ANALOGUE SCALES
FOR COLD WATER FOOT
B A T H

INTENSITY OF SENSATION

No Sensation — The Most Intense Sensation Imaginable

UNPLEASANTNESS

ot At All
npleasant — The Most Unpleasant Feeling Imaginable

Name: ______________________
Date: ______________________
List: ______________________

SENSATION INTENSITY

No sensation — the most intense feeling imaginable

14 ____

13 ____

12 ____

11 ____

10 ____

9 ____

8 ____

7 ____

6 ____

5 ____

4 ____

3 ____

2 ____

1 ____

Name: ______________________
Date: ______________________
List: ______________________

UNPLEASANTNESS

Not at all unpleasant	the most unpleasant feeling imaginable

14 ____

13 ____

12 ____

11 ____

10 ____

9 ____

8 ____

7 ____

6 ____

5 ____

4 ____

3 ____

2 ____

1 ____

APPENDIX D

Script for Explaining VASs

Script For Explaining Use Of The Visual Analogue Scales

Before beginning the tasks we would like to explain our use of the Visual Analogue Scales. Our scales consist simply of two horizontal lines which are labeled at each end with a descriptive phrase. For example say on the extreme left might say, "I feel no sensation," or "I feel the most intense sensation I can imagine" to a specific stimulus.

We will use scales which assess the intensity of the sensation you will experience and which also assess any unpleasantness you might experience during this experiment. We want you to realize that the experiment is not concerned with suffering. While some of the conditions may be unpleasant to you and you are free to discontinue at any time, we are interested in how you rate the different conditions in terms of sensory intensity and in terms of relative unpleasantness.

The sensory intensity scale is described on the left by the phrases "no sensation" and on the right by the phrase "the most intense sensation imaginable." The phrase "no sensation" means you do not feel anything at all in *your foot*. The phrase "the most intense sensation imaginable" means you cannot imagine it feeling more intense than it does at that moment.

The pain unpleasantness scale is labeled on the left by the phrase "not at all unpleasant" and on the right by the phrase "the most unpleasant feeling imaginable." The phrase "not at all unpleasant" means there is nothing at all you dislike about this feeling. It has no negative aspects. It is not at all unpleasant. The phrase "the most unpleasant feeling imaginable" means the unpleasantness is the greatest it could possibly be at that moment.

During the tasks you will be asked to mark each line to indicate the intensity and unpleasantness of the sensation. We ask that you please make your mark as straight as possible through the horizontal line. It is very important to realize that the distance of your mark from the left most extent of the line indicates the "strength" of your response. That is, the distance of your mark along the line indicates the intensity or amount of unpleasantness you felt or are feeling.

Also we want you to scale your experience such that you mark sensations "relative" to each other. If one sensation is half as intense or half as unpleasant as another we want you to place your mark half as far along the line for the weaker as compared to the stronger.

It is also important that you understand the difference between what we mean by intensity versus the unpleasantness of the stimuli you will be feeling. We would explain what we mean by the terms "intensity" and "unpleasantness" by using the analogy of a radio playing music.

When you listen to a radio playing, its volume is much like the intensity of the heat or cold sensations you will be feeling. If the music is played loudly, we would say it is very "intense." If it is being played softly, we would say it is less "intense." You might think of the loudness of the music as being the strength of the music. The stronger the sound, the louder the music. Since loudness can be thought of as intensity, we could also say that the stronger the sound, the more intense it is. Your bodily sensations can be thought of in the same way as the music. The stronger your sensations, the more intense they are. You can, therefore, make judgments concerning the "intensity" of your sensations for the heat or cold pain stimuli.

Returning to our radio analogy, let's suppose the music being played on the radio was music you really disliked. You found it unpleasant. There was nothing you liked about this music. You begin to turn the radio down to change the intensity of the sound. However, within reason making the music less or more intense has no effect on your like of the music and thus your rating of unpleasantness. This is an example where unpleasantness ratings stay the same even though the intensity ratings change with the change in sensory intensity of the physical stimulus.

Again, say a song that is played on the radio is one that you find unpleasant. You begin to turn the radio down to make the music less strong. You find that if you can hear this song even a little bit you find it very unpleasant. In this example, your intensity rating would be very low, but your unpleasantness rating would be very high!

Using this analogy it can be seen that music can have two dimensions, an intensity and an unpleasantness dimension and that these two dimensions can be measured separately.

It turns out that sensations can be described using these two separate dimensions. We can use the scales you just looked at to measure these dimensions along a continuum ranging from "no sensation" to " the most intense sensation imaginable" and from "not at all unpleasant" to "the most unpleasant feeling imaginable".

Your own personal sensations may fall anywhere along this continuum and may vary from measurement to measurement. All that really matters is that you try to use the scales in a consistent manner. By that we mean that if you experience one sensation as twice as intense as an earlier sensation, then you would make your mark twice as far away from the left end of the scale as your first mark.

The reason we expose you to the thermal stimuli first is so you can form a mental representation of each stimulus and will be better able to compare them. Look at this example we have previously marked as a guide.

At intervals during each of the tasks we will ask you to rate the intensity and/or unpleasantness of your sensation at that moment. Please rate this sensation by making a vertical mark through the line of each scale. Remember, each scale is a continuum and you will place your mark along that continuum to indicate the levels of intensity and unpleasantness.

If you have any questions about using these scales, please ask the investigator before we begin.

APPENDIX E

Publication Version

Perceptual and Cognitive Abnormality Model of Hypochondriasis: Psychophysiological Correlates of Amplification and Misinterpretation

James R. Craft and Sandra E. Gramling
Virginia Commonwealth University

This project was completed as a Masters' Thesis requirement by the first author under the supervision of the second author. Reprint requests should be addressed to Sandra E. Gramling, Ph.D., Department of Psychology, Virginia Commonwealth University, Box 2018, Richmond, Virginia 23284-2018

Running head: PSYCHOPHYSIOLOGICAL CORRELATES OF AMPLIFICATION

Abstract

Hypochondriasis is a disorder that may affect ten percent of all individuals seeking medical care. This places a great burden on the health care resources that are currently available. Unfortunately, very few of these individuals come to the attention of mental health professionals.

Various models have attempted to conceptualize hypochondriasis. These include the psychiatric model, the psychodynamic model, the social learning and the perceptual or cognitive abnormality model.

The perceptual or cognitive abnormality model suggests that individuals who are hypochondriacal misinterpret and/or amplify normal bodily sensations. These processes lead the individuals to believe they are suffering from a serious disease. Few empirical studies have been conducted to confirm this model, and no research has been conducted testing this model using psychophysiological measures to test whether or not these indices are indeed different for non-hypochondriacal persons.

Pain is a symptom often reported by hypochondriacs and this is what usually brings them into contact with the health care system. Being able to measure how hypochondriacs react to the experience of pain would give insight into whether or not they react more strongly to pain than do non-hypochondriacal persons. Although the objective measurement of pain has been considered difficult in the past, recent work by

researchers using visual analogue scales have shown them to be valid and reliable instruments for measuring both the sensory and affective dimensions of the pain experience.

The present study tested the perceptual and cognitive abnormality model of hypochondriasis using painful physical stimuli (heat stimulation and a cold pressor task) to measure subjects' pain tolerance and to rate their experience of pain. Subjects rated their pain experience on both sensory (intensity) and affective (unpleasantness) dimensions using visual analogue scales. The model was also tested using a psychological stressor, a visualization task which incorporated everyday life events. The psychophysiological measure heart rate was continuously recorded to assess subjects' physiological activity to stress. It was hypothesized that hypochondriacal individuals would withdraw their feet from the cold water bath, before being instructed to, at a significantly higher rate than the control group. It was also hypothesized that visual analogue scale ratings of intensity and unpleasantness would be significantly higher for the hypochondriacal group than for the control group for both cold pressor and thermal radiant heat. Further, it was hypothesized that the hypochondriacal group would exhibit increased heart rate, as well as a longer return to baseline time compared to the control group.

In general, the data offered little support for the hypotheses used to test the amplification/misinterpretation components of the perceptual and cognitive abnormality model. Methodological problems with the study were discussed and improvements suggested. Also, problems and advantages of the present model were noted.

Introduction

Hypochondriasis has a substantial impact on the general practice of medicine. The most conservative estimates place the number at 10% of the medical population (Ford, 1986). It has also been estimated that the "worried well" account for 50% of the cost of adult ambulatory medical care (Barsky & Klerman, 1983).

One conceptualization of hypochondriasis suggests that these individuals may suffer from a perceptual or cognitive abnormality. Barsky & Klerman (1983) describe several ways this abnormality may be expressed. Hypochondriacal individuals may amplify normal bodily sensation (i.e. experience stimuli as more noxious or intense than non-hypochondriacal persons) and/or misinterpret the bodily sensations which accompany emotional arousal (e.g. anxiety) or normal bodily functioning (e.g. indigestion; Barsky and Klerman, 1983).

In this conceptualization, the perceptual or cognitive defect is considered the primary source of the problem. Hypochondriacal individuals who amplify and/or misinterpret bodily symptoms have a more difficult time normalizing these sensations because to them these sensations are more intense and/or have different meaning than those of non-hypochondriacal individuals.

The amplification hypothesis suggests that the hypochondriac experiences normal bodily sensations as more intense and more noxious than non-hypochondriacal persons. This view suggests that hypochondriacal persons express more physical symptoms than others because they have lower thresholds and tolerance for physical discomfort.

A second aspect of the perceptual/cognitive deficit conceptualization of hypochondriasis is that hypochondriacal individuals misinterpret normal bodily sensations (Barsky & Klerman, 1983). They take a normal, trivial, or transient symptom and misattribute it to serious disease. Once the individual has interpreted the sensations as pathological symptoms, this interpretation tends to be used again and again leading to perpetuation and self-validation of the pathological nature of the symptoms (Barsky & Klerman, 1983).

The perceptual/cognitive model of hypochondriasis suggests that hypochondriacal behavior may be primarily due to a perceptual defect and that the illness behavior associated with hypochondriasis is an inevitable sequelae of this primary perceptual defect. The specific processes which have been suggested for this perceptual defect are amplification of bodily sensations (Feuerstein, Labbe, & Kuczmierczyk, 1986; Barsky & Klerman, 1983) and misinterpretation (Barsky & Klerman, 1983). The goal of this investigation was to provide additional information on the processes of amplification and misinterpretation, by measuring pain thresholds and physiological reactivity in subjects scoring high on a paper and pencil measure of hypochondriasis.

In terms of physiological reactivity it was hypothesized that hypochondriacal persons would be more reactive to physical and psychological stressors. Heart rate should be higher in the hypochondriacal group. There should also be a longer recovery time (return to baseline levels) indicating an increased time for the system to reestablish equilibrium.

An individual who amplified sensations presumably experienced those sensations as more noxious and intense than those who did not amplify (Barsky & Klerman, 1983; Hanback & Revelle, 1986). Visual Analogue Scale (VAS) ratings of the sensory-intensive (intensity) dimension and affective-motivational (unpleasantness) dimension of pain were used to assess this hypothesis. Individuals who amplified sensations should presumably rated the intensity of the stimuli to be greater than those who do not amplify.

The misinterpretation hypothesis of hypochondriasis was evaluated by measuring the subject's psychophysiological reactivity to stress. Reactivity has been shown to be a reflection of a cognitive appraisal process, as well as an interpretive process (Williams, 1986). Presumably, there would have been autonomic changes produced in the body due to these cognitive processes, which could be measured using psychophysiological recording methods. The reactivity measured in this study was elicited using physical (heat and cold) and psychological stimuli. The subjects also used VASs to rate the intensity (sensory-intensive) and unpleasantness (affective-motivational) components of the sensations. Other studies have indicated that VAS affective-motivational ratings are more related to interpretive processes than are the sensory-intensive dimensions of VAS ratings (Price, Barrell, &

Gracely, 1980).

Data indicating heightened physiological reactivity and/or lowered sensory threshold in persons who score high on hypochondriacal scales would support a cognitive/perceptual abnormality model of hypochondriasis. Using VAS data, it may be possible to get a clearer picture of the differences between amplification and misinterpretation. The VAS allows for the separation of the subjects' sensory and affective dimensions in their response to pain. Using a VAS it is also possible to quantify these dimensions, allowing for comparisons within and across subjects with different painful stimuli and responses (Price, Harkins, & Baker, 1987; Price & Harkins, 1987; Price, 1988). Elevation of both VAS dimensions relative to controls would suggest a response bias that may be mediated by the putative perceptual and cognitive abnormality in hypochondriasis.

The independent measurement of the two pain dimensions, sensory-intensive and affective motivational, may be useful in drawing conclusions regarding the importance of amplification or misinterpretation as a process in hypochondriasis. The sensory-intensive dimension of the pain report should be more affected than the affective-motivational dimension if an amplification process is occurring. However, if a misinterpretational process is occurring, then the affective-motivational should be the more affected dimension. Elevation of both VAS dimensions relative to controls would support the perceptual and cognitive abnormality hypothesis, but it would not provide differential support for the amplification versus misinterpretation hypothesis.

There have been no empirical studies published in the literature testing pain thresholds and assessing physiological reactivity to test the amplification and misinterpretation processes which may be occurring in hypochondriasis. One study (Hanback & Revelle, 1978) has used a student population and found lower sensory thresholds among students scoring high relative to low on a hypochondriacal scale. The present study attempted to test the amplification/misinterpretation hypothesis with the more sophisticated procedures outlined above with an analogue population similar to Hanback and Reveille's. If differences were found in this population, then this would make a stronger case for the perceptual abnormality conceptualization of hypochondriasis. It would also provide strong preliminary data for an investigation with clinically diagnosed hypochondriacal individuals.

Methods

Subjects

Volunteer subjects were recruited from undergraduate psychology courses and received class credit for participating. Potential subjects (N = 300) were screened with a paper and pencil measure of hypochondriasis (i.e. MMPI hypochondriasis scale without K correction). One group of eighteen subjects was selected from those subjects scoring high on this measure, relative to the subject pool (1.5 SD above the mean). Another group of eighteen students was selected from those subjects scoring in the normal range (+/- .5 SD from the mean). This second group served as the control group. Other criteria for selection included gender (female) and ethnicity (white). All subjects were fully informed about the procedure and gave their written consent before participating in the study. Subjects who were currently receiving treatment for a medical or psychiatric problem were excluded from the testing.

Environment

With the exception of pre-experiment screening to determine a score on the hypochondriasis measure, all parts of the procedure were conducted in the psychophysiological laboratory of the Department of Gerontology located on the medical campus of Virginia Commonwealth University. The stress tasks were administered in a specially constructed isolation chamber. Other aspects of the experiment including electrode preparation and placement were performed in an adjacent lab and office space.

Equipment

A heat stimulator was used to assess pain threshold levels in one of the tasks. This stimulator was built by the VCU Department of Biomedical Engineering. The stimulator had a hand-held contact thermode with a surface area of 1 centimeter and delivered heat stimuli at six pre-set levels (43, 45, 47, 48, 49, & 51 degrees Celsius). The pulses could be delivered in any order, and were under push-button control.

The stimuli were programmed to be presented for five seconds and to rise to the predetermined temperature from a baseline of 35 degrees Celsius. The thermode itself had an active heating element with an approximate rise time of 17 degrees/second.

The cold pressor tank consisted of a styrofoam tank approximately 35 cm x 35 cm x 38 cm. The tank was divided in the center by a wire mesh screen which allowed for crushed ice in one compartment and ice-free water in the other (Spanos, Ollerhead, & Gwynn, 1986). A thermometer attached to the tank allowed for continuous monitoring of water temperature which was maintained at 4 degrees Celsius. An 8 channel Grass Instruments Model 8 polygraph was used to record the physiological measures.

Dependent Measures

Heart Rate Heart rate was recorded using a Grass 7p-6 preamplifier and a 7p44 cardiotachometer. Electrodes (Ag/AgCl) were utilized in a Lead III configuration. Heart rate was recorded as beats per minute. There were 3 three minute periods analyzed (the YELP stressor however was only two minutes in length). The first period ended the fourteen minute baseline period. The second followed the onset of each stressor. The final period consisted of the first three minutes of each recovery phase. These periods were broken into one minute intervals and mean heart rates were obtained for these intervals.

Visual Analogue Scales During both the cold pressor and heat stimulator tasks, VASs were used to assess the subject's response to the experimental pain. The construction and validation of these scales has been detailed previously (see Price and Harkins, 1987). During the experimental procedures subjects were asked to make a mark on the line indicating the intensity and unpleasantness of the sensation, respectively. The distance of the subject's mark from the left hand edge of the line was measured to the nearest millimeter. In the heat stimulator task, subjects were exposed to a broad range of heat pulses (35 degrees Celsius to 51 degrees Celsius) and asked to rate both the intensity and unpleasantness of the pain.

Procedures

Phase I

Subjects were pre-screened and selected on the basis of their scores on a paper and pencil measure of hypochondriasis. The experimenter was blind to the subjects' scores on the screening instrument. Individuals were told not to smoke or ingest caffeine for eight hours prior to their participation in the study. Subjects were randomly placed into one of six experimental conditions (see Table 1).

Insert Table 1 about here

Phase II

Selected subjects first filled out a consent form. Subjects were assured that they were free to withdraw at any time during the experiment without penalty. Once informed consent was given, several pre-test paper and pencil measures were administered including a medical questionnaire requesting information about physical or mental conditions which might prevent them from participating in the study. Information was also requested about menses, prescription and non-prescription medication, and whether or not the subject had smoked or ingested caffeine in the past eight hours.

If the subjects had no physical or mental conditions and had not smoked or consumed caffeine in eight hours several other self-report questionnaires were administered. Subjects who did not meet these criteria were excluded from the study.

The expression of pain can be influenced or altered by several factors other than the painful stimuli itself. These include anxiety (Pennebaker, 1982), neuroticism (Costa & McCrae, 1985), and contextual/environmental factors (Beecher, 1956). Because of this, these factors were assessed for all subjects. The specific instruments included the State-Trait Anxiety Inventory (Spielberger, Gorush, & Lushene, 1970), the Eysenck Personality Inventory (Eysenck & Eysenck, 1964), the Inventory to Diagnose Depression (Zimmerman & Coryell, 1987), the Brief Symptom Index, Miller Behavioral Style Scale (Miller, 1987), and the Perceived Impact Questionnaire. The Perceived Impact Questionnaire developed by Dr. Steve Harkins measures 18 different mood states using VASs.

Phase III

After completion of the paper and pencil measures, the subjects were taken to a private section of the laboratory where the electrodes were placed on the subjects by a female assistant. The subjects then listened to tape recorded instructions which had been taken from the literature (Harkins, Price, & Martelli, 1986) concerning the use of VASs to record the intensity and unpleasantness of the painful stimuli. Tape recorded instructions were used because physiological and self-report responses to stressors can be altered depending on the instructions given to the subject (e.g., Seligman, 1975). With the completion of these instructions, a 14 minute adaptation period ensued wherein physiological functioning was recorded while the subjects sat alone in the isolation chamber. Subjects were instructed to simply relax and get used to the chamber. The last three minutes of this adaptational period was used to calculate baseline heart rate. After baseline measurements were taken the subjects were exposed to one of three coping tasks. These tasks were counterbalanced in their presentation to prevent bias from order effects. The tasks were the cold pressor task, the thermal stimulator task, and the visualization stressor task.

Cold Pressor Task The cold pressor task consisted of having the subjects submerge their non-dominant foot, up to the ankle, into a cold water bath which was maintained at 4 degrees Celsius. Subjects were told to leave their foot in the cold water bath until they were instructed to take it out or until they "absolutely couldn't stand it any longer." The subjects were informed that at certain time intervals (every 15 seconds for 3 minutes) they would be asked to rate first the intensity and then the unpleasantness of the sensation they were experiencing using the VASs. The subjects were not aware of the interval length nor the total time length of the stressor. The subjects were instructed when to make their ratings by the experimenter. This continued for 3 minutes or until voluntary termination by the subject.

Heat Stimulator Tasks This task consisted of applying different heat pulses to a subject's non-dominant ventral forearm using a hand-held contact thermode. It was explained that the subject would be asked to rate the intensity and unpleasantness of the sensations they were experiencing using VASs. The subjects were first exposed to all heat stimuli in ascending order (43, 45, 47, 48, 49, & 51 degrees Celsius). After this initial exposure the subjects were then administered a series of discrete heat pulses according to one of two counterbalanced schedules. Subjects were exposed to two identical series of heat pulses. During the first exposure, the subjects were instructed to record a rating of the intensity of the sensation they experienced. During the second exposure, the subjects were instructed to record a rating of the unpleasantness of the sensation they experienced. This continued until completion of the schedule or voluntary termination by the subject.

Visualization Stressor Task This task involved having the subjects visualize a stressful event. The event was one selected from a group called Your Everyday Life Pressures (YELP) (Rosenthal et al., 1989). In this procedure, the subjects were read a card which contained a script describing a stressful event. The subjects were asked to close their eyes and visualize what it would be like to be in that situation, making their experiences as vivid as possible. At the end of two minutes the subjects were asked to open their eyes and the final five minute recovery period began. Heart rate only was recorded during this task.

Phase IV

At the end of the final recovery period, the experimenter returned to the chamber and the subjects were briefed concerning the nature of the experiment. After the briefing, the electrodes were removed and the subjects were escorted from the chamber to fill out two final questionnaires. At this point, the subject completed a post-test Perceived Impact Questionnaire to assess their mood after the testing procedures and the 63 item Ways of Coping questionnaire (Folkman and Lazarus, 1985). This ended the subjects' participation in the experiment.

Results

SUBJECT VARIABLES

A. Hypochondriasis scores - The original criteria for selection into the groups were based on scores on the MMPI hypochondriasis scale (scale 3) for the original screening population (N = 155). Scores falling 1.5 standard deviations or more above the mean for the high group and ± .5 standard deviations around the mean for the normal (low) group were used for selection. The mean for the screening questionnaire

(N=155) was 9.27, with a SD = 5.28. This resulted in original criterion scores of 18 or above for the high group and 7 - 12 for the low group. Later in the experiment the criteria were expanded to 1 standard deviation above the mean for inclusion in the high group, and 1 standard deviation below the mean for the low group in order to facilitate subject recruitment. This resulted in a range of scores for the high group (n=18) being 14 - 28 (mean = 17.22, SD = 3.75), while the range for the low group (n=18) was 4 - 8 (mean = 6.28, SD = 1.64).

B. Mood and Personality variables - To insure that the groups did not differ on other variables which might affect the outcome of the dependent measures, separate analyses were performed on reported state variables of mood and personality. A MANOVA was performed using the 18 state items from the Perceived Impact Questionnaire, the global symptom index score from the Brief Symptom Inventory and the state score of the State-Trait Anxiety Inventory. There were no significant differences between the groups ($F(1,34) = 1.32$ $p > .29$). This indicated that the two groups did not vary in terms of their mood states.

Another MANOVA was run on personality variables which may have altered the subject's report of pain sensitivity. These variables were the neuroticism and extroversion scores from the Eysenck Personality Inventory, the total score from the Inventory to Diagnose Depression, trait score from the State-Trait Anxiety Inventory, and the score of the difference of the monitor and blunter scores on the Miller's Behavioral Style Scale. There was no significant difference between the groups. This shows that overall there were no trait personality differences between the two groups. However, the univariate F-tests revealed several significant variables known to be associated with hypochondriasis. The first was the neuroticism score ($F(1,34) = 6.85$ $p < .013$) and the second was the depression score ($F(1,34) = 5.42$ $p < .026$). See table 2 for the means and standard deviations for each variable in this and all other analyses reported in this study.

Insert Table 2 about here

Order Effects - The stressors were presented in 6 different counterbalanced orders. This was done in an attempt to counteract any effects which might arise due to stressor presentation order. SPF-ANOVAs were performed for heart rate data for each of the 3 stressors, as well as report of sensory intensity and unpleasantness for both the cold pressor and heat stimulator tasks.

The main effect for order was not significant in any of these analyses. For the heart rate data the results were: (1) cold pressor $F(5,19) = 1.59$ $p > .2$ (2) heat stimulator $F(5,30) = .82$ $p > .5$ (3) YELP $F(5,30) = 1.37$ $p > .25$. The VAS heat data yielded an $F(5,30) = 1.08$ $p > .39$, while VAS response to the cold pressor task were similarly unaffected by order of stimulus presentation, $F(5,17) = 1.17$ $p > .36$. These results showed that regardless of which order the stressors were presented there were no significant differences in either heart rate or VAS ratings of heat or cold pain.

Heart Rate - As a way to test the amplification hypothesis regarding hypochondriasis, it was predicted that those individuals with higher hypochondriacal scores would be more physiologically active than those individuals with lower scores. Greater physiological reactivity should be reflected in increased heart rate as well as longer times to return to baseline level for the hypochondriacal group after the application of each stressor. A preliminary SPF-ANOVA revealed no significant differences between the two groups, (F (1,33) = 1.47 p >.23), on baseline heart rate (see table 3). This suggested that hypochondriacal

----

Insert Table 3 about here

----

individuals were not more physiologically active before the introduction of a stressor. Because of the absence of baseline differences between groups, subsequent analyses were performed on raw scores rather than difference scores.

For the heat stimulator task, a repeated measures ANOVA with one grouping factor (high or low hypochondriasis scores) and two within subject factors was performed. The within subject variables consisted of three levels of condition (baseline, stressor, and recovery) and three levels of time (three one minute intervals within each condition). The main effect for condition approached, but did not reach significance, F (2,64) = 2.91, p = .062 indicating that heart rate tended to vary as a function of condition (i.e. baseline, stressor, recovery). The SPF-ANOVA for the heat stimulator revealed a significant main effect for time. As can be seen in figure 1, heart rate tended to decrease during the stressor phase relative to baseline and recovery phases. The significance level was $F(2,64) = 11.9$, $p < .001$. There was no group effect indicating that overall, the highs and lows did not exhibit differences in heart rate on this task. No other significant effects were demonstrated on the heart rate data.

The analysis of the heart rate data in the cold pressor task included only those individuals who completed the task, in order to control for the length of exposure to the stressor. A repeated measures ANOVA with one grouping factor (high or low hypochondriasis scores) and two within subject factors was performed. The within subject factors included three levels of condition which reflected baseline, stressor, and recovery as well as three levels of time (three one minute intervals within each condition). Several significant results were obtained, though again, no main effect for group was obtained. The main effect for condition ($F(2,44) = 15.21$, $p < .001$) was significant, indicating that heart rate differed as a function of baseline - stress - recovery conditions. Figure 2 illustrates that this main effect is likely due to the increase in heart rate observed in the stress condition relative to the other two conditions. The second main effect was for time. Here there were differences in heart rate depending on the level of time (1 minute, 2 minutes, or 3 minutes) with an $F(2,44) = 9.62$, $p < .001$. This effect is probably accounted for by the relatively higher heart rates observed during the first minute each level of condition.

There were also several two-way interaction effects which proved to be significant. The first of these was the group by time interaction, $F(2,44) = 3.62$, $p < .05$. This indicated that the differences in heart rate observed at intervals of 1 minute, 2 minutes, and 3 minutes differed according to group membership. Visual inspection of figure 2 suggests that this interaction is largely attributable to the more rapid recovery in heart rate in the low relative to the high hypochondriacal group. A second two-way interaction was significant, the condition by time interaction, {$F(2,44) = 4.84$, $p < .001$}. Here heart rates observed at intervals of 1 minute, 2 minutes, and 3 minutes differed according to the stress interval condition of baseline, stressor, or recovery. Figure 2 illustrates that the pattern of decreases in heart rate, in recovery, differed from the pattern observed during the other two conditions. There were no other significant effects for the cold pressor task. There were also no significant between or within subjects differences on the heart rate data for the YELP stressor.

Visual Analogue Scales - As a method of testing the amplification/misinterpretation formulation of hypochondriasis it was hypothesized that visual analogue scale ratings of both intensity and unpleasantness for the cold pressor and heat stimulator tasks would be significantly higher in the hypochondriacal group relative to the control group. If amplification was occurring, intensity ratings would be higher for hypochondrical subjects. If misinterpretation was the process taking place, this should be evidenced by higher unpleasantness ratings for the hypochondriacal group. Repeated measures ANOVAs were used to assess the overall significance of this hypothesis for each stressor.

For the cold pressor stressor, hypochondriacal scores were again used to delineate groups. The repeated measures design used two levels of pain quality (intensity and unpleasantness) and thirteen levels of time (fifteen second intervals for three minutes plus an initial baseline) (see table 4).

Insert Table 4 about here

The analysis revealed one significant main effect. The main effect was for time with an $F(12,276) = 56.48$, $p < .001$ and is illustrated in figure 3. The time effect is largely attributable to the dramatic increase in VAS scores obtained at times 2 - 13 relative to time 1. There was also an interaction effect which was significant. This was the quality by time interaction, $F(12,276) = 2.17$, $p = .013$. This indicated that quality ratings differed the longer the subject was exposed to the stressor. Figure 4 illustrates the interaction with sensory intensity ratings being greater than unpleasantness ratings initially, but unpleasantness ratings become greater as exposure to the stressor continues. No other effects were significant for this analysis.

The repeated measures analysis for the heat stimulator used the same group variable and quality variable as the cold pressor. The design also used seven levels of temperature (35, 43, 45, 47, 48, 49, and 51 degrees Celsius) (see table 5). There were two significant main effects as well as two significant interaction effects in this analysis.

Insert Table 5 about here

The first main effect was for temperature {F (6,204) = 159.53, p <.001). This effect is illustrated in figure 5, indicating that the higher the temperature, the higher the VAS ratings. The second main effect was for quality, F (1,34) = 14.31, p <.001. There were significant differences between the reports of sensory intensity and unpleasantness for the subjects, with sensory intensity being generally higher than unpleasantness (see figures 6 and 7, and table 6). The first significant interaction

----

Insert Table 6 about here

----

was a two-way interaction of group by quality, F (1,34) = 4.55, p <.04. Here report of pain quality differed significantly according to group membership. The second interaction was a three-way interaction of group by quality by temperature. In this interaction, F (6,204) = 2.71, p <.015. Figures 6 and 7 illustrate that while intensity ratings are consistently higher than unpleasantness in the high hypochondriacal group, the pattern differs for the low group. There were no other significant effects in this analysis.

Discussion

The procedures employed in the present experiment produced a number of reliable results consistent with findings in previous experiments. This experiment attempted to test several hypotheses which might confirm that hypochondriacal persons amplify or misinterpret normal bodily sensations. This model is called the perceptual and cognitive abnormality model (Barsky and Klerman, 1983). In this model, a perceptual or cognitive defect is considered the primary source of the problem. Hypochondriacal behavior is considered by Barsky and Klerman to be a natural consequence of the individual's abnormal bodily perceptions. These abnormal sensations are presumed to occur because the person amplifies normal bodily sensations, experiencing them as more noxious or intense than normal individuals, or they may misinterpret normal bodily sensations which accompany emotional arousal or normal bodily functioning. In general, the data offered little support for the hypotheses used to test the amplification/misinterpretation components of the perceptual and cognitive abnormality model. The results will be discussed in the context of each of the hypotheses tested.

Physiological Reactivity

A portion of the explanation of the misinterpretation/ amplification hypothesis dealt with physiological reactivity. Reactivity involves the misinterpretation component of the model. Reactivity has been shown to reflect cognitive appraisal and interpretive processes. Presumably, there would be autonomic changes produced in the body due to these cognitive processes which would be reflected in increased physiological reactivity. It was hypothesized that increased heart rate as well as a longer return to baseline levels after the application of each stressor would be exhibited in the hypochondriacal group relative to the control group.

The cold pressor data showed a significant interaction effect for group and time. High scorers took longer returning to baseline heart rate levels than low scorers. This supports a hypothesis of greater reactivity among hypochondriacs which in turn supports the misinterpretation aspect of the model. Results relevant to the hypothesis in general, however, were not obtained (see table 3).

The heat stimulator task did not produce significant results on the heart rate data. One explanation for the lack of significance might be attributed to the severity of the stressor. The discrete pulses of the heat stimulator may not have been of sufficient duration to produce stress-related changes between the groups. However, heart rate responds rapidly to stress and the high group was supposed to be amplifying sensations which suggests more rapid responding . Also, since differences approached significance for condition (baseline, stressor, recovery) this suggests that the stressor had an effect.

There are two theories which could be used to explain the heart rate results seen in the heat stimulator task. The first of these theories was proposed by John Lacey.

The key point of Lacey's theory of psychophysiological reactivity has to do with what he calls "environmental intake" or "environmental rejection." These concepts are part of Lacey's refutation of a theory of general physiological arousal. With environmental intake, an individual is engaging in attentive observation of the external environment and wants to accept environmental impacts (Lacey, Kagan, Lacey, & Moss, 1963). When the individual is involved with environmental rejection, one of two things may be happening. First, the individual may be involved in some type of mental work, such as solving arithmetic problems, or other problem solving activities. In this case the person wants to "reject" information from the environment in order to better concentrate on the cognitive activity required in problem solving. Lacey contends that cardiovascular activity can help in this regard (Lacey, 1959). This occurs due to the pressure sensitive receptors in the carotid sinus. These receptors exhibit tonic inhibitory control over cortical electrical activity. According to Lacey, an increase in heart rate is likely to have inhibitory effects on both cortical and motor activity. He asserts that these changes may lead to inhibitory effects on sensory and perceptual events. When cardiac deceleration occurs the person is attempting to take in environmental information. Changes in baroreceptors would cause faster cortical electrical activity and motor control due to a lack of inhibition.

The other theory which could be used to explain the results of the study is what might be called the somatic activity theory by Paul Obrist, a former student of John Lacey. Obrist's theory states that heart rate is directly linked to somatic activity, more specifically, the striate musculature (Obrist, Webb, Sutterer, & Howard, 1970). Whenever somatic activity is modified, the heart must respond to this activity and so the heart rate will be altered.

Obrist believes that whenever individuals are involved in what Lacey would call "environmental intake" what is really happening is that they are becoming more somatically quiet (Obrist et al., 1970). They simply aren't moving around as much when they are sitting quietly attending to the environment. With less movement comes less need for blood to the striate musculature, which is manifested in cardiac deceleration. When an individual is involved in "environmental rejection" such as with mental arithmetic or with an aversive stimulus, Obrist believes they are tensing their muscles more. This increased tension causes the need for more blood to the striate musculature which results in cardiac acceleration (Obrist et al., 1970).

It is my belief that Lacey's theory best accounts for the cardiac changes seen in this study. There are several reasons for this. First is the fact that our subjects did not somatically exert themselves anymore in the stressor phase of the heat stimulator task than in the baseline or recovery phases.

The subjects were all seated in a straight backed chair during all phases of the heat stimulator task. The positions of the subjects remained relatively the same during all phases. The one exception was that during the stressor phase subjects were asked to expose their ventral forearms so that the heat stimuli could be placed there. Their arm was supported by the arm of the chair, but there may have been some increased tension in the arm due to the unnatural position. If Obrist's theory is correct, increased tension should have led to cardiac acceleration, rather than the deceleration seen (see figure 1).

The second piece of supporting evidence for the Lacey theory has to do with the instructions the subjects were given for the heat stimulator task. The subjects were told to pay attention to each individual stimulus as they were going to have to compare it with all previous stimuli they had been exposed to in order to rate the intensity and unpleasantness of that stimulus. These instructions asked the subjects to attend to the environment carefully.

Our instructions and stimuli were similar to a study conducted by Lacey which he called "Flash" (Lacey et al., 1963). The stimulus was one of several Lacey was using to study directional fractionation and environmental intake and rejection. During this experiment, subjects were stimulated by flashes at 10 cycles per second by a Grass Photostimulator. Subjects were given instructions to note and detect the varying colors and patterns produced. The subjects were also told they would be asked at the end of the experiment to describe what they saw. The subjects produced cardiac deceleration with heart rate levels going below resting levels (Lacey et al., 1963).

Our subjects were also asked to note the stimuli, as they would have to report on them later. If Obrist were correct, cardiac acceleration should have occurred due to increased demands on the musculature. Subjects were required to mark a response on a visual analogue scale after each stimulus. This required a subject to pick up a pencil, change position slightly, and make the mark. More movement was required than in the baseline state so deceleration should not be seen.

In our study, another stressor task was called "YELP", in which the subjects were read a short description of an incident where the subjects witness a purse snatching. The subject must identify the person from a lineup, and go to court many times. After the description is read, the subject was asked to mentally place themselves in that situation and to try to imagine really being there. The visualization lasted two minutes. There was no change in heart rate from baseline to stressor (see figure 5). It may be that the subjects first attended to the stimulus by listening to the description. This would have led to cardiac deceleration. Next the subjects were concentrating on the situation and rejecting the environment. This would lead to cardiac acceleration. The mean effect would have been no change. Lacey found similar results when he used stimuli which required both attention and rejection (Lacey et al., 1963). It would seem that if the Obrist theory were correct we should have seen either the acceleration caused by the tensing of muscles during "mental work" or the deceleration produced by sitting quietly (Obrist et al., 1970). Interbeat interval recording would shed more light on cardiac reactivity.

In the final stressor, the cold pressor task, cardiac acceleration was seen (see figure 2). Both theories would predict this. Lacey would say the rejection of the aversive stimuli was causing the acceleration, while Obrist would contend it is due to the tensing of the muscles which occurs when someone is exposed to an aversive stressor. In order to answer this question it would be necessary to look at EMG readings for the subjects. These readings would be helpful in providing more definitive answers for all stressor conditions.

It is not possible to definitively conclude which theory best explains the results obtained in this study. More information is needed for this, particularly EMG readings. However it does not seem possible to explain the results obtained in the heat stimulator task using the Obrist theory. While it is speculative, the Lacey theory seems to provide an explanation which best fits the data obtained.

As with the heat stimulator, the YELP stressor did not produce significant heart rate results. This may have been related to differences in the use of the stressor between this experiment and the original study. In the original study which used this task (Rosenthal et al., 1989) the female subjects had a mean heart rate change of 15.60 beats per minute compared to a 3.00 beats per minute change for the subjects in our study. In the first study the subjects were exposed to three different YELP stressors for a total of six minutes, while the subjects in the present experiment were exposed to one stressor for a total of two minutes. The additional exposures may have made the experience more stressful. The scene for this study was chosen for its relevance to a college population. It seemed likely that on an urban campus, the subjects would have concerns about witnessing a scene involving an assault and robbery and would be more likely to find this scene realistic. Perhaps this was not as relevant as assumed. Individuals in this study may not have good visualization skills. No pre-screen for visualization skills was used to test the subjects ability as was done in the original study. It was also impossible to monitor a subjects performance on this task. The subjects may not have been performing the task, or may not have been performing it with the intensity and consistency needed to produce a stressful response.

Having their eyes closed and being quiet may have served to have the opposite effect on the subjects than the one desired.

Visual Analogue Scales

Visual analogue scale ratings of both intensity and unpleasantness of cold pressor and heat pain were hypothesized to be significantly higher in the hypochondriacal group relative to the control group. This hypothesis was concerned with attempting to clarify differences between amplification and misinterpretation. If the person was amplifying sensations then the sensory-intensive dimension of the pain report should be more affected than the affective-motivational dimension. A misinterpretational process should yield opposite results, with the affective-motivational dimension being higher than the sensory-intensive. This is because the person experiences normal sensations but draws erroneous conclusions about their severity. An alternate explanation may be that an individual simply has a bias toward higher scoring on the VAS scales. If this is the case, our hypothesis would not explain this.

This hypothesis was not strongly supported by the data since the between-group difference appeared as an interaction of group and condition and it was only on the heat stimulator task. The lack of a between-group main effect might be explained again by the severity of the stressor. It may be that the cold pressor task is so severe that it focuses the attention of the hypochondriacal person not allowing the misinterpretation to occur. This would allows normal interpretation to occur. This explanation seems somewhat implausible and a more parsimonious explanation would be that there are no group differences.

For the heat stimulator task, the generally increased affective ratings of the low group at the higher temperatures was surprising. This was unexpected, since the hypothesis predicted higher affective ratings for the high group. This would have supported the misinterpretation part of the hypochondriasis concept. The higher affective ratings of the high group at the lower temperatures (35, 43, 45) support the hypothesis, however the absence of the effect at the higher temperatures (48, 49, 51) would seem to be inconsistent. A possible explanation of this phenomenon may be that hypochondriacal individuals have adapted to higher levels of pain and do not experience them as aversely as normal individuals. The amplification may make lower levels seem more unpleasant, but the higher levels may bring out the adaptational coping strategy. This does not really make sense however, since amplification should amplify all the sensations making them more unpleasant. While it was not statistically significant, in general, the sensory intensive ratings of the high group were higher than those of the low group. This is suggestive of support for the amplification portion of the hypothesis. The marked jump of both the intensity and unpleasantness ratings for both groups at 47 degrees is thought to be spurious, due to miscalibration of the thermal stimulator, particularly since the ratings decline at the next highest temperature.

Methodological Considerations

Instrumentation

There were other factors which may have improved this study, allowing for greater support of the amplification/ misinterpretation hypothesis. Perhaps the hypochondriasis scale (scale one) of the MMPI was not the proper screening instrument to use to delineate the groups. The amplification/misinterpretation process may not be tapped by the factors measured by the hypochondriasis scale. Kellner (1986) asserts that the hypochondriasis scale of the MMPI consists largely of somatic symptoms and does not measure hypochondriacal beliefs and attitudes.

The possibility of overlap is even greater in the instrument used in this study due to the lack of K correction. The K scale consists of thirty items interspersed throughout the MMPI and is designed as a measure of defensiveness toward answering the test items (Meehl & Hathaway, 1956). The hypochondriasis scale is one of the scales to which the K score is added. In the present experiment we were unable to add any K correction to the scale score. This could lead to an underestimation of hypochondriasis among our analog population. To be considered clinically hypochondriacal, a person must obtain a T score of 70 on an MMPI scale. This translates to a raw score of 20 if K-correction is used based on norms obtained for North Carolina college freshmen (Greene, 1980).

In order to examine our classification and therefore to know whether our sample could be considered hypochondriacal, K-correction must be added. Greene (1977) states that for college students, K scale scores of 55 to 70 should be considered average. Using those college students' norms a T score of 62 for K (midway between 55 and 70) translates to a raw score of 19. This might be considered an average raw score for K among college freshmen. Since one-half the total K score is added to the hypochondriacal scale this would mean that 10 raw score points should be added to our samples' scores in order to assess their level of hypochondriasis in the manner recommended by the inventory. By using an average K score and adding it to the scores of our sample, all 18 subjects classified as high hypochondriacal would still be correctly classified from a clinical definition.

The difficulty here is in applying an "average" score. The K scale is a measure of defensiveness. It would be very difficult to know how individuals would respond to the entire K scale. It may be that some individuals who would be classified as hypochondriacal using MMPI criteria might be quite willing to admit to psychological or physiological weaknesses as would be indicated by low K scores (Meyer, 1983). Admission of such weaknesses might be the person's way of seeking validation for their symptoms. However, it might also be the case that certain individuals who would be considered hypochondriacal are unwilling to admit to psychological or physiological weaknesses. They may believe that people will try to tell them it's all in their head when they are convinced it is not. These individuals may believe it is in their best interest not to admit to a great deal of psychological or physical distress. These are the people the scale was designed to correct for. Given the possibility of these two different types of responding, it would not be meaningful to add an average score to every subject's score in our sample. This being the case, it is necessary to examine the sample's classification without K-correction.

In order to obtain a T score of 70 without K-correction it is necessary to obtain a raw score of 18 on the hypochondriasis scale

(Greene, 1980). In examining the raw scores of the sample classified as hypochondriacal using the statistical method, it is found that 12 of the 18 individuals failed to obtain a raw score of 18 or better. This means that two-thirds of the hypochondriacal sample would not be considered clinically hypochondriacal. This may explain, in part, the failure of this study to obtain stronger results. The analog subjects used in this study were not clinically hypochondriacal. They were therefore probably a non-representative sample and so not appropriate to test hypotheses regarding hypochondriasis.

Subject Selection. Another possible problem may have been in using an analog population. Hanback and Revelle (1978) used a student population to test heightened perceptual sensitivity and achieved mixed results. It may be that the phenomenon is not strong enough in this population, but needs to be tested in a clinical population where they are more likely to be seen. Another possible way to improve selection might be having individuals identified by medical personnel as meeting the criteria for hypochondriasis as they would be familiar with the person's medical history and health care utilization.

Measurement. Failure to observe group differences in this study may be related to the use of insensitive measures and/or failure to operationalize the amplification model properly. There are other measures that could be taken as well. Physiologically, electrodermal response would certainly be another way to look at reactivity as well as electromyography and respiration. Perhaps a better test might involve measuring physiological sensitivity in a different way. Hanback and Revelle (1978) had success using visual two-flash fusion sensitivity.

Their basis for physiologically based hypochondriasis was a tendency for the hypochondriacal individual to perceive more bodily sensations than normal. They believed that heightened arousal lead to greater sensitivity to stimulation. It might be useful to determine sensory thresholds across a variety of modalities including auditory and pricking pain as a way to improve measurement.

Stressors. The YELP stressor did not appear to be stressful enough. Other stressors produce stronger effects. Mental arithmetic or reciting a personally embarrassing event might produce a more marked physiological effect than the one produced with the YELP stressor. Mental arithmetic or a personally embarrassing event produce a strong physiological reaction and are considered to be quite stressful by the participant. The response is however ideographic in nature. The primary reason for using the YELP stressor in this study was to get a standardized stressor. Expansion of the number of YELP stressors may have improved physiological response. Perhaps better use of the cold water bath may have improved results. The water may not have been cold enough or perhaps circulating the water might have helped.

Better dependent measures may have improved results, but perhaps the measures taken were not the best in terms of testing the model. The measures may not have operationalized the amplification/ misinterpretation model properly. The use of visual analogue scale ratings and measurement of heart rate may not be the best way to support our hypotheses. It may be that individuals who amplify do not experience the amplified sensations as more noxious.

Problems with the Model

There are methodological changes that could have been made to improve the study, but it may be that the perceptual and cognitive abnormality model is not the best one to explain hypochondriasis. In this study no strong support was found for physiological sensitivity. Even if this was only a partial explanation for hypochondriasis, this should have been observed in the measures taken in the present experiment. Barsky and Klerman (1983) assert that hypochondriacal behavior is the inevitable and normal consequence of a perceptual and cognitive abnormality. Why it is inevitable is not clear and Barsky and Klerman do not elaborate on their reasons or offer alternative explanations. Better understanding of the inevitability of this behavior would lend strength to this model of hypochondriasis.

Conclusion

Further research is needed in order to better clarify the amplification/misinterpretation hypothesis. While the results of this study do not fully support the hypothesis, they cannot rule it out either. This is the first study to use physiological measures in an attempt to demonstrate differences between normals and hypochondriacal individuals who may be amplifying or misinterpreting their bodily sensations. This still provides the most basic evidence for amplification and misinterpretation. Improved techniques and better population selection are needed before definitive answers may be reached.

REFERENCES

Barsky, A. J., & Klerman, G. L. (1983). Overview: Hypochondriasis, bodily complaints, and somatic styles. American Journal of Psychiatry, 140, 273-283.

Beecher, H. K. (1956). The subjective response and reaction to sensation. American Journal of Medicine, 20, 107-113.

Costa, P. T., & McCrae, R. R. (1985). Hypochondriasis, neuroticism, and aging. American Psychologist, 40, 19-28.

Eysenck, H. J. & Eysenck, S. G. B. (1964). Manual of the Eysenck personality inventory. London: University of London Press.

Feurstein, M., Labbe, E. E., & Kuczmierczyk, A. R. (1986). Health Psychology: A psychobiological perspective. New York: Plenum Press.

Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. Journal of Personality and Social Psychology, 48, 150-170.

Ford, C. V. (1986). The somatizing disorders. Psychosomatics, 27, 327-337.

Greene, R. L. (1977). The MMPI: A practical guide. New York: Oxford University.

Greene, R. L. (1980). The MMPI: An interpretive manual. New York: Greene and Stratton.

Hanback, J., & Revelle, W. (1978). Arousal and perceptual sensitivity in hypochondriacs. Journal of Abnormal Psychology, 87, 523-530.

Harkins. S.W., Price, D.D., & Martelli, M. (1986). Effects of age on pain perceptions: Thermonociception. Journal of Gerontology, 41, 58-63.

Kellner, R. (1986). Somatization and hypochondriasis. New York: Praeger.

Lacey, J. I. (1959). Psychophysiological approaches to the evaluation of psychotherapeutic process and outcome. In E. A. Rubinstein & M. B. Parloff (Eds.), Research in psychotherapy (pp. 160-208). Washington, DC: American Psychological Association.

Lacey, J. I., Kagan, J., Lacey, B. C., & Moss, H. A. (1963). The visceral level: Situational determinants and behavioral correlates of autonomic response patterns. In P. H. Knapp (Ed.), Expression of the emotions in man (pp. 161-196). New York: International Universities Press.

Meehl, P. E., & Hathaway, S. R. (1956). The K factor as a suppressor variable in the MMPI. In G. S. Welsh, & W. G. Dahlstrom (Eds.), Basic readings on the MMPI in psychology and medicine (pp. 12-40). Minneapolis: University of Minnesota.

Miller, S. M. (1987). Monitoring and blunting: Validation of a questionnaire to assess styles of information seeking under threat. Journal of Personality and Social psychology, 52, 345-353.

Obrist, P. A., Webb, P. A., Sutterer, J. R., & Howard, J. L. (1970). The cardiac-somatic relationship: Some reformulations. Psychophysiology, 6, 569-587.

Pennebaker, J. W. (1982). The psychology of physical symptoms. New York: Springer.

Price, D. D. (1988). Psychological and neural mechanisms of pain. New York: Raven Press.

Price, D. D., Barrell, S J., & Gracely, R. H. (1980). A psychophysical analysis of experimental factors that selectively influence the affective dimension of pain. Pain, 8, 137-149.

Price, D. D., & Harkins, S. W. (1987). Combined use of experimental pain and visual analogue scales in providing standardized measurement of pain. Clinical Pain, 3, 1-8.

Price, D. D., Harkins, S. W., & Baker, C. (1987). Sensory-affective relationships among different types of clinical and experimental pain. Pain, 28, 297-307.

Rosenthal, T.L., Montgomery, L.M., Shadish, W.R. Edwards, N.B., Hutcherson, H.W., Follette, W.C., & Lichstein, K.L. (1989). Two new, brief, practical stressor tasks for research purposes. Behavior Therapy, 20, 545-562.

Seligman, M.E.P. (1975). Helplessness: On depression, development, and death. San Francisco: W. H. Freeman.

Spanos, N. P., Ollerhead, V. G., & Gwynn, M. I. (1985). The effects of three instructional treatments on pain magnitude theories of hypnotic analgesia. Imagination, Cognition, and Personality, 5, 321-337.

Spielberger, C.D., Forush, R., & Lushene, R.L. (1970). Manual for the state-trait anxiety inventory. Palo Alto: Consulting Psychologist Press.

Williams, R. B. (1986). Patterns of reactivity and stress. In K. A. Matthews, S. M. Weiss, T. Detre, T. M. Dembroski, B. Falkner, S. B. Manuck, & R. B. Williams Jr. (Eds.), Handbook of stress, reactivity, and cardiovascular disease (pp. 109-126). New York: John Wiley & Sons.

Zimmerman, M., & Coryell, W. (1987). The inventory to diagnose depression (IDD): A self-report scale to diagnose major depressive disorder. Journal of Consulting and Clinical Psychology, 55, 55-59.

Table 1

Stressor Presentation Order

Order 1	Order 2	Order 3	Order 4	Order 5	Order 6
1	1	2	2	3	3
2	3	1	3	1	2
3	2	3	1	2	1

Note. 1 - cold pressor task 2 - YELP visualization stressor 3 - heat stimulator task. The stressors within each order were presented in descending order.

Table 2

Mood and Personality Variable Scores

	Group			
	High		Low	
Variable	M	SD	M	SD
Depression[a]	16.14	15.71	13.01	17.65
Anxiety[a]	35.57	24.27	24.70	14.85
Frustration[a]*	25.87	24.73	10.65	15.66
Anger[a]	9.02	14.10	7.05	14.40
Fear[a]	16.92	17.62	11.05	10.69
Excitement[a]	21.83	17.37	18.83	21.47
Arousal[a]	18.89	15.41	19.87	22.98
Astonished[a]	5.70	8.10	12.21	18.50
Happy[a]	46.70	20.02	44.55	27.76
Tired[a]*	55.18	24.66	33.20	27.77
Bored[a]	26.59	19.93	16.75	19.23
Calm[a]	56.83	26.37	41.05	23.15
Drousy[a]	37.54	23.84	25.92	25.39
Distressed[a]	19.71	20.30	13.91	14.69
At Ease[a]	45.27	26.43	58.12	21.17
Tense[a]	33.99	25.14	23.56	18.26
Relaxed[a]	47.50	23.08	53.34	23.75
Annoyed[a]	14.86	22.32	7.59	10.88
Global Symptom Index[b]	39.44	11.47	41.67	17.78
Somatization[b]	38.72	21.03	30.56	22.49
Obsessive-Compulsive[b]	44.33	11.84	37.28	17.73
Insecurity[b]	40.28	15.27	27.72	23.05
Depression-BSI[b]	29.89	19.17	22.56	20.96
Anxiety-BSI[b]	40.17	11.22	32.56	18.24
Hostility[b]	46.06	18.37	33.39	22.37
Phobia[b]	17.06	23.99	18.50	23.53
Paranoia[b]	33.11	24.03	23.44	24.24
Psychoticism[b]	30.61	22.52	15.06	21.72
Neuroticism[c]*	14.06	5.01	9.72	4.92
Extraversion[c]	13.33	3.56	11.22	4.82
Barsky & Klerman	9.72	2.47	9.50	2.66
Monitor[d]	10.89	2.95	9.17	4.15
Blunter[d]	4.44	2.23	3.94	2.65
Depression Total[e]*	17.06	9.82	10.17	7.82
State Anxiety[f]	35.94	12.91	33.00	11.06
Trait Anxiety[f]	42.72	11.93	36.44	15.19

Note. n = 18 for both groups. Data are expressed as mean and standard deviation, as derived from personality and mood questionnaires. [a] = Perceived Impact Questionnaire. [b] = Brief Symptom Index. [c] = Eysenck Personality Inv [d] = Miller Behavioral Style Scale. [e] = Inventory to Diagnose Depression. [f] = State-Trait Anxiety Inv. * = $p < .05$ for entire sample means.

Table 3

Heart Rate Measurement for All Stressors by Group

		Group			
		High		Low	
Measurement Period	Minute	M	SD	M	SD
Baseline	1	79.06	9.39 (18)	82.25	10.38 (18)
	2	77.00	9.46	81.25	11.33
	3	79.17	9.24	81.81	8.76
Cold Pressor Task	1	85.93	10.27 (15)	93.10	10.42 (10)
	2	86.50	11.41	89.50	10.82
	3	85.86	11.79	92.40	11.21
Cold Pressor Recovery	1	82.64	12.00	88.70	11.58
	2	79.21	11.24	73.50	23.33
	3	77.43	10.60	70.80	22.64
Heat Stimulator Task	1	77.67	12.04 (18)	74.31	18.87 (16)
	2	77.11	8.72	73.31	18.51
	3	76.72	10.11	73.00	18.88
Heat Stimulator Recovery	1	82.33	9.13	80.62	20.78
	2	79.78	20.48	78.44	20.48
	3	79.11	10.58	78.12	20.01
YELP Task	1	78.06	10.03 (18)	76.12	19.02 (17)
	2	77.78	9.77	76.18	19.86
YELP Recovery	1	80.28	9.59	78.00	21.38
	2	77.28	10.10	77.59	20.56

Note. Data are expressed as mean and standard deviation. Numbers in parentheses indicate the number of subjects completing each task.

Table 4

Visual Analogue Scale Ratings for Cold Pressor Task by Group

Group: High (n=15)

Time	Sensory Intensity M	Sensory Intensity SD	Unpleasantness M	Unpleasantness SD
1	12.26	14.29	5.60	7.13
2	65.56	23.89	66.28	28.90
3	71.19	21.13	70.57	24.15
4	73.63	21.86	75.79	22.13
5	76.46	20.68	77.72	20.16
6	74.97	18.98	76.46	19.65
7	74.53	19.16	77.74	19.11
8	71.96	20.65	76.98	19.18
9	68.21	22.75	75.43	20.83
10	68.05	22.35	73.64	22.50
11	65.97	23.58	69.16	25.62
12	64.93	21.93	71.95	18.94
13	67.34	19.44	70.52	20.79

Group: Low (n=10)

Time	Sensory Intensity M	Sensory Intensity SD	Unpleasantness M	Unpleasantness SD
1	13.24	15.28	2.20	2.35
2	65.64	22.07	61.43	26.86
3	68.85	22.82	66.82	25.08
4	73.54	19.23	70.09	25.37
5	77.85	15.18	74.32	24.38
6	75.50	16.17	74.26	23.69
7	75.41	15.84	75.17	22.45
8	78.24	14.75	75.41	21.76
9	74.55	17.49	74.65	22.12
10	77.40	15.30	73.56	23.01
11	71.61	21.86	70.66	25.80
12	78.67	16.98	75.73	22.87
13	78.79	15.02	75.51	22.96

Note. Data are expressed as mean and standard deviation. Unequal n's reflect the differing number of finishers in each group. Group membership is determined by score on the MMPI scale 3.

Table 5

Visual Analogue Scale Ratings for Heat Stimulator Task

Temperature	M	SD
	Sensory Intensity (N=36)	
35	16.09	15.48
43	29.19	14.67
45	29.38	13.99
47	50.86	17.46
48	48.36	17.41
49	58.65	16.77
51	70.63	14.90
	Unpleasantness (N=36)	
35	8.16	10.51
43	18.29	12.49
45	23.64	11.92
47	50.26	17.97
48	42.36	16.23
49	53.92	20.33
51	62.71	19.48

Note. Data are expressed as mean and standard deviation. The N of 36 reflects total subject number. Temperature is expressed in degrees Celsius.

Table 6

Visual Analogue Scale Ratings for Heat Stimulator Task by Group

Temperature	Group: High (n=18) M	SD	Low (n=18) M	SD
	Sensory intensity ratings			
35	18.07	18.03	14.11	12.65
43	28.35	14.76	30.03	14.95
45	31.80	15.94	26.96	11.67
47	56.35	16.47	45.38	17.11
48	54.82	20.84	41.90	10.09
49	57.99	19.21	59.31	14.46
51	70.78	17.79	70.47	11.86
	Unpleasantness ratings			
35	10.54	13.31	5.78	6.18
43	19.88	13.42	16.70	11.65
45	24.90	13.40	22.37	10.46
47	46.45	18.75	54.08	16.82
48	39.21	15.23	45.51	17.00
49	49.43	22.86	58.41	16.91
51	59.22	22.60	66.21	15.64

Note. Data are expressed as mean and standard deviation. Group membership is determined by score on the MMPI scale 3. Temperature is expressed in degrees Celsius.

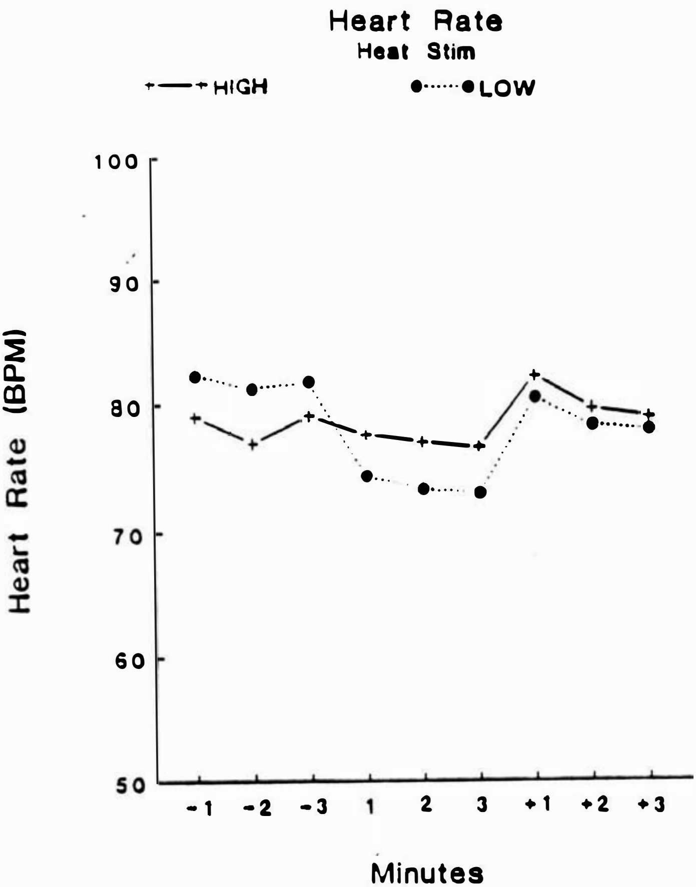
Heart Rate
Heat Stim
HIGH
LOW
Heart Rate (BPM)
100
90
80
70
60
50
-1
-2
-3
1
2
3
+1
+2
+3
Minutes

Figure 1.

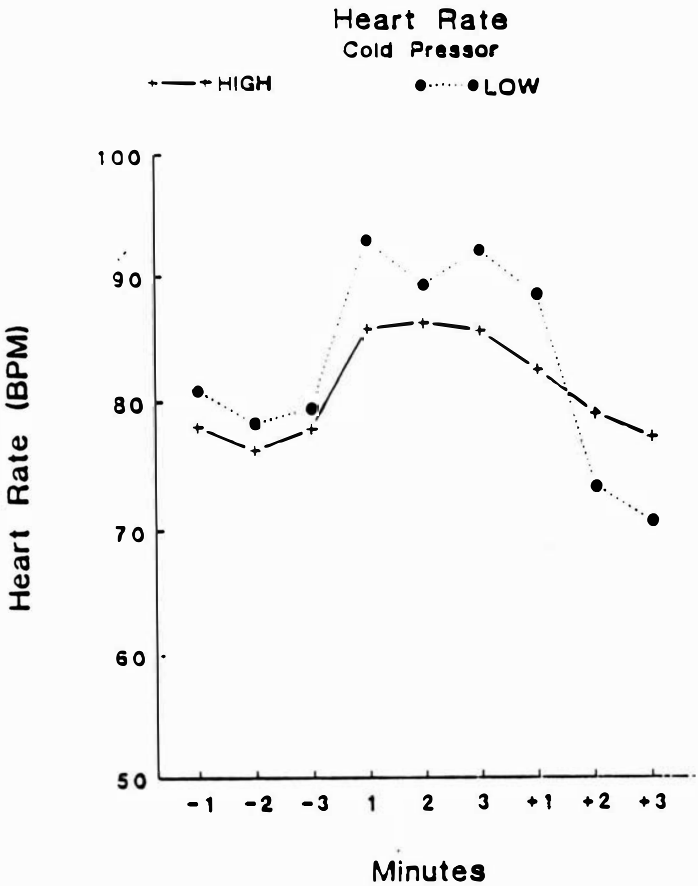
Heart Rate
Cold Pressor
HIGH
LOW
100
90
80
70
60
50
Heart Rate (BPM)
-1
-2
-3
1
2
3
+1
+2
+3
Minutes

Figure 2.

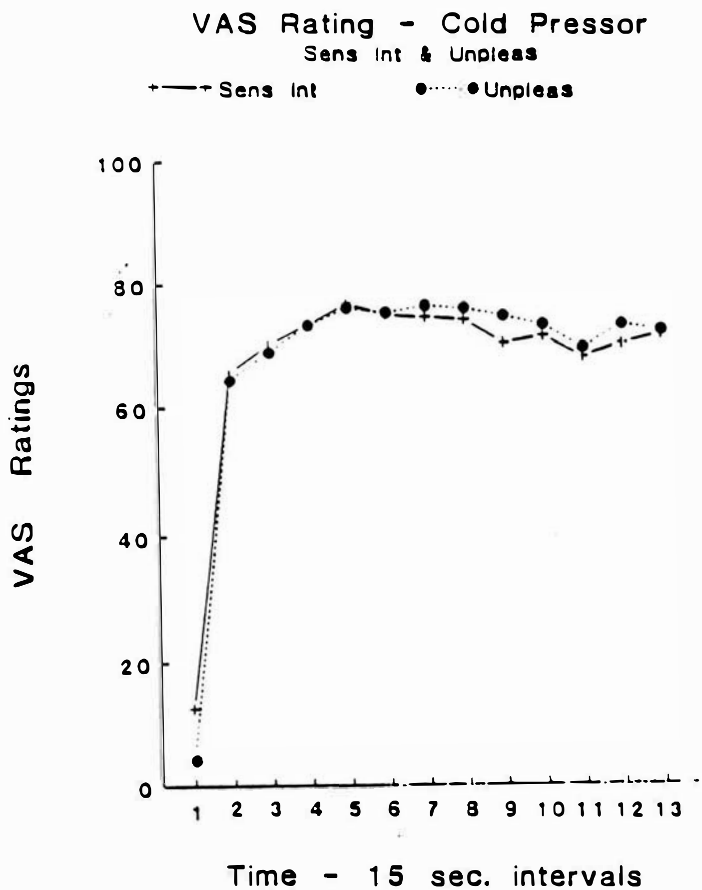
VAS Rating - Cold Pressor
Sens Int & Unpleas
Sens Int
Unpleas
100
80
60
40
20
0
VAS Ratings
1 2 3 4 5 6 7 8 9 10 11 12 13
Time - 15 sec. intervals

Figure 3.

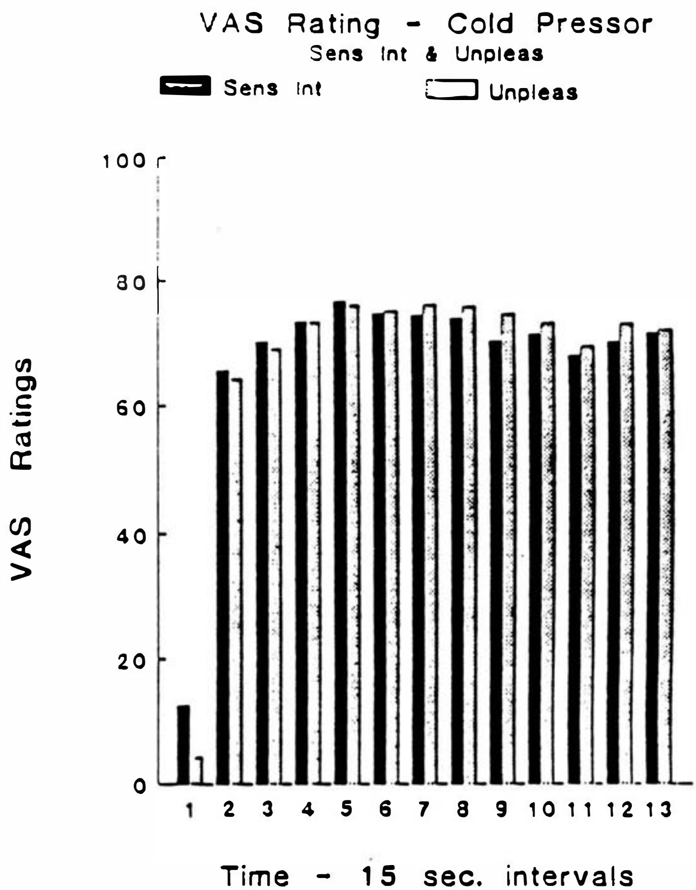
VAS Rating - Cold Pressor
Sens Int & Unpleas
Sens Int
Unpleas
VAS Ratings
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12 13
Time - 15 sec. intervals

Figure 4.

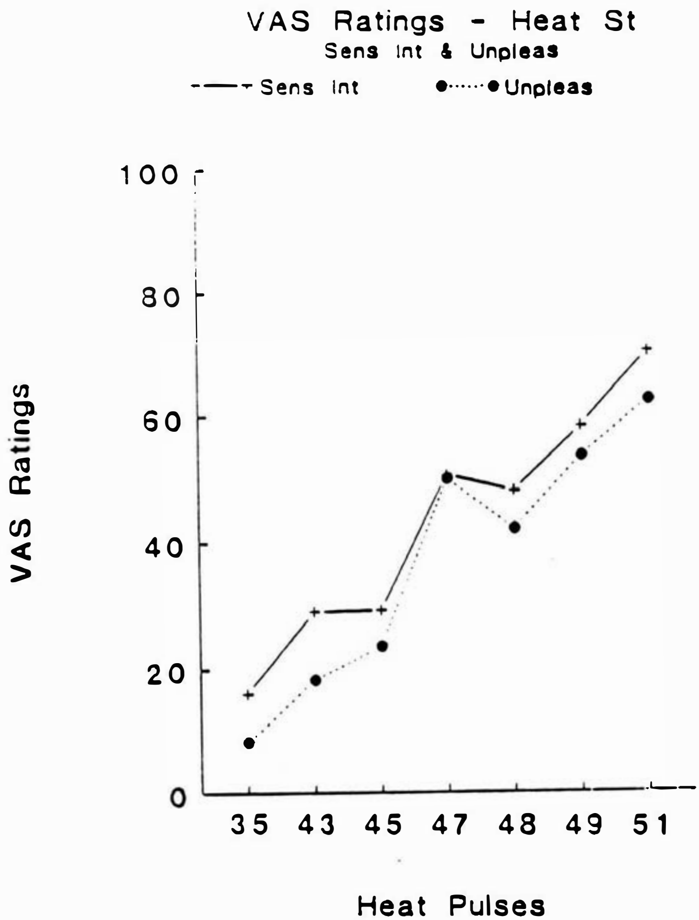
VAS Ratings - Heat St
Sens Int & Unpleas
Sens Int
Unpleas
VAS Ratings
100
80
60
40
20
0
35
43
45
47
48
49
51
Heat Pulses

Figure 5.

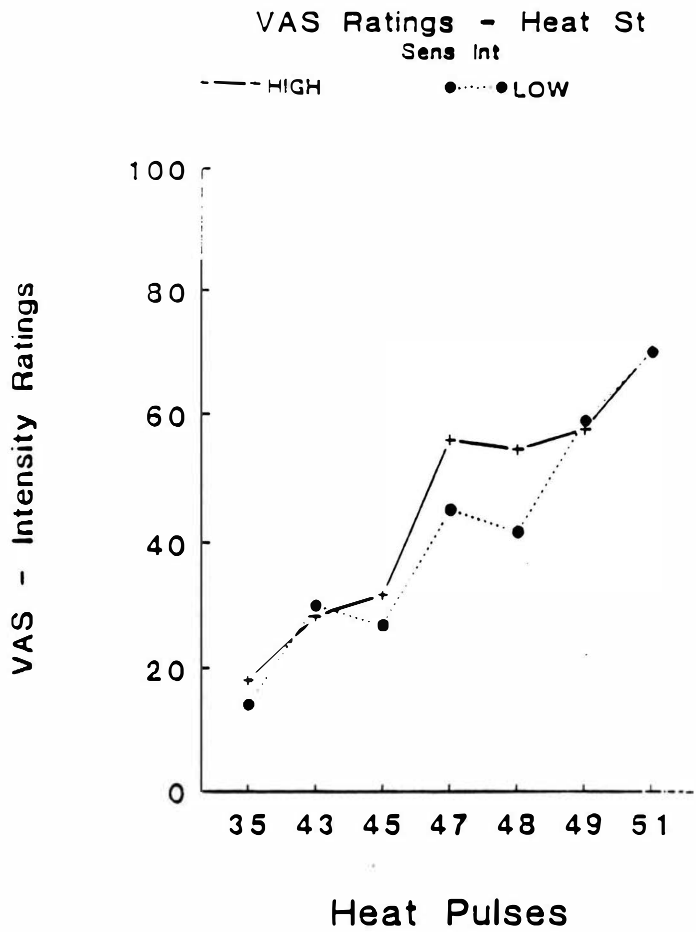
VAS Ratings - Heat St
Sens Int
HIGH
LOW
100
80
60
40
20
0
VAS - Intensity Ratings
35 43 45 47 48 49 51
Heat Pulses

Figure 6.

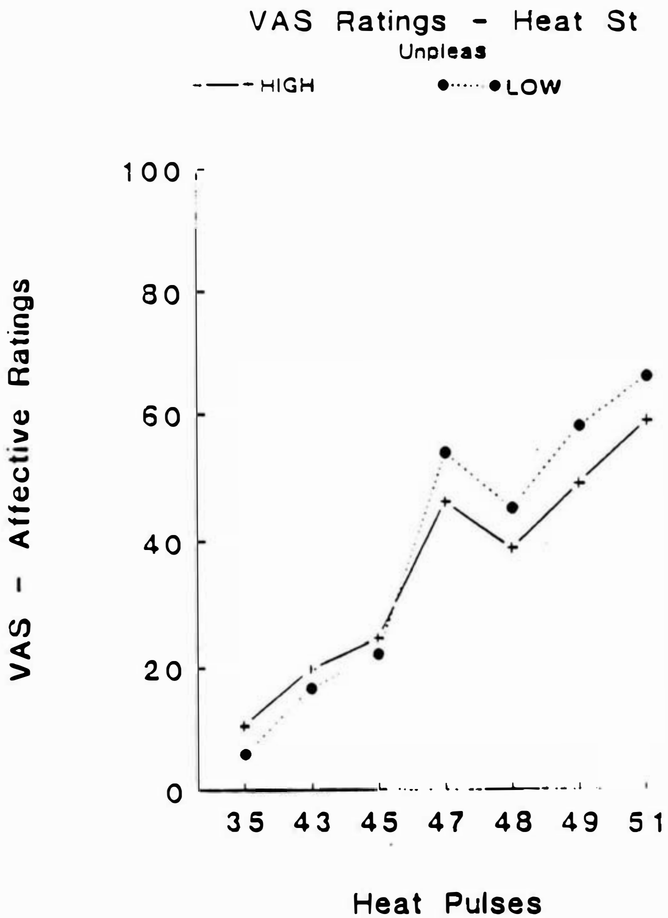
VAS Ratings - Heat St
Unpleas
HIGH
LOW
100
80
60
40
20
0
VAS - Affective Ratings
35 43 45 47 48 49 51
Heat Pulses

Figure 7.

Figure Captions

Figure 1. Mean heart rate for the heat stimulator task by group. Heart rate is expressed in beats per minute. Minutes expressed as baseline (-1, -2, -3), stressor (1, 2, 3), and recovery (+1, +2, +3).

Figure 2. Mean heart rate for the cold pressor task by group. Heart rate is expressed in beats per minute. Minutes expressed as baseline (-1, -2, -3), stressor (1, 2, 3), and recovery (+1, +2, +3).

Figure 3. Mean VAS ratings for sensory intensity and unpleasantness for the cold pressor task for entire sample. VAS ratings made at 15 second intervals.

Figure 4. Mean VAS ratings for sensory intensity and unpleasantness for the cold pressor task for entire sample. VAS ratings made at 15 second intervals.

Figure 5. Mean VAS ratings for sensory intensity and unpleasantness for the heat stimulator task for entire sample. Heat pulses are expressed in degrees Celsius.

Figure 6. Mean VAS ratings for sensory intensity for the heat stimulator task by group. Heat pulses are expressed in degrees Celsius.

Figure 7. Mean VAS ratings for unpleasantness for the heat stimulator task by group. Heat pulses are expressed in degrees Celsius.

Vita

[redacted]