Threat Schemas and Cardiac Patients: Evaluation of Conceptual Implicit Memory

A Thesis by

Susan K. Heffelfinger

Department of Psychology

Submitted in Partial Fulfillment of the Requirements for the

Degree of Master of Science

in the School of Graduate and Postdoctoral Studies

Finch University of Health Sciences/ The Chicago Medical School

1999

UMI Number: 1396368

UMI
300 North Zeeb Road
Ann Arbor, MI 48103

Table of Contents

List of Tables

Abstract

Information processing biases have been suggested to play a significant role in the development and /or maintenance of symptomatology in a variety of anxious populations. In the present study, cardiac patients enrolled in an outpatient cardiac rehabilitation program (n=18) were compared to cardiac health professionals (n=20) on a measure of conceptual implicit memory, the white noise paradigm (Jacoby, Allan, Collins, & Larwill, 1988). We predicted that cardiac patients would exhibit an implicit memory bias for cardiac-relevant stimuli as compared to health professionals by rating the white noise associated with threat-relevant stimuli as less loud than health professionals did. We further predicted that this effect would be specific to cardiac threat words. To test this, we presented social threat stimuli to participants along with cardiac-relevant and neutral stimuli, predicting that cardiac patients would rate noise associated with cardiac threat words as less loud than noise associated with social threat words. Initial analysis to test the paradigm's utility as a measure of implicit memory failed to reveal the expected general priming effect. Further analyses revealed that the paradigm operated for only a subset of the word stimuli. Only subjects who encoded Tape B in the encoding phase of the white noise task showed the general priming effect at one noise level, the low noise level. Therefore, further analyses were conducted with only this subgroup of 7 cardiac patients and 11 health professionals. Between groups analysis revealed a trend for cardiac patients to rate cardiac words as less loud than health professionals. However, cardiac patients did not rate noise surrounding cardiac words as less loud than that of neutral and social threat words. Limited evidence was found using the white noise procedure for a cardiac specific threat schema. Evidence regarding the utility of this paradigm as an implicit memory measure is reviewed and results are discussed in terms of implicit memory theory.

Acknowledgements

I would like to thank the following people who have contributed to the completion of this project:

Special thanks to Dr. John Calamari, my advisor, for patience and guidance throughout this project and my training. He has helped foster my clinical and research interests and provided opportunities for me to explore these avenues.

Thank you to Dr. John Burns, whose thoughtful reviews and comments as a second reader were much appreciated.

Thanks to Dr. Joseph Zander, Nina Schilli, and Dr. Myalls, of Lutheran General Hospital, Advocate Health Care, who allowed this project to take place at Lutheran. Also, thank you to the Cardiac Rehab Staff--Chris, Shawn, Carolyn, Mary Jean, Susan, Andy, and Simone-- for their support and humor every Monday, Wednesday, and Friday during data collection.

Thank you to Pete Nierenberger for many hours of time and effort spent recording the tapes for the study. His expertise made the project possible. Also, thanks to Amy Janeck for lending her voice to the recordings.

Special thanks to those close to my heart: my entire family, in particular my parents, Lynn and Kathy Heffelfinger; my friends and fellow classmates; and finally, Pratip Nag. Thank you all for your encouragement, support, and love; my gratitude is beyond measure. R.I.P. Bubba.

Introduction

Psychological variables affecting rehabilitation from cardiac illness have received an increasing amount of attention over the past decade as researchers have attempted to illuminate both the etiology and aftermath of coronary illnesses. Depression and anxiety are common after a cardiac event and are often understood to be the result of a natural grief reaction to the perceived vulnerability and loss of capability (Katon & Sullivan, 1990). In patients recovering from myocardial infarction (MI), depression and anxiety have been shown to be predictive of rehabilitative prognosis. Specifically, depression and anxiety have been shown to be risk factors for cardiac morbidity in the first twelve months of rehabilitation (Frasure-Smith, Lesperance, & Talajic, 1995). The cognitive mechanisms underlying depression and anxiety have long been a focus in research on patients with emotional disorders (McNally, 1995), but there has been limited study of how physical illness impacts cognitive processing. Initial studies with health psychology populations provide evidence for the importance of information processing theories in smoking cessation (Gross, Jarvik, & Rosenblatt, 1993), eating disorders (Channon, Hemsley, & deSilva, 1988; Cooper & Fairburn, 1993/1994; Green & Rogers, 1993), and chronic pain (Edwards & Pearce, 1994). Researchers have also used cognitive psychology theories to examine health-related information processing in normal populations (Bishop & Converse, 1988) and in hypertensive and MI patients (Leventhal, Meyer, & Nerenz, 1980; Leventhal & Nerenz, 1982; Meyer, Leventhal, & Gutmann, 1985; Petrie & Weinman, 1997). While there has been some investigation of health-related information processing and cognitive representations of illness in cardiac patients, there have been no studies assessing implicit memory bias in a cardiac population. The proposed study is designed to investigate implicit memory bias in a population of outpatients recovering from one or more cardiac events.

Cognitive Processing and Psychopathology

Cognitive psychologists have developed various models to explain how individuals process information from their environment. Recent research by experimental psychopathologists has focused on possible cognitive biases in information processing with emotionally disordered patients. The last decade has seen a surge in the study of emotionally disordered subjects using information processing paradigms (Dalgleish & Watts, 1990). This work has yielded cognitive models of both anxiety and depression and it is hypothesized that cognitive processes are distorted in these emotional disorders. For instance, Beck and Emery (1979) proposed a cognitive model of anxiety, stating that individuals who are anxious have developed "danger" or threat schemata that, under a state of activation, drive the individual to selectively process information from the environment. These individuals exhibit a bias to selectively process information which is relevant to personal danger. In other words, they are hypervigilant for stimuli in the environment which may be threatening to them.

Later, Foa and Kozak (1986) described the mechanisms governing the processing of emotional information. They posited that emotions are represented by information structures in memory. Certain information structures serve as programs to escape or avoid danger, according to the model, and when these are activated, anxiety occurs.

Information processing biases have been suggested to play a significant role in the development and/or maintenance of symptomatology in a variety of anxious populations, such as generalized anxiety disorder (GAD: Williams, Watts, MacLeod, & Mathews, 1988) and panic disorder (McNally, 1994).

Mineka and Sutton (1992) outlined several types of cognitive biases which involve the selective processing of information, including attentional bias and memory bias. Researchers have been able to show information processing biases more consistently in attention in a variety of clinical populations (Logan & Goetsch, 1993; McNally, 1995), but results have been less consistent in the area of memory bias (Amir, McNally, Riemann, & Clements, 1996a).

Attentional Bias in Anxiety

Mineka and Sutton (1992) argued that anxiety has an automatic influence on the individual's allocation of attention, resulting in the direction of attention to potentially threatening stimuli in the environment. Researchers have found support for attentional bias using a variety of techniques. For instance, MacLeod and Mathews (1988) demonstrated an attentional bias in anxious subjects using the probe detection technique. Anxious subjects have also shown selective processing of threat cues when measured by a modified Stroop task (Mathews & MacLeod, 1985). Mathews and MacLeod (1985) demonstrated that relative to normal controls, anxious subjects take longer to color-name anxiety-relevant threat words. Similarly, McNally, Kaspi, Riemann, and Zeitlin (1990) showed this attentional bias in patients with post-traumatic stress disorder (PTSD) using a modified Stroop paradigm. Other emotionally disordered populations have also demonstrated an attentional bias as measured by the modified Stroop task, including panic patients (McNally, Riemann, & Kim, 1990), simple phobia patients (Watts, Trezise, & Sharrock, 1986), and socially phobic patients (Hope, Rapee, Heimberg, & Dombeck, 1990). The consistency of the attentional bias finding by experimental psychopathologists is in contrast to the mixed results in the realm of memory bias.

Memory Bias in Anxiety

Research in memory bias has been linked more closely with depressive disorders, than with anxiety (Mineka and Sutton, 1992). While there is support for a link between memory and anxiety, there are conflicting results. Part of this may be due to the different memory systems studied (Amir et al., 1996a). Researchers have examined both implicit and explicit memory processes. Explicit memory refers to the conscious recollection of previously presented information and has traditionally been measured with tests of recognition, free recall, and cued recall (Schacter, 1987). Implicit memory refers to processes which are relatively automatic and involve activation and integration (Mathews, Mogg, May & Eysenck, 1989). Implicit memory tests are indirect assessments, in contrast to the direct assessment nature of explicit memory tasks. Researchers have measured implicit processes using perceptual (data-driven) tests or conceptually driven tests (focusing more on an event's meaning). In perceptual implicit memory paradigms data is presented in degraded form (i.e., words shown in rapid succession or fragmented items). Perceptual tests of implicit memory include word stem completion and word fragment completion, as well as word identification or picture fragment identification. In word completion tasks, subjects are presented with a word fragment or stem and asked to complete it with the first appropriate word they can produce. Priming is reflected in these tasks by the tendency for subjects to complete the items with words they were exposed to on a prior list (Schacter, 1987). Mandler (1980) proposed that implicit memory is the result of a mental representation, or schema, being activated and thereby becoming more accessible but not necessarily more retrievable.

The findings regarding implicit memory bias in anxious populations have been mixed. Some researchers have found enhanced priming of threat material in clinical populations. For instance, Cloitre, Shear, Cancienne, and Zeitlin (1994) found enhanced priming for threat material using a word stem completion task in panic patients. Similarly, MacLeod and McLaughlin (1995) found an implicit memory advantage for threat stimuli in generalized anxiety disorder (GAD) patients compared with non-anxious controls. Mathews, Mogg, May, and Eysenck (1989) have also shown this effect in GAD patients using a word completion task.

Other investigations yield no evidence of implicit memory bias. For example, Rapee (1994) failed to replicate the memory bias effect in a panic population. Similarly, Mathews, Mogg, Kentish and Eysenck (1995) failed to find the effect in a GAD population.

One reason for the lack of consensus in this area is the different measures that have been used to assess implicit memory and the possible contamination of the implicit measure by explicit strategies used by the subject. Amir et al. (1996a) and McNally (1995) have stated the most valid measure of implicit memory is one which taps conceptual meaning as opposed to perceptual processes. Most studies have used perceptual tasks, such as the word stem completion task, which has been criticized because of the possibility of contamination of the implicit measure by explicit strategies (Perruchet & Baveux, 1989).

In summary, information processing paradigms have been widely used in the study of emotionally disordered populations. The attentional bias effect is a robust finding across the anxiety disorders, with clinically anxious subjects in various populations showing differential encoding of threat-related (i.e., disorder relevant) stimuli. However, studies of implicit memory bias have been mixed, perhaps due to methodological and measurement issues. These cognitive psychology paradigms have utility outside the realm of emotional disorders and may inform researchers about cognitive processes involved in physical illness as well.

Cognitive Processing in Health Populations

There has been investigation of health-related information processing in medical populations, but very few studies have focused specifically on implicit memory bias in these groups. Illness perception researchers began by focusing on fear and perceptions of illness as threat (Scharloo & Kaptein, 1997). Illness representations have been hypothesized to play an important role in guiding coping (medical and nonmedical) and in the understanding, evaluation, and regulation of treatment (Leventhal, Meyer, & Nerenz, 1980).

Despite differences in methodology and terminology in the field of illness representations, there is a consensus among health psychology researchers that there are five dimensions people use to cognitively organize their illness experience (Scharloo & Kaptein, 1997). These dimensions were proposed by Leventhal et al. (1980) as part of his common sense model of illness representations. Researchers agree that illness experience is organized cognitively along five dimensions: identity, cause, consequences, time-line, and controllability (Baumann, Cameron, Zimmerman, & Leventhal, 1989; Lau & Hartman, 1983; Leventhal, Meyer, & Nerenz, 1980). Identity refers to the name or label a patient gives to his or her illness, along with the signs and symptoms s/he attributes to it. Cause refers to the ideas the patient has about possible etiologies for the illness (i.e., biological or environmental). The third dimension of consequences reflects the patient's ideas about short and long-term effects of the disease. Time line refers to the beliefs and expectations the patient has about the course and chronicity of his or her illness. Finally, controllability refers to the extent to which the patient believes s/he or medical professionals can impact the course of illness and recovery.

Leventhal et al. (1980) proposed that people often have highly idiosyncratic conceptions of the physical symptoms that are associated with specific diseases such as hypertension and cancer. Their theoretical model, the self regulatory processing system (also know as the common sense model of illness representations), proposed that representation of illness is a result of cognitive response to symptoms and illness, and is processed in parallel to emotional responses.

The common sense model of illness cognition is different from other conceptualizations because of it focus on proximal goals (i.e., symptoms) as ongoing guides to self-regulation and adherence. In Leventhal's initial common sense model of illness, the patient forms representation of his or her own illness based on several components: identity, cause, time line, and consequences. Lau and Hartman (1983) found support for these four components, but also cited a need for a fifth component of cure and controllability. As stated previously, there is now a consensus among health psychology researchers about these five dimensions. These dimensions are important because the patient uses these processes to form a mental representation and guide coping (Weinman, Petrie, Moss-Morris, & Horne, 1996).

Researchers have applied cognitive psychology theory to the problem of explaining health-related information processing. Cognitive theorists such as Rosch (1978) have used a prototype model to explain categorization decisions. The prototype model contends that recognition of physical objects and the processing of related information is influenced heavily by preexisting conceptions the person has of various types of objects. While processing, the person classifies an object according to degree of fit exhibited with the idealized prototypes of different categories of objects. For instance, when an individual determines that the object before them is a cup it is because they have perceived the physical characteristics of the cup and engaged in a process of comparing this set of characteristics to general, idealized prototypes s/he holds for "cup," "mug," "bowl," etc. If the number of like characteristics is more than the number of characteristics that are "not cup," then the determination is made that the object is, in fact, a cup.

Bishop (1981) and Bishop and Converse (1986) applied cognitive theory to the processing of physical symptoms. These authors asserted that an integral step in the process of care-seeking for physical illnesses was the individual's interpretation of the symptoms they were experiencing. They cite evidence that individuals respond differently to physical symptomatology and show that despite frequency of symptom experience, certain symptoms go untreated and possible ignored. For instance, Bishop (1984) found that even some of the most seemingly serious symptomatology went untreated (i.e., severe depression and rectal bleeding). Bishop and Converse (1986) found support for their disease prototype model of the interpretation of physical symptoms that suggests that individuals process information about their physical symptoms based on certain preconceived notions they hold about how symptoms for disease fit together. They showed that subjects, consistent with prototype theory, were more likely to recognize a symptom set as indicative of a specific disease when all of the symptoms related closely to the subjects' commonly held prototype for that illness. For instance, subjects were presented with the following prototypical flu symptoms: fever, sore throat, aches all over, headache, chills, and nasal congestion. These six related symptoms contrast with the four unrelated symptoms of difficulty hearing, swollen ankle, pain in shoulder, and weight gain. Subjects were more confident about and better able to identify symptom sets as indicators of a specific disease when the symptom set was highly prototypical of a particular disorder (i.e., had only one, if any, irrelevant symptoms). Further, their work showed that explicit diagnosis increased the recall of symptoms that were consistent with the prototype while decreasing recall of symptoms that were irrelevant to the subjects' prototype.

While Bishop and Converse (1986) showed support for the hypothesis that individuals have well-structured and fairly stable mental representations of symptoms and the other attributes that are associated with a particular disease or illness state, they only looked at the cognitive aspect of these mental representations. The emotional aspects of the experience of symptoms and illness were not discussed. Further, they only considered symptoms associated with different diseases, not other components which have been proposed to be important in forming mental representations.

Leventhal and Nerenz (1982) studied the common sense models of illness in hypertensive patients and found that the components of identity, consequences, time line and cause interrelated in several different schemas of illness: acute, cyclic, and chronic. Much of the early research generated by Leventhal and colleagues focused on severe illnesses, leading Lau and Hartman (1983) to hypothesize that this narrow examination caused them to overlook a fifth common component of cure or how the individual goes about recovering from the illness. They argued that if Leventhal et al. had considered illnesses from which patients had recovered, instead of only severe illnesses, then the cure component would have been seen as theoretically important.

Leventhal, Meyer, and Nerenz (1980) and Meyer, Leventhal, and Gutman (1985) have also studied hypertensive patients and found support for the development of implicit representations of illness and subsequent treatment compliance behavior.

Edwards and Pearce (1994) investigated internal pain representations (i.e., pain schemata) in a chronic pain population using a perceptual memory task. Chronic pain patients, health professionals, and normal controls were compared on a task testing implicit memory in unprimed words only. Subjects were presented with 12 three-letter word stems and asked them to complete the items with the first two words of any length that came to mind. The authors reported that chronic pain patients produced a significantly greater number of pain-related word completions when compared to non-patient controls. Health professionals produced an average number of pain-related words that was intermediate to the other two groups. The authors maintained that this data could be interpreted as evidence of a specific pain schema in chronic pain patients or as evidence of differences in baseline levels of activation of pain schemas.

In summary, there is a consensus in the health psychology field that people cognitively organize their illness experience, including cardiac illness, along the dimensions of identity, cause, time line, consequences, and, lastly, cure and controllability. Previous studies have examined illness schemas using Leventhal et al.'s (1980) theoretical model to determine coping and adherence behaviors, as well as health-care utilization behaviors. Cardiac illness perceptions, or cardiac schemas, have been studied and shown to be important in determining attendance at cardiac rehabilitation programs and return to work (Petrie & Weinman, 1997). However, most of the information processing studies with cardiac patients and in other health psychology populations have focused only on patients' conscious beliefs about illness and how these affect coping and other behaviors, not on the unconscious or automatic process used to process information about their illness. Information processing outside of awareness, so often the focus of study in emotional disorders, may also have an effect on cardiac patients' illness rehabilitation and recovery. In fact, none of the research that has been done to date with cardiac illness perceptions and schemas has utilized the cognitive psychology paradigms which are used in psychopathology research. The study of cardiac schemas has been limited to either interview or self-report questionnaire methods. This is problematic because self-report data is heavily influenced by the defensiveness bias and, therefore, raises questions about the accuracy of the report (Croyle, Sun, & Hart, 1997). Defensiveness is a component of health-related cognition across a variety of illness domains. Patients suffering from a variety of illnesses manifest this defensive bias, perhaps, according to Croyle, Sun, and Hart (1997), because of a general tendency to forget or minimize information or stimuli that threatens the self-concept. Because cardiac illness is personally relevant and the situation is ambiguous (two factors important in defensiveness) cardiac patients may be likely to minimize or inaccurately report on measures designed to assess cognitive processes and the emotional impact of cardiac event. To date, no studies have examined implicit memory bias and cardiac schemas using measures that are free of the defensiveness bias. In the present study, a cognitive psychology paradigm was used to assess implicit memory bias in a population of cardiac patients recovering from a cardiac event. This paradigm is an indirect measure and, therefore, not subject to the defensiveness bias seen with self-report measures.

Methodological and Conceptual Issues in Assessing Implicit Memory

Although implicit memory is a conceptual, or meaning-based process, many researchers have utilized perceptual tasks to assess it. Perceptual tasks, like the word stem completion task, require subjects to respond to stimuli presented in degraded form (Amir et al., 1996). These perceptual tasks, including the word stem completion task, have been criticized by McNally (1995) and Amir et al. (1996a) for a number of reasons. First, because these tasks are perceptual in nature, they are not appropriate as measures of meaning based (conceptual) processes. Second, subjects may rely on explicit memory to generate the missing stimuli (i.e., word stem endings), thereby contaminating the assessment of implicit memory. If subjects use effortful, controlled explicit memory to generate word endings or other stimuli, then the implicit measure is not valid. Finally, performance on such tasks may also be influenced by subjects' avoidance of threat-related stimuli. McNally (1995) and Amir et al. (1996a) posit that a true measure of implicit memory must utilize a conceptual task which avoids the problems of contamination by explicit memory.

<u>The white noise paradigm</u>

Jacoby, Allan, Collins, and Larwill (1988) devised the white noise paradigm to test implicit memory through an indirect method that did not depend upon the perceptual characteristics of the stimuli. The white noise paradigm is a conceptual task where subjects are required to make subjective judgements about noise levels. Jacoby et al. (1988) argued that prior experience (previous presentation of stimuli) influences subjective experience (rating of the noise). In the white noise paradigm task, subjects first encode test stimuli (i.e., words or sentences). Then they rate the volume of background noise associated with the previously encoded stimuli (old) as well as new stimuli. Jacoby et al. (1988) demonstrated that subjects rated the noise accompanying old sentences as less loud than noise accompanying new sentences. The authors interpreted this as evidence of the influence of implicit memory on the subjective experience of noise judgement. Other researchers have used this paradigm to examine implicit memory bias in panic disorder (Amir et al., 1996a) and obsessive compulsive disorder (OCD: Foa et al, 1997). Amir et al. (1996) found a differential priming effect for threat stimuli between panic patients and normal controls at the low noise level. The authors argued this was evidence for the automatic accessibility of threat-relevant information in panic patients. Foa et al. (1997) investigated implicit memory bias in OCD patients using the white noise paradigm and replicated Jacoby et al.'s (1988) earlier findings that participants rated noise associated with old stimuli as less loud than noise associated with new stimuli. However, they did not find support for an implicit memory bias for threat-relevant stimuli.

There are several advantages to using the white noise paradigm. First, the task is a measure of conceptual implicit memory, not of perceptual implicit memory. Therefore, subjects are not asked to generate threat-relevant stimuli as they are in perceptual tasks. Second, because the measure is indirect, explicit strategies do not contaminate the measure. Finally, the white noise paradigm is useful because it avoids the limitations of self-report strategies and the defensiveness bias.

Rationale of the present study

Information processing biases have been hypothesized to play a significant role in the development and/or maintenance of symptomatology in a variety of populations, but implicit memory bias has never been examined in a cardiac population. In this study we investigated information processing in a cardiac population using an implicit memory paradigm to assess for implicit memory bias. Implicit memory paradigms are used to measure how information is represented in cognitive memory structures or schema. For this study, a conceptual implicit memory measure was used to assess the cognitive mechanisms and internal representations of cardiac events in cardiac patients. If a cardiac threat schema develops and is chronically activated, according to information processing theories, then the cardiac patient will engage in selective processing of environmental stimuli. This constant state of hypervigilance (i.e., scanning one's body for signs of another cardiac event) may have implications for the individual's rehabilitation. This area of research may facilitate identification of effective psychological interventions and approaches for the rehabilitation of cardiac patients.

Specific hypotheses of the present study

In this investigation cardiac patients' implicit memory for cardiac information was compared to the implicit memory of cardiac health professionals. We hypothesized cardiac patients would be characterized by an implicit memory bias for cardiac-relevant stimuli, and would, therefore, rate noise surrounding cardiac-relevant words as less loud than noise surrounding neutral and social threat-relevant words. We expected this effect would be specific for cardiac threat and not just threat in general. Therefore, noise ratings were also assessed for social threat words. We expected cardiac patients would rate noise surrounding cardiac-relevant words as less loud than noise surrounding social threat words.

Hypothesis #1: All subjects will rate the white noise surrounding old words (regardless of word type) as less loud than the noise surrounding new words (Jacoby et al., 1988). This finding would support the utility of the white noise paradigm as an implicit memory measure.

Hypothesis #2: Cardiac subjects will rate the white noise surrounding cardiac-relevant words as less loud than the white noise surrounding neutral and social threat words, while cardiac health professionals will not show this effect. This finding would show support for the hypothesis that cardiac patients develop and exhibit an implicit memory bias for threat-relevant material (cardiac-related material).

METHOD

Participants

Subjects were 20 cardiac patients enrolled in an outpatient cardiac rehabilitation program in Park Ridge, IL, and 20 health professionals currently working with cardiac patients in community hospitals in suburban Chicago. The cardiac patients were in phase II of their recovery from a major cardiac event (i.e., coronary artery bypass surgery, myocardial infarction, angioplasty, etc.). The Phase II Cardiac Rehabilitation program is an individualized exercise program which begins when the patient is discharged from the hospital following his or her cardiac event. Patients complete 1-3 months of medically monitored exercise at a frequency of 3 sessions per week. To meet inclusion criteria, the patient must have experienced a cardiac event or illness in the past six months (i.e., myocardial infarction, angioplasty, or bypass surgery), be a native English speaker, and deny any hearing problems. Cardiac status (i.e., date and type of cardiac event) was assessed by patients' self-report and confirmed by medical records. These patients were compared to a control group of health professionals who worked with cardiac patients as part of their daily jobs. This group included exercise physiologists, nurses, and electrocardiogram (EKG) technicians. Controls were free of diagnosed cardiovascular conditions. All participants included in the study denied any hearing problems that could interfere with their ability to perceive the stimuli in the white noise paradigm and spoke English as their first language.[1]

---

[1] One health care worker whose native language was not English was included in the study because she spoke extremely fluent English.

Measures

Implicit Memory Assessment: The white noise paradigm task was used to assess implicit memory bias. In this task, participants were presented with cardiac-related, neutral, and social threat words on an audiotape. In the test phase of the experiment, the words were presented with varying levels of white noise. We chose 3 different noise levels (low (64$\pm$1 dB), medium (68$\pm$1 dB), and high (72$\pm$1 dB) based on previous studies which used 3 levels to provide subjects with a variety of white noise levels (Amir et al., 1996; Jacoby et al., 1988), as well as to maximize the chance of finding an effect in at least one noise level. Subjects were asked to listen to the words, repeat them, and rate the volume of the background noise. The test audiotape had a total of 54 words: 18 cardiac-related (i.e., procedure, nitroglycerin), 18 neutral (i.e., pillow, leaf), and 18 social threat words (i.e., criticism, lonely). The cardiac words were selected using a pool of words rated as the most related to a cardiac event or cardiac illness by cardiac patients and health professionals. A group of 17 cardiac patients and cardiac professionals were surveyed and asked to rate the relatedness of a list of cardiac words to cardiac events and conditions. The words with the highest means for both groups were selected. The neutral and social threat words were selected from pools of matched word sets used in previous investigations of information processing biases (Mathew, Mogg, Kentish, & Eysenck, 1995). All the words were matched on frequency in the English language (Carroll, Davies, & Richman, 1971). The word frequencies of the 3 word types (cardiac, neutral, and social threat) ranged from 99.4- 113.1 and were not significantly different ($\underline{p}$=.841). There were two equivalent sets of words constructed for the encoding phase audiotapes, set A and set B, and these sets were counterbalanced when presented to subjects in each group. The test words and the white noise were recorded through a Panasonic Digital AV mixer on separate channels, with test words on the left and white noise on the right. A Shure SM58 microphone was used for the voice and the white noise was generated by a Panasonic AG 1950-VCR tuner. The "left" speaker was placed on top of the "right" and study participants were seated directly in front of the speakers, about 5-7 feet away.

In the first phase of the white noise task, the encoding phase, subjects listened to an audiotape of 27 words (9 cardiac-related, 9 neutral, and 9 social threat) and repeated each one. These words were from either set A or set B. These words were presented again in the test phase with 27 new words. Next, in the practice phase, subjects practiced rating the background noise on neutral words. Subjects listened to 9 words, masked by varying levels of white noise (low, medium, and high), repeated the word, and then rated the volume level of the background noise on a scale from 1 to 5 (least noise to greatest noise). The volume level was constant for the words (at the same decibel level throughout), while the white noise which masked the words alternated between one of the three decibel levels, in a fixed random manner. The test phase was next; here, subjects listened to the entire set of 54 words (half of which have been previously presented), repeated each word and rated the volume level of the white noise in the background. There was only one audiotape for the test phase; all subjects heard and rated the stimuli using this same tape. At the end of the white noise implicit memory task, subjects completed two forms, rating the words on their relatedness to cardiac events and their degree of emotionality.

Emotionality Rating: The Emotionality Rating measured the extent to which subjects perceived the test words as emotionally-laden. Subjects rated the meaning of the word for them personally on a scale of -3 (very disturbing) to +3 (very pleasant), with 0 being neutral.

Relatedness Rating: The Relatedness Rating measured subjects' perception of how related the test words were to cardiac events or conditions. Specifically, cardiac patients rated how related the words were to their own cardiac event and health professionals rated relatedness to cardiac events in general. This measure used a scale from -3 (very unrelated) to +3 (very related).

Demographic Data: Subjects provided information on the date and type of their cardiac event, medication status, marital status, gender, education, age, and history of cardiac health.

Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961): The BDI is a 21-item self-report instrument which measures cognitive and somatic symptoms of depression. Subjects indicate, on a scale of 0 to 3, the severity of each symptom presented, with total scores ranging from 0 to 63. All the major signs of depression are included in the 21 items, but the majority evaluate cognitive symptoms. Rehm (1988) reported test-retest reliability for one to three months at .74, and alpha coefficients of .76-.95 on tests of internal consistency.

Spielberger State-Trait Anxiety Inventory (STAI; Spielberger, et al., 1983): The STAI is a self-report measure which will be used to assess both state and trait anxiety in subjects. The STAI consists of two 20-item subscales. The state subscale assesses the current level of anxiety using ratings from 1 to 4, and total scores ranging from 20 to 80. Tests of internal consistency for this subscale yield alpha coefficients ranging from .90-.93 for college females (Spielberger et al., 1983). Test-retest reliability for the STAI-S for one hour between testing is .16-.31 (Spielberger et al., 1983). The trait subscale is a measure of the subject's general anxiety level tendencies. The STAI-T total scores range from 20 to 80, with individual items rated on a scale from 1 to 4. Spielberger et al. (1983) reported test-retest reliability over a two month period at .73-.86, and alpha coefficients of .90 on tests of internal consistency.

Anxiety Sensitivity Index (ASI; Reiss, Peterson, Gursky, & McNally, 1986): The ASI measures beliefs regarding the negative somatic and social consequences of anxiety. This self-report instrument can be conceptualized as a "fear of fear" measure (Bellack & Hersen, 1988). It has 16 items which are rated from 0 to 4 according to the individual's tendency to respond fearfully to symptoms of anxiety. The range of total scores is 0 to 64. Split half reliability for the ASI is .85 (Peterson & Heilbronner, 1987), while test-retest reliability for two weeks ranged from .71 to .75 (Reiss et al., 1986).

Procedure

Cardiac subjects were informed of the study at the time of their initial stress evaluation and asked to participate during their regular exercise class once they started the program. All patients who met inclusion criteria were asked to participate. Eligible health professionals were approached by the investigator and asked to participate. All subjects were informed that participation was voluntary and confidential, and that the study protocol consisted of a single 30-40 minute session.

Following the subjects' signed informed consent, subjects completed the white noise paradigm. Then the subjects completed several questionnaires: the Anxiety Sensitivity Index; the Beck Depression Inventory; the State-Trait Anxiety Inventory; and a demographic sheet. Subjects were then thanked for their participation and debriefed.

Results

Data screening

Prior to analysis, data was assessed for existence of missing values, outliers, and normal distributions. There were two missing data points on the State version of the STAI. The STAI-S subscale mean was calculated for each subject and used to replace the missing values. Frequency distributions of white noise rating scores were examined and no significant deviations from normality were found. Two cases in the cardiac group were univariate outliers because of their extremely high z scores (+ 3 SD) on a number of the noise rating means. These cases were deleted, leaving 20 cases in the health professionals group and 18 in the cardiac patient group. All analyses conducted and reported represent data from the remaining 38 cases.

Demographic and questionnaire data

Independent group t-tests and chi square tests were used to determine if groups differed on demographic and questionnaire variables. The two groups did not differ significantly on scores for the ASI [$t(36) = 0.26$, $p = .80$], the STAI-S [$t(36) = 0.12$, $p = .91$], or the STAI-T [$t(36) = 0.88$, $p = .39$]. However, cardiac patients were significantly older [$t(36) = 6.50$, $p = .0001$], had fewer years of education [$t(36) = -4.82$, $p = .0001$], and had higher scores on the BDI [$t(36) = 2.54$, $p = .02$] than health professionals. The groups differed on gender, as well, with more male cardiac patients and more female health professionals [$X^2(1) = 13.81$, $p = .0001$]. The two groups did not differ in number of people married [$X^2(1) = 1.64$, $p = .20$], divorced [$X^2(1) = 0.01$, $p = .94$], or widowed [$X^2(1) = 2.346$, $p = .13$], but health professionals were more likely to be single [$X^2(1) =$

6.41, p = .01] than cardiac patients. These results are summarized in Table 1.

The cardiac patients had all experienced a cardiac event or condition in the months prior to testing, with the mean time since cardiac event at 2.83 months (SD=1.10). Patients experienced a broad range of cardiac events, including angioplasty only (n = 4), coronary artery bypass (n = 3) or bypass plus angioplasty (n = 6), and myocardial infarction plus angioplasty (n = 6) or myocardial infarction plus bypass (n = 2). These figures are summarized in Table 2.

Assessment of paradigm validity

The first analysis conducted was a test of the validity of the white noise task as a measure of implicit memory. We expected to find evidence of a general priming effect in the analysis of the noise ratings, predicting that noise surrounding old words would be rated as less loud than noise surrounding new words. Using the raw data, we ignored word type and subject group to examine the noise rating means for old and new words. However, a paired samples t-test of old vs. new words' noise rating means was not significant [$t(37) = .269$, $p = .79$].

Because we had hypothesized we might only see the priming effect at certain noise levels, we then submitted these data to a 2 (Presentation: Old vs. New) X 3 (Noise Level: Low, Medium, High) analysis of variance (ANOVA) with repeated measures on both factors. Contrary to our hypothesis, this did not produce a significant main effect for presentation [$F(1, 33) = .073$, $p = .79$]. The analysis did produce a significant main effect for noise level [$F(2, 74) = 733.08$, $p < .0001$]. The interaction of noise level and presentation was non-significant [$F(2, 74) = 1.31$, $p = .28$]. The means and standard

Table 1

Mean scores and standard deviations for demographic variables and questionnaire data

	Cardiac Group (n = 18)		Health Professional Group (n = 20)	
	M	SD	M	SD
Age**	60.17	(12.56)	35.00	(11.30)
Education (years)**	14.00	(2.14)	17.00	(1.69)
ASI	19.06	(10.87)	18.25	(8.27)
BDI**	7.44	(7.44)	2.90	(2.77)
STAI-S	29.72	(7.09)	29.45	(7.47)
STAI-T	35.61	(11.71)	32.70	(8.66)
Sex (M/F)**	11/7		1/19	
Marital Status* (M/S*/D/W)	15/0/1/2		13/6/1/0	

Note. ASI = Anxiety Sensitivity Index; BDI = Beck Depression Inventory; STAI-S = State-Trait Anxiety Inventory- State Scale; STAI-T = State-Trait Anxiety Inventory-Trait Scale; Sex (M = male; F = female); Marital Status (M= married; S= single; D= divorced; and W= widowed). *$p<.05$. **$p<.001$.

Table 2

Types of cardiac events experienced by cardiac patients and time since event

Cardiac Group (n = 18)		
Event type	n	Mean time since event in months (SD)
Angioplasty only	4	3.25 (1.26)
Coronary Artery Bypass Surgery	6	2.83 (1.33)
Bypass only (n =3)		
Bypass+angioplasty (n =3)		
Myocardial Infarction (MI)	8	2.63 (0.92)
MI + angioplasty (n =6)		
MI + bypass (n =2)		

deviations of noise ratings for both groups are presented in Table 3.

Examination of apparatus

Since the overall priming effect was not found as hypothesized, we did not proceed with the planned analyses. Instead, we attempted to determine if technical problems with the apparatus could have prevented the expected priming effect. We examined the two sets of stimuli presented in the encoding phase for inconsistencies. Two tapes – Tape A and Tape B– were presented in a counterbalanced order in the encoding procedure. These tapes had equivalent sets of words on them that were matched for word frequency in the English language and relatedness to cardiac events/conditions. A review of the encoding tapes and the test tape did not reveal any discernable differences. Further analyses were conducted to determine if priming occurred for only one tape.

Paired t-tests were conducted separately on old vs. new words' noise rating means for Tape A and Tape B. Subjects who were presented Tape A ($n = 21$) in the encoding phase showed the opposite of the predicted priming effect in the test phase; these subjects rated noise associated with old words as louder than that of new words [$t(20) = 4.05$, $p = .001$]. For Tape B only, subjects ($n = 17$) rated old words as less loud than new words, an indication of priming [$t(16) = -3.01$, $p = .008$]. These results are summarized in Table 4.

Since the priming effect was not found in the overall sample, conducting further analyses on the entire sample was not justified. Instead, the experimental analysis to test our main hypotheses was conducted only on data from subjects who received Tape B during priming since this was the only tape that was associated with the predicted implicit memory effect.

Table 3

Mean scores and standard deviations for noise ratings

	Cardiac Group (n = 18)		Health Professional Group (n = 20)	
	New	Old	New	Old
	M SD	M SD	M SD	M SD
Noise Level				
Low				
Word Type				
Cardiac	1.69 (.55)	1.91 (.71)	1.97 (.75)	2.07 (.65)
Neutral	1.69 (.58)	1.70 (.50)	1.83 (.71)	1.90 (.65)
Social threat	1.65 (.51)	1.67 (.62)	1.93 (.55)	1.98 (.71)
Medium				
Word Type				
Cardiac	3.30 (.48)	3.39 (.40)	3.43 (.49)	3.47 (.50)
Neutral	3.19 (.51)	3.00 (.46)	3.45 (.46)	3.38 (.52)
Social threat	3.13 (.47)	3.22 (.43)	3.45 (.53)	3.50 (.58)
High				
Word Type				
Cardiac	4.37 (.47)	4.35 (.45)	4.62 (.31)	4.68 (.33)
Neutral	4.46 (.46)	4.41 (.41)	4.67 (.34)	4.48 (.32)
Social threat	4.26 (.45)	4.17 (.42)	4.58 (.30)	4.53 (.45)

Note. Scores range from 1 to 5.

Table 4

Mean scores and standard deviations of noise ratings for both tapes

	Tape A ($n = 21$)		Tape B ($n = 17$)	
Noise ratings	M**	SD	M*	SD
Old words	29.70	(2.76)	28.06	(3.77)
New words	28.60	(2.28)	29.26	(3.68)

Note. *$p < .05$. **$p < .001$.

Paired samples t-tests for presentation effect were conducted on the remaining data to determine if the paradigm had operated at all noise levels for Tape B. There was no evidence of priming at the medium [$t(16) = -1.17$, $p = .26$] or high [$t(16) = -1.13$, $p = .28$] noise levels. However, there was a presentation (priming) effect at the low noise level [$t(16) = -2.82$, $p = .01$].

Therefore, all remaining analyses conducted used Tape B subjects, low noise level scores only. This significantly reduced our sample size and we, therefore, modified our original analytic strategy and chose more appropriate analyses to test our hypotheses.

Main analyses

Due to small sample size (see Table 5), an omnibus test was no longer appropriate. Therefore, to test the hypothesis that cardiac patients would rate noise surrounding cardiac words as less loud than noise surrounding other word types, a within-group analysis was conducted. A one-way repeated measures ANOVA revealed that there were no significant differences in noise ratings across word type for cardiac patients [$F(2, 12) = 0.14$, $p = .87$]. Cardiac patients did not rate noise surrounding cardiac words as significantly less loud than noise surrounding neutral and social words. This analysis was repeated for the health professional group. As expected, the health professionals did not rate noise levels differently across word types [$F(2, 18) = .24$, $p = .79$]. There were no significant differences in noise ratings for the three different word types.

To test the hypothesis that cardiac patients would differ from health professionals in their ratings of noise surrounding cardiac words, between group analyses were performed. Independent groups t-tests revealed a trend for cardiac patients to rate

Table 5

Mean scores and standard deviations for low noise ratings for Tape B subjects only

	Cardiac Group (n = 7)	Health Professional Group (n = 10)
	M SD	M SD
Low Noise Level		
Word Type		
Cardiac	1.67 (.50)	2.17 (.55)
Neutral	1.62 (.46)	2.07 (.70)
Social threat	1.62 (.61)	2.10 (.67)

cardiac words as less loud than health professionals [t (15) = -1.91, p = .08]. No between group differences were found for neutral [t (15) = -1.48, p = .16] or social threat [t (15) = -1.51, p = .15] words.

Discussion

Previous studies have examined information processing and found it to be important in the etiology and/or maintenance of anxiety disorders, including generalized anxiety disorder (GAD: Williams, Watts, MacLeod, & Mathews, 1988) and panic disorder (McNally, 1994). The assumption underlying this work is that individuals with anxiety disorders process threat information in a biased manner. One type of information processing bias, attentional bias, has consistently been found in a variety of anxious populations using paradigms such as the modified Stroop paradigm (Mathews & MacLeod, 1985) and the dot probe detection technique (MacLeod & Mathews, 1988). Researchers have found evidence of attentional bias in patients with PTSD (McNally, Kaspi, Riemann, & Zeitlin, 1990), social phobia (Hope, Rapee, Heimberg, & Dombeck, 1990), simple phobia (Watts, Trezise, & Sharrock, 1986), and panic (McNally, Riemann, & Kim, 1990).

Memory bias is another type of information processing bias that has been investigated in the study of anxiety disorders; however, the findings in this area have been more complex and less consistent than in the area of attentional bias. Evidence for an implicit memory bias has been particularly mixed (McNally, 1995). There has been evidence of enhanced priming of threat material in various clinical populations, including GAD (Mathews et al., 1989), panic disorder (Cloitre, Shear, Cancienne & Zeitlin, 1994), and PTSD (Zeitlin & McNally, 1991). Yet other studies yield no implicit memory biases in the same populations; for example, researchers failed to replicate these effects in panic (Otto, McNally, Pollack, Chen & Rosenbaum, 1994) and GAD (Mathews, Mogg, Kentish, & Eysenck, 1995) populations. Some of the contradictory results in the implicit memory field could be due to the variety of implicit memory measures used and the possible contamination of implicit memory by explicit or strategic processes (Amir et al., 1996a).

In his review of implicit memory, Schacter (1987) documented the robust evidence for the existence of implicit memory across different materials, tasks, and subject populations, despite the fact that there are several different phenomena that fall under the rubric of implicit memory. The area that pertains to the present study and the investigations of cognitive biases in anxiety disorders is the direct or repetition priming research. Schacter describes direct priming effects as a facilitation of stimulus processing due to previous experience with the same stimulus. While no one theoretical account can explain the diversity of implicit memory phenomena seen in research over the past 40 years, according to Schacter (1987), the direct or repetition priming effects can be explained using one theoretical explanation of implicit memory, activation theory. The activation views, according to Schacter, attribute priming effects on implicit memory tasks to the automatic and temporary activation of cognitive representations. The present study used the white noise paradigm task to measure implicit memory based on this theory.

In an attempt to improve upon methodology in implicit memory bias research, experimental psychopathologists have adapted Jacoby's white noise paradigm and applied it to the study of anxiety disorders and implicit memory bias. The white noise paradigm has advantages over traditional measures of implicit memory. First, it is a conceptual measure, tapping the meaning of words, not focusing on their perceptual characteristics (McNally, 1995). The measure is also free from the risk of contamination by strategic or explicit processes because the task is an indirect one, asking subjects to rate noise, not create words from word stems (Amir et al., 1996a). Using the white noise paradigm, researchers have found evidence for enhanced priming of threat material in several populations, including PTSD patients (Amir, McNally, & Wiegartz, 1996b) and panic patients (Amir et al., 1996a).

In this study an attempt was made to evaluate implicit memory bias in a population of cardiac patients to determine if the personal experience of a cardiac event leads to changes in information processing, specifically to an implicit memory bias. Contrary to expectations, we did not find an overall priming effect for old vs. new words, the core indicator of implicit memory with this paradigm. Evidence of a general priming effect was found only for a subset of subjects who received Tape B in the encoding phase, and only at the low noise level.

Therefore, subjects who were asked to listen to Tape B were included in the limited analyses. This analysis included only a small number of cardiac patients ($\underline{n}$=7) and health professionals ($\underline{n}$=11). We had hypothesized that cardiac patients would show an implicit memory bias for cardiac words by rating noise associated with cardiac words as less loud than health professionals did, and, further, that this bias would be specific for cardiac stimuli, such that cardiac patients would rate noise associated with cardiac words as less loud than that of neutral or social threat words. Contrary to expectations, there was little evidence for a cardiac-specific implicit memory bias. Between group analysis did reveal a trend for cardiac patients to rate noise associated with cardiac stimuli as less loud than health professionals. However, cardiac patients did not rate noise associated with cardiac stimuli as significantly less loud than noise surrounding neutral and social threat words.

We did not see evidence of the general priming effect or implicit memory bias using the white noise paradigm. There are no published studies reporting difficulty in achieving the general priming effect for old vs. new stimuli. However, in a personal communication to Amir in 1993, Jacoby noted that researchers have found that the priming effect disappears if the lapse between stimuli and white noise onset is greater than .5 seconds. He termed this the asynchrony problem. It is possible the procedure of recording the mix of white noise and word stimuli led to the synchronization problem noted by Jacoby, although efforts were made to avoid this problem during the recording of the tapes for this study and subsequent review has revealed no discernable latencies.

While the white noise paradigm has advantages over the traditional measures of implicit memory, there is evidence that the paradigm is a somewhat fragile one. Some problems have been noted in attaining the implicit memory bias effect. For example, Foa et al. (1997) failed to find any evidence of an implicit memory bias in an OCD population. The authors conclude that perhaps OCD patients, by virtue of their overall elevated anxiety, are characterized by a perceptual deficit rather than a memory deficit, thereby explaining the lack of an implicit memory effect. This is the only published study that failed to find evidence of an implicit memory bias for threat-relevant stimuli using the paradigm, but other researchers have had difficulty obtaining the effect at various noise levels. In a study of panic patients, Amir et al. (1996a) found the implicit memory bias only at the low noise level (60 ± 1 dB), not at medium (64 ± 1 dB) or high (68 ± 1 dB) levels. The authors surmised that the range of effective noise levels might be different across age groups. Their study used an older sample (mean age= 44 years) than other studies (Foa, et al., 1996; Jacoby et al., 1988). However, using slightly different noise levels, Amir, McNally, and Wiegartz (1996b) found the enhanced priming for threat material only at the high noise level (64 ± 1 dB) in their study of vets with PTSD with a mean age of approximately 47 years. The authors in this study suggested that perhaps the clinical condition and the nature of the test sentences produced floor effects in the low and medium levels. Taken together, the studies that have utilized the white noise paradigm provide some support for the paradigm's utility in measuring implicit memory bias, but the effects are clearly not robust. Even slight deviations in procedure seem to reduce the chances of obtaining consistent effects.

There are several limitations to the current study that should be mentioned. First, due to the fact that the paradigm operated only at one noise level for a subgroup of the sample, our study only compared low noise level (64 ± 1 dB) scores for a small number of cardiac and health professionals. Given that previous researchers have had difficulty finding the effect at all noise levels, our examination of only one volume significantly lessened our chances of finding the effect. Additionally, this extremely reduced sample size further reduced the likelihood of obtaining the effect. Second, the cardiac group was a heterogenous group that included patients with a variety of cardiac events. The group included subjects who had experienced life-threatening heart attacks with subsequent invasive bypass surgeries to patients who had experienced only the less invasive angioplasty procedures. Perhaps the severity (or perceived severity of the event) is a factor in determining whether an information processing bias develops. It is possible that our diverse patient sample differed based on type of event, but our small sample size precluded analyses to determine this. Third, the cardiac group also varied in time since event and number of sessions attended in rehabilitation class. Cardiac patients in our sample had experienced their events anywhere from 2 to 5 months previously. If an activated cardiac threat schema changes over time or over the course of rehabilitation interventions, this might explain the lack of findings in our cardiac population.

Despite the limited evidence provided by this study for a cardiac-specific threat schema in cardiac patients, this area warrants further investigation. Future studies could look at a more homogenous group of cardiac patients (e.g., patients who have experienced a first-time MI in the previous 1-2 months and who are in the first month of cardiac rehabilitation). Clearly, further research can improve upon this investigation by examining a larger sample of cardiac patients using a more robust implicit memory measure or combination of cognitive processing measures to evaluate the impact cardiovascular disease might have on information processing.

REFERENCES

Amir, N., McNally, R.J., Riemann, B.C., & Clements, C. (1996a). Implicit memory bias for threat in panic disorder: Application of the 'white noise' paradigm. Behavior Research and Therapy, 34(2), 157-162.

Amir, N., McNally, R.J., & Wiegartz, P.S. (1996b). Implicit memory bias for threat in posttraumatic stress disorder. Cognitive Therapy and Research, 20(6), 625-635.

Baumann, L.J., Cameron, L.D., Zimmerman, R.S., & Leventhal, H. (1989). Illness representations and matching labels with symptoms. Health Psychology, 8, 449-470.

Beck, A.T., & Emery, G. (1979). Anxiety disorders and phobias: An information processing perspective. New York: Basic Books.

Beck, A.T., Ward, C.H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. Archives of General Psychiatry, 4, 561-571.

Bishop, G.D. (1981). Understanding the understanding of illness: Lay disease representations. In J.A. Skelton & R.J. Croyle (Eds.), The mental representation of health and illness: Models and applications. New York: Springer-Verlag.

Bishop, G.D. (1984). Gender, role and illness behavior in a military population. Health Psychology, 3, 519-534.

Bishop, G.D., & Converse, S.A. (1986). Illness representations: A prototype approach. Health Psychology, 5(2), 95-114.

Carroll, J.B., Davies, P., & Richman, B. (1971). Word frequency book. New York: American Heritage.

Channon, S., Hemsley, D., & de Silva, P. (1988). Selective processing of food words in anorexia nervosa. British Journal of Clinical Psychology, 27, 259-260.

Cloitre, M., Shear, M.K., Cancienne, J., & Zeitlin, S.B. (1994). Implicit and explicit memory for catastrophic associations to bodily sensation words in panic disorder. Cognitive Therapy and Research, 18(3), 225-240.

Cohen, J. (1992). A power primer. Psychological Bulletin, 112(1), 155-159.

Cooper, M. J., & Fairburn, C. G. (1993). Demographic and clinical correlates of selective information processing in patients with bulimia nervosa. International Journal of Eating Disorders, 13(1), 109-116.

Cooper, M. J., & Fairburn, C. G. (1994). Changes in selective information processing with three psychological treatments for bulimia nervosa. British Journal of Clinical Psychology, 33, 357-365.

Croyle, R.T., Sun, Y., & Hart, M. (1997). Processing risk factor information: Defensive biases in health-related judgments and memory. In K.J. Petrie & J.A. Weinman (Eds.), Perceptions of Health & Illness (pp.267-290). The Netherlands: Harwood Academic Publishers.

Dalgleish, T., & Watts, F. (1990). Biases of attention and memory in disorders of anxiety and depression. Clinical Psychology Review, 10, 589-604.

Edwards, L. C., & Pearce, S. A. (1994). Word completion in chronic pain: Evidence for schematic representation of pain? Journal of Abnormal Psychology, 103(2), 379-382.

Foa, E.B., Amir, N., Gershuny, B., Molnar, C., & Kozak, M.J. (1997). Implicit and explicit memory in obsessive-compulsive disorder. Journal of Anxiety Disorders, 11(2), 119-129.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. Psychological Bulletin, 99(1), 20-35.

Frasure-Smith, N., Lesperance, F., & Talajic, M. (1995). The impact of negative emotions on prognosis following myocardial infarction: Is it more than depression? Health Psychology, 14(5), 388-398.

Green, M. W., & Rogers, P. J. (1993). Selective attention to food and body shape words in dieters and restrained nondieters. International Journal of Eating Disorders, 14(4), 515-517.

Gross, T. M., Jarvik, M. E., & Rosenblatt, M. R. (1993). Nicotine abstinence produces content-specific Stroop interference. Psychopharmacology, 110, 333-336.

Hope, D.A., Rapee, R.M., Heimberg, R.G., & Dombeck, M.J. (1990). Representation of the self in social phobia: Vulnerability to social threat. Cognitive Therapy and Research, 14, 177-189.

Jacoby, L.L., Allan, L.G., Collins, J.C., & Larwill, L.K. (1988). Memory influences subjective experience: Noise judgments. Journal of Experimental Psychology: Learning, Memory, and Cognition, 14, 240-247.

Katon, W., & Sullivan, M. D. (1990). Depression and chronic medical illness. Journal of Clinical Psychiatry, 51(6), 3-11.

Lau, R.R., & Hartman, K.A. (1983). Common sense representations of common illnesses. Health Psychology, 2, 167-185.

Leventhal, H., Meyer, D., & Nerenz, D. (1980). The common sense representation of illness danger. In S. Rachman (Ed.), Medical psychology (vol. 2, pp. 7-30). Elmsford, NY: Pergamon.

Leventhal, H., & Nerenz, D. (1982). Representations on threat and the control of stress. In D. Meichenbaum, and M. Jaremko (Eds.), Stress management and Prevention: A Cognitive-Behavioral Approach, (pp.5-38). New York: Plenum Press.

Logan, A.C., & Goetsch, V.L. (1993). Attention to external threat cues in anxiety states. Clinical Psychology Review, 13, 541-559.

McNally, R. (1994). Panic Disorder: A critical analysis. New York: Guilford Press.

McNally, R. (1995). Automaticity and the anxiety disorders. Behavior Research and Therapy, 33(7), 747-754.

McNally, R., Kaspi, S.P., Riemann, B.C., & Zeitlin, S.B. (1990). Selective processing of threat cues in post-traumatic stress disorder. Journal of Abnormal Psychology, 99, 398-402.

McNally, R., Riemann, B.C., & Kim, E. (1990). Selective processing of threat cues in panic disorder. Behavior Research and Therapy, 28, 407-412.

MacLeod, C., & McLaughlin, K (1995). Implicit and explicit memory bias in anxiety: A conceptual replication. Behavior Research and Therapy, 33(1), 1-14.

MacLeod, C., & Mathews, A. (1988). Anxiety and the allocation of attention to threat. The Quarterly Journal of Experimental Psychology, 40A(4), 653-670.

Mandler, G. (1980). Recognizing: The judgment of previous occurrence. Psychological Review, 87, 252-271.

Mathews, A., & MacLeod, C. (1985). Selective processing of threat cues in anxiety states. Behaviour Research and Therapy, 23(5), 563-569.

Mathews, A., Mogg, K., Kentish, J., & Eysenck, M. (1995). Effect of psychological treatment on cognitive bias in generalized anxiety disorder. Behavior Research and Therapy, 33, 293-303.

Mathews, A., Mogg, K., May, J., & Eysenck, M. (1989). Implicit and explicit memory bias in anxiety. Journal of Abnormal Psychology, 98(3), 236-240.

Meyer, D., Leventhal, & Gutmann, M. (1985). Common sense models of illness: The example of hypertension. Health Psychology, 4(2), 115-135.

Mineka, S., & Sutton, S. (1992). Cognitive biases and the emotional disorders. Psychological Science, 3(1), 65-69.

Perruchet, P., & Baveux, P. (1989). Correlational analyses of explicit and implicit memory performance. Memory and Cognition, 17, 77-86.

Peterson, R., & Heilbronner, R.L. (1987). The Anxiety Sensitivity Index: construct validity and factor analytic structure. Journal of Anxiety Disorders, 1, 117-121.

Petrie, K.J., & Weinman, J.A. (Eds.). (1997). Perceptions of Health and Illness: Current Research and Applications. The Netherlands: Harwood Academic Publishers.

Rapee, R.M. (1994). Failure to replicate a memory bias in panic disorder. Journal of Anxiety Disorders, 8(4), 291-300.

Rehm, L.P. (1988). Assessment of Depression. In M. Hersen & A.S. Bellack (Eds.), Behavioral assessment: A practical handbook (3rd ed., pp. 313-364) New York: Pergamon Press.

Reiss, S., Peterson, R.A., Gursky, D.M., & McNally, R.J. (1986). Anxiety sensitivity, anxiety frequency and the prediction of fearfulness. Behavior Research and Therapy, 24, 1-8.

Rosch, E. (1978). Principles of categorization. In E. Rosch & B.B. Lloyd (Eds.), Cognition and Categorization (pp. 27-48). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Schacter, D. L. (1987). Implicit memory: History and current status. Journal of Experimental Psychology: Learning, Memory, and Cognition, 13(3), 501-518.

Scharloo, M., & Kaptein, A. (1997). Measurement of illness perceptions in patients with chronic somatic illness: A review. In K.J. Petrie & J.A. Weinman (Eds.), Perceptions of Health & Illness (pp.103-154). The Netherlands: Harwood Academic Publishers.

Spielberger, C.D., Gorsuch, R.L., Luchene, R., Vagg, P.R., & Jacobs, G.A. (1983). Manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologist Press.

Watts, F.N., Trezise, L., & Sharrock, R. (1986). Processing of phobic stimuli. British Journal of Clinical Psychology, 25, 253-261.

Weinman, J., Petrie, K.J., Moss-Morris, R., & Horne, R. (1996). The Illness Perception Questionnaire: A new method for assessing the cognitive representation of illness. Psychology and Health, 11(3), 431-445.

Williams, J.M.G., Watts, F.N., MacLeod, C., & Mathews, A. (1988). Cognitive Psychology and Emotional Disorders. New York: Wiley.

Appendix A

Word Set A (Tape A)

Cardiac-Relevant Words:

procedure
illness
health
medical
anxiety
nitroglycerin
hospital
physician
surgeon

Neutral Words:

predict
leaf
switch
cherry
refrigerator
bath
washing
pillow
broom

Social Threat Words:

spite
mistake
blame
abandoned
stupid
offended
lonely
invisible
errors

Appendix B

Word Set B (Tape B)

Cardiac-Relevant Words:

pain
fatigue
patient
operation
lifestyle
scar
surgery
medicine
catheter

Neutral Words:

fountain
violet
opera
marble
upstairs
garage
lamp
curtain
purchase

Social Threat Words:

awkward
failed
criticism
forgotten
shy
useless
argument
foolish
silly