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# Information Processing In Anxiety And Depression: Attention Responses To Mood Congruent Stimuli

Glen Edward Berry

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**Information Processing in Anxiety and Depression:  
Attentional Responses to Mood Congruent Stimuli**

by

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**Department of Psychology**

**Submitted in partial fulfilment  
of the requirements for the degree of  
Doctor of Philosophy**

**Faculty of Graduate Studies  
The University of Western Ontario**

**London, Ontario**

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## Abstract

Previous research (e.g., MacLeod & Mathews, 1990) has found that anxious individuals show an attentional bias towards negative information, but evidence for such a bias in depressed individuals is equivocal. Conversely, there are fairly consistent findings that depressed individuals display a recall bias for negative information, whereas the findings for anxious individuals are mixed. However, task demands from this research may not have allowed anxious and depressed subjects to process information to the same extent. In the present study, 15 clinically depressed, 15 clinically anxious, 16 community control, 17 mildly depressed, 19 mildly anxious, and 17 nonclinical control subjects were tested on three attentional (modified dot probe, lexical decision, and negative priming) and two memory (word recall, and word completion) tasks using positive and negative words that were related to anxiety, depression, or a control condition. Clinically anxious and clinically depressed subjects both showed that some types of negative information (e.g., anxiety related) were more accessible than positive, but others were not (e.g., depression related, control). Also, clinically depressed subjects showed a tendency to disproportionately attend to negative information in general, whereas clinically anxious subjects avoided it. However, clinically depressed subjects were found to be slower to process information, and this effect could not be accounted for by motor retardation alone. It was concluded that clinically anxious and clinically depressed individuals recognize and respond to negative information in a similar fashion, except that clinically depressed individuals are slower in general to carry out these processes. The results from the two memory tasks indicated that clinically depressed subjects show a recall

advantage for negative information. Clinically anxious subjects showed a similar, but less robust pattern. On all tasks, nonclinical samples showed similar, but less pervasive and less robust effects as their clinical counterparts. Overall, the results suggest that anxiety and depression are characterized by similar attentional biases, except that depressed individuals are slower processors. This difference may produce divergent patterns in later cognitive processes (e.g., memory) or their products.

**Keywords:** Anxiety, Depression, Attention, Memory, Information Processing

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## **CHAPTER I: INTRODUCTION**

The purpose of this dissertation is to investigate the nature of mood-congruent information processing in emotional disorders (i.e. depression and anxiety disorders). Emotional disorders are among the most prevalent of all psychiatric disorders. Klerman (1978) estimates that 12 percent of all adults will require treatment for depression during the course of their life. Other estimates suggest that a clinically significant episode of depression will be experienced by upwards of 25 percent of the general population at some point in their life (Weissman, Myers, & Harding, 1978). Anxiety disorders are estimated to be experienced by 8 percent of the population each year (Weissman, 1985; Barlow, 1988).

The study of anxiety and depression has spanned a wide range of phenomena, including transient mood states and life-long, persistent patterns of disturbed mood. Findings associated with clinical levels of anxiety or depression may or may not be associated with these moods in milder states (Bower, 1987). It is important therefore to specify which phenomena are being referred to as anxiety and depression in this investigation.

### **Definitions**

#### **Depression**

The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994) lists Depressive Disorder under the category

of Mood Disorders. Within this category, other disorders such as Bipolar Disorder are also classified. Hereafter in this paper, the term depression will refer to unipolar depression, a diagnosis of which requires at least one depressive episode with no history of manic episodes.

The feature most strongly associated with depression is a depressed mood or loss of interest in usual activities and pastimes. Other features can include psychomotor retardation, decreased energy, difficulties with concentration and problem solving, and disturbances in sleep and appetite. These disturbances must persist with little variance for a period of at least two weeks before a diagnosis of depression is appropriate.

Cognitions for depressed individuals are usually reported to be centered around loss, worthlessness, and hopelessness. MacLeod and Mathews (1990) state that cognitive processing deficits for depressed individuals include slowed preparatory or planning processes, and impaired memory on free and incidental recall tasks.

### Anxiety

Furthermore, the DSM-IV lists a variety of disorders under the blanket category of Anxiety Disorders. Some of these include: Simple Phobias, Panic Disorder, Agoraphobia, Social Phobia, and Generalized Anxiety Disorder (GAD). Although the issues discussed in this paper are most often referring to Generalized Anxiety Disorder, the term anxiety may be extended to all of these disorders. One notable exclusion is Obsessive-Compulsive Disorder (OCD). Obsessive-Compulsive

Disorder follows a qualitatively different course and generally requires a different treatment approach than other anxiety disorders (Barlow, 1988). Furthermore, the past research discussed in this investigation that includes anxious subjects has not yet been extended to include individuals with OCD. Consequently, although OCD is listed under anxiety disorders in the DSM-IV, it is not intended to be included by the term anxiety in this paper.

The essential feature of anxiety is excessive worry about life circumstances. This worry is out of proportion with what would normally be dictated by the situation. In some cases the worry is not associated with any particular situation, but persists even when no obvious "trigger" can be identified. Associated features can include hyper-motor tension, autonomic hyperactivity, and hypervigilance. Anxious individuals often report cognitions centered around inadequacy, helplessness, and a sense of "impending doom". Cognitive processing deficits for anxious individuals have included reduced working memory capacity and disruptions in high level organizational processing (MacLeod & Mathews, 1990).

### The Relationship Between Anxiety and Depression

Anxiety and depression have been closely related clinically, empirically, and theoretically. Although models of these disorders often describe a distinct etiology for each, a high rate of comorbidity suggests that the development and maintenance of these emotional disorders are more closely related (Barlow, 1988, 1991). For example, Gotlib (1984) found a high correlation between self-report measures of

depression and anxiety in university students, and suggested that sub-clinical anxiety and depression are indistinguishable. Also, Barlow (1988; 1991) has argued that only depressive symptoms, but not anxious symptoms, are useful in discriminating anxiety and depression. He also reports that depression is rarely found without additional anxious symptoms, but that anxiety may be found without depressive symptoms. Watson and Kendall (1989) suggest that the lack of pleasurable affect in depressives is the most distinguishing feature between these moods. Also, they point out that the typical behaviours of anxious and depressed individuals result from this difference.

### **Clinical Models of Anxiety and Depression and Information Processing**

Most clinical theories do not make predictions about automatic, cognitive processes in emotional disorders, or when they do, the predictions are typically sweeping or vague. Psychodynamic, behavioural, and cognitive models differ in terms of how they explain the development and maintenance of anxiety and depression. Within the realm of making judgements or interpretations, all of these models predict that anxious and depressed individuals have a more negative or less positive world view compared to normal individuals. Typically, these models have had less to say about the more low-level information processes such as attention and than about more strategic, high-level processes such as attitudes, judgements, and interpretations. However, because of their emphasis on cognitive processing in the development and maintenance of emotional disorders, cognitive models have made explicit predictions regarding the more automatic processes. It should be mentioned



here that information processing theory lends itself to cognitive models of emotional disorders because of common terminology only. Although cognitive models have typically been more empirically based than others, much of the pioneering research has followed suit by examining higher level processing.

Freud did not have access to information processing theory, but his psychoanalytic model does address how anxious and depressed individuals perceive the world. The psychodynamic view holds that both anxiety and depression are characterized by a negative world view (Freud, 1940; Fenichel, 1945). Anxious individuals tend to view the world as being more threatening than do normals. Depressed individuals tend to view the world as an environment of deprivation, lack, or loss. Although these perceptual sets can certainly be considered cognitive processes, it is important to recognize that they refer to rather high-level processes such as judgements, or interpretations.

Behavioural theorists have traditionally had less interest in theories of depression than in other disorders such as anxiety. According to behaviourists, anxiety develops from a process of conditioning which can be reversed through a process of desensitization. Although there are no explicit predictions about information processing, this model does suggest that the condition of anxiety drives and reinforces avoidant behaviours (Hoberman & Lewinsohn, 1985). Thus, if any information processing pattern is characteristic of anxiety, it would emerge as an avoidance bias. With regard to depression, the important assumption for behaviouralists is that depressive feelings and behaviour result from a "low rate of

positive reinforcement and/or a high rate of aversive experience" (Hoberman & Lewinsohn, 1985, p. 43). This relationship can result from either a reduction in the effect of positive reinforcements or an increase in the impact of negative events. Thus, depressed individuals are believed to view the world as being either more negative or less positive.

A more recent interpretation of depression suggests that depressed individuals actually tend to be more accurate than normals in describing the world; a phenomenon known as depressive realism (Alloy & Abramson, 1988). From this point of view, normal individuals tend to be biased towards positive information whereas depressed individuals do not. Thus, depressed individuals are 'less positive', rather than 'more negative' in their view of the world.

Two basic types of information processing models pioneered cognitive theories of the etiology and maintenance of emotional disorders: (1) the schema model (Beck, 1967), and (2) the semantic network model (Bower, 1981; 1987; Teasdale, 1988). These models have developed from research in different areas, and as a result there are some fundamental differences between the two theoretical standpoints. Specifically, Bower's (1981) model suggests that cognitive distortions result from mood, whereas Beck's (1967) model suggests that pathological mood results from cognitive distortions. Regardless of the different roles assigned to mood and cognition, these models share some common predictions regarding the nature of certain cognitive processes in emotionally disordered individuals (MacLeod & Mathews, 1990). Specifically, they predict attentional and memory biases towards

mood congruent information for both disorders.

As Kuiper, Olinger, and Martin (1993) have pointed out, the earlier cognitive models of Beck (1967; 1976) and others have evolved to include a more complicated interaction of stress and vulnerabilities that play a role in the etiology, maintenance, and remission of depression. For example, whereas earlier versions of Beck's model emphasized that depression was the result of negative schemata, later versions (e.g., Beck, 1984; Beck & Epstein, 1982) emphasized that these schemata interact with negative life events and other vulnerabilities to produce depression. Other more recent cognitive models of depression (e.g., Abramson, Alloy, & Metalsky, 1988; Alloy, Hartlage, & Abramson, 1988; Kuiper, Olinger, & Martin, 1988) have included among such vulnerabilities: negative life events, situational cues, social support difficulties, a depressogenic attributional style, physiological factors, and perception of self-worth. More recent models of anxiety (e.g., Barlow, 1988) have paralleled the evolving cognitive models of depression by clearly emphasizing the interaction of psychological and physiological factors to produce symptoms of the disorder (see appendix A for a review of Barlow's model).

### **The Interaction of Emotion and Cognition**

In line with these evolving cognitive models and following from neuropsychological models of emotional disorders, (e.g., Roy-Byrne & Wingerson, 1992; Gray, 1982) it is assumed in this paper that the etiologies of both anxiety and depression include psychological and physiological factors. Although the focus of this

paper is on the psychological factors, both are considered to be important and interactive factors because of the central role of emotion in these disorders.

Arguments regarding the primacy of emotion vs. cognition have tended to be circular and territorial (e.g., Zajonc, 1980; Mandler, 1980). Scherer (1984) has argued that emotions should be examined according to their function. Evolutionary explanations for emotions suggest that there are at least two functions of emotion. The first is that there is some form of emotional expression that serves to communicate information to others. The second is that the accompanying physiological changes serve to prepare the organism for future action. Darwin (1889) described the evolution of emotions in a number of species with considerably less cognitive capacity than in humans. He argued that there are innate, hard-wired, and emotion-specific responses that have evolved within and across species. Following this point of view, a number of more recent emotion theorists have argued that certain hard-wired, emotion-specific responses are still present in humans (e.g., LeDoux, 1989; Barlow, 1988; Berry, 1991). Furthermore, these emotional responses likely include affecting the way information is processed, which may be analogous to schematic processing.

Most theorists now view emotion as a mediating process between physiological and psychological processes (e.g., Oatley & Johnson-Laird, 1987), or as an orienting function that includes cognitive, physiological, and other dimensions (e.g., Scherer, 1984; LeDoux, 1989). Although it does not necessarily follow that emotional disorders must then result from some dysfunction with each of these dimensions, the

complexity and variability of features accompanying anxiety and depression suggest that physiological and psychological factors both contribute to these disorders. With regard to anxiety and depression, it may be more appropriate to view mood-congruent information processing patterns according to the function of the particular mood or emotion, rather than to assume that a particular mood must facilitate the processing of mood-congruent information.

### **Investigating Information Processing in Anxiety and Depression**

Many investigations of psychological processes in the emotional disorders have employed surveys that measure high-level, conscious, or strategic processes (e.g., attitudes, judgements, or interpretations). While this kind of information is valuable, Gotlib (1984) has argued that such measurements are both inaccurate and inappropriate for measuring noncontrolled, automatic processes. The fairly recent implementation of designs measuring information processing (especially attention) have proved valuable in increasing precision of clinical theory. Whereas most clinical models would predict that both anxious and depressed individuals would display mood-congruent attentional and memory biases, the accumulated evidence suggests that the relationship between biases in these processes and emotional disorders is more complex than any of the clinical models allow. Perhaps the most striking pattern that has emerged from evidence is that anxious individuals display attentional biases towards mood-congruent information, but show no such bias on memory tasks. Conversely, depressed individuals show biases towards mood-congruent information

on memory tasks, but there is little evidence of any attentional bias.

The following chapter will review the empirical research that has examined attention and memory processes in anxiety and depression, outline recent attempts to account for these patterns, and present some methodological and theoretical concerns regarding them. Finally, three tasks will be presented that examine attention and memory in anxious and depressed subjects in light of the concerns raised in this paper.

**CHAPTER II:**  
**EMPIRICAL INVESTIGATIONS OF ATTENTION AND MEMORY IN**  
**ANXIETY AND DEPRESSION**

It has already been mentioned that the bulk of studies investigating various aspects of clinical models have made use of surveys or self report methodologies. Whereas these methods are useful in obtaining certain kinds of information (e.g., such as attitudes, judgements, or interpretations), they are inappropriate for investigating more automatic cognitive processes such as attention and memory (Gotlib, 1984).

Within the last decade, a number of studies have begun to investigate cognitive processes in anxiety and depression implementing information processing designs. This section reviews the investigations of attention and memory in anxious and depressed subjects, and also reviews some current models that have attempted to account for the findings.

**The Nature of Attentional Bias in Anxiety and Depression**

One of the common predictions made by clinical theories is that individuals experiencing a certain mood should display attentional biases towards stimuli that are congruent with that mood. One paradigm that has been utilized to assess information processing in depressed individuals has been the Stroop task. Originally developed by Stroop (1935), this procedure involves naming the ink colour of various words. A robust finding from this task is that subjects will take longer to name the ink colour of

the names of colours when the names are incongruent with the ink colour. Stroop suggested that automatic processing of the words' meaning interfered with the competing task of naming the ink colour, and hence decreased performance.

Gotlib and McCann (1984) extended this procedure to the study of information processing in depressives. They argued that if depressives display enhanced processing of negative stimuli, then this processing should interfere with performance on the Stroop task when these individuals are required to name the colours of negative content words. Gotlib and McCann (1984) tested mildly depressed and nondepressed subjects on three Stroop tasks using negative, neutral, and manic content words. The results indicated that nondepressed individuals displayed equivalent performance on all three tasks, whereas depressed subjects took longer to name the colours of depressed content words than for the other two conditions. In a second study, Gotlib and McCann (1984) showed that this processing bias was not exhibited by groups of nondepressed subjects after experiencing either depression, elation, or neutral mood induction procedures. This suggests that depressed individuals found it difficult to ignore the depressed content of the words.

Other investigations have shown either the same (Williams & Nulty, 1986), or a similar pattern of results (Williams & Broadbent, 1986). For example, Williams and Broadbent used a modified emotional Stroop test to examine performance in patients who had recently attempted suicide by means of a drug overdose. They compared the latencies for naming the colours of general emotional words (e.g., helpless) and of words that were more specifically related to the patients (e.g.,



overdose). Williams and Broadbent found that the patients took longer to name the colours of words that were more specifically related to their own pathology, rather than just depressive or negative words in general.

Gotlib and Cane (1987) investigated whether or not the apparent processing bias represents a stable characteristic of depressed individuals. To accomplish this, Gotlib and Cane tested clinically depressed psychiatric patients in episode and after remission on a similar Stroop task as was used by Gotlib and McCann (1984). They found that these subjects took longer to name the colours of depressed content words than nondepressed content words as did Gotlib and McCann (1984), but this effect was only present while the depressed subjects were in episode.

Convergent evidence of a processing bias towards negative information has also been found in a dichotic listening task (McCabe and Gotlib, 1991). The dichotic listening procedure allowed for an examination of the generalizability of the Stroop effect on an auditory task. In this procedure, subjects are required to repeat (or "shadow") stimuli presented in one ear and attempt to ignore different stimuli that are simultaneously presented to the other ear. The accuracy of the "shadowing" reflects one measure of the amount of attention being allocated to the shadow channel; or conversely, the number of shadowing errors reflects the amount of attention being allocated to the distracting stimuli. Another measure of this "attention drain" is to measure the performance on a separate task while attempting to shadow the auditory stimuli. Following a task outlined by Bargh (1982), McCabe and Gotlib (1991) presented depressed subjects with a shadowing task and also instructed them to

respond to an intermittent light probe by immediately pressing a button. Thus, the latency to the light probe reflects the amount of attention allocated to the distracting stimuli. McCabe and Gotlib reasoned that if depressed individuals are characterized by a processing bias towards negative information, their latencies to a secondary light-probe task would be expected to increase when words in the unattended channel are of negative content. Furthermore, McCabe and Gotlib (1991) tested depressed subjects while they were in episode and then again after remission of symptoms. The results showed no differences between depressed and nondepressed subjects with regard to the number of shadowing errors. However, depressed subjects displayed higher latencies to the light probe for negative-content distractors than for positive or neutral-content distractors. This effect only occurred at the initial testing when the depressed subjects were in episode, and not at the second test when the subjects were in remission. Nondepressed subjects showed no differences for distractor content at either test session. As a result, Gotlib and McCabe (1991) suggest that whereas currently depressed individuals appear to display evidence of a processing bias towards negative information, this bias can only be viewed as a concomitant of depression.

Other investigations have examined attentional biases in anxious subjects. For example, Mathews and MacLeod (1985) used the Stroop paradigm with threat related words to test performance in anxious subjects. Mathews and MacLeod categorized the anxious subjects as "social" or "physical" worriers according to the predominant concerns of the subjects (i.e., social worriers might find it difficult to talk to

unfamiliar people, whereas physical worriers might be concerned about the possibility of health problems such as a heart attack). Furthermore, Mathews and MacLeod tested these subjects on four Stroop tasks: one task contained words related to physical threat, a second contained words related to social threat, and the third and fourth tasks contained physical and social content words of a positive nature. They found that control subjects showed no differences in performance on any of the four tasks. However, anxious patients showed slower performance on threat related tasks. Also, "physical" worriers showed slower performance on both the physical and social threat tasks, but "social" worriers showed slower performance only for the social threat task.

Another investigation by Watts, McKenna, Sharrock, and Trezise (1986) examined Stroop performance in spider-phobic subjects. For one task, the content of the words used was related to spiders (e.g., crawl). On a second task, the words were of general emotional content. The results indicated that whereas the phobic subjects showed little difference from controls in performance for general emotion words, these subjects showed considerable disruption in performance for the spider related words.

Thus, the Stroop studies have demonstrated effects related to both the mood and the specificity of the subjects. However, there have been two main criticisms of these Stroop studies (Williams, Watts, MacLeod, & Mathews, 1988; MacLeod & Mathews, 1990). One criticism of these studies is that both anxious and depressed subjects often experience both moods. Consequently, it is difficult to determine

which mood is responsible for the effect. For example, Mathews and MacLeod found that the degree of disrupted performance was significantly related to both depressed and anxious moods (as assessed by the Beck Depression Inventory (BDI) and the State-Trait Anxiety Inventory (STAI)). Whereas the subjects in Gotlib and McCann's (1984) study were categorized according to the BDI, anxious mood was not assessed. Although Williams and Broadbent found that poor performance correlated with current depressed mood as assessed by the Profile of Mood States (McNair, Lorr, & Droppleman, 1981), the specificity of the word content may also have accounted for the results. Hence, there is evidence to suggest that both the specificity and mood content of the stimuli can interfere with Stroop performance, but evidence for which mood (depression or anxiety) is responsible for the effect is inconclusive.

A second criticism of the Stroop studies is that it is difficult to determine whether or not the results are due to a perceptual effect or a response effect (Williams *et al.*, 1988). The perceptual explanation suggests that subjects experiencing a certain mood tend to notice mood congruent stimuli more readily than subjects not experiencing that mood. This would suggest therefore, that on the emotional Stroop task these subjects selectively attend to the content of the words which decreases performance on the colour naming task. However, it is possible that the effect is due to response characteristics. According to this view, all subjects (experiencing a certain mood or not) perceive the stimuli and content to the same degree. However, there is a difference in the subsequent processing of the stimuli. Specifically, anxious subjects may be more ready to respond to threatening stimuli, and so the inhibition of

this response results in longer latencies. Also, the decreased performance may be the result of avoiding the threatening stimuli, rather than an attraction to the threatening aspects. For example, Durup and Klein (1993) have argued it is possible that threatening stimuli induce arousal in all subjects, but this arousal may produce different effects on the performance of anxious and normal subjects. Arousal at lower levels tends to enhance performance on cognitive tasks, whereas arousal at higher levels tends to interfere. The arousal may enhance performance in normal subjects, but whereas anxious subjects already experience a higher degree of arousal, the effects of the stimuli may interfere with their performance. The evidence from the Stroop tasks is consistent with both the perception and response explanations. In order to differentiate between these two possible explanations, a different task is required that separates the stimuli intended to attract and distract attention.

Such a task was employed by MacLeod, Mathews, and Tata (1986). These investigators presented anxious and nonanxious subjects with neutral and threatening word pairs (one word presented above the other) on a video screen for 500 milliseconds, and subjects were required to read the top word aloud. Immediately following, a dot probe appeared at one of the word positions. Subjects were required to respond to the dot as quickly as possible by pressing a button. If the dot appeared within the area that was being attended to by the subject, then the latency to that dot presentation should be decreased. The results indicated that anxious subjects responded faster to dot probes that appeared in the same position as where a threat word had been presented. Nonanxious subjects showed the reverse pattern; latencies

were slower to probes that replaced threat words. This would suggest that anxious subjects allocate attention towards threatening stimuli, whereas nonanxious subjects allocate attention away from threatening stimuli. Thus, this study has demonstrated attentional biases in anxious subjects that are independent of response biases.

Williams et al. (1988) point out that the results found by MacLeod, Mathews, and Tata (1986) do not necessarily indicate that anxious subjects are more perceptually sensitive to threatening stimuli, but rather that these subjects tend to allocate more attention towards threatening stimuli than do normal counterparts. On the basis of MacLeod et al.'s (1986) findings, Williams et al. (1988) hypothesize the existence of a decision mechanism which is "(a) at a pre-attentive level, (b) sensitive to general differences in threat, (c) allocates attention to different parts or aspects of the environment, and (d) is independent of response bias" (p. 67). Whereas the latter three points seem necessary to explain the results obtained by MacLeod et al. (1986), the suggestion that this mechanism operates pre-attentively may be misleading. The concept of pre-attentive processing usually refers to "hard-wired" perceptual processes that segregate perceptual features and thereby guide attentional focus (e.g., Neisser, 1967; Treisman, 1986). Pre-attentive processes operate completely outside the realm of volitional or controlled processes. It seems unlikely that the process or mechanism by which anxious individuals allocate attention towards threatening words constitutes a pre-attentive process. That is not to say that the attentional biases exhibited by anxious subjects reflect deliberate, intentional strategies. In fact, it is quite likely that the bias is automatic. However, automatic processes differ from pre-attentive

processes in that automatic processes are the result of an overlearning of controlled processes. In other words, an automatic process is one that was previously a controlled process that over time required less control due to practice or habit.

Therefore, it may be more accurate to refer to the attentional bias exhibited in anxious individuals as being automatic, rather than pre-attentive.

The diminished role of volitional control in Williams et al.'s (1988) account of an attentional bias in anxious individuals deserves some further discussion. Durup and Klein (1993) have pointed out that most of the effect from MacLeod et al. (1986) (i.e., enhanced performance following threatening stimuli) resulted from trials when the probe appeared in the location of the upper word. In fact, the effect was twice as large when the probe appeared in the upper location than in the lower location. Since subjects were required to read the top word aloud on each trial, the task demanded that attention be allocated towards that location. Thus, whereas anxious subjects did show enhanced performance relative to controls when the probe followed threatening stimuli, this does not necessarily reflect the kind of attentional bias proposed by Williams et al. (1988). Klein, Kingstone, & Pontefract (1992) have distinguished between volitional control of attention (endogenous control) and attention that is attracted by external events (exogenous control). They have argued that endogenous and exogenous control of attention is mediated by different mechanisms in the brain. Thus, attention that is intentionally directed towards some location is not equivalent to attention that is distracted or "captured" by something at that location. Given that subjects in the MacLeod et al. (1986) study had attention directed towards the upper

location, and it was mostly at this location that anxious subjects displayed enhanced performance, it is likely that the bias reflects strategic or volitional control of attention.

Broadbent and Broadbent (1988) carried out a series of studies to investigate some potential concerns and implications regarding the study by MacLeod et al. (1986). In particular, Broadbent and Broadbent (1988) were concerned that there may be some other explanation of the effect due to the nature of clinically anxious people. However, in a replication of MacLeod et al. (1986), Broadbent and Broadbent (1988) found that the same effect occurs in some normal subjects as well. They noted that most of these subjects had scored high on an anxiety trait scale. Secondly, Broadbent and Broadbent (1988) investigated whether or not the attentional bias was a function of transient state-anxiety, or more long lasting trait-anxiety. Relative to state-anxiety, they found that there was a stronger, and curvilinear relationship between trait-anxiety and the attentional bias. Thirdly, the experimenters were concerned that the dot that appeared in MacLeod et al.'s (1986) study may have only appeared after the threatening words. As a result, the presence of a threatening word may signal that 'something is about to happen' and thus draw attention. The threatening words may have also been distinct because they could all be categorized as such, whereas there was presumably no relationship between the other words. Consequently, Broadbent and Broadbent (1988) replicated the experiment using threatening words and animal names. Furthermore, the dot appeared equally often after threatening and non-threatening words. They found the same pattern of results as was found by MacLeod



et al. (1986). This suggests that the content of the threatening words had some effect on the attention of the anxious subjects. In a final study, Broadbent and Broadbent (1988) investigated whether or not the content of the threatening words had an immediate effect on the subjects, or whether the effect built up after several trials. If there was an immediate effect, it would suggest that the content of the words was being analyzed pre-attentively. However, they found that the effect tended to build up throughout the course of the experiment. This suggests that the attentional bias was a learned pattern.

Other investigations have also examined the nature of attentional bias in anxious individuals. For example, Mathews, May, Mogg, and Eysenck (1990) investigated whether or not the attentional bias phenomenon found in anxious individuals could be attributed to a general deficit in the ability to focus attention or ignore irrelevant distraction. They also investigated whether or not any deficit was affected by distractors of emotional content. Mathews et al. tested currently anxious, recovered anxious, and normal controls on two attention tasks. The first task required the subject to identify a letter ("A" or "B"), which was sometimes presented in the presence of a distractor (digits 1 to 7), and sometimes presented after the target location was cued. The results indicated no group differences in the ability to focus attention or ignore distractors. The second task was modified by using words for stimuli instead of letters and digits. Subjects were required to respond to a target word ("left" or "right"), which was sometimes presented in the presence of a distractor word. The content of the distractor words was either positive, neutral,

physically threatening, or socially threatening. The results indicated that when the target location was unknown (thus requiring search), both currently anxious and recovered anxious subjects were slower when distractors were threatening than nonthreatening. Mathews et al. concluded that an attentional bias towards threatening cues (during search) is characteristic of individuals vulnerable to anxiety, and not just a concomitant of current mood.

In an attempt to replicate several previous findings of attentional bias in anxious individuals, Mogg, Mathews, and Eysenck (1992) tested currently anxious, recovered anxious, and normal control subjects using the same dot-probe task as MacLeod, Mathews, and Tata (1986). In addition to replicating Macleod et al.'s (1986) original finding of a mood congruent attentional bias in anxious subjects, Mogg et al. (1992) found that the bias towards social threat stimuli was associated with the extent of the subjects' social anxiety. The same relationship was not found between anxiety about physical harm and physically threatening words. In contrast to the findings of Mathews et al., (1990), the results also indicated that the attentional responses of recovered anxious subjects did not significantly differ from either control or currently anxious subjects.

Mogg, Bradley, Williams, and Mathews (1993) demonstrated that the attentional bias displayed by anxious subjects can occur even when stimuli are presented for very brief durations. Although there have also been failures to find this effect (e.g., Mogg et al., 1991), others have shown that anxious subjects without concurrent depressive symptoms are more likely to show an attentional bias with brief

exposure durations than anxious subjects with concurrent depressive symptoms (Bradley, Mogg, Millar, & White, 1995).

In summary, there is fairly strong evidence to suggest that anxious individuals have a tendency to attend to threatening stimuli. There is conflicting evidence as to whether or not this bias is related to or affected by trait vs. state anxiety, socially vs. physically threatening stimuli, and whether or not the effect is only present with currently anxious mood as opposed to being an enduring characteristic of the individual.

One might expect a similar attentional bias for depressed individuals towards depressing stimuli; however this is not the case. As Williams *et al.* (1988) have pointed out, the Stroop studies may not actually be measuring attention, but may instead be measuring how responsive subjects are to various stimuli. In studies that have examined attention in depressed individuals, there tends to be no attentional bias towards negative content words. Macleod and Mathews (1990) state that they found no evidence for selective attention in depressives when utilizing the same dot-probe design that MacLeod *et al.* (1986) used to test anxious subjects.

Several investigations have used lexical decision tasks to measure the speed of processing emotionally valenced words. Two of these investigations used mood induction procedures to manipulate the mood states of the subjects (e.g., depression, elation, neutral), but found no differences in the latencies for positive, neutral, and negative words (Clark, Teasdale, Broadbent, & Martin, 1983; Challis & Krane, 1988). MacLeod, Tata, and Mathews (1987) used the same paradigm to test

clinically depressed subjects. They found no significant differences between the latencies of depressed and normal subjects for neutral, negative, and positive words. Although they found no evidence of an attentional bias towards negative stimuli, there was a tendency (nonsignificant) for depressed subjects to respond slower to negative words than to positive words.

In another study, Gotlib, McLachlin, and Katz (1988) presented three types of word pairs (neutral-depressed, neutral-manic, manic-depressed) to depressed and non-depressed subjects. Using a methodology somewhat analogous to that of MacLeod *et al.* (1986), Gotlib *et al.* found that depressed subjects attended to manic, depressed, and neutral words about the same. However, they did find that non-depressed individuals tended to attend more to manic words than to depressed words. They proposed that there is a tendency for normals (non-depressed) to allocate more attention towards positive words, but this tendency is not present in depressed individuals. In contrast to normals, attention in depressed individuals does not 'zoom in' to particular stimuli, but tends to stay 'zoomed out'. As a result, there is a tendency to attend to every type of stimulus. Other investigations have also pointed out that differences between normal and depressed subjects are due to biases in normals just as often as biases in depressives (Alloy & Abramson, 1988). The hypothesis that depressed individuals are actually more evenhanded than normals is referred to as "depressive realism". Once again however, the investigations of depressive realism tend to be measurements of attitudes and high level judgements. The findings of Gotlib *et al.* (1988) are the first to demonstrate this evenhandedness in

attentional processes. This same finding was replicated in a similar study by McCabe and Gotlib, (1995).

The apparent findings that depressed subjects display no differential processing for positive and negative information may not in itself reflect that they do not selectively process negative information. A typically characteristic feature of depressed individuals is a general slowing of performance on tasks. MacLeod and Mathews (1990) have pointed out that this slowing is not completely due to psychomotor retardation, but is also due to a slowing of some central cognitive operations. In particular, Byrne (1976) measured the latencies of depressed and normal subjects during the preparatory, decision, and execution stages of a task. The depressed subjects were found to be slower in both the preparatory and execution stages. Thus, it is possible that depressed subjects are slower to process information and most attentional paradigms present stimuli too briefly for them to adequately process the information.

Berry, McCabe, and Youn (1993) attempted to determine if longer stimulus durations would allow depressed subjects to display attentional biases towards negative information. To accomplish this, normal and mildly depressed subjects were tested on a dot probe task similar to that of MacLeod *et al.* (1986), but with two important changes. One change was that instead of a dot probe appearing on certain trials, subjects were required to respond to a letter (an "X" or "Y") that on every trial followed the presentation of a word pair. This manipulation, suggested by Durup and Klein (1993), allowed for 120 trials of useful information, as opposed to only 40 to

50 useful trials in the original dot probe paradigm. The second change was to repeat the block of trials four times, with the stimulus display remaining for either 500, 750, 1000, or 1250 milliseconds. This change was made to ensure that all subjects had sufficient time to process the content of the stimulus words. If depressed subjects disproportionately attend negative stimuli, it was expected that they would respond faster to the probe following negative target words relative to neutral and positive target words. Furthermore, if depressed subjects are also slower processors than normals, this effect should only appear when stimuli are presented for longer durations.

Contrary to predictions, mildly depressed subjects did not respond faster to probes following negative stimuli than to positive or neutral stimuli. However, there was a tendency for mildly depressed subjects to respond slower to the probe after being presented with negative target words relative to neutral and positive target words. This tendency was only observed at stimulus durations of 1000 and 1250 milliseconds, and was not observed for control subjects. Although the findings were tentative, they suggest that processing in depressed individuals is disrupted by mood-congruent stimuli, provided that enough time is allowed for the content of the stimulus words to be processed.

According to Berry et al. (1993), there are two possible explanations to account for the disrupted processing in depressed subjects. The first explanation is that the depressed subjects had a tendency to avoid negative stimuli rather than be attracted towards them. The second explanation is that depressed subjects were in

fact attracted to the negative stimuli, so much so that it interfered with task performance. While both of these explanations remain a possibility, they both suggest that mildly depressed subjects show differential processing to negative stimuli occurs if stimuli are displayed longer.

In summary, there appears to be evidence that supports the predictions of information processing models that anxious individuals should display an attentional bias towards threatening stimuli. The evidence is not so clear with depression. The bulk of evidence suggests that a similar pattern is not present in depressed individuals. However, it is possible that this pattern is an artifact resulting from slower processing rates in depressives. To date, research has not directly tested the extent to which a stimulus word is processed during the attentional tasks. Instead, most attentional tasks involve presenting stimuli for one fixed duration and there is an assumption that all subjects process information at the same rate. Consequently, it is just as plausible to argue that the attentional differences found in anxious and depressed subjects are due to different processing rates as it is to argue that they are due to different processing styles.

### **The Nature of Memory Bias in Anxiety and Depression**

In contrast to the accumulated evidence of a mood congruent attentional bias in anxious individuals, the most robust findings of a mood congruent memory bias have been found in depressed individuals. There are a number of studies that have found a negative content memory bias with depressed subjects (e.g., Teasdale & Fogarty,

1979; Bradley & Mathews, 1983; Clark & Teasdale, 1982; Williams & Broadbent, 1986), demonstrating a reversal of a common phenomenon that pleasant memories are more accessible in normal subjects (MacLeod & Mathews, 1990).

Clark and Teasdale (1982) presented neutral cue words to depressed and normal subjects. Subjects were then required to report the first memory elicited by the cue word. The results showed that depressed subjects recalled more negative memories, whereas normal subjects recalled more positive memories, indicating that at the least depressed subjects show a preference to recall negative memories.

In a similar task, Williams and Broadbent (1986) supplied cue words of negative or positive emotional content to suicide attempters and normals. Although the type of memory recalled was constrained by the type of cue word supplied, suicide attempters recalled specific negative memories faster than specific positive memories. On the other hand, normal subjects recalled specific positive memories faster than specific negative memories. The results suggest that more than just a preference, depressive subjects demonstrate an increased ability to recall negative memories. However, it is difficult to determine whether or not past experiences of depressed individuals have resulted in a disproportionate amount of negative memories, thus making such memories more accessible.

Recall tasks for experimentally presented stimuli have also demonstrated memory biases for depressed subjects, but the finding seems to depend upon the nature of the encoding task. For example, Roth and Rehm (1980), and Frith *et al.* (1983) reported that depressed subjects showed no recall advantage for negative



versus positive words that had been previously rated by the subjects (e.g., likeability, pleasant/unpleasant).

However, depressed subjects have been found to recall more negative words than positive on an incidental recall task (McDowell, 1984). McDowell argued that the rating tasks provide strong recall cues which mask the effects of depression. Interestingly, several studies (e.g., Derry & Kuiper, 1981; Bradley & Mathews, 1983, 1988) have demonstrated that depressed subjects show a recall bias for negative words when the words are rated on some self-relevant dimension (e.g., destructiveness, trait characteristics), but this bias disappears when the words are rated on the descriptiveness of someone else.

Thus, it seems unlikely that differences in past experience alone can account for the recall biases in depressed individuals. Other confirming evidence comes from studies that have demonstrated that the recall bias is dependent upon the presence and intensity of depressed mood (e.g. Bradley & Mathews, 1988; Clark & Teasdale 1982; Slife, Miura, Thompson, Shapiro, & Gallagher, 1984).

Compared to depression, there is little evidence of a similar recall bias in anxiety. Three studies have reported such a bias with anxious subjects (Nunn, Stevenson, & Whalan, 1984; Greenberg & Beck, 1989), but MacLeod and Mathews (1990) have argued that methodological flaws limit the usefulness of two of these findings. Nunn *et al.* (1984) reported that agoraphobic subjects recalled more threatening words on a recall task than did normal subjects. However, MacLeod and Mathews (1990) point out that some words that are threatening to agoraphobics (e.g.,

street, travel) would be considered neutral to normal subjects.

Greenberg and Beck (1989) presented anxious and normal subjects lists of trait adjectives, which were to be judged as self-descriptive or not. In an unexpected recall task, anxious subjects recalled more anxiety related trait words (e.g., disturbed). However, recall was only scored for trait words that were judged as self-descriptive, and anxious subjects endorsed more anxiety related words. As a result, the number of anxiety related words that could be scored on the recall task was greater than for normal subjects (MacLeod & Mathews, 1990).

McNally, Foa, and Donnell (1988) employed a self-referent encoding task to investigate recall of threatening and nonthreatening words in normal and panic disorder subjects. The results showed that panic disorder subjects recalled more threatening words, whereas normals recalled more nonthreatening words. However, other studies employing a similar design have found the reverse or no effect in generalized anxiety patients (Mogg, Mathews, & Weimann, 1987; Mogg, 1988), spider phobics (Watts, Trezise, & Sharrock, 1986), and speech anxious subjects (Foa, McNally, & Murdock, 1989). As a result of these findings, Mogg *et al.* (1987) hypothesized that anxious individuals tend to avoid elaborative processing of threatening information and that only the affective content is encoded.

Mathews, Mogg, May, and Eyesenk (1989) tested anxious and normal subjects on two types of memory tasks: a cued recall task, and a word completion task. Previous research (e.g., Graf & Mandler, 1984) has suggested that these tasks test two different processes. Cued recall tasks measure elaboration, or the extent to which

a memory representation is associated with other memory representations, which renders it more retrievable. Word completion tasks measure the extent to which a memory representation is integrated, which renders it more accessible, but not necessarily more retrievable. In a sense, integration refers to how "noticeable" or "recognizable" a memory representation is, whereas elaboration refers to the extent that a memory representation is connected to others. Mathews et al. (1989) found that anxious subjects did not differ from normals on the cued recall task. However, anxious subjects did produce more threatening word completions than did normals. It was argued that in anxiety states memory representations of threatening information are more integrated, accessible, or more readily activated, but not necessarily more elaborated or retrievable.

Finally, Burke and Mathews (1992) investigated autobiographical memories in GAD patients and normals. Subjects were required to recall either an anxious or nonanxious personal memory after being presented with a neutral cue word. The results indicated that anxious subjects recalled more anxiety related memories, and recalled them more rapidly than did normals, contrasting with the findings of Mathews et al. (1987). Burke and Mathews suggest two possible explanations for their findings. First, anxious subjects may differ from normals in the number of threatening events in past experience. Second, anxious individuals may be more likely than normals to encode an event as being threatening. Burke and Mathews also note that the memories recalled by anxious subjects were judged to be more general than others, which may be gleaned as support for Mogg et al.'s (1987) hypothesis that

anxious individuals avoid elaborative processing.

In summary, the evidence for mood congruent memory biases in anxiety and depression is not as clear as for attentional biases. The most robust effects are for mood congruent recall in depressive subjects, although this appears to be dependent upon the encoding task. Anxious and depressed subjects have only occasionally been tested within the same study. Taken together, the evidence suggests that anxious and depressed individuals exhibit different types of memory biases which may result from the encoding process.

#### **Accounting for Biases in Attention and Memory**

Evidence from the perceptual task studies (e.g., MacLeod et al., 1986; Gotlib et al., 1988) suggests that a different type of attentional bias is characteristic of normal, depressed, and anxious individuals. Williams et al. (1988) have proposed that these differences in attentional biases reflect different types of processing, or more specifically, different processes by which a schema can be activated. This argument is largely based on an investigation by Graf and Mandler (1984) and a brief discussion of their findings is warranted.

The main purpose of Graf and Mandler's (1984) study was to determine how individuals could show evidence of being previously exposed to a stimulus while being unaware of its presentation. In their investigation, subjects were exposed to a list of words and were required to complete a task involving either some structural aspect of the words (e.g., word length) or some semantic aspect (e.g., categorical

meaning). This study phase was followed by a test phase in which subjects were required to recall words, identify words presented for brief durations, or complete word stems. Graf and Mandler found that subjects tended to complete the word stems according to the words that they had just studied, but that the structural and semantic tasks showed no difference in the extent of this bias. Thus, it would seem that structural aspects of a word such as shape or length are just as important cues as the meaning of a word on word stem completion tasks. However, the semantic task did improve performance better than the structural task for recall and recognition tests. Graf and Mandler accounted for these results by proposing that schemata can be activated in two ways: (1) integration, and (2) elaboration.

According to Graf and Mandler (1984), integration is the mutual and automatic activation of the associated components within a schema. Hence, if a particular schema is well integrated, it is more likely that a component within the schema will activate another component within that schema. In a sense, the degree of integration reflects the strength of associative connections among components of a schema. Thus, integration makes the word or concept represented by that schema more "accessible" and more likely to be noticed or identified.

Elaboration refers to the relationships between a schema and other mental events or other schemata. This includes the formation of new relationships or reactivation of existing relationships. Elaboration depends upon strategic processes. For example, subjects often tend to cluster words or items on a recall task. This clustering forms new relationships between words that were not previously associated

with each other. Thus, elaboration allows for the association of a concept and its context, making that concept more "retrievable".

An analogy can be drawn between elaboration and integration, and two different ways that a light bulb can be turned on. A light bulb might be controlled by a dimmer switch that can be gradually increased until it is noticeably "on". In a similar fashion, integration refers to how close a memory representation is to being "activated" On the other hand, a light bulb may be connected to many different on/off switches and so the chance of the light bulb being turned on increases with the number of connections. Similarly, elaboration refers to the number of connections between a particular memory representation and other thoughts or memories.

Williams et al. (1988) suggest that emotional disturbances may be characterized by a disruption in one of these processes. They suggest that the process of integration (which Williams et al. (1988) refer to as "priming") maps on to the "noticing effect" or hypervigilance associated with anxious individuals. If anxious individuals do allocate attention towards threatening stimuli (as suggested by MacLeod et al.'s (1986) study). Williams et al. (1988) argue that this should "increase the extent to which an item is primed", or integrated (p. 171). Hence, they suggest that what is characteristic about anxious individuals is an increase in attentional resources towards threatening stimuli which makes these stimuli more noticeable. Furthermore, Williams et al. (1988) argue that depressed individuals do not show a priming (or integration) effect, but rather attentional resources are allocated towards elaborative processes. They suggest that contextual cues such as affective valence of stimuli or

subjective mood are encoded with the item. As a result, these individuals display an increase in the recall of negative and self-referent information because these are well connected to other thoughts and memories. In summary, Williams et al. (1988) suggest that anxious individuals tend to allocate more resources towards the automatic processes of encoding and retrieval, whereas depressed individuals tend to allocate more resources towards the more effortful processes.

In summary, a number of investigators have argued that anxious individuals exhibit an attentional bias towards threatening information, whereas depressed individuals exhibit a recall bias for negative information (e.g., Williams et al., 1988; Macleod & Mathews, 1990). It has also been argued that integrative processing is a characteristic feature of anxiety, whereas elaborative processing is a characteristic feature of depression. As a result, anxious and depressed individuals exhibit different products in memory. For example, anxious individuals tend to show a bias for negative information on memory tasks that measure the extent of integration, whereas depressed individuals tend to show a bias for negative information on memory tasks that measure the extent of elaboration. Although there is empirical evidence from a number of perceptual and memory tasks that imply support for this pattern of processing in anxiety and depression, several methodological and conceptual concerns remain.

One main concern is that previous studies have not measured the extent of stimulus processing on attentional tasks. Consequently, an important question remains as to whether or not anxious and depressed individuals process the same amount of

information within a fixed interval. Previous findings suggest that anxious individuals show an attentional bias towards negative information, whereas depressed individuals show no differential processing of negative and neutral stimuli. However, it is arguable that depressed individuals are slower to process the content of any words, as suggested by Berry *et al.*, (1993). As a result, longer stimulus durations may be required for depressed individuals to display differential processing.

In summary, none of the investigations implementing attentional tasks has ensured that all subjects are able to recognize the content of the stimuli presented. As a result, we cannot determine if the pattern of evidence is a result of different types of processing in anxious and depressed individuals, or if it is a result of different rates of processing. One possible solution is to make use of a lexical decision task to ensure that the content of the stimuli is being processed (Coltheart, 1984), rather than just displaying stimuli for a fixed interval. Such a manipulation could be valuable in determining the rate at which anxious and depressed individuals process various types of stimuli. It also provides a starting point in examining patterns of processing in response to the recognition of mood-congruent stimuli. For example, by measuring the latency to a probe after the lexical decision task, we can have an indicator of how mood-congruent stimuli affect the rate of subsequent processing.

A second concern with many of the attentional tasks is the use of inappropriate stimuli as depression-relevant or anxiety-relevant. For example, MacLeod and Mathews (1990) found no evidence of a mood-congruent attentional bias in depressed subjects. However, the negative and presumably mood-congruent



stimuli used were the same stimuli used as anxious mood-congruent when testing anxious subjects (e.g., MacLeod *et al.*, 1986). Other investigations (e.g., Mogg, Mathews, & Eysenck, 1992) have divided stimuli into categories relevant to either physical or social threat. However, as McCabe and Gotlib (1991) have pointed out, anxiety relevant stimuli may not be appropriate as depression relevant stimuli. More appropriate sets of stimuli would include words that discriminate between anxiety relevant and depression relevant. Greenberg and Alloy (1989) have developed lists of neutral, depression relevant, and anxiety relevant adjectives that best discriminate between the three dimensions. In addition, each list of adjectives can be subdivided into positively or negatively valenced words. For example, "HAPPY" and "SAD" are considered to be positive and negative depression relevant words, respectively. Also, "TENSE" and "CALM" are considered to be negative and positive anxiety relevant words, respectively. It is possible that subjects may show specific differences between speed of processing of positive and negative words on one mood dimension (presumably a mood relevant dimension), but not necessarily on all of them. Thus, these adjectives are more likely to discriminate between anxiety and depression mood-congruent effects because they represent these dimensions with more precision than a single set of negative stimuli.

A third concern is that the type of processing exhibited by anxious and depressed subjects is inferred rather indirectly from performance on various memory tasks. The difficulty is that the pattern of findings on memory tasks is somewhat equivocal for anxious and depressed subjects. As Roediger and McDermott (1992)

have pointed out, these tasks may not be the best indicators of encoding processes. Another approach would be to examine the nature of processing (attentional processes in particular) after a mood-congruent stimulus has been recognized. In this way, we can explore more directly the nature of processing in anxious and depressed individuals as a response to mood-congruent stimuli.

Some researchers have argued that anxious individuals engage in some kind of cognitive avoidance once a threatening stimulus is perceived (e.g., MacLeod & Mathews, 1990; Mathews, Mogg, May, & Eysenck, 1989; Barlow, 1988). This is thought to occur because there seems to be no memory bias to correspond with the well documented attentional bias found in anxious subjects. However, there have been conflicting results regarding possible memory biases with anxious subjects (e.g., Burke & Williams, 1992), and so the strength of this argument is somewhat weakened. Furthermore, it is not clear how stimulus avoidance can be reconciled with facilitated performance on some perceptual tasks.

A fourth concern is that while some investigations have tested clinically depressed or clinically anxious subjects, others have tested nonclinical populations (e.g., "mildly depressed" or "mildly anxious" university students). Although arguments can be made that these two populations (clinical and nonclinical) are generalizable to one another (e.g., Vrendenburg, Flett, & Krames, 1993), presumably because of similar moods, it does not necessarily follow that information processing styles for these two groups are also equivalent. If anxiety and depression are characterized by the degree of integration and elaboration of certain kinds of

information, milder forms of this mood may not be pervasive enough to produce any measureable biases. Thus, it is important to test both clinical and nonclinical samples of depressed or anxious subjects on the same tasks before generalizing from one population to the other can be justified.

A final concern is that there has been no attempt to explain what type of processing bias is exhibited when both anxiety and depression are present. If anxiety is characterized by integrative processing and depression is characterized by elaborative processing, as Williams *et al.* (1988) suggest, how do these patterns manifest themselves in a comorbid state? MacLeod and Mathews (1990) have suggested that some of the effects found in depression (e.g., Gotlib *et al.*, 1984) may be due to co-existing anxiety. Thus, this implies that the effects of anxiety may be stronger than the effects of depression on perceptual processes. However, the opposite might be said for memory processes.

Some insight into this question may come from theories regarding how anxiety and depression are related. Barlow (1988) has speculated that anxiety and depression share a common diathesis. In particular, he suggests that a major factor is experience with unpredictable and uncontrollable negative life events. Barlow argues that the major difference between depression and anxiety is the action tendencies (and supportive physiology) that are characteristic of the coping response. Basically, he suggests anxious individuals are constantly trying to cope with potential threats in the environment whereas depressed individuals have given up trying. Barlow also suggests that long-term anxiety may lead to depression. He bases this hypothesis on

the fact that anxious individuals can be found who are not depressed, but it is rare to find depressed individuals who are not anxious. While Barlow's (1988) hypothesis that anxiety and depression can be placed on a temporal continuum may account for the relationship between the two disorders, it should be mentioned that other factors (e.g., severity; or various psychological, physiological, or personality characteristics) may also comprise possible continua. Nonetheless, if Barlow's hypothesis is correct, one might expect a gradual shift from the pattern of processing that characterizes anxiety to the pattern of processing that characterizes depression. Some of the manipulations suggested earlier (e.g., lexical decision task, measuring processing responses to stimuli, etc.) may provide a measure for examining shifts in the pattern of processing from anxiety to depression.

The present investigation is concerned with whether or not there are characteristic processing patterns for anxious and depressed individuals in response to a threatening or negative stimulus after it is recognized. Does processing remain fixed on the location of the stimulus, or is the location avoided? What effect does this have on subsequent task performance? If task performance decreases, is it the result of avoiding the stimulus or the result of some other process interfering? Three tasks are outlined below that can shed light on these questions. Both clinical and nonclinical samples of anxious and depressed subjects were tested along with appropriate controls. Furthermore, stimuli used were adjectives that discriminate between anxious and depressed mood states (Greenberg & Alloy, 1989). Each subject completed all three tasks in a single session.

The first task involved a lexical decision task followed by a probe task to examine how quickly anxious and depressed subjects can process mood congruent information and how easily attention can be disengaged from these stimuli. Thus, in addition to measuring the relative accessibility of mood congruent information compared to mood incongruent information, this task measured attentional responses to such stimuli to determine if attraction or avoidance were characteristic patterns in anxiety or depression. The second task examined the extent to which attention is distracted by mood congruent stimuli in anxious and depressed subjects, and attempted to measure how efficiently the distracting information was inhibited. One major difference between this task and the first task is that the requirements for the first task demanded that subjects attend to mood congruent information, whereas the second task required subjects to direct attention away from mood congruent information. Finally, the third task made use of two memory tasks (word stem completion and word list recall) to examine if the type of procedure used affects whether or not anxious or depressed subjects display memory biases for mood congruent information.

### **CHAPTER III: LEXICAL DECISION AND PROBE TASKS**

Although there have been a number of studies that have measured attentional allocation of anxious and depressed subjects during the recognition process of mood congruent stimuli, there has been no investigation of their attentional responses after recognition. As discussed in previous chapters, there are several concerns about recent information processing tasks and the conclusions regarding processing patterns in depressed and anxious subjects. A major concern is that the pattern of findings could be attributed to a slower rate of processing in depressives. Furthermore, there have been no direct measurements of the processing response once mood congruent stimuli have been recognized. The present investigation is concerned with whether or not there are characteristic processing patterns in response to the recognition of mood congruent stimuli.

MacLeod and Mathews (1990) argued that the Stroop tasks (which show that performance in both anxious and depressed subjects is disrupted by negative words) are not appropriate measures of selective attention. They suggested that the performance decline in anxious and depressed subjects could represent either 1) selective attention towards negative information, or 2) selective responding to negative information. To an extent, the dot probe task described by MacLeod, Mathews, and Tata (1986) is a better gauge of selective attention because it measures the attentional resources available to complete a secondary task (i.e., detecting the dot probe) that is independent of the first task (i.e., reading words). However, performance decline or

facilitation on the dot probe task still does not necessarily represent selective attention to that location. It is possible that recognition or processing of negative stimuli affects the amount of attentional resources to process information on a subsequent task. Consequently, latencies to detect a probe may indeed indicate the relative proximity of attention to that location, but this will depend on the degree to which a previously presented word was processed and any characteristic responses to the content of that word. For example, results found by Berry *et al.*, (1993) seemed to indicate that differences in performance between mildly depressed subjects and controls depends on the extent to which the stimuli were processed. Furthermore, it was clear that such a task cannot easily identify the style of response to mood congruent stimuli. Thus, response style may also need to be measured in order to determine if selective processing had occurred.

The purpose of this study is 1) to measure how quickly anxious and depressed subjects can process the content of mood congruent words, and 2) to measure how easily depressed and anxious subjects can disengage attention from a mood congruent stimulus after it has been recognized. A lexical decision task (i.e. word/nonword discrimination) will be employed to ensure that the content of the stimulus word has been processed. In the majority of the perceptual tasks reviewed, subjects were instructed to read aloud the presented stimuli. However, the lexical decision task provides a better measure of content processing than pronouncing the word (Coltheart, 1978). A probe discrimination task (i.e., X/Y discrimination) followed the subjects response to the lexical decision. True probe tasks are designed so that a

secondary demand is made on processing resources before the first task is completed. However, in the present investigation, the aim was to determine if there is any characteristic attentional response after the first task is completed. To accomplish this, the probe was designed to appear either at the same or different location than stimuli for the lexical decision task, and would appear after either a short or long delay. It is possible that after processing mood-congruent stimuli, the attention of anxious and depressed subjects may avoid that particular location. Consequently, responses to a subsequent letter probe would be slower if it appeared at the same location as the mood-congruent stimuli than if it appeared away from it. It is also possible that attention is facilitated by the presentation of mood-congruent stimuli, and in such a case latencies to a letter probe at that same location would be faster. Furthermore, the letter probe followed the lexical decision task after one of two possible delays (ie., short or long). Given the fact that processing may indeed be slower in depressives, attentional responses to mood-congruent stimuli may not be displayed immediately after the presentation of such stimuli. Thus, the letter probe task provided both a spatial and temporal map of attention following the processing of mood congruent stimuli. Both clinical and nonclinical samples were tested on this task in order to determine which effects, if any, can be generalized from one population to the other.



## **Method**

### **Subjects**

#### **Clinical Sample:**

The clinical sample included 15 clinically anxious (panic disorder with agoraphobia,  $n=6$ ; panic disorder without agoraphobia,  $n=4$ ; and GAD,  $n=5$ ), 15 clinically depressed (major depression,  $n=14$ ; dysthymia,  $n=1$ ), and 16 normal control subjects (no history of anxiety, depression, or other mental disorder). Due to the comorbidity of anxiety and depression, it is rare that two pure populations can be obtained. Therefore, selection of subjects depended mostly upon primary diagnosis. Barlow (1988) points out that anxiety can be found without depression, but rarely is depression ever found without anxiety. As a result, the most available groups to measure were anxiety without depression and anxiety with depression.

In addition to primary diagnosis, selection of appropriate subjects also depended upon a DSM-IV diagnostic interview. Potential subjects were not considered if there was any history of substance abuse, neurological disorder, psychosis, or personality disorder. All subjects completed the Centre for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977), the State-Trait Anxiety Inventory (STAI) (Spielberger, 1970), and the WAIS-CLARKE vocabulary test.

Anxious and depressed subjects were currently in treatment and were recruited from: London Psychiatric Hospital, London, Ontario; Victoria General Hospital, London, Ontario; St. Joseph's Hospital, London, Ontario; Valley Regional Hospital,

Kentville, Nova Scotia; West Kings Memorial Hospital, Berwick, Nova Scotia; and Soldier's Memorial Hospital, Middleton, Nova Scotia. Potential subjects were approached by their primary therapist and given a brief description of the study. They were asked if they would consent to be contacted by the experimenter to answer any questions and arrange a time for testing. Subjects for the clinical sample were entered in two \$100 lotteries for their participation. After completion of the experiment, subjects were debriefed and any further questions were answered.

#### Nonclinical Sample:

In addition to the clinical sample, a nonclinical sample of mildly anxious ( $n=19$ ), mildly depressed ( $n=17$ ), and control ( $n=17$ ) university students was also tested. These subjects completed screening surveys and were selected based on the following criteria: anxious subjects scored 38 or above on the Trait scale of the STAI and below 15 on the CES-D to be considered non-depressed, and subjects who scored 22 or higher on the CES-D were considered depressed regardless of their score on other scales. The control group scored below 38 on the Trait scale of the STAI and below 15 on the CES-D. The nonclinical sample received course credit points for their participation in the study.

#### Apparatus and Stimuli

The stimuli are divided into main categories: words and nonwords. The words in this study were taken from Greenberg and Alloy (1989) (see Table 1).

**TABLE 1. Stimuli developed by Greenberg and Alloy (1989)**

	<b>CONTROL</b>	<b>DEPRESSION RELEVANT</b>	<b>ANXIETY RELEVANT</b>
<b>POSITIVE</b>	congenial cooperative genuine polite scrupulous tactful amiable cordial ethical honest mannered nice	loveable motivated outgoing potent valuable worthy ambitious eager energetic enthusiastic lively praiseworthy	calm confident relaxed serene secure unruffled assured comfortable competent consistent graceful invulnerable
<b>NEGATIVE</b>	crude discourteous nosy phony thoughtless uncivil disrespectful immoral obnoxious rude ungrateful unprincipled	deficient inadequate lazy powerless weak withdrawn ineffective insignificant lowly shameful sluggish uninspired	anxious irritable jittery nervous tense touchy edgy inconsistent offensive shaky unsafe unsteady

These words can be subdivided according to their mood-relevant content (neutral, anxiety-relevant, depression-relevant), as well as positive or negative valence. These words were matched across the six categories for word length and frequency of usage. The nonwords used were created by taking a noun, changing the first letter, and then adding an adjective ending (e.g., "desk"- "mesk"- "meskable"). The nonwords were designed to approximate the words in length and adjective endings. There were 144 words in all, with 72 nonwords and 12 words of each of the six categories. Other stimuli included a fixation cross, "+", and an "X" and "Y" probe.

The experiment was controlled by an IBM compatible 386 PC equipped with millisecond timing software and an external response panel. The response panel consisted of two large buttons, which were used for both the "word/nonword" and "X/Y" discriminations. Stimuli were presented on a 14" monitor. With a viewing distance of 60 cm, the letters subtended a visual angle of about 0.71 deg vertical and 0.29 deg horizontal. The fixation cross presented at the centre of the screen subtends a visual angle of about 0.29 deg square.

Although the word and nonword stimuli always appeared at the centre, the probes appeared at the same location or about 2.1 deg vertical above or below fixation.

### Procedure

Subjects were tested in a single session, along with the two other experimental tasks. Half of the subjects in each group completed this task before the second task,

while the other half completed the second task before the present one. All subjects completed the two memory tasks last. The present task consists of 288 trials, and a different trial order was randomly generated for each subject. Each word and nonword were presented on two occasions, with the "X/Y" probe presented following a 100 msec. delay one time and following an 800 msec. delay the other time. In addition, the position of the "X/Y" probe (above, below, or directly at fixation) was counterbalanced across the six word types.

On a single trial, subjects were presented with a fixation cross on the centre of the screen for 500 msec. Following this, the fixation cross was replaced by either a stimulus word or nonword. The display remained on the screen until the subject responded by depressing one of the buttons on the response panel, signalling "word" or "nonword". Immediately after the subject's response, the stimulus word disappeared from the screen. Following a delay of either 100 or 800 msec., the letter probe (either an "X" or a "Y") appeared with an equal chance of being located directly at, above, or below fixation. The subject was then required to make this discrimination of whether or not the letter was an "X" or a "Y" and respond by depressing the appropriate button on the response panel.

Reaction times and accuracy were recorded for the lexical decision task, as well as for the probe task. Following from Broadbent and Broadbent's (1988) finding that mood-congruent attentional biases tend to build up over trials, separate analyses were also carried out on the reaction times to the lexical decision and probe tasks for the first and last half of trials.

## Results

### Subject Characteristics

Scores on the various psychometric scales and other subject data are presented for the clinical and nonclinical subject groups in Tables 2 and 3, respectively. With a significance level of .05, t-tests indicated that clinically depressed subjects scored higher on the CES-D than did clinically anxious subjects, and clinically anxious subjects in turn scored higher than did control subjects. Clinically anxious and depressed subjects did not differ in their scores on the Trait anxiety scale, but both groups scored higher than the control group.

Clinically depressed subjects scored higher on the State anxiety scale than clinically anxious subjects, who in turn scored higher than control subjects. However, Trait scores have generally been more closely associated with information processing biases (e.g., Broadbent *et al.*, 1988). Clinically anxious and clinically depressed subjects did not differ on Trait anxiety scores; a common finding reflecting the high rate of comorbidity of the two disorders. Clinically anxious and clinically depressed subjects did not differ in terms of anxiolytic medication, but clinically depressed subjects received more anti-depressant and anti-psychotic medication than clinically anxious subjects. One depressed subject received anti-cholinergic medication to help alleviate the side effects of anti-psychotics. Also, clinically depressed subjects were, in general, hospitalized more than clinically anxious and control subjects. There were no significant differences between the three groups in age, years of education, or for scores on the WAIS-CLARKE.

**Table 2. Mean test scores and subject data for clinical sample (standard deviations in parentheses).**

	GROUP		
	<u>Anxious (n=15)</u>	<u>Depressed (n=15)</u>	<u>Control (n=16)</u>
S-AI	42 (10.4) <sup>d,c</sup>	53 (10.6) <sup>a,c</sup>	32 (4.8) <sup>a,d</sup>
T-AI	56 (9.4) <sup>c</sup>	61 (8.3) <sup>c</sup>	31 (6.4) <sup>a,d</sup>
CES-D	23 (10.7) <sup>d,c</sup>	36 (12.1) <sup>a,c</sup>	11.5 (3.6) <sup>a,d</sup>
WAIS-CLARKE	27 (5.4)	27 (6.5)	31 (3.6)
Age	37 (11.7)	36 (8.5)	29 (6.0)
Hospitalization (in weeks)	0.93 (2.4) <sup>d</sup>	18 (17.7) <sup>a,c</sup>	0 (0) <sup>d</sup>
Education	13 (3.1)	13 (1.5)	15 (1.5)
Anxiolytics (daily diazepam equivalents in mgs.)	8.3 (10.8) <sup>c</sup>	6.0 (9.2) <sup>c</sup>	0 (0) <sup>a,d</sup>
Anti-depressants (daily amitriptyline equivalents in mgs.)	2.3 (45.7) <sup>d</sup>	136 (106.5) <sup>a,c</sup>	0 (0) <sup>d</sup>
Anti-psychotics (daily chlorpromazine equivalents in mgs.)	0 (0) <sup>d</sup>	35 (66.4) <sup>a,c</sup>	0 (0) <sup>d</sup>
Anti-cholinergics (daily benztropine equivalents in mgs.)	0(0)	.13 (.63)	0 (0)

<sup>a</sup> - differs from anxious group ( $p < .05$ )

<sup>d</sup> - differs from depressed group ( $p < .05$ )

<sup>c</sup> - differs from control group ( $p < .05$ )

**Table 3. Mean raw scores on STAI and CES-D for nonclinical sample**

	GROUP		
	Mildly Anxious	Mildly Depressed	Control
S-AI	40.7	42.8	34.8
T-AI	43.0	44.0	34.2
CES-D	14.4	24.4	10.2



Mildly anxious and mildly depressed subjects did not differ on State and Trait anxiety scores. However, mildly depressed subjects scored higher than mildly anxious subjects on the CES-D ( $t(34) = 7.45, p < .001$ ). Both mildly anxious and mildly depressed subjects scored higher than control subjects on all scales.

### **Lexical Decision Task**

**Clinical sample:**

#### **Accuracy**

The number of incorrect responses for the lexical decision task were subjected to a 3 (GROUP: anxious, depressed, control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) repeated measures ANOVA. Subjects in each group responded with 90% accuracy or above. There were no significant main effects or interactions.

#### **Reaction Times**

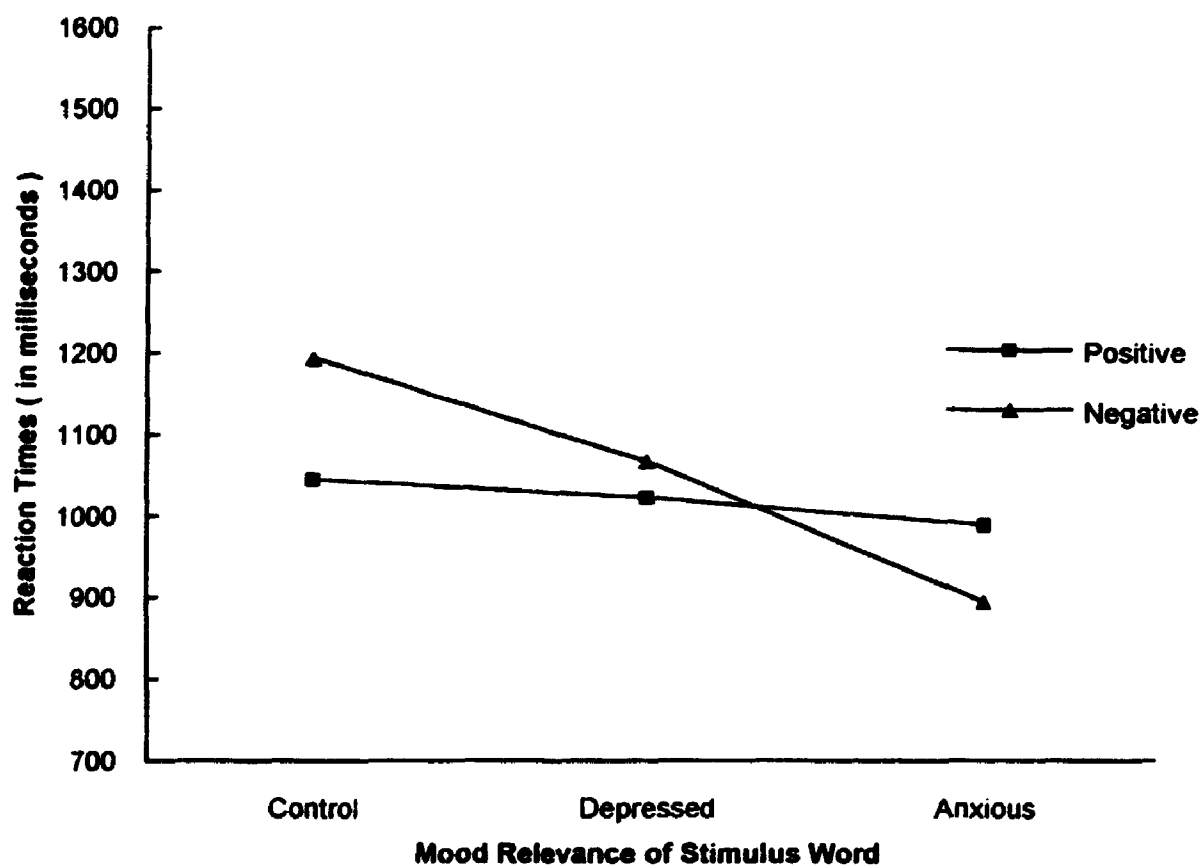
This task was designed to examine whether or not depressed and anxious subjects process word content at the same rate, and whether or not they differentially process anxious, or depressed word content. To achieve this, reaction time scores for correct trials on the lexical decision task were subjected to a 3 (GROUP: anxious, depressed, control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) repeated measures analysis of variance (ANOVA).

Trials with latencies greater than 3 seconds were excluded from analysis. The results showed a main effect of GROUP ( $F(2,43) = 11.24, p < .001$ ), and a main effect of WORD CONTENT ( $F(2,86) = 35.47, p < .001$ ). Depressed subjects were slower to respond in general to the lexical decision task ( $X = 1375$  msec.) than control subjects ( $X = 931$  msec.), ( $t(43) = 1.86, p < .05$ ), but latencies for anxious subjects ( $X = 1036$  msec.) were not significantly different from either depressed or control subjects. Subjects as an entire group showed a tendency to respond faster to words with anxious content ( $X = 1042$  msec.) than depressed content ( $X = 1124$  msec.) ( $t(86) = 3.6, p < .01$ ), and responded faster to words with depressed content than to words with neutral content ( $X = 1176$  msec.), ( $t(86) = 2.29, p < .05$ ).

Significant interactions included WORD CONTENT X WORD SIGN ( $F(2,86) = 15.26, p < .001$ ), GROUP X WORD CONTENT ( $F(4,86) = 2.53, p < .05$ ), and GROUP X WORD CONTENT X WORD SIGN ( $F(4,86) = 2.53, p < .05$ ). No other main effects or interactions approached significance ( $p > .1$ ).

The interaction of interest is GROUP X WORD CONTENT X WORD SIGN and to pursue this, the WORD CONTENT X WORD SIGN interactions were examined for each group individually. Reaction times for the lexical decision to various word types are given for anxious, depressed, and control subjects in figures 1, 2 and 3, respectively. For each group, a separate 3 (WORD CONTENT) X 2 (WORD SIGN) ANOVA was carried out. The results indicated that for anxious subjects there was a main effect of WORD CONTENT ( $F(2,28) = 27.14, p < .001$ ) and a significant WORD CONTENT X WORD SIGN interaction, ( $F(2,28) = 6.95,$

Figure 1. Latencies (in milliseconds) on the lexical decision task for clinically anxious subjects.



**Figure 2. Latencies (in milliseconds) on the lexical decision task for clinically depressed subjects.**

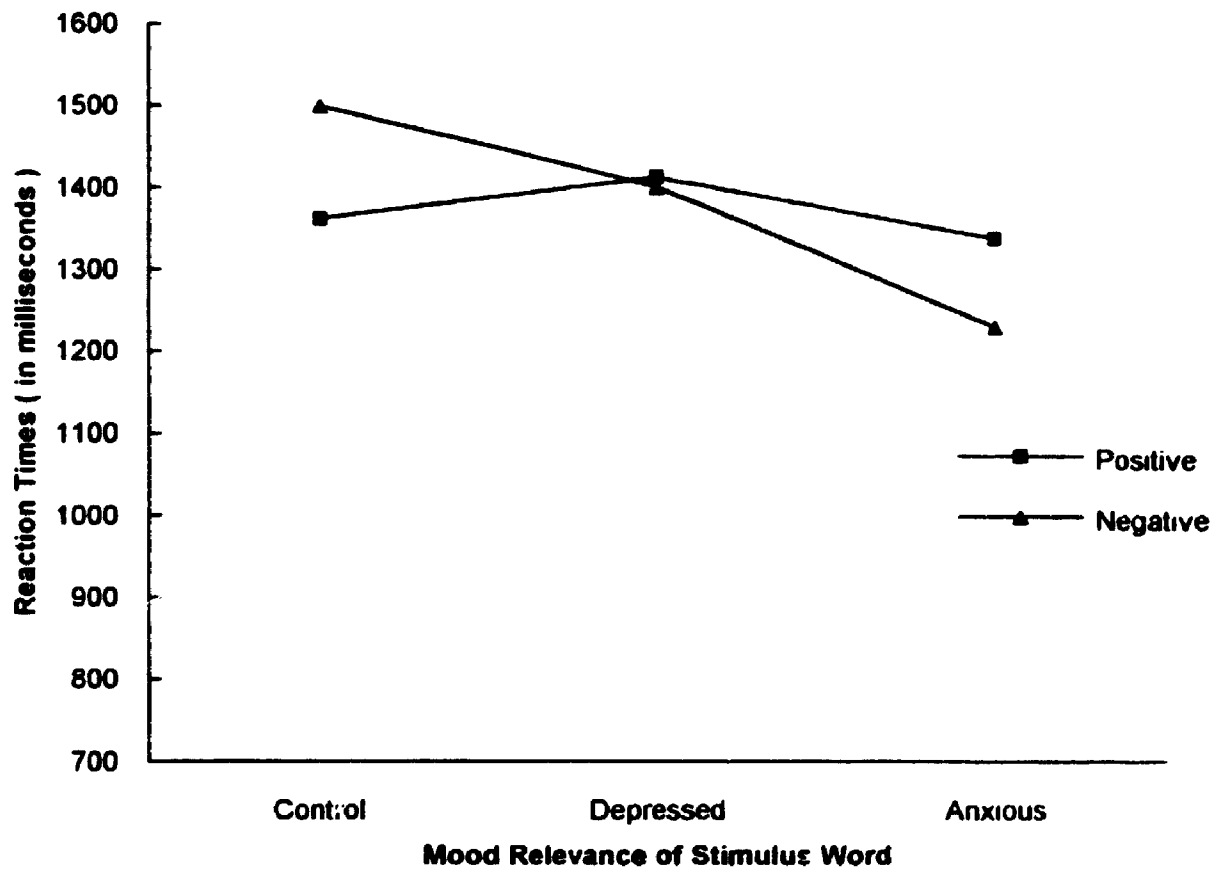
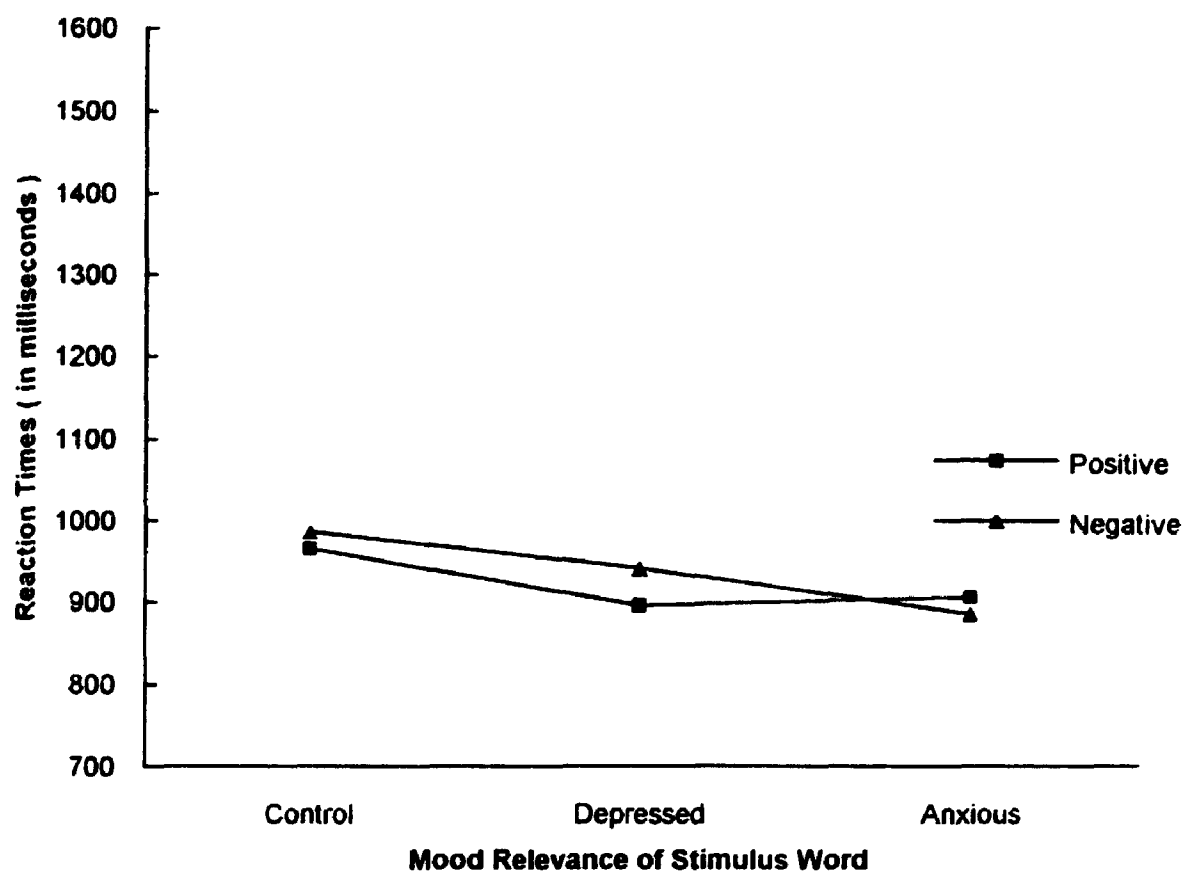


Figure 3. Latencies (in milliseconds) on the lexical decision task for control subjects.



$p < .01$ ). Post-hoc analyses using Dunn's T indicated that anxious subjects were faster to respond to anxious-content words ( $X = 943$  msec.) than depressed-content words ( $X = 1046$  msec.) or control words ( $X = 1120$  msec.), ( $t(28) = 2.194, p < .05$ ;  $t(28) = 3.65, p < .001$ ). Also, anxious subjects responded faster to positive control words ( $X = 1045$  msec.) than to negative ( $X = 1194$  msec.) ( $t(28) = 2.315, p < .05$ ), but this difference was not observed for depressed-content words ( $X = 1023$  and  $1068$  msec., respectively). Conversely, anxious subjects responded faster to negative anxious words ( $X = 895$  msec.) than positive anxious words ( $X = 990$  msec.), but the difference was only marginally significant ( $t(28) = 1.41, p < .1$ ).

Depressed subjects also showed a main effect of WORD CONTENT, ( $F(2,28) = 9.93, p < .001$ ), and a significant WORD CONTENT X WORD SIGN interaction, ( $F(2,28) = 7.71, p < .01$ ). Post-hoc analyses indicated that depressed subjects responded faster to anxious words ( $X = 1286$  msec.) than to control words ( $X = 1431$  msec.), ( $t(28) = 2.1, p < .05$ ). Latencies to depressed words ( $X = 1408$  msec.) were not significantly different from either of these. As with anxious subjects, depressed subjects also responded faster to positive control words ( $X = 1362$  msec.) than to negative ( $X = 1500$  msec.) ( $t(28) = 2.1, p < .05$ ) and showed no differences for depressed content words ( $X = 1413$  and  $1402$  msec., respectively). However, depressed subjects were faster to respond to negative anxious words ( $X = 1232$  msec.) than to positive ( $X = 1340$  msec.), ( $t(28) = 1.76, p < .05$ ).

Control subjects showed only a main effect of WORD CONTENT, ( $F(2,30) = 7.13, p < .01$ ). Post-hoc tests showed that similar to the other subject groups, control

subjects responded slower to control words ( $X = 997$  msec.) than to anxious content words ( $X = 896$  msec.) ( $t(30) = 2.6, p < .01$ ) or depressed content words ( $X = 919$  msec.), ( $t(30) = 1.77, p < .05$ ).

### Blocking Effects

The pattern of reaction times for the lexical decision task did not differ between the first and second half of trials. However, the WORD CONTENT main effect diminished in the second half of trials, as did the WORD CONTENT X WORD SIGN and GROUP X WORD CONTENT X WORD SIGN interactions. Also, overall latencies decreased in the second half of trials relative to the first half ( $F(1,43) = 39.82, p < .001$ ).

### Summary for Clinical Sample

All subject groups showed a tendency to be faster for anxious words than for control words, and reaction times for depressed words tended to be in between. Only depressed and anxious subjects showed any differences between positive and negative words across the three word contents. In fact, based on the WORD CONTENT X WORD SIGN interactions, both anxious and depressed subjects showed basically the same pattern of results; the main difference being that depressed subjects took longer in general to respond. Depressed subjects also consistently showed larger variances, but Mauchly sphericity tests indicated that the assumption of homogeneity of variances was not violated. Although the same general pattern of reaction times was

observed for early and late trials, the differences were smaller for late trials. Since this task to some extent measures the relative accessibility of the words, practice may have increased the accessibility of all words and thus the difference between different word types diminished.

#### Nonclinical Sample:

##### Accuracy

The number of incorrect responses for the lexical decision task were subjected to a 3 (GROUP: anxious, depressed, control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) repeated measures ANOVA. Subjects in each group responded with at least 90% accuracy. There were no significant main effects or interactions.

##### Reaction Times

As with the clinical sample, the nonclinical sample reaction time scores for correct trials on the lexical decision task were subjected to a 3 (GROUP: mildly-anxious, mildly-depressed, control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) repeated measures ANOVA. There was also a main effect of WORD CONTENT, ( $F(2,100) = 19.57, p < .01$ ). Post-hoc analyses showed that subjects were faster to respond to anxious words ( $X = 838$  msec.) than to control words ( $X = 917$  msec.), ( $t(100) = 1.89, p < .05$ ). Latencies



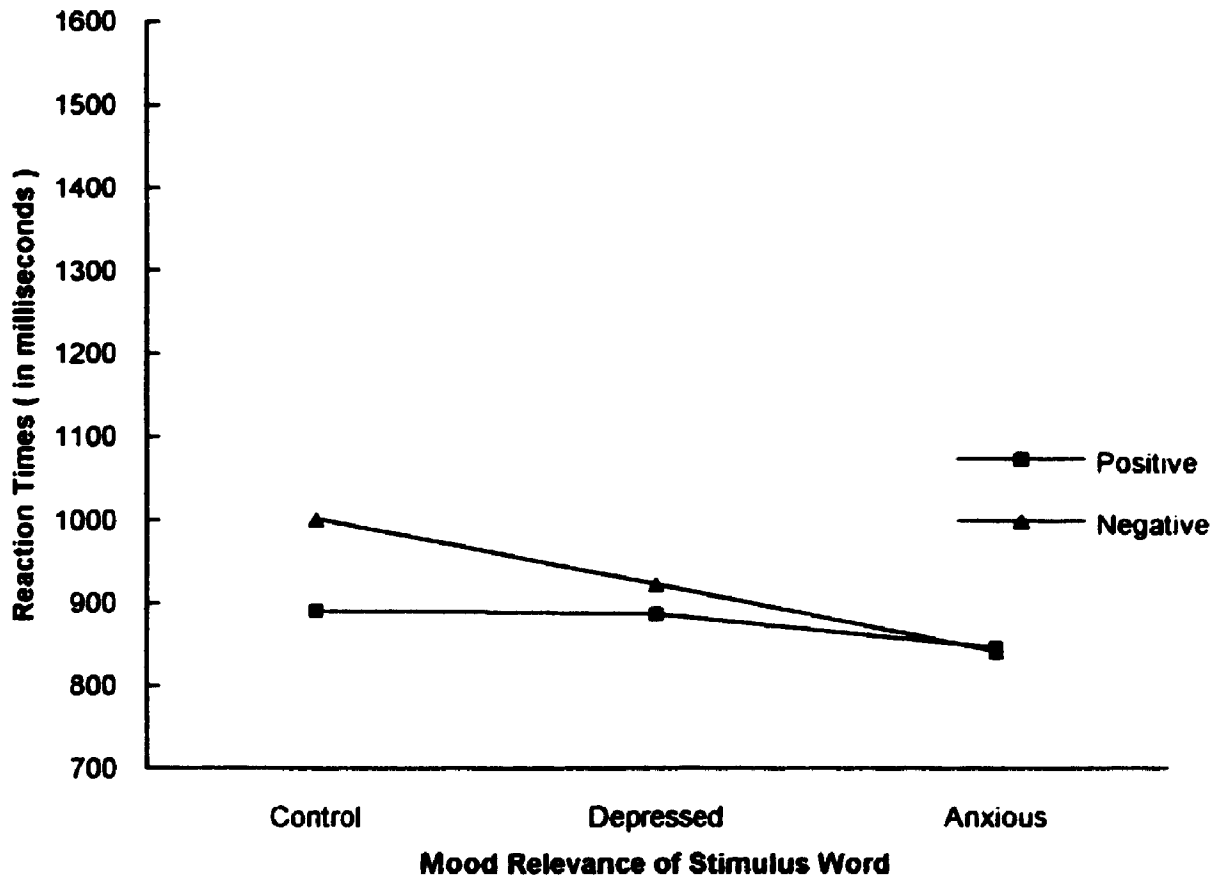
to depressed words ( $X = 885$  msec.) did not significantly differ from latencies to either anxious or control words.

Significant interactions included GROUP X WORD SIGN ( $F(2,50) = 5.27$ ,  $p < .01$ ), WORD CONTENT X WORD SIGN ( $F(2,100) = 6.68$ ,  $p < .01$ ), and GROUP X WORD CONTENT X WORD SIGN ( $F(4,100) = 2.25$ ,  $p < .05$ ). All other main effects and interactions were non-significant, ( $p > .1$ ).

The interaction of interest is GROUP X WORD CONTENT X WORD SIGN, and to examine this pattern more closely, 3 (WORD CONTENT) X 2 (WORD SIGN) ANOVAS were calculated for each group separately. Figures 4, 5 and 6 show the WORD X SIGN interaction for mildly anxious, mildly depressed, and nonclinical control subjects, respectively.

Mildly anxious subjects showed a main effect of WORD CONTENT, ( $F(2,36) = 8.17$ ,  $p < .001$ ), a main effect of WORD SIGN, ( $F(1,18) = 9.55$ ,  $p < .01$ ), and a significant WORD CONTENT X WORD SIGN interaction, ( $F(2,36) = 6.64$ ,  $p < .01$ ). Post-hoc analyses indicated that latencies for anxious words ( $X = 845$  msec.) were faster than for control words ( $X = 947$  msec.) ( $t(36) = 2.019$ ,  $p < .05$ ), but latencies for depressed words ( $X = 905$  msec.) did not differ from either of the other word types. Mildly anxious subjects were faster to respond to positive words ( $X = 875$  msec.) than negative words ( $X = 923$  msec.) in general, and post-hoc analyses showed that this difference was significant for control words ( $X = 891$  and  $1002$  msec., respectively) ( $t(36) = 3.5$ ,  $p < .001$ ), but not for anxious or depressed words.

**Figure 4. Latencies (in milliseconds) to the lexical decision task for mildly anxious subjects.**



**Figure 5. Latencies (in milliseconds) to the lexical decision task for mildly depressed subjects.**

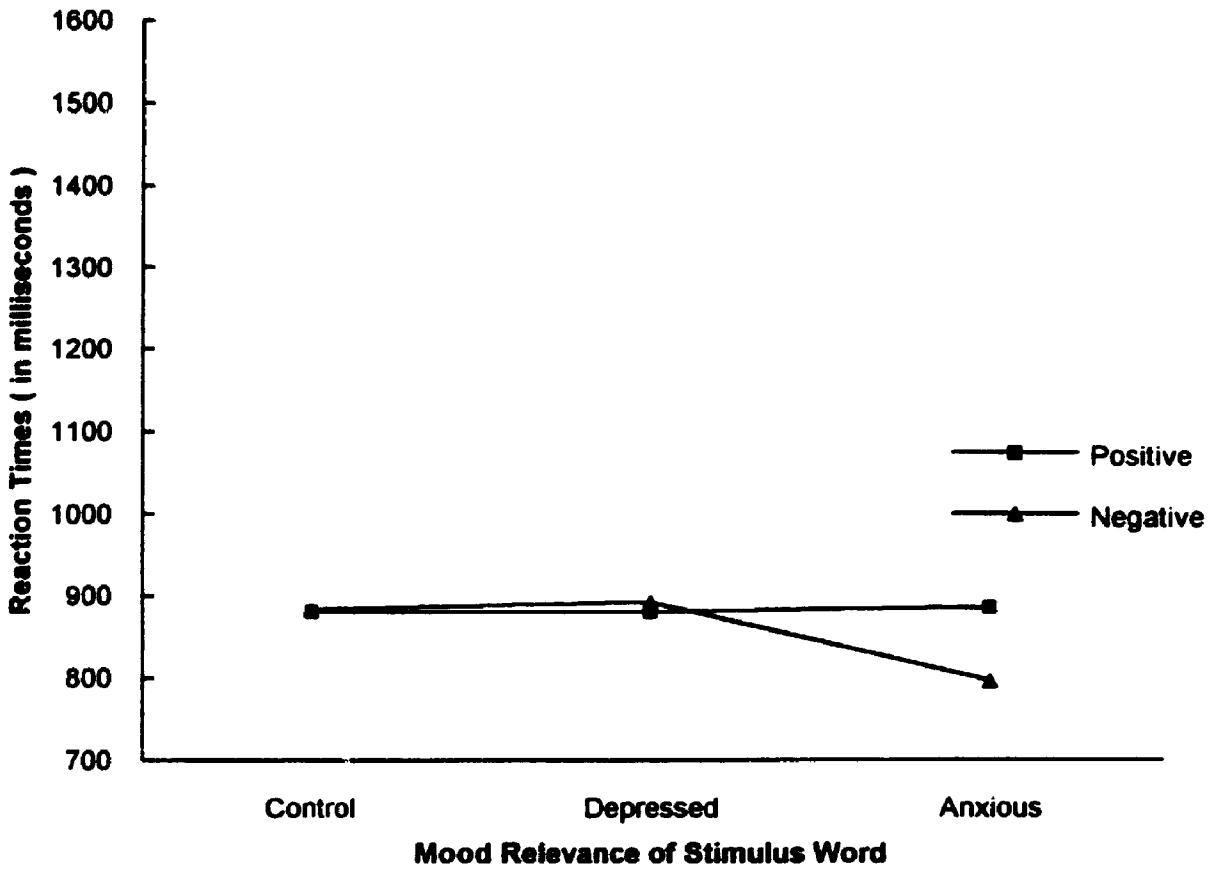
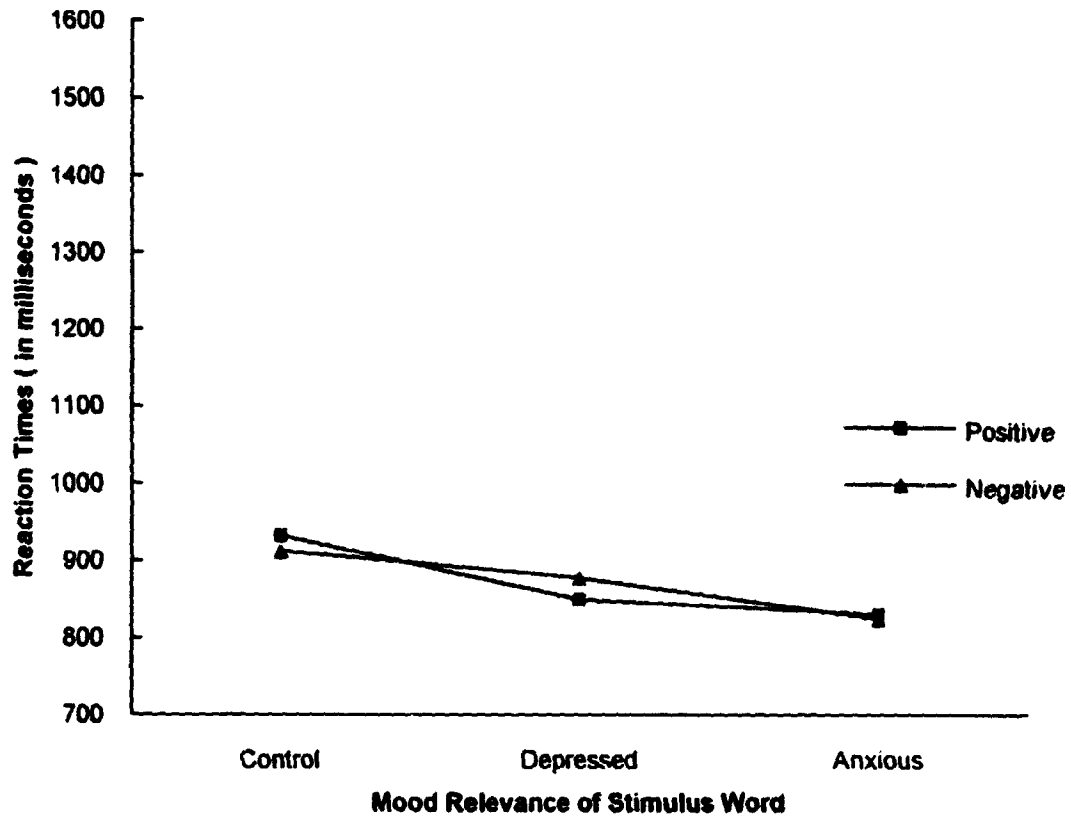


Figure 6. Latencies (in milliseconds) to the lexical decision task for nonclinical control subjects.



Mildly depressed subjects showed a main effect of WORD CONTENT only, ( $F(2,32) = 5.39, p < .01$ ), but post-hoc analyses showed that latencies for anxious words ( $X = 842$  msec.) were only marginally faster than for depressed words ( $X = 886$  msec.) or control words ( $X = 882$  msec.). Also, the WORD CONTENT X WORD SIGN interaction was only marginally significant, ( $F(2,32) = 2.89, p < .1$ ). Latencies were faster for words with negative-anxious content ( $X = 797$  msec.) than for other words ( $X = 884$  msec.), but there was little differentiation among the other word types.

Likewise the control subjects showed only a main effect of word content, ( $F(2,32) = 8.56, p < .001$ ). Post-hoc tests showed that as with the other subject groups, control subjects responded faster to anxious content words ( $X = 828$  msec.) than to control words ( $X = 923$  msec.), ( $t(32) = 2.04, p < .05$ ). Latencies to depressed content words ( $X = 864$  msec.) did not significantly differ from either anxious or control words. There was little differentiation between positive and negative valence regardless of word content.

### Blocking Effects

The pattern of reaction times for the non-clinical sample on the lexical decision task did not differ from the first to second block of trials. Subjects were faster to respond in the second block of trials than in the first ( $F(1,50) = 30.0, p < .001$ ), and the WORD CONTENT interaction diminished from the first block of trials to the second.

### Summary for Nonclinical sample

The first important finding was that the nonclinical sample of mildly depressed subjects were not slower to respond than other subjects, a pattern that was observed with the clinically depressed subjects. Nonetheless, mildly anxious and mildly depressed subjects did show some similarities to the clinical sample: mildly depressed subjects were faster to respond to negative anxious words, and mildly anxious subjects were slower to respond to negative control words.

### **Probe Task**

Clinical Sample:

### Accuracy

The number of incorrect trials for the probe task were subjected to a 3 (GROUP: anxious, depressed, and control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) X 2 (PROBE DELAY: 200 msec, 800 msec) X 2 (PROBE POSITION: at fixation, above/below fixation) repeated measures ANOVA. There were no significant main effects or interactions.

### Reaction Times

In addition to examining the nature of processing mood-congruent stimuli, this task was aimed at examining the nature of processing after such stimuli are recognized. Reaction times for correct trials on the probe task were subjected to a 3

(GROUP: anxious, depressed, and control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) X 2 (PROBE DELAY: 200 msec, 800 msec) X 2 (PROBE POSITION: at fixation, above/below fixation) repeated measures ANOVA. The results showed a main effect of GROUP ( $F(2,43) = 6.97, p < .01$ ), PROBE DELAY ( $F(1,43) = 41.0, p < .001$ ), and PROBE POSITION ( $F(1,43) = 13.64, p < .001$ ). Depressed subjects were slower than anxious or control subjects to respond to the probe, but post hoc t-tests indicated that no pairwise comparisons were significant. Subjects were faster to respond to the probe following an 800 msec delay ( $X = 662$  msec.) than following a 200 msec delay ( $X = 739$  msec.). Also, subjects were faster to respond to the probe when it appeared at fixation ( $X = 694$  msec.) than when it appeared above or below fixation ( $X = 707$  msec.). No other main effects approached significance ( $p > .1$ ). The only significant interaction was WORD CONTENT X WORD SIGN ( $F(2,86) = 3.55, p < .05$ ) and post hoc t-tests indicated that subjects responded faster to the probe when it followed positive control words ( $X = 674$  msec.) than negative control words ( $X = 732$  msec.), ( $t(86) = 1.77, p < .05$ ).

### Blocking Effects

Overall reaction times decreased for the second block of trials compared to the first block ( $F(1,44) = 39.21, p < .001$ ). Unlike the lexical decision task, the pattern of results for GROUP effects on the probe task differed according to early or late trials. Results for the first block of trials yielded a significant main effect of GROUP

only ( $F(2,43) = 8.16, p < .01$ ). However, results from the second block of trials yielded a main effect of GROUP ( $F(2,43) = 5.24, p < .01$ ), and a GROUP X PROBE DELAY X PROBE POSITION X WORD SIGN interaction ( $F(2,43) = 4.14, p < .05$ ). Pursuing the latter interaction, GROUP X WORD SIGN interactions were calculated for both levels of DELAY and POSITION (i.e., short delay at fixation, short delay away from fixation, long delay at fixation, and long delay away from fixation). For each of these conditions, Table 4 shows the reaction times of each group to the probe following positive and negative words.

The GROUP X SIGN interaction was only significant for Long Delay at Fixation ( $F(2,43) = 5.28, p < .01$ ). Post hoc t-tests also indicated that when the probe appeared at fixation after a long delay, anxious subjects were faster to respond following negative words ( $X = 577$  msec.) than positive ( $X = 646$  msec.), ( $t(14) = 2.48, p < .05$ ), and depressed subjects were slower ( $X = 748$  and  $658$  msec., respectively), ( $t(14) = 2.0, p < .05$ ). After a Short Delay, there was a nonsignificant tendency for anxious subjects to be slower to respond to a probe at fixation following negative words than positive, and depressed subjects were slower to respond to the probe away from fixation following negative words than positive.

### Summary for Clinical Sample

Group effects only appeared in the second block of trials, and may reflect either the nature of the processing biases or an adjustment to task demands. These effects seemed to be more related to positive/negative valence than to mood-relevance



**Table 4. Latencies (in milliseconds) to letter probe for clinical sample.****Short Delay at Fixation**

Word Sign	Group		
	Anxious	Depressed	Control
Positive	708	800	619
Negative	746	773	580

**Short Delay away from Fixation**

Word Sign	Group		
	Anxious	Depressed	Control
Positive	708	773	572
Negative	699	826	576

**Long Delay at Fixation**

Word Sign	Group		
	Anxious	Depressed	Control
Positive	646	688	546
Negative	577	748	539

**Long Delay away from Fixation**

Word Sign	Group		
	Anxious	Depressed	Control
Positive	645	732	557
Negative	667	744	571

which was observed in lexical decision task. These WORD SIGN effects have been found in other probe tasks (e.g., MacLeod & Mathews, 1990) and are not incompatible with the results from the lexical decision task. The lexical decision task reflects the time required to process the information whereas the probe task reflects the response to that information. Both mood-relevance and word-sign seemed to be important in determining how quickly subjects could process or identify a negative word, but subjects may respond to all negative words in the same way.

After a longer delay (i.e., 800 msec.), anxious subjects showed a tendency to respond significantly faster to negative words than positive words at fixation. Barlow (1988) and others have suggested that anxious individuals tend to avoid negative information once it is identified or recognized, but then later return attention to the source of apprehension. It is interesting to note that after a short delay, anxious subjects were slower to respond to probes at fixation following negative words than positive words, but the difference was not significant.

Finally, note that depressed subjects responded significantly slower following negative words than positive words at fixation after a long delay; a finding similar to the preliminary investigation. Unlike anxious subjects, depressed subjects did not show a tendency to avoid negative stimuli soon after their presentation. When the probe appeared after a short delay, depressed subjects showed a (nonsignificant) tendency to be slower to respond if it followed negative words than positive. However, this was only observed when the probe appeared away from fixation. Since the probe task followed a lexical decision task at fixation, this pattern may suggest

that depressed subjects were slower to shift attention away from fixation following negative words. Thus, depressed subjects may not show enhanced performance following the processing of negative information, but there is at least some suggestion that their attention lingers at the same location.

**Nonclinical sample:**

#### Accuracy

The number of incorrect trials for the probe task were subjected to a 3 (GROUP: anxious, depressed, and control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) X 2 (PROBE DELAY: 200 msec, 800 msec) X 2 (PROBE POSITION: at fixation, above/below fixation) repeated measures ANOVA. Subjects in each group responded with at least 90% accuracy. There were no significant main effects or interactions.

#### Reaction Times

Reaction times for correct trials on the probe task were subjected to a 3 (GROUP: anxious, depressed, and control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) X 2 (PROBE DELAY: 200 msec, 800 msec) X 2 (PROBE POSITION: at fixation, above/below fixation) repeated measures ANOVA. The results showed a main effect of PROBE DELAY ( $F(1,50) = 37.06, p < .001$ ), and PROBE POSITION ( $F(1,50) = 13.28, p < .001$ ).

Subjects were faster to respond to the probe following a 800 msec delay ( $X = 576$  msec.) than following an 200 msec delay ( $X = 624$  msec.). Subjects were faster to respond to the probe when it appeared at fixation ( $X = 591$  msec.) than when it appeared above or below fixation ( $X = 611$  msec.). No other main effects approached significance ( $p > .1$ ).

Significant interactions included PROBE DELAY X PROBE POSITION ( $F(1,50) = 4.97, p < .05$ ), PROBE DELAY X WORD SIGN ( $F(1,50) = 4.38, p < .05$ ), and GROUP X PROBE POSITION X WORD SIGN ( $F(2,50) = 5.84, p < .01$ ). Pursuing the GROUP effects, PROBE POSITION X WORD SIGN interactions were calculated for each group, but was only significant for mildly anxious subjects ( $F(1,18) = 7.79, p < .05$ ). Table 5 shows the PROBE POSITION X WORD SIGN interaction for the three groups. Post hoc t-tests indicated that mildly anxious subjects responded faster to the probe following positive words ( $X = 573$  msec.) than negative words ( $X = 619$  msec.) when it appeared at fixation ( $t(18) = 2.77, p < .01$ ).

### Blocking Effects

Subjects were faster to respond to the probe during the second half of the trials ( $F(1,50) = 7.87, p < .01$ ). The results were also analysed separately for each block of trials. There were no significant GROUP main effects or interactions for the first block. However, analysis of the second block of trials yielded a significant GROUP X PROBE DELAY X WORD SIGN interaction ( $F(2,50) = 4.57, p < .05$ ) and a

**Table 5. Latencies (in milliseconds) to letter probe presented at and away from fixation for nonclinical sample.**

		GROUP		
		Anxious	Depressed	Control
Fixation	Positive	573	577	603
	Negative	619	588	584
Away	Positive	631	598	601
	Negative	612	608	613

significant GROUP X PROBE POSITION X WORD SIGN interaction ( $F(2,50) = 5.15, p < .01$ ).

PROBE DELAY X WORD SIGN interactions were calculated for each group and are displayed in Table 6. The interaction was only significant for mildly depressed subjects ( $F(1,16) = 6.26, p < .05$ ). Post hoc T-tests indicated that they responded slower to the probe following negative words ( $X = 621$  msec.) than positive words ( $X = 593$  msec.) after a short delay ( $t(16) = 1.77, p < .05$ ). The pattern was reversed, but nonsignificant after a long delay.

PROBE POSITION X WORD SIGN interactions were calculated for each group and are displayed in Table 7. The interaction was only significant for mildly anxious subjects ( $F(1,18) = 8.68, p < .01$ ). Post hoc T-tests indicated that they responded slower to the probe following negative words ( $X = 605$  msec.) than positive words ( $X = 574$  msec.) at fixation ( $t(18) = 1.983, p < .05$ ) and faster to respond to the probe following negative words ( $X = 583$  msec.) than positive words ( $X = 619$  msec.) away from fixation ( $t(18) = 2.244, p < .05$ ).

#### Summary for Nonclinical Sample

As with the clinical sample, group differences for the nonclinical sample were observed in the second block of trials. Mildly anxious subjects were significantly slower to respond to the probe following negative words at fixation, but significantly faster away from fixation. This pattern suggests that they generally avoided the location where negative words were presented. Mildly depressed subjects were

**Table 6. Latencies (in milliseconds) to the letter probe following short (100 msec.) and long (800 msec.) delays for nonclinical sample (second block of trials only).**

		GROUP		
		Anxious	Depressed	Control
SHORT	Positive	608	593	601
	Negative	609	621	575
LONG	Positive	585	575	568
	Negative	579	548	579

**Table 7. Latencies (in milliseconds) to letter probe presented at and away from fixation for nonclinical sample (second block of trials only).**

		GROUP		
		Anxious	Depressed	Control
Fixation	Positive	574	580	589
	Negative	605	573	573
Away	Positive	619	588	579
	Negative	583	596	581



significantly slower to respond to the probe if it followed negative words after a short delay than after a long delay. This suggests that location is an important factor for mildly anxious subjects, whereas the delay duration is an important factor for mildly depressed subjects. The clinical counterparts showed that both the delay and location of the probe were important factors, which suggests that as with the lexical decision task, the nonclinical sample showed a similar, but less complete pattern of results to the clinical sample.

#### Discussion of Lexical Decision and Probe Tasks

The results from the WORD CONTENT X WORD SIGN interactions on the lexical decision task indicated that clinically anxious and clinically depressed subjects both show an advantage for processing negative anxiety words compared to positive, but the difference was only marginally significant for anxious subjects. Both groups showed a significant disadvantage for processing negative control words compared to positive. Control subjects showed no differences. Interestingly, previous examinations of lexical decision tasks have shown no differences between positive, negative, and neutral word types (Clark, Teasdale, Broadbent, & Martin, 1983; Challis & Krane, 1988; MacLeod, Tata, and Mathews, 1987). In this investigation, there were no differences between positive and negative words in general, but instead these word sign differences depended also upon the mood relevance of the word content. Thus, if only negative and positive words had been used, no differences would have been found across groups. It is also important to note that depressed

content words did not discriminate between groups. This might also explain why depressed subjects have not displayed mood-relevant biases. Finally, the similar patterns displayed by anxious and depressed subjects simplifies the question of how comorbid states would affect cognitive processes. In this investigation, anxious and depressed subjects show the same pattern, except that depressed subjects tended to be slower.

The slower responses by clinically depressed subjects could be explained simply as slower execution time, either because of motivation or psychomotor retardation, but it could also reflect slower or less efficient processing. The degree of delay in depressed subjects relative to control subjects was not the same for the lexical decision task and the probe task, yet both tasks demanded the same motor response (i.e., button press). The fact that the lexical decision task is a more complicated task than an X/Y discrimination task (thus requiring more processing), taken with the fact that the delay for depressed subjects relative to control subjects was greater on the lexical decision task than for the probe task, suggests that depressed subjects are actually slower to process the information.

It should be noted that correlations between effects and scores on psychometric tests and other subject data were not useful in discriminating the relative contribution of depressed or anxious mood. Overall latencies were significantly correlated with scores on the CES-D ( $r = 0.5$ ), anti-depressant medication ( $r = 0.4$ ), and anti-psychotic medication ( $r = 0.5$ ). However, within the depressed group alone all of these correlations were reduced and none were significant ( $p > .05$ ). In addition, only

4 subjects were presently taking anti-psychotic medication and their average response time did not differ from the rest of the depressed group.

The nonclinical sample showed some similarities to the clinical sample, but the differences observed for clinically anxious and depressed subjects were only partially observed for the nonclinical sample. Interestingly, post hoc tests on the WORD CONTENT X WORD SIGN interactions indicated that mildly anxious subjects were slower to respond to negative control words whereas mildly depressed subjects were faster to respond to negative anxious words. This might suggest that in milder states, the two moods manifest different styles of processing negative information. Mild anxiety may be associated with a tendency to suppress or avoid certain types of negative information, whereas mild depression may be associated with an attraction towards other types of negative information.

Based on post hoc tests following from the significant GROUP X PROBE DELAY X PROBE POSITION X WORD SIGN interaction, the results from the probe task suggested that clinically anxious subjects tended to avoid the location of negative information relative to positive soon after presentation, but then return to that location after a longer duration. There may be some evidence from marginally significant post hoc tests to suggest that attention for clinically depressed subjects is less likely to move away from the location of negative information relative to positive soon after presentation, but significant post hoc tests showed they were more likely to avoid the location after a longer duration. Thus, the time elapsed since the presentation of negative stimuli would seem to be an important factor in determining

the response style of both anxious and depressed individuals.

As with the lexical decision task, nonclinical samples showed some similarities to their clinical counterparts on the probe task. Based on significant WORD SIGN X PROBE POSITION and WORD SIGN X PROBE DELAY interactions, both mildly anxious and mildly depressed subjects showed some evidence of avoiding the location where negative words had been presented relative to positive. However, the time course of this avoidance response did not follow the same pattern as clinically anxious or clinically depressed subjects.

The results from the lexical decision task indicated that anxious and depressed individuals both show a similar processing advantage for negative anxious information than positive, and a disadvantage for processing negative control information than positive. Control subjects showed no such biases. The results from the probe task suggested that anxious and depressed individuals differ in their response to negative information. Whereas anxious individuals likely avoid negative information, and later return attention to that location, the attention of depressed individuals may tend to linger at that location and then later avoid it. Control subjects showed no characteristic patterns of response.

## **CHAPTER IV: NEGATIVE PRIMING OF MOOD CONGRUENT STIMULI**

The first task measured the relative accessibility of mood congruent stimuli and also measured temporal and spatial attentional responses to such stimuli. The results showed that anxious and depressed subjects display a similar pattern for selective accessibility of certain types of negative information; the main difference being that depressed subjects were slower to respond. Control subjects showed no evidence of this selectivity. Anxious and depressed subjects showed different patterns of responding to negative information. Whereas anxious subjects initially avoided negative information, there was evidence to suggest that depressed subjects initially had difficulty disengaging attention from negative information.

The purpose of this task was to examine the ease with which anxious and depressed subjects can inhibit and then disinhibit the content of mood-congruent stimuli. This task was based on research on the phenomenon of negative priming (e.g., Tipper, 1985; Tipper & Driver, 1988). On a typical negative priming task, subjects are required to respond to a target in the presence of a distractor. Subjects must actively ignore or "inhibit" the processing of the distractor. On some trials, the target stimulus is the same as or categorically related to the distractor from the previous trial. Typically, subjects are slower to respond to targets when they were related to previous distractors than when they are unrelated to previous distractors; presumably because the features and/or content of the stimulus are still being inhibited. The important issue here is that subjects will respond slower to a target

when there was a related distractor on the previous trial than they would normally respond to that same target when the distractor on the previous trial was unrelated. There is some evidence to suggest that subjects display a more robust negative priming effect if they show little interference from simultaneous distractors and likely represents how efficiently distractors can be inhibited (Tipper & Baylis, 1987). In this investigation, the negative priming task was implemented to examine how easily anxious and depressed subjects can inhibit and then disinhibit mood-congruent stimuli.

The important questions for this task are: 1) how well can anxious and depressed subjects make lexical decisions about a nonword with a mood-congruent distractor; and 2) how well can these subjects make lexical decisions about mood-congruent targets when the target was previously a distractor. Thus, anxious and depressed subjects were examined for how well they can inhibit the mood-congruent distractors on one trial (distractor trial), and then examined for how well they can disinhibit the mood-congruent stimuli on the next trial (target trial). From Tipper and Baylis (1987), it is assumed that if stimuli are efficiently avoided they will easily be inhibited on the distractor trial, but not so easily disinhibited on the target trial. However, if subjects are attracted to mood-congruent stimuli, they will be hard to inhibit on the distractor trial, but easy to disinhibit on the target trial.

The degree to which anxious and depressed subjects are distracted by mood-congruent stimuli cannot necessarily be predicted from the lexical decision task. Although both groups of subjects showed unique response patterns to mood-congruent stimuli on the probe task, the demands of that task demanded that subjects attend and

process such stimuli. However, on the distractor trials of this task, subjects had attention directed away from the mood-congruent distractors and towards a nonword target. Hence, subjects were not required to process the distractor in order to complete the task.

This task was not necessarily investigating the phenomenon of negative priming itself, but rather how easily subjects are distracted or selectively distracted by mood-congruent stimuli, and how efficiently the inhibition of distractors takes place. If inhibition of distractors on the distractor trial has no effect on the subsequent target trial, the expected pattern of responses to the target trial resembles that of the lexical decision task since the demands on the subject would be the same. It is possible that negative priming may not take place because lexical decision tasks have not been used in a negative priming paradigm and so there may be task demands that wash out any effects of negative priming.

## **Method**

### **Subjects**

The subjects were the same as in the first task.

### **Stimuli and Apparatus**

The stimuli were the same as in the lexical decision task, except that a larger number of nonword stimuli were added in order to accommodate the "filler" trials

required in this task.

No probes were used in this task. Target and distractor stimuli were presented about 0.29 deg above and below fixation. Additional stimuli included a small arrow subtending a visual angle of about 0.29 deg. that was presented at fixation to indicate whether the top or bottom stimulus was the target for that particular trial.

### Procedure

The experiment consisted of 216 trials in all. On each trial, the subject was presented with a fixation cross "+" for 500 msec. The fixation cross was then replaced with a small arrow which pointed either to the top or bottom of the screen and indicated which stimulus would be the target. The arrow appeared on the screen for 200 msec., followed by the presentation of both a target word and a distractor word slightly above and below fixation. The subject was required to respond to the target stimulus by discriminating whether or not it is a word. On one third of the trials, the distractor stimulus became the target stimulus on the subsequent trial. For such trials, the distractor of the first trial always changed position to become the target on the next trial. Reaction time and accuracy were recorded for "distractor trials", for which the target was always a nonword and the distractor was a word; and for "target trials", for which the distractor was always a nonword and the target was the word used as a distractor on the previous trial.



## Results

### Clinical Sample

#### Distractor Trial:

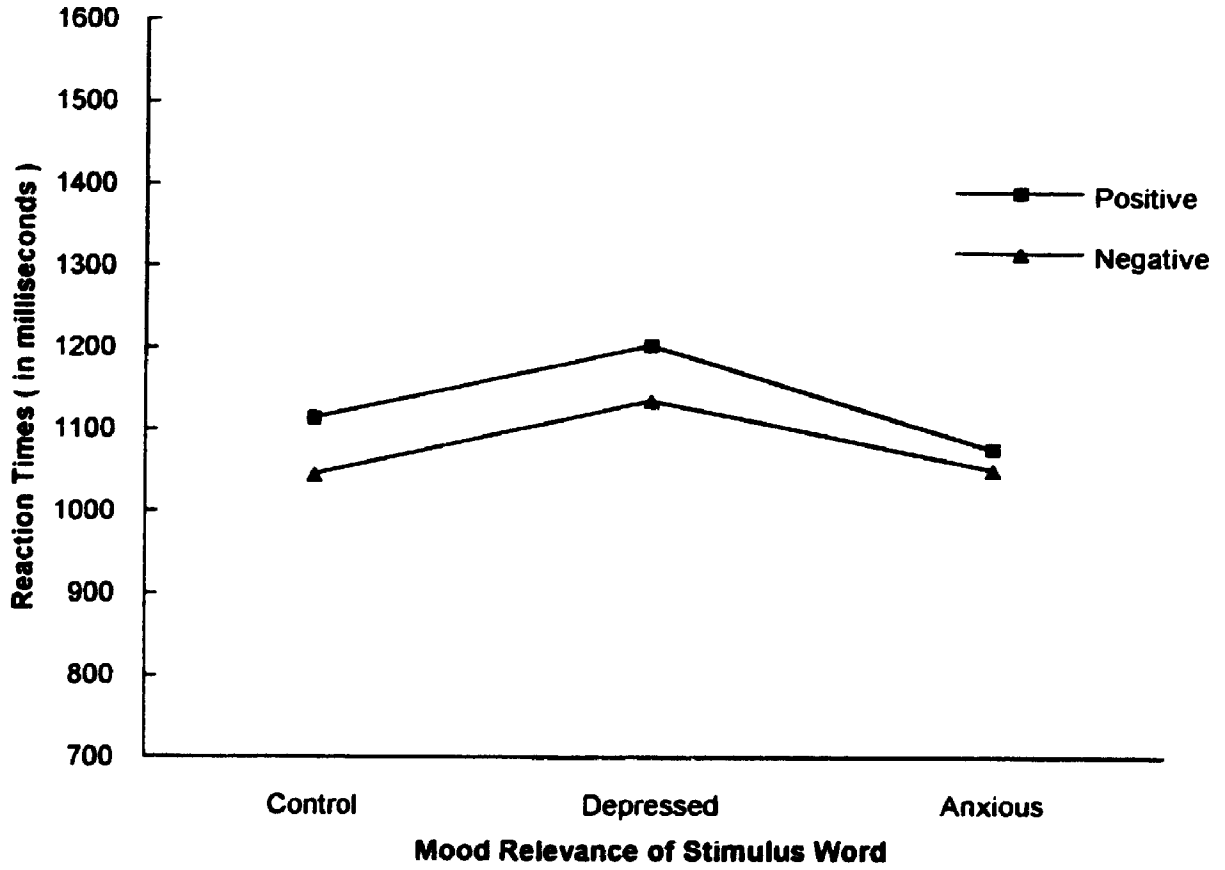
#### Accuracy

Analysis of accuracy data showed no main effects or interactions. However, the data from one depressed subject were excluded from analysis because error rates suggested responding at a chance level. All other subjects in each group responded with 90% accuracy or above.

#### Reaction Times

Mean reaction times were subjected to a 3 (GROUP: anxious, depressed, control) X 3 (distractor WORD CONTENT: anxious, depressed, control) X 2 (distractor WORD SIGN: positive, negative) ANOVA. Reaction times for anxious, depressed, and control subjects are shown in Figures 7, 8, and 9, respectively. The results showed a main effect of GROUP ( $F(2,42) = 10.56, p < .001$ ), WORD CONTENT ( $F(2,84) = 7.37, p < .001$ ), and a significant GROUP X WORD SIGN interaction, ( $F(2,42) = 5.71, p < .01$ ). Due to the fact that on these trials the target was a nonword and the nonwords were not controlled for difficulty across the different word types, main effects and interactions that did not include group effects were not informative for this trial. Any patterns of reaction times comprise an effect of the distractor as well as the level of difficulty of the target, so only group

**Figure 7. Latencies (in milliseconds) on the distractor trial for clinically anxious subjects.**



**Figure 8. Latencies (in milliseconds) on the distractor trial probe for clinically depressed subjects.**

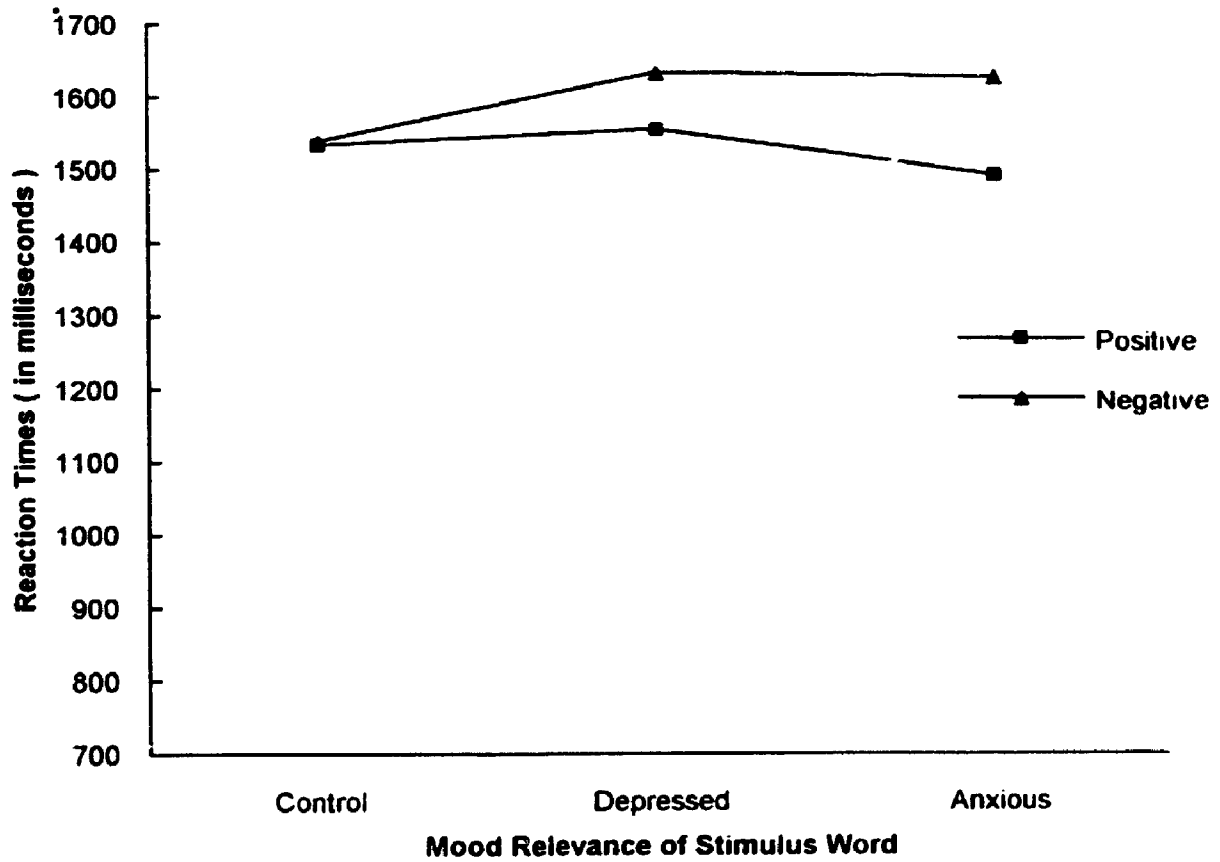
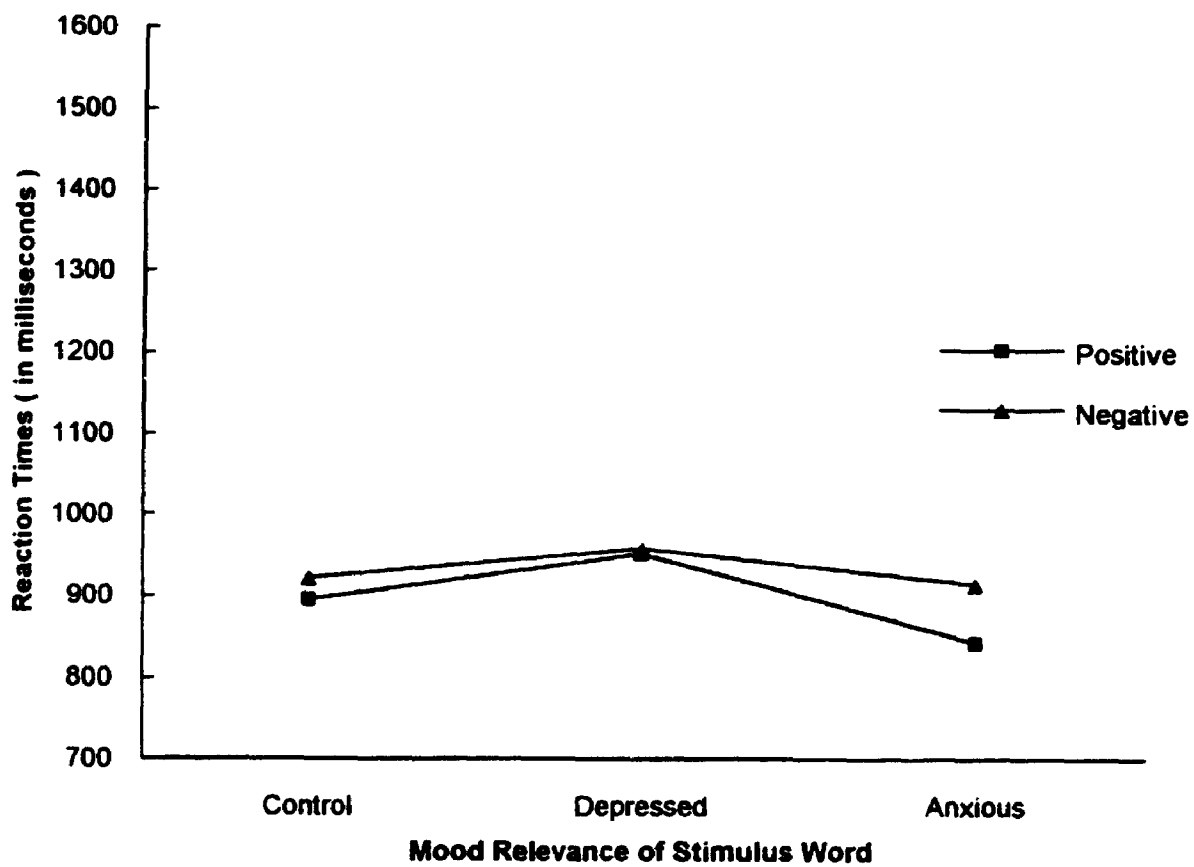


Figure 9. Latencies (in milliseconds) on the distractor trial for control subjects.



differences are of interest for these trials. Posthoc tests using Dunn's T showed that depressed subjects were slower to respond in general ( $X = 1564$  msec.) than control subjects ( $X = 914$  msec.) ( $t(41) = 1.84$ ,  $p < .05$ ), but were only marginally slower than anxious subjects ( $X = 1104$  msec.). To elucidate the GROUP X WORD SIGN interaction, separate dependent t-tests were performed on the positive and negative means for each group. Depressed subjects were slower to respond to the target when the distractor was negative ( $X = 1600$  msec.) than positive ( $X = 1527$  msec.), ( $t(13) = 2.06$ ,  $p < .05$ ). Anxious subjects showed a trend in the opposite direction and were actually faster to respond when the distractor was negative than positive, but the difference was not significant.

### Blocking Effects

The pattern of results did not change from the first block to the second. The GROUP X WORD SIGN interaction was not significant for either block individually.

### Target Trial:

### Accuracy

Analysis of accuracy data showed no significant main effects or interactions. Subjects in each group responded with at least 90% accuracy.

### Reaction Times

Mean reaction times were subjected to a 3 (GROUP: anxious, depressed, control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) ANOVA. Reaction times for anxious, depressed, and control subjects are shown in Figures 10, 11, and 12, respectively. The results showed a main effect of GROUP ( $F(2,42) = 7.68, p < .001$ ), WORD CONTENT ( $F(2,84) = 11.55, p < .001$ ), and a significant WORD CONTENT X WORD SIGN interaction, ( $F(2,82) = 7.20, p < .001$ ). Depressed subjects were slower to respond in general than anxious or control subjects, but post hoc t-tests showed these pairwise differences to be only marginally significant.

If distractors have no effect on subsequent trials, the expected pattern of results should resemble that of the lexical decision task. In fact, the pattern for each group does resemble the results from the lexical decision task, but there was no GROUP X WORD CONTENT X WORD SIGN interaction. However, variances for this task were about twice that for the lexical decision task and so the interaction was likely "washed out" because of individual differences that were unrelated to mood. Inspection of the means indicated that all subjects tended to be faster for these trials than for the lexical decision task. Anxious and depressed subjects tended to be slower to respond to positive words on this task relative to the lexical decision task, whereas control subjects tended to be slower to respond to negative words on this task compared to the lexical decision task. These differences were nonsignificant and tentative at best, but might suggest that anxious and depressed subjects are more

**Figure 10. Latencies (in milliseconds) on the target trial for clinically anxious subjects.**

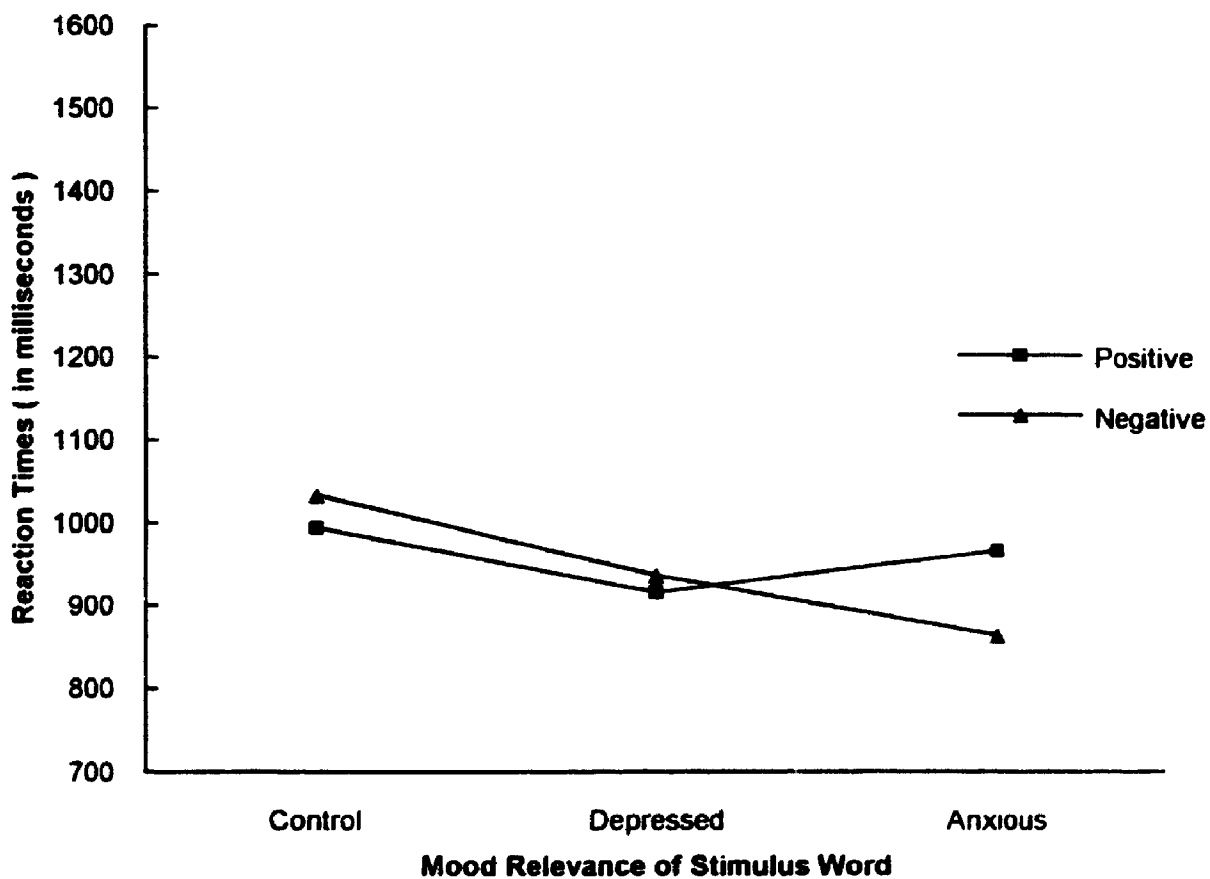


Figure 11. Latencies (in milliseconds) on the target trial for clinically depressed subjects.

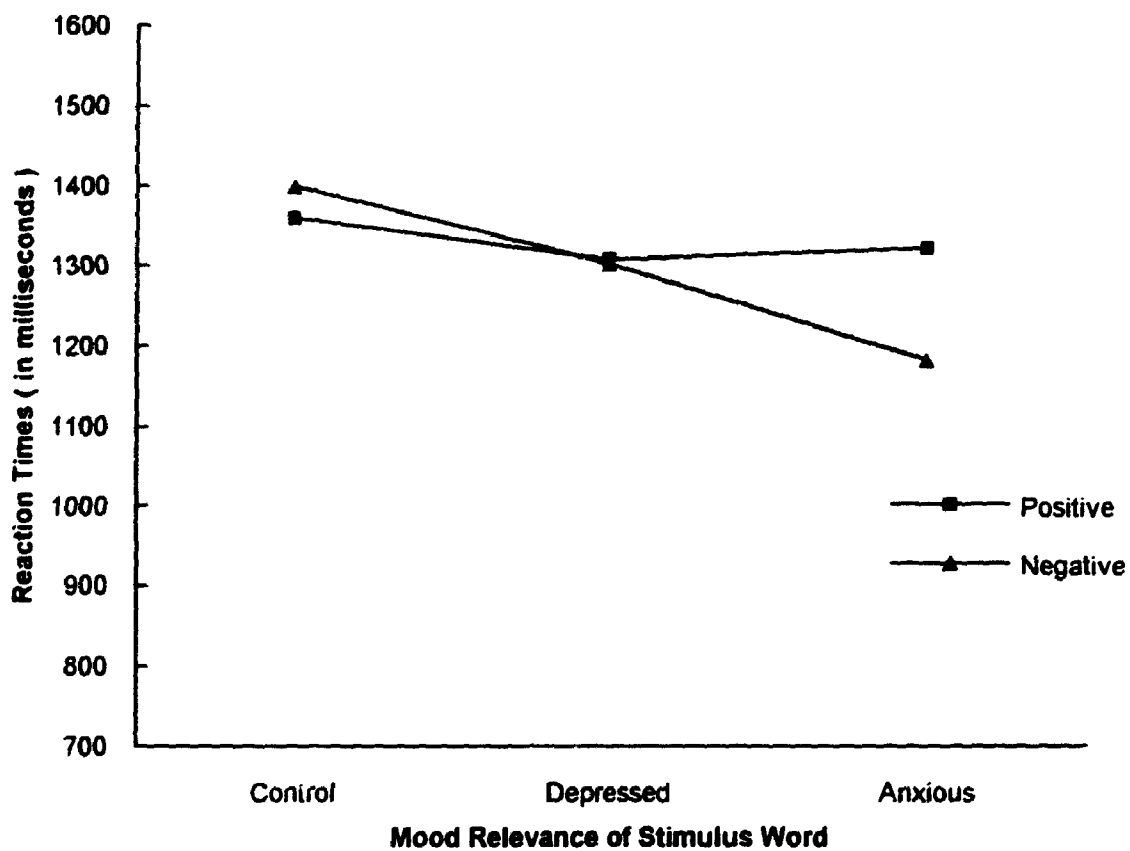
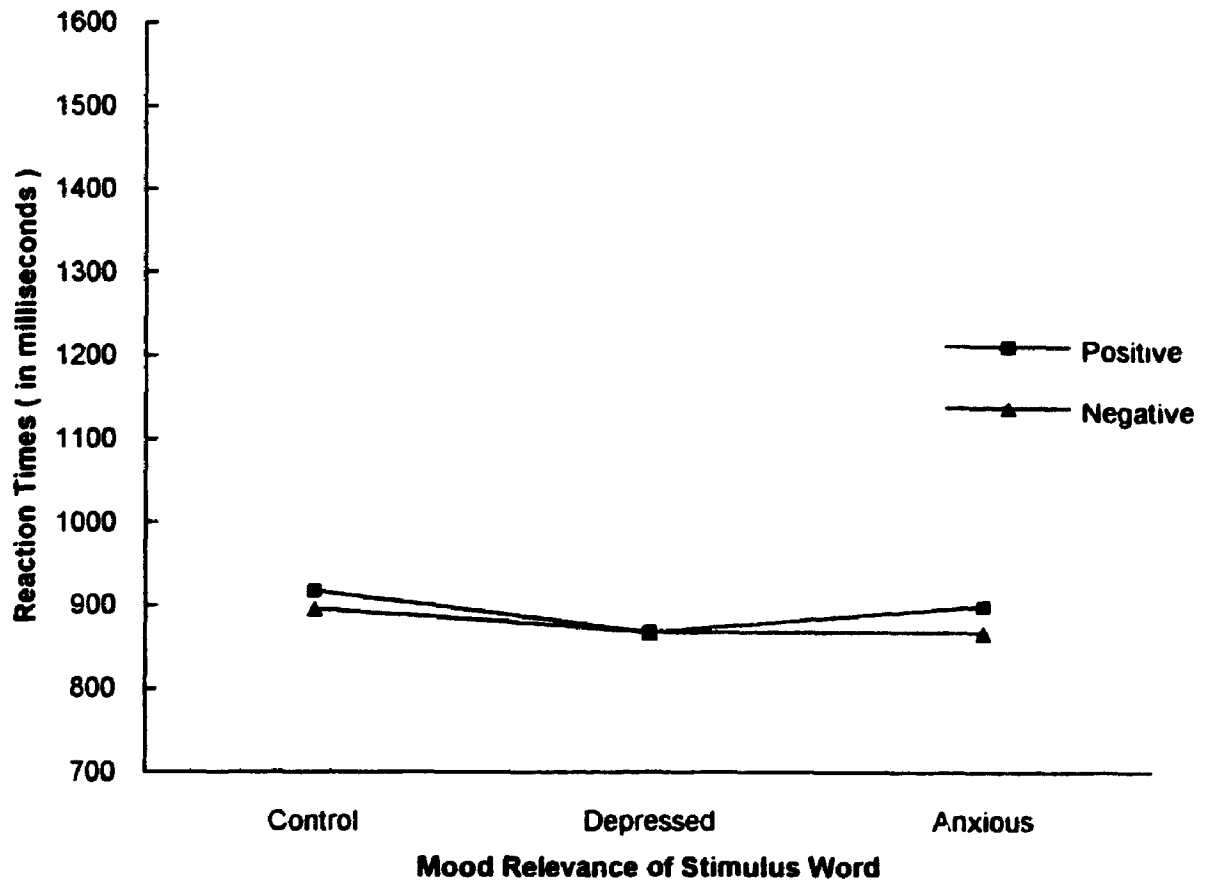




Figure 12. Latencies (in milliseconds) on the target trial for control subjects.



efficient at inhibiting positive distractors than negative (and hence show some negative priming effects), whereas control subjects are more efficient at inhibiting negative distractors than positive.

### Blocking Effects

To examine blocking effects, mean reaction times were subjected to a 3 (GROUP: anxious, depressed, control) X 2 (BLOCK: first half of trials, second half of trials) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) ANOVA. The results showed a main effect of GROUP ( $F(2,41) = 7.79, p < .001$ ), and of WORD CONTENT ( $F(2,82) = 7.98, p < .001$ ).

Significant interactions included BLOCK X WORD CONTENT ( $F(2,82) = 5.27, p < .01$ ), BLOCK X WORD SIGN ( $F(1,41) = 4.25, p < .05$ ), WORD CONTENT X WORD SIGN ( $F(2,82) = 7.20, p < .001$ ), AND BLOCK X WORD CONTENT X WORD SIGN ( $F(2,82) = 12.8, p < .001$ ).

Examination of the first block of trials showed a GROUP X WORD CONTENT interaction which produced a pattern resembling that found in the lexical decision task. Anxious and depressed subjects were faster to respond to anxious words in general than control words, with depressed words somewhat in between. As with the lexical decision task, these effects were largely due to the negative words and the pattern was not observed for control subjects. This interaction was not found in the second block of trials. However, the WORD CONTENT X WORD SIGN interaction produced a different pattern across blocks. While the first block more or

less resembled the lexical decision task, anxious and depressed subjects showed no differences between negative and positive control words on the second block. Also, all subjects were slower to respond to negative than positive depressed words; depressed subjects showing the largest difference and control subjects showing the smallest. An analysis of trials revealed that the second block provided only two trials with a negative, depressed target. Furthermore, these were the two longest words in that category and consequently skewed the means for all subjects. As a result, the changes across blocks were rendered uninterpretable.

#### Summary for clinical sample

Depressed subjects were slower to respond to a nonword target when the distractors were negative words. Anxious subjects showed a nonsignificant tendency to be faster to respond to a nonword target with negative distractors. Control subjects showed no differences. There was no strong evidence of negative priming effects and the higher variances on this task relative to the lexical decision task suggest that it may be measuring individual differences other than the effects of mood. It is possible that the phenomenon of negative priming does not affect lexical decision tasks in general. Nonetheless, there may be some (nonsignificant) indications that anxious and depressed subjects are more efficient at inhibiting positive words than negative, but control subjects are more efficient at inhibiting negative words than positive.

## **Nonclinical Sample**

**Distractor Trial:**

### Accuracy

Analysis of accuracy data showed no significant main effects or interactions.

Subjects in each group responded with 90% or better accuracy.

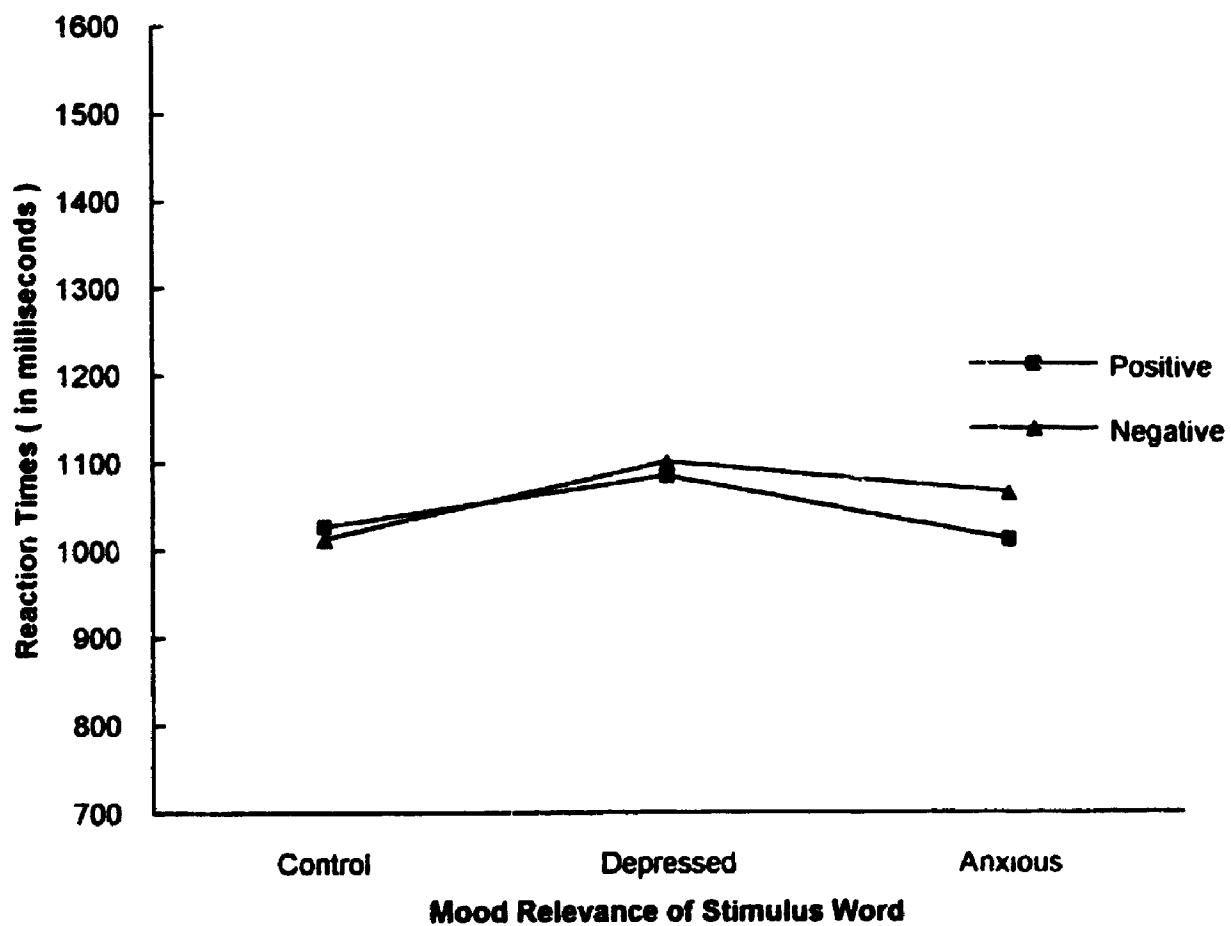
### Reaction Times

Mean reaction times were subjected to a 3 (GROUP: mildly anxious, mildly depressed, control) X 3 (distractor WORD CONTENT: anxious, depressed, control) X 2 (distractor WORD SIGN: positive, negative) ANOVA. Reaction times for mildly anxious, mildly depressed, and nonclinical control subjects are shown in Figures 13, 14, and 15, respectively. The results showed a main effect of WORD CONTENT ( $F(2,100) = 8.04, p < .001$ ) and of WORD SIGN ( $F(1,50) = 4.46, p < .05$ ). There were no GROUP effects, and consequently no informative differences for this trial

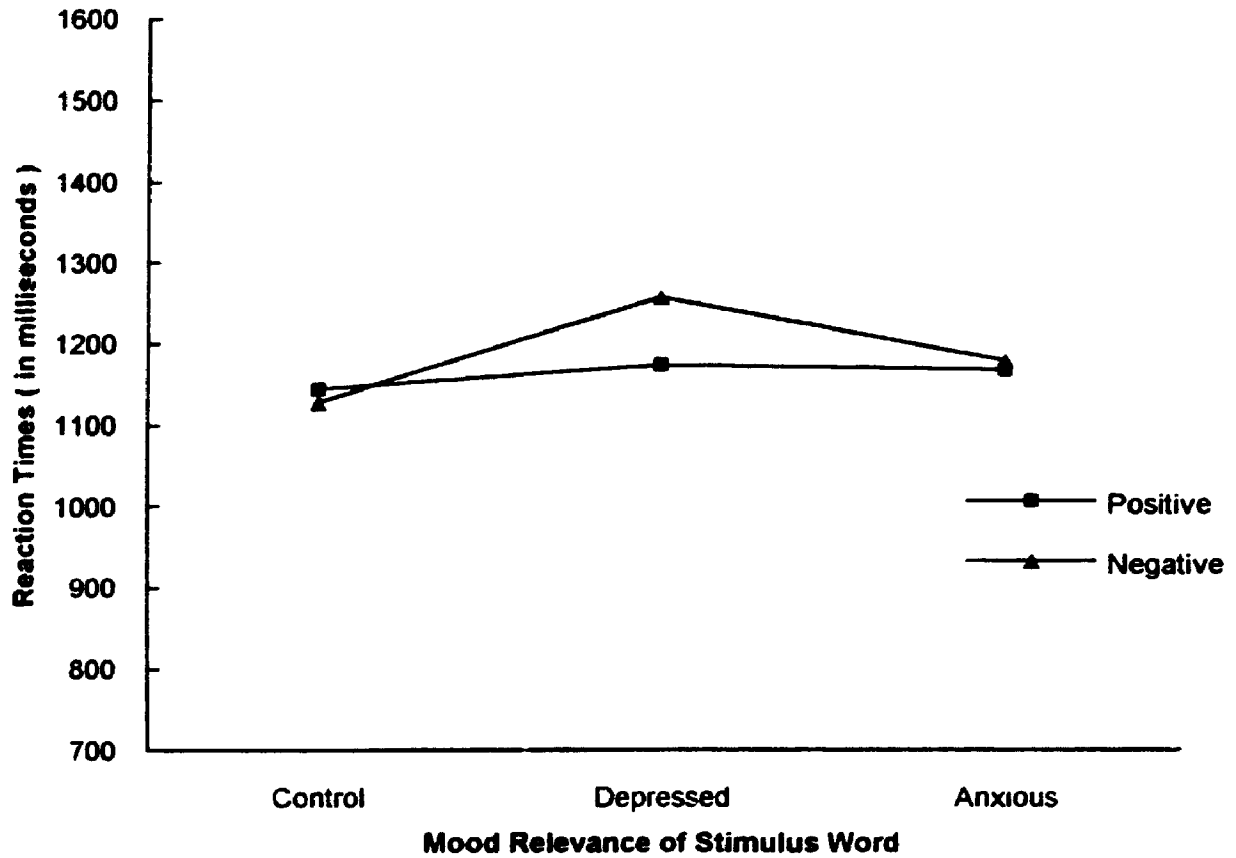
### Blocking Effects

Mean reaction times were subjected to a 3 (GROUP: mildly anxious, mildly depressed, control) X 2 (BLOCK: first half of trials, second half of trials) X 3 (distractor WORD CONTENT: anxious, depressed, control) X 2 (distractor WORD SIGN: positive, negative) ANOVA. The results showed a main effect of BLOCK ( $F(1,50) = 13.50, p < .001$ ); subjects were faster to respond on the second block of

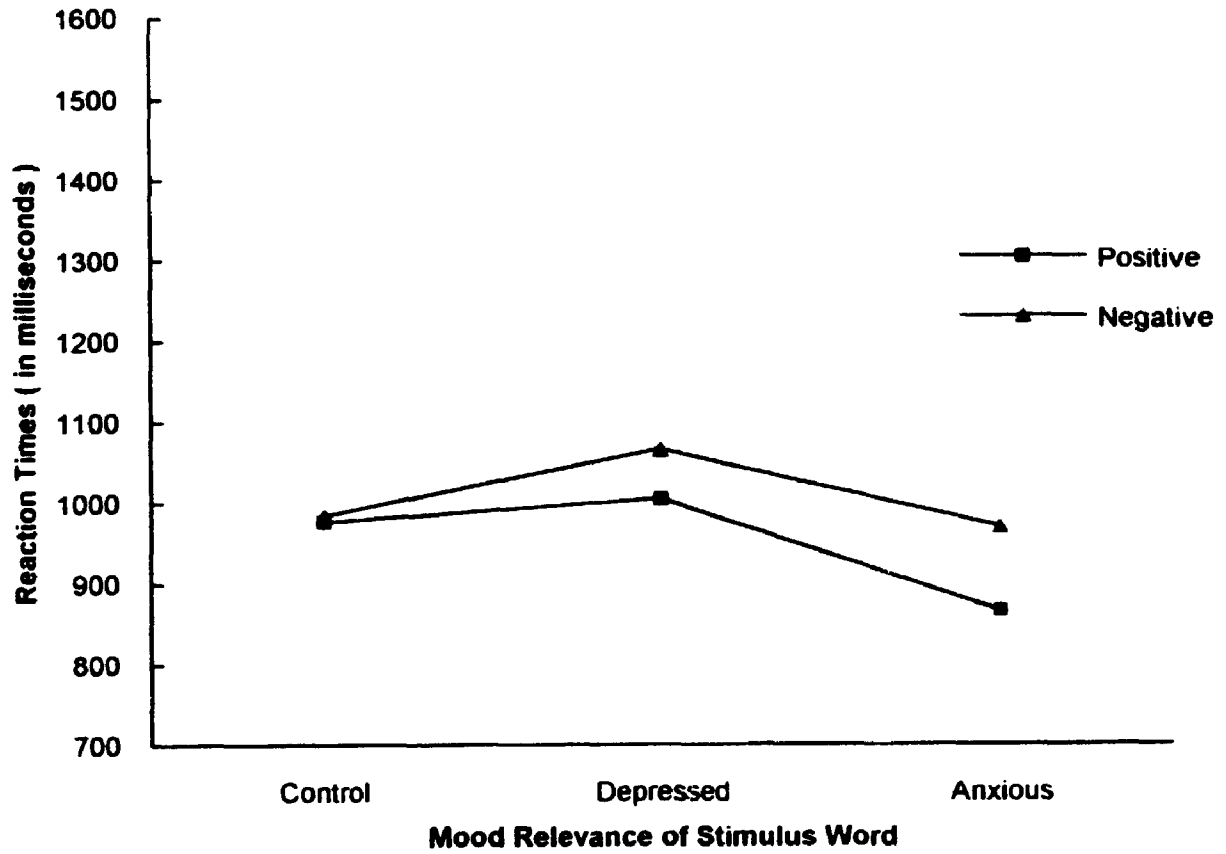
**Figure 13. Latencies (in milliseconds) on the distractor trial for mildly anxious subjects.**



**Figure 14. Latencies (in milliseconds) on the distractor trial for mildly depressed subjects.**



**Figure 15. Latencies (in milliseconds) on the distractor trial for nonclinical control subjects.**



trials. Significant interactions included BLOCK X WORD CONTENT ( $F(2,100) = 5.01, p < .01$ ), WORD CONTENT X WORD SIGN ( $F(2,100) = 3.16, p < .05$ ), BLOCK X WORD CONTENT X WORD SIGN ( $F(2,100) = 17.93, p < .001$ ). These interactions were not informative as they comprise differences which are just as likely to be due to nonword difficulty as distractor content. Once again, there were no GROUP effects.

Target Trial:

#### Accuracy

Analysis of accuracy data showed no significant main effects or interactions.

#### Reaction Times

Mean reaction times were subjected to a 3 (GROUP: mildly anxious, mildly depressed, control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive, negative) ANOVA. Reaction times for mildly anxious, mildly depressed, and nonclinical controls are shown in Figures 16, 17, and 18, respectively. As with the clinical sample, variances for this task were again much higher than for the lexical decision task. The results showed no GROUP effects, no significant main effects, and only a WORD SIGN X WORD CONTENT interaction ( $F(2,100) = 3.20, p < .05$ ).

There were no obvious trends, but all subjects showed a tendency to be slower



**Figure 16. Latencies (in milliseconds) on the target trial for mildly anxious subjects.**

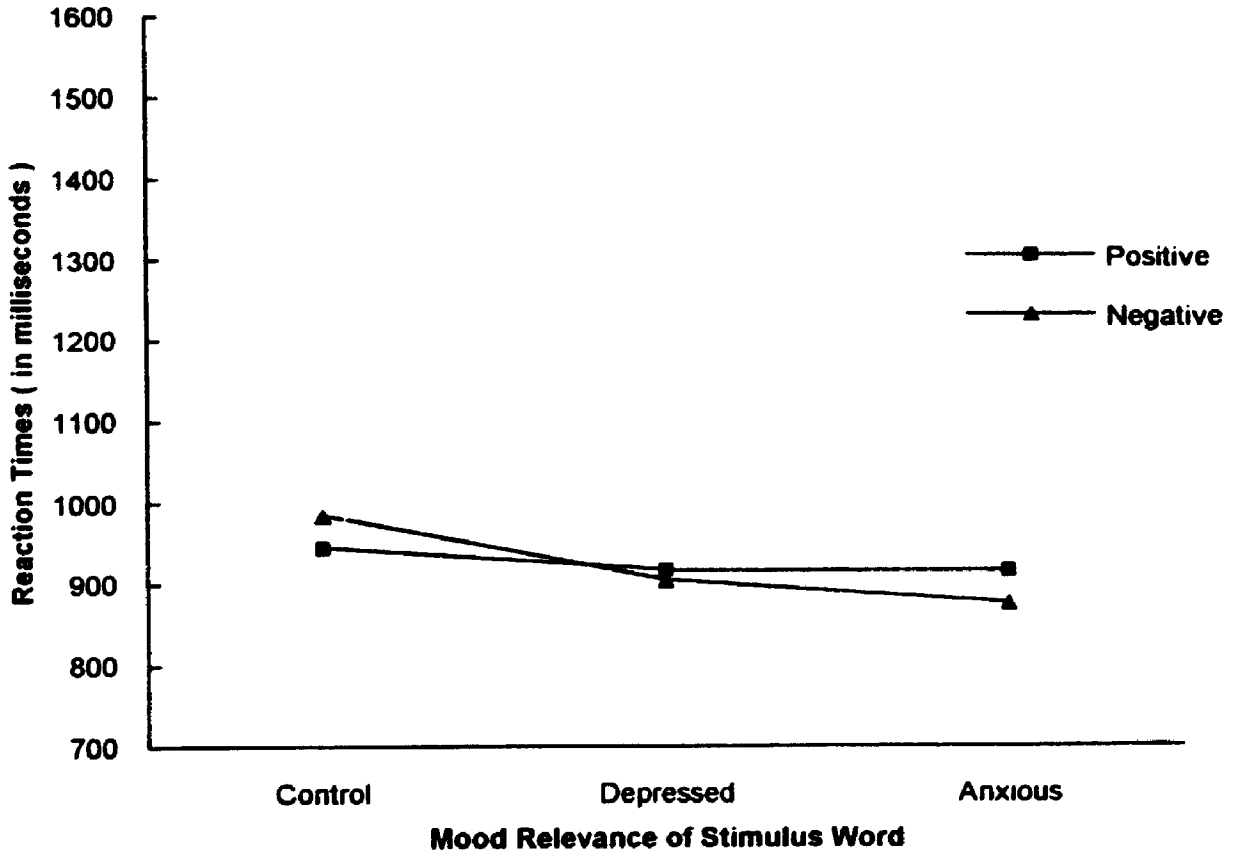
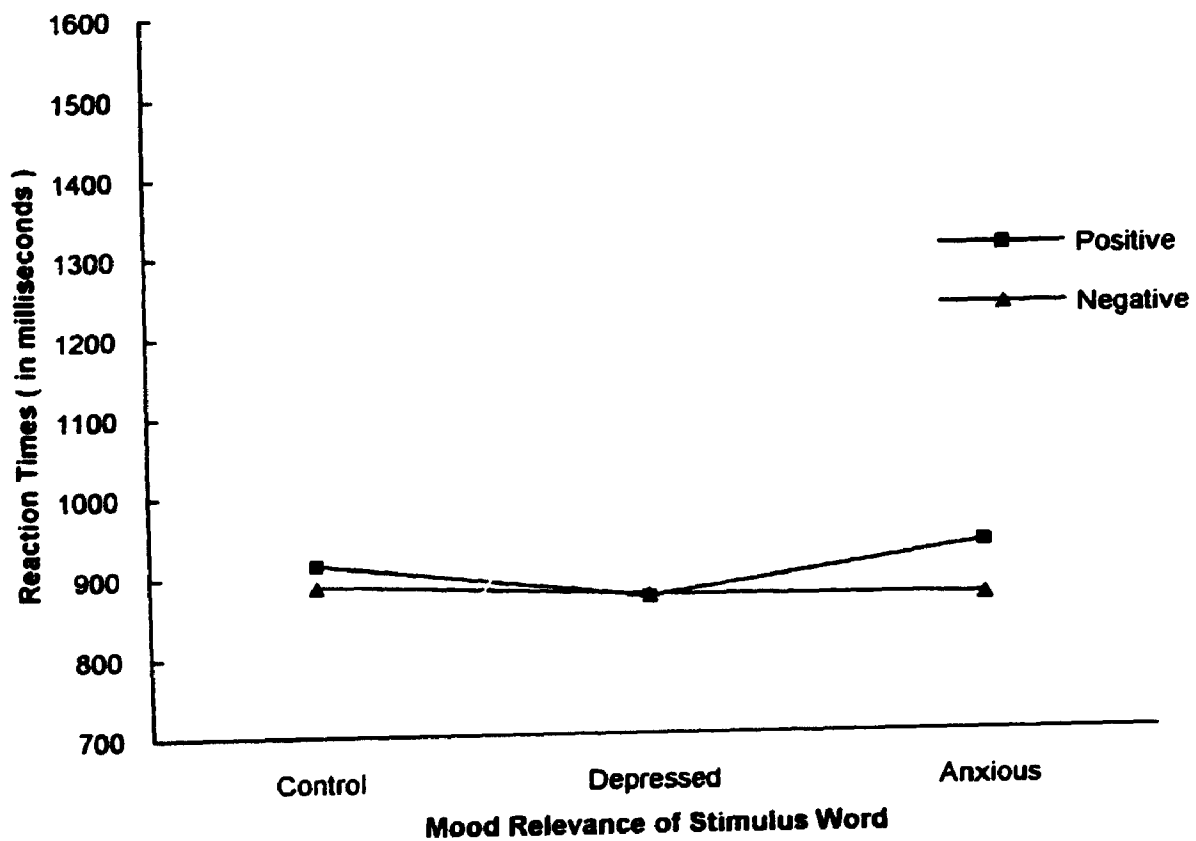
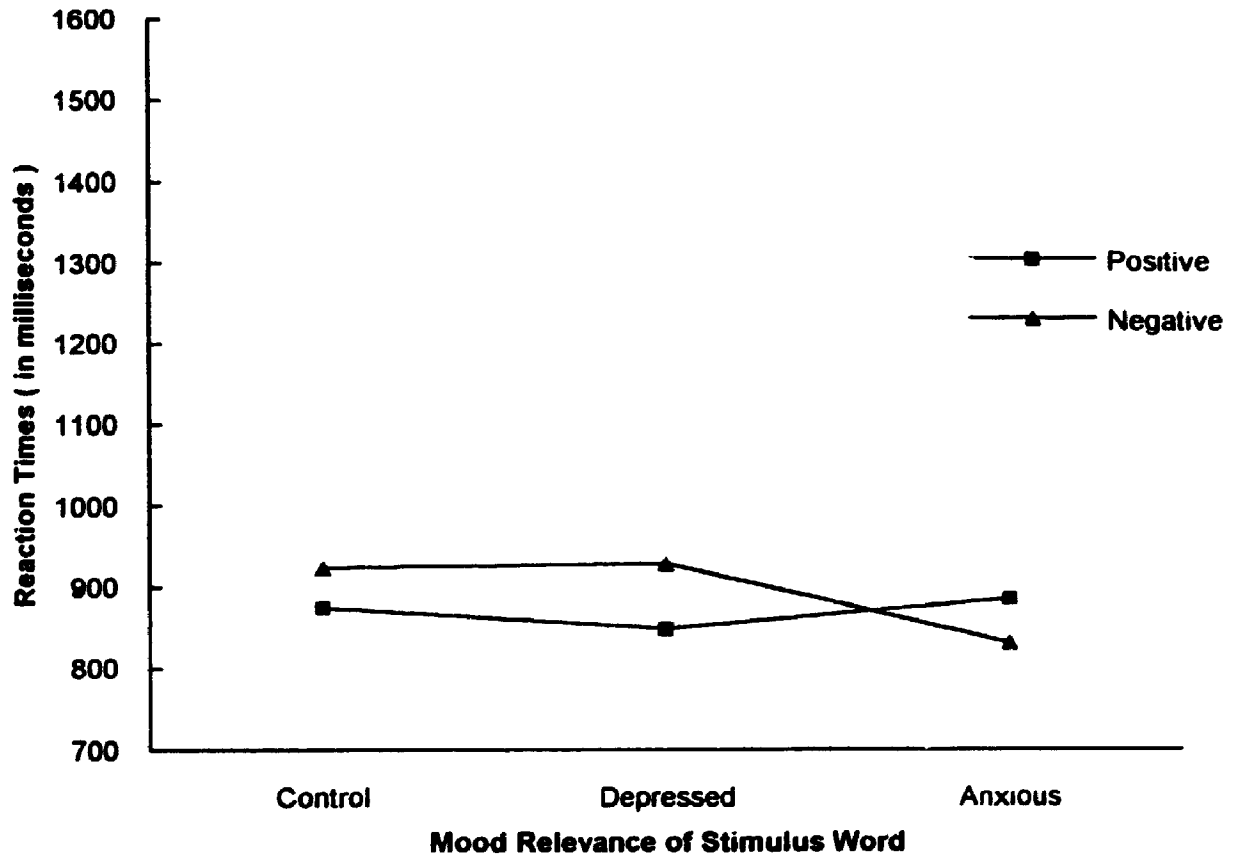


Figure 17. Latencies (in milliseconds) on the target trial for mildly depressed subjects.



**Figure 18. Latencies (in milliseconds) on the target trial for nonclinical control subjects.**



compared to the results from the lexical decision task. Mildly anxious and mildly depressed subjects showed a tendency to be slower on this task compared to the lexical decision task for positive words, whereas control subjects were relatively slower to respond to negative words on this task compared to the lexical decision task.

### Blocking Effects

The results across blocks for the nonclinical sample showed the same pattern as with the clinical sample. The first block produced patterns of results similar to the lexical decision task, which would suggest that negative priming did not occur. On the second block of trials, all subjects showed a tendency to respond slower to negative than positive depressed words. As described for the clinical sample, this was an artificial trend produced by an unbalanced level of difficulty for the stimuli in the second block of trials.

### Summary for nonclinical sample

Mildly anxious, mildly depressed, and control subjects showed no differences in the degree to which they were distracted by the various word contents. There may be a slight tendency for mildly depressed subjects to be more distracted by, or perhaps show less facilitation from, positive anxious words relative to control or mildly anxious subjects, but there were no significant differences. As with the clinical sample, variances were higher on the target trial than for the lexical decision

task, which suggests that differences on the negative priming task are due to individual differences that are unrelated to mood. There was no strong evidence of negative priming. However, as with the clinical sample there were indications that mildly anxious and mildly depressed subjects were slower to respond to positive words on the target trial relative to the lexical decision task, whereas control subjects were slower to respond to negative words on this task compared to the lexical decision task. This would suggest that mildly anxious and mildly depressed subjects were more efficient at inhibiting positive words than negative, whereas control subjects were more efficient at inhibiting negative words than positive.

### **Discussion**

Blocking effects were not interpretable on this task because the number and difficulty level of target and distractor words were not balanced across blocks. Instead, one random order of trials was generated for all subjects that allowed for target trials to follow distractor trials amidst filler trials. Consequently, the degree to which distraction or any possible negative priming effects build up across trials remains unknown.

Depressed subjects were more distracted by negative words than positive, whereas control subjects showed no differences. Anxious subjects showed a nonsignificant tendency towards facilitation from negative distractors. This would apparently contradict previous research findings that anxious subjects are more likely to selectively attend negative stimuli (e.g., MacLeod, Mathews, & Tata, 1986) and

depressed subjects are not (MacLeod and Mathews, 1990). However, the results from this task are not incompatible with previous findings. One major difference between this task and other studies is that stimuli were presented for longer durations on this task since they remained until the subject responded. This allowed for more processing of the stimuli compared to other designs where the stimuli are presented for a fixed duration. Consequently, depressed subjects were more likely to process the content of the stimuli or distractors on this task.

The resulting patterns must be viewed in light of the findings from the lexical decision and probe tasks. Whereas both anxious and depressed subjects displayed greater accessibility for certain negative words (anxiety related) and less so for others, these groups showed different patterns of response to such stimuli. Depressed subjects may have showed some difficulty moving attention away from negative stimuli, whereas anxious subjects showed somewhat of a tendency to avoid negative stimuli. These response patterns were evident soon after the lexical decision was made, but actually reversed if the duration was increased. On this task, subjects were presented with a nonword target and distractor words. Assuming that both the target and distractor are processed, and given that processing of nonwords was slightly slower than for words, it is possible that anxious and depressed subjects both processed the content of the distractors and their different patterns of responding to such stimuli resulted in different distraction patterns. Thus, anxious subjects may have processed the content of a negative distractor and avoided it, thus producing a relative advantage for processing the target nonword. In contrast, depressed subjects

may also have processed the content of a negative distractor, but attention lingered at that location producing a relative disadvantage for processing the target nonword. Control subjects may or may not have been distracted, but there was no evidence of selective distraction on this task and they showed no selective response pattern on the probe task.

The nonclinical sample showed little similarity to the clinical sample in that there were no group differences on the distractor trial. On the probe task, mildly anxious were relatively faster to respond to the probe following positive words than negative words. Mildly depressed subjects showed a tendency to respond slower to a probe that followed soon after the presentation of negative words. Both of these findings could be construed as evidence of distraction in that the presentation of negative words interfered with subsequent responses more so than positive words, but these patterns did not translate into distraction on this task. One possible explanation is that the lexical decision task demanded processing of positive or negative stimuli for a response, whereas the distractors on this task did not. Thus, the mood related processing biases may simply be stronger or more pervasive for the clinical sample.

Finally, there was no strong evidence of negative priming on the target trials. Variances were higher than predicted by the lexical decision task for both clinical and nonclinical samples. This might suggest that the degree to which negative priming occurs is unrelated to mood, or at least is just as related to other factors. However, when compared to the lexical decision task there was a nonsignificant tendency for anxious and depressed subjects to respond slower to positive words on target trials,

whereas control subjects responded slower to negative words. The same pattern was observed for the nonclinical sample. This could be taken as tentative evidence for negative priming and although far from robust, it would suggest that anxious and depressed subjects are more efficient at inhibiting positive words than negative, and control subjects are more efficient at inhibiting negative words than positive.



## **CHAPTER V: WORD COMPLETION AND WORD RECALL TASKS**

Past research has generally found that depressed subjects show a recall bias for negative information, whereas anxious subjects show no reliable pattern (MacLeod & Mathews, 1991). The most reliable results have been found using trait adjectives (e.g., Derry & Kuiper, 1981). Some researchers have argued that the discrepancy between anxious and depressed subjects on memory tasks represents unique processing advantages for these groups and so different kinds memory tasks are required to display memory biases in anxious subjects (e.g., MacLeod & Mathews, 1990). However, others have argued that the apparent differences in anxious and depressed subjects on memory tasks has been the result of different methods used to test these subjects from time to time (Roediger & MacDermott, 1992). Regardless, the type of task and encoding strategy appear to be very important factors for measuring memory biases.

All subjects completed this task after completing the first two attention tasks, and so those tasks must be considered as part of the encoding procedure. Given that both anxious and depressed subjects displayed differential processing to positive and negative stimuli in the first two tasks, this task likely measures the extent of such selective encoding as well as any potential retrieval biases.

Nonetheless, the purpose of this study is to test both anxious and depressed subjects using both free recall and word completion tasks to assess memory biases in these subjects. Comparison of the results from the two types of tasks should provide

a measure of accessibility versus retrievability. Also, this study employed a wider array of stimuli than other investigations. This is particularly important since the results from the lexical decision task suggest mood congruence may be more specific than most memory tasks have allowed.

## METHOD

### Subjects

Subjects were the same as in the first two tasks.

### Apparatus and Stimuli

The 72 words taken from Greenberg and Alloy (1989) were divided into two lists (A and B) which were counterbalanced for word length, frequency of usage, and type of word (word content and word sign). The order of words for each list was randomized and printed on a single sheet to be used for the free recall task. The order of words for each list was then randomized a second time and the first three letters of each word was printed on a single sheet to be used for the cued recall task.

### Procedure

All subjects completed the two attention tasks before the memory tasks. Since the stimuli from the attention tasks were the same used for the memory tasks, the attention tasks themselves comprised a part of the encoding process.

For the free recall task, subjects were given either list A or B to read for 5 minutes. Subjects were instructed to imagine each word before moving on to the next and that afterwards they would be asked to recall as many words as possible. Subjects were then given 3 minutes to write down as many words from the list as they could remember.

For the cued recall task, subjects were given a list of word stems generated from either list A or B. Subjects were instructed to write down the first word they could think of that began with the three letters of the word stem. Subjects were given 3 minutes to complete as many word stems as possible on the list.

Half of the subjects in each group received List A for the free recall task, and List B for the cued recall task, while the other half received the opposite lists. In addition, half of the subjects completed the free recall task first, and the other half completed the cued recall task first.

## Results

### Word Recall Task:

Responses were considered correct if they appeared on the original list given. Responses with minor spelling errors were accepted as correct if they remained phonetically similar to the original word (e.g., "imoral" for "immoral", or "ambicious" for "ambitious"). Responses that were incorrect because they did not appear on the original list given, but nonetheless had been presented as a stimulus on

the attentional tasks were considered to be "intrusions". Responses that were similar to a word on the original list, but were recalled with a changed valence, (e.g. powerless recalled as powerful) were also counted as intrusions.

### Clinical Sample

The mean percentage of correct words recalled were subjected to a 3 (GROUP: anxious, depressed, control) X 3 (WORD CONTENT: anxious, depressed, control) X 2 (WORD SIGN: positive or negative valence) ANOVA. Mean percentage of words recalled and intrusions are shown for anxious, depressed, and control subjects in Table 8. The results showed a main effect of GROUP ( $F(2,42) = 9.05$ ,  $p < .001$ ) and a WORD CONTENT X WORD SIGN interaction ( $F(2,84) = 6.94$ ,  $p < .01$ ). Posthoc t-tests indicated that control subjects recalled more words ( $X = 36\%$ ) than depressed subjects ( $X = 21\%$ ) ( $t(42) = 1.701$ ,  $p < .05$ ), but anxious subjects ( $X = 25\%$ ) did not differ from either depressed or control subjects. Posthoc t-tests also indicated that subjects as an entire group recalled more positive depressed words ( $X = 32\%$ ) than negative ( $X = 20\%$ ) ( $t(84) = 3.05$ ,  $p < .01$ ), and more negative anxious words ( $X = 32\%$ ) than positive ( $X = 24\%$ ), ( $t(84) = 2.183$ ,  $p < .05$ ).

Mean percentage of intrusions were subjected to a 3(GROUP) X 3(WORD CONTENT) X 2(WORD SIGN) ANOVA. There were no significant main effects or interactions. Adjusting the mean percentage of recalled words to include intrusions made no difference to the pattern of results.

**Table 8. Mean percentage of words recalled and intrusions on the word recall task for clinical sample (standard deviations in parentheses).**

		<b>Anxious Group</b>		
		<b>Control</b>	<b>Depressed</b>	<b>Anxious</b>
<b>Positive</b>		25 (20)	32 (25)	22 (20)
<b>Negative</b>		23 (18)	15 (15)	35 (23)
<b>Intrusions</b>				
<b>Positive</b>		3	2	3
<b>Negative</b>		5	0	5
		<b>Depressed Group</b>		
		<b>Control</b>	<b>Depressed</b>	<b>Anxious</b>
<b>Positive</b>		20 (22)	25 (18)	18 (13)
<b>Negative</b>		22 (22)	18 (17)	25 (15)
<b>Intrusions</b>				
<b>Positive</b>		7	2	0
<b>Negative</b>		2	3	5
		<b>Control Group</b>		
		<b>Control</b>	<b>Depressed</b>	<b>Anxious</b>
<b>Positive</b>		45 (20)	40 (25)	33 (22)
<b>Negative</b>		35 (20)	27 (20)	37 (20)
<b>Intrusions</b>				
<b>Positive</b>		3	0	2
<b>Negative</b>		2	2	2

### Nonclinical Sample

Analyses for the nonclinical sample yielded no GROUP effects, and only a WORD CONTENT X WORD SIGN interaction ( $F(2,100) = 8.25, p < .001$ ). Mean percentage of words recalled and intrusions for mildly anxious, mildly depressed, and nonclinical control subjects are displayed in Table 9. Posthoc t-tests indicated that subjects as an entire group recalled more negative depressed words ( $X = 41\%$ ) than positive ( $X = 28\%$ ) ( $t(100) = 3.096, p < .01$ ) and more positive anxious words ( $X = 41\%$ ) than negative ( $X = 29\%$ ), ( $t(100) = 3.096, p < .01$ ).

Analysis of intrusions showed a main effect of WORD SIGN ( $F(1,50) = 5.76, p < .05$ ) and indicated that subjects in general showed more positive intrusions ( $X = 4\%$ ) than negative ( $X = 2\%$ ). However, this was qualified by a GROUP X WORD SIGN interaction ( $F(2,50) = 3.91, p < .05$ ). Separate dependent t-tests were performed on positive and negative means for each group and showed that only depressed subjects recalled more positive intrusions ( $X = 15\%$ ) than negative ( $X = 3\%$ ), ( $t(16) = 2.4, p < .01$ ). There was also a WORD CONTENT X WORD SIGN interaction ( $F(2,100) = 4.28, p < .05$ ). Posthoc t-tests indicated that subjects in general tended to recall more positive control intrusions ( $X = 7\%$ ) than negative ( $X = 2\%$ ) ( $t(100) = 3.293, p < .01$ ), but this effect was not observed for mildly anxious subjects.

Adjusting the mean percentage of recalled words to include intrusions had no effect on the pattern of results.

**Table 9. Mean percentage of words recalled and intrusions on the word recall task for nonclinical sample (standard deviations in parentheses).**

<b>Mildly Anxious Group</b>			
	<b>Control</b>	<b>Depressed</b>	<b>Anxious</b>
<b>Positive</b>	30 (27)	28 (28)	38 (20)
<b>Negative</b>	35 (23)	40 (22)	23 (18)
<b>Intrusions</b>			
<b>Positive</b>	3	3	2
<b>Negative</b>	3	2	0
<b>Mildly Depressed Group</b>			
	<b>Control</b>	<b>Depressed</b>	<b>Anxious</b>
<b>Positive</b>	30 (20)	23 (20)	47 (20)
<b>Negative</b>	33 (20)	42 (27)	33 (20)
<b>Intrusions</b>			
<b>Positive</b>	10	2	3
<b>Negative</b>	0	0	3
<b>Control Group</b>			
	<b>Control</b>	<b>Depressed</b>	<b>Anxious</b>
<b>Positive</b>	35 (23)	33 (18)	37 (18)
<b>Negative</b>	32 (22)	40 (25)	30 (20)
<b>Intrusions</b>			
<b>Positive</b>	7	2	0
<b>Negative</b>	2	3	7

### Summary for word recall task

Contrary to predictions, the results from the clinical sample indicated no group differences except that depressed subjects recalled fewer words in total than control subjects. Nonetheless, the recall patterns of anxious and depressed subjects were more similar to each other than to the control group. Relative to control subjects, both anxious and depressed subjects recalled a larger proportion of negative anxious words and a smaller proportion of positive neutral words, but the differences were not significant.

Results from the nonclinical sample yielded no significant group differences. Inspection of the means indicated a tendency for mildly depressed subjects to recall fewer positive depressed words and more positive anxious words relative to control subjects. Mildly anxious subjects tended to recall fewer negative anxious words than control subjects. Also, mildly depressed subjects recalled significantly more positive intrusions than negative, and this effect was strongest for control words. Mildly anxious subjects showed a nonsignificant trend in the same direction, but control subjects did not.

### Word Completion Task:

In some cases, two words had the same three-letter word stem. Therefore, although subjects were given a list of word stems from half of the original stimulus list, any responses from the original list were included for analysis.



### Clinical Sample

The mean percentage of completed words and intrusions from the stimulus list for anxious, depressed, and control subjects are displayed in Table 10. The results showed a main effect of WORD SIGN ( $F(1,42) = 5.26, p < .05$ ), indicating that as an entire group subjects tended to recall more negative words ( $X = 37\%$ ) than positive words ( $X = 32\%$ ), but this was qualified by a GROUP X WORD SIGN interaction ( $F(2,42) = 4.23, p < .05$ ). Separate dependent t-tests were performed on positive and negative means for each group, and indicated that depressed subjects recalled more negative words ( $X = 34\%$ ) than positive ( $X = 21\%$ ) ( $t(14) = 3.00, p < .01$ ), but anxious and control subjects showed no differences.

As with the free recall test, there was also a significant WORD CONTENT X WORD SIGN interaction ( $F(2,84) = 31.72, p < .001$ ). Subjects as an entire group recalled more positive depressed words ( $X = 40\%$ ) than negative ( $X = 33\%$ ), ( $t(84) = 1.826, p < .05$ ). Also, all subjects showed a tendency to recall more negative anxious words ( $X = 45\%$ ) than positive ( $X = 16\%$ ), ( $t(84) = 8.216, p < .001$ ).

Analysis of intrusions showed no significant main effects or interactions. Adjusting the mean percentage of recalled words to include intrusions made no difference to the pattern of results.

### Nonclinical Sample

The mean percentage of words completed and intrusions from the stimulus list are displayed in Table 11 for mildly anxious, mildly depressed, and nonclinical

**Table 10. Mean percentage of words and intrusions identified from the stimulus list for clinical sample (standard deviations in parentheses).**

		Anxious Group		
		Control	Depressed	Anxious
Positive		35 (20)	45 (22)	12 (15)
Negative		35 (20)	30 (15)	50 (18)
<b>Intrusions</b>				
Positive		7	3	2
Negative		2	2	2
		Depressed Group		
		Control	Depressed	Anxious
Positive		28 (27)	30 (27)	5 (8)
Negative		28 (20)	32 (20)	42 (30)
<b>Intrusions</b>				
Positive		3	5	2
Negative		2	2	8
		Control Group		
		Control	Depressed	Anxious
Positive		55 (30)	45 (25)	32 (35)
Negative		38 (25)	37 (30)	43 (27)
<b>Intrusions</b>				
Positive		7	7	3
Negative		5	0	2

**Table 11. Mean percentage of words and intrusions identified from stimulus list for nonclinical sample (standard deviations in parentheses).**

<b>Mildly Anxious Group</b>			
	<b>Control</b>	<b>Depressed</b>	<b>Anxious</b>
<b>Positive</b>	70 (28)	43 (27)	70 (20)
<b>Negative</b>	48 (15)	67 (27)	53 (25)
<b>Intrusions</b>			
<b>Positive</b>	10	7	3
<b>Negative</b>	2	3	5
<b>Mildly Depressed Group</b>			
	<b>Control</b>	<b>Depressed</b>	<b>Anxious</b>
<b>Positive</b>	70 (23)	38 (23)	68 (18)
<b>Negative</b>	50 (22)	57 (28)	48 (20)
<b>Intrusions</b>			
<b>Positive</b>	12	3	5
<b>Negative</b>	3	2	8
<b>Control Group</b>			
	<b>Control</b>	<b>Depressed</b>	<b>Anxious</b>
<b>Positive</b>	75 (23)	47 (23)	75 (17)
<b>Negative</b>	58 (22)	80 (25)	48 (23)
<b>Intrusions</b>			
<b>Positive</b>	12	8	3
<b>Negative</b>	3	3	7

control subjects. Analyses for the nonclinical sample on the cued recall task yielded a main effect of WORD SIGN ( $F(1,50) = 5.3, p < .05$ ) indicating that nonclinical subjects as an entire group recalled more positive words ( $X = 62\%$ ) than negative ( $X = 57\%$ ). However this was qualified by a significant WORD CONTENT X WORD SIGN interaction ( $F(2,100) = 46.51, p < .001$ ). Posthoc t-tests showed that subjects tended to recall more positive control words ( $X = 72\%$ ) than negative ( $X = 52\%$ ) ( $t(100) = 5.297, p < .01$ ), and more positive anxious words ( $X = 71\%$ ) than negative ( $X = 50\%$ ) ( $t(100) = 5.297, p < .01$ ), but more negative depressed words ( $X = 68\%$ ) than positive ( $X = 43\%$ ), ( $t(100) = 6.180, p < .01$ ).

Analysis of intrusions showed a main effect of WORD SIGN ( $F(1,50) = 11.37, p < .001$ ), indicating that subjects as an entire group tended to recall more positive intrusions ( $X = 7\%$ ) than negative ( $X = 4\%$ ). There was also a WORD CONTENT X WORD SIGN interaction ( $F(2,100) = 9.36, p < .001$ ). Post hoc t-tests showed that all subjects tended to recall more positive control intrusions ( $X = 11\%$ ) than negative ( $X = 3\%$ ) ( $t(100) = 4.481, p < .01$ ), more positive depressed intrusions ( $X = 6\%$ ) than negative ( $X = 3\%$ ) ( $t(100) = 1.792, p < .05$ ), but more negative anxious intrusions ( $X = 7\%$ ) than positive ( $X = 4\%$ ), ( $t(100) = 1.792, p < .05$ ). Adjusting for intrusions, analyses yielded the same effects, but also yielded a significant main effect of WORD CONTENT ( $F(2,100) = 3.7, p < .05$ ).

### Summary

Results on the word completion task for the clinical sample resembled findings

from other research that depressed subjects show a recall advantage for negative words over positive words, but control and anxious subjects do not. In comparison to control subjects, anxious subjects actually recalled fewer positive anxious and positive control words, but the difference was not significant. Depressed subjects, relative to control subjects, recalled fewer positive words in all categories.

Results from the nonclinical sample showed no group differences. It is possible that the first two tasks enhanced the encoding process to provide strong recall cues which masked any effects of mood for this sample.

### **Discussion**

The results from these tasks suggest that memory capacity is reduced for depressed subjects. This could simply be a consequence of fatigue or decreased motivation often associated with depression. The word completion task likely requires less processing resources than the recall task, since all subjects recalled more words on the word completion task. Most previous studies have tested recall using categories such as "pleasant" and "unpleasant", and the relevance of these categories to a particular mood is unknown. Given that in this study subjects were given six categories of words and that a recall bias may only appear for one or two of these categories, mood congruency effects on this recall task may have been washed out due to limitations in memory capacity.

The nonsignificant trends from the recall task and the significant findings from the word completion task suggest that depressed subjects do show an advantage

recalling negative information relative to control subjects. Anxious subjects showed a similar, but nonsignificant pattern as depressed subjects on both tasks. Depending on the mood relevance of the words being compared, this pattern could either be viewed as a negative bias or a lack of a positive bias. Unfortunately, the degree to which such a bias is produced by the accessibility of information rather than retrieveability cannot adequately be assessed from this study. MacLeod and Mathews (1990) have argued that anxious subjects may not show any retrieval biases for negative information on recall tasks, but the automatic attentional biases they display suggest that negative information may be more accessible. Since retrieval biases may have been "washed out" on the recall task due to either the use of a wider array of stimuli or possibly because of capacity limitations, the effects of retrievability cannot be ruled out as a factor on the word completion task.

Once again, it should be noted that these results likely reflect the products of the encoding process from the first two attentional tasks just as much as they reflect memory processes. An appeal might be made that anxious or depressed subjects always encode information according to some bias and so the first two attentional tasks do not confound the encoding process any more than everyday experience. However, no attempt was made to assess word completion biases in subjects before completing the attentional tasks and so the extent of influence from these tasks versus experience in general cannot be measured.

The results from the lexical decision task indicated that certain categories of negative words are more accessible than others for anxious and depressed subjects.

The results from the memory tasks do not display the same pattern (e.g., the number of words recalled do not simply reflect their accessibility). Rather, the relative number of words recalled likely reflects encoding strategies resulting from attentional responses to the stimuli. For example, the attention of depressed subjects tended to linger at the location of previously presented negative words. As a consequence, these words might be expected to be recalled more easily.

One might expect the opposite pattern for anxious subjects since they display a tendency to avoid such stimuli. However, anxious subjects showed a similar, albeit less robust pattern as depressed subjects. There were some indications from the negative priming task that anxious subjects are not very efficient in their avoidance or inhibition of negative information. Also, the results from the probe task indicated that although anxious subjects tend to avoid negative stimuli initially, their attention later returns to that location if there are no other constraints. Thus, the inability to inhibit negative information, presumably at the loss of processing resources that can be allocated towards positive information, results in a relative retrieval advantage for negative words.

The nonclinical sample did not display a similar pattern as the clinical sample on the memory tasks. In general, mildly anxious and mildly depressed subjects showed either partial or less robust effects relative to their clinical counterparts on the attention tasks. Thus, it is possible that the biases they display are not strong or pervasive enough to produce memory biases that could compete with strong recall cues encoded from the first two tasks.

## **CHAPTER VI: STOCHASTIC MODELLING OF SPEED OF PROCESSING**

The attention tasks described in this paper were designed to examine the information processing styles of anxious and depressed individuals towards mood-congruent information. While such tasks represent an advance from previous attempts to predict the nature of perceptual biases from self-report measures, the precision of predictions can be further enhanced by the implementation of stochastic modelling. A stochastic model is the mathematical representation of any empirical process that is governed by probabilistic laws (Doob, 1953). It should be mentioned that the advantage of such models lies more with decreasing the uncertainty produced by vague predictions than in discovering "new" information.

For example, one finding that was evident in each of the reaction time tasks was that clinically depressed subjects were slower to respond. This is not a new finding and has usually been attributed to the psychomotor retardation associated with depression (Mathews and MacLeod, 1990). Hartlage, Alloy, Vasquez, and Dykman (1993) have argued that while there is evidence to suggest that depression interferes with intentional or "effortful" processing, there is little evidence to suggest that processing capacity is reduced in depressed individuals. However, there are some reasons to believe processing itself is slower for depressed subjects (e.g., Byrne, 1976). In fact, the results from the present investigation indicate that the delayed responses by depressed subjects cannot be completely accounted for by an explanation



of slower motor execution. For example, the degree of delay by depressed subjects on complicated tasks (e.g., the lexical decision task) is greater than the delay on simpler tasks (e.g., the probe task), even though the motor response is equivalent. If depressed subjects were only slower because of motor execution, the expected delay would be constant across all tasks requiring a similar motor response.

While the results from the present investigation demonstrated that depressed subjects were generally slower to respond on reaction time tasks than other subjects, they have provided little information regarding why their response times were slower. Neufeld (1994) has outlined a number of possible effects on information processing that would produce increased latencies on attentional tasks (e.g., processing capacity depletion, high and low arousal effects, and intrusive associations). Furthermore, Neufeld outlines various strategies for modelling these possibilities and testing their predictions against observed data.

The following developments make no attempt to discern the nature of the effects producing slower reaction times for depressed subjects. Rather, a basic attempt is made to present mathematical arguments in support of the hypothesis that depressed subjects are slower than nondepressed subjects (for any of the possible reasons outlined by Neufeld, 1994) to process information on the attentional tasks. This idea can be demonstrated by estimating the rate of processing on lexical decision and probe tasks for clinically depressed, clinically anxious, and control subjects. The response time to the X/Y probe task is comprised of the time required to identify the probe and select a response, as well as the time to execute the motor response

itself. Thus,

$$RT = PT + MT$$

where RT is the total response time,

PT is the time required for processing,

and MT is the time required to execute the motor response.

Townsend (1984) suggests an estimate of 160 milliseconds for motor response.

Hence, MT for controls would be 160. Table 12 shows the observed RT, estimated MT, and estimated PT for all subjects in the clinical sample ( $n = 46$ ) on the lexical decision and probe tasks. Since the motor response required on the the lexical decision task is identical to the motor response required on the probe task, the expected value of MT is equivalent for both tasks. Subtracting the expected MT from the total RT for the lexical decision task provides an estimate of PT for that task.

Reaction times can be modelled using an exponential distribution where the probability density function is given by  $f(t) = ve^{-vt}$  with a "rate of processing" parameter of  $v$  (Townsend and Ashby, 1983). The mean for this distribution would be given by  $1/v$ , and the variance would be given by  $1/v^2$ . Thus, the expected value for PT would be  $1/v$ , and so  $v = 1/PT$ . Although there are precedents for assuming an exponential distribution to model reaction time data (see Neufeld, 1994), observed data from the lexical decision and probe tasks can be compared to data predicted by the exponential distribution. The probability distribution function for the exponential distribution is given by  $F(t) = 1 - e^{-vt}$ . Using the estimated rates of processing,  $v$ , for

**Table 12. Estimated rate of processing (in seconds) for clinical sample on the lexical decision and probe tasks.**

Lexical Decision Task

Total Reaction Time	(RT)	=	1.115
Motor Response Time	(MT)	=	0.160
Processing Time	(PT)	=	0.955
Rate of Processing	(v)	=	1.05

Probe Task

Total Reaction Time	(RT)	=	0.701
Motor Response Time	(MT)	=	0.160
Processing Time	(PT)	=	0.541
Rate of Processing	(v)	=	1.85

the lexical decision and probe tasks, Table 13 shows the predicted frequencies of responses that fall within various 100 millisecond ranges. Also shown are the observed frequencies from the lexical decision and probe tasks. Chi-square tests showed that the distribution of observed response times did not differ from predicted distribution for the lexical decision task ( $X^2(6) = 4.453, p = 0.616$ ) or for the probe task ( $X^2(6) = 4.739, p = 0.578$ ). Therefore, a reasonable argument can be made that the reaction time data from these tasks constitute an exponential distribution.

Table 14 shows the observed reaction times, estimated motor response time, and estimated processing times for each group on the lexical decision and probe tasks. Assuming the null hypothesis that anxious, depressed, and control subjects all process information at about the same rate, depressed and anxious subjects show an increase in MT on the probe task relative to control subjects.

The estimated taskwise rate of processing for control and anxious subjects is 1.30 and 1.37 lexical decisions per second respectively, and 1.0 for depressed subjects. One method for determining if the rate of processing for depressed subjects is slower than for anxious or control subjects is to compare the "survivor function" for these estimates. The survivor function represents the distribution's probability of completing a process after a time,  $t$ , and is given by  $F(t) = e^{-\lambda t}$  (Neufeld, 1994). These functions can then be compared using a Wilcoxon D statistic (a chi-square statistic with degrees of freedom equal to the number of groups minus one; Lee & Desu, 1972) under the null hypothesis that each group represents the same survival distribution. Comparison of the estimated survival functions for anxious, depressed

**Table 13. Predicted and observed frequencies of response times for the lexical decision and probe tasks.**

**Lexical Decision Task**

<b>Median of 200 msec. range</b>	<b>Observed Frequency</b>	<b>Expected Frequency</b>
750	13	12
950	9	10
1150	12	8
1350	5	6
1550	3	5
1750	2	4
1950+	2	3

**Probe Task**

<b>Median of 100 msec. range</b>	<b>Observed Frequency</b>	<b>Expected Frequency</b>
475	9	11
575	10	9
675	7	8
775	11	7
875	5	6
975	3	4
1075+	1	2

**Table 14. Estimated rates of processing on the lexical decision task the clinical sample.**

	Group		
	Control	Anxious	Depressed
Probe RT	.575	.719	.789
Probe PT	.415	.415	.415
Probe MT	.160	.304	.374
Lexical RT	.931	1.036	1.375
Lexical MT	.160	.304	.374
Lexical PT	.771	.732	1.001
Rate (v)	1.30	1.37	1.0

and control subjects yielded a significant difference ( $D(2) = 6.885, p < .05$ ).

Pairwise comparisons indicated a significant difference between the survival distributions of depressed subjects and anxious subjects ( $D(1) = 6.189, p < .05$ ) and a significant difference between depressed subjects and control subjects ( $D(1) = 4.320, p < .05$ ). There was no significant difference between the survival distributions of anxious and control subjects. Thus, even after controlling for motor response time, the likelihood of processing continuing beyond a given time is significantly greater for depressed subjects than anxious or control subjects. Since previous attentional studies have presented stimuli for fixed durations, it is unlikely that anxious and depressed subjects both processed the stimuli to the same extent. Consequently, it is arguable that depressed subjects did not display attentional biases in those studies because they did not process the stimuli to the same extent as controls. Further research might implement stochastic modelling to test whether or not processing capacity depletion, arousal effects, or intrusive associations can account for the slower rates of processing exhibited by depressed subjects.

## **CHAPTER VII: GENERAL DISCUSSION**

### **Summary of Results**

The results from the **GROUP X WORD CONTENT X WORD SIGN** interactions on the lexical decision task showed that clinically anxious and clinically depressed subjects are faster to process the content of negative than positive information when it is anxiety related, but the difference was only marginally significant for clinically anxious subjects. However, both groups were slower to process the content of negative than positive information when it is unrelated to anxiety or depression. Controls showed no differences between positive or negative information, regardless of its relation to mood. This suggests that while certain types of negative information (e.g., anxiety related) seem disproportionately accessible to anxious or depressed individuals compared to controls, other types are not. Clinically anxious and clinically depressed individuals differed mainly in overall response speed.

Interestingly, mildly anxious and mildly depressed subjects showed different "partial effects" relative to their clinical counterparts. **GROUP X WORD CONTENT X WORD SIGN** interactions indicated that whereas mildly depressed subjects showed some advantage for accessing negative anxious information, mildly anxious subjects showed a disadvantage for accessing negative control information.

On the subsequent probe task, **WORD SIGN X PROBE DELAY X PROBE POSITION** interaction indicated that clinically depressed subjects showed a nonsignificant tendency to "linger" at a location where negative information had



previously been presented. There were also nonsignificant indications that clinically anxious subjects avoided the location where negative information had previously been presented. These "responses" to negative information were not dependent upon mood relevancy. It would appear that while certain types of negative information are more accessible to anxious and depressed subjects, their response is similar to any type of negative information. These effects were only evident shortly after the presentation of negative stimuli. As the duration increased, clinically depressed subjects tended to avoid the location of negative stimuli, where clinically anxious subjects tended to return to that location.

As with clinically anxious subjects, WORD SIGN X PROBE POSITION interactions suggested that mildly anxious subjects tend to avoid the location where negative information had previously been presented. Also, mildly depressed subjects were slower to respond to a probe following negative information. As with clinically depressed subjects, the delayed response to the probe only occurred when it was displayed shortly after the negative stimuli, but reversed after longer durations. Unlike the clinical sample, the tendency for mildly depressed subjects to respond slower to a probe that closely followed the presentation of negative stimuli was not related to location. Therefore, it cannot be determined if the response of these subjects to negative stimuli reflects avoidance or interference.

The results from the distraction task (e.g., GROUP X WORD SIGN interactions) indicated that clinically depressed subjects showed impaired performance at identifying a target nonword in the presence of distractors with negative content,

whereas clinically anxious subjects showed (nonsignificant) facilitated performance. The performance of control subjects did not differ across the type of distractors. This suggests that both clinically anxious subjects and clinically depressed subjects were affected by the presence of distractors with negative content, but whereas clinically anxious subjects likely tended to avoid such information, clinically depressed subjects had difficulties inhibiting it. Mildly anxious and mildly depressed samples showed no obvious patterns of distraction relative to controls.

The negative priming trials showed no real evidence that negative priming occurred. However, there may be some indications that control subjects were more efficient at inhibiting negative information than positive, but clinically anxious and clinically depressed subjects showed the opposite trend. The nonclinical sample showed a similar pattern to the clinical sample.

The results from the two memory tasks were not informative in determining whether or not negative information is more "retrieveable" versus more "accessible" for anxious or depressed subjects. The GROUP X WORD SIGN interactions on the word completion task suggested that clinically depressed subjects tended to recall fewer positive words than control subjects, and clinically anxious subjects showed a nonsignificant trend in the same direction. Nonclinical samples showed no obvious recall patterns. It is possible that the strength of recall cues provided by the attention tasks or the broad range of stimuli used "washed out" any mood related recall biases.

Taken together, the results from these tasks suggest that clinically anxious and clinically depressed subjects process mood congruent information in a similar fashion,

but they respond differently to this information. Once recognized, the attention of clinically anxious subjects tends to avoid negative information, whereas the attention of clinically depressed subjects tend to linger at that location before avoiding. Mildly anxious and mildly depressed subjects tended to show less robust, or partial patterns relative to the clinical sample.

#### Speed of Processing and Time Course of Response

It has been demonstrated that the rate of processing for depressed subjects is slower than for anxious or control subjects. In fact, there is evidence from the first task to suggest that the rate of processing is the only difference between anxious and depressed individuals in processing mood relevant information. It could be argued that the processing bias displayed in depressed individuals was due to the concurrent anxious mood, and the only effect added by depressed mood is the slower rate of processing. Correlations of these effects with psychometric scaling of anxious and depressed mood could not resolve this problem. However, given that depression is so frequently associated with anxious mood (Barlow, 1988), the utility of assessing the effects of depression in the absence of anxiety is questionable.

Anxious and depressed subjects did show differences in their response to mood congruent information. However, the apparent difference in response style may also reflect differential speeds of processing. For example, anxious subjects showed some tendency to avoid attending a location soon after negative information had been presented, but later returned attention to that location. There is some suggestion that

the attention of depressed subjects tends to linger at a location soon after negative information is presented, but they later avoid attending that location. However, it is arguable that depressed subjects show the same response style as anxious subjects, but depressed subjects are just slower to display the avoidance response. If so, one might expect that anxious subjects attend the location of negative information, perhaps very briefly, before avoiding that location. There is evidence to suggest that the attentional bias towards negative information displayed by anxious subjects can occur when subjects are not consciously aware of the stimuli (e.g., Mogg, Bradley, & Williams, 1993; Mathews & MacLeod, 1986). Although these studies do not show that anxious subjects process information faster than controls, they do indicate that anxious subjects may respond to stimuli based on little information. Thus, it may be that anxious and depressed individuals both selectively attend and then avoid negative information, but the entire response process is slower for depressed individuals. Contrary to the suggestion of MacLeod and Mathews (1990) that anxious individuals allocate resources to the 'earlier' processes and depressed individuals allocate resources to the 'later' processes, the results from the present investigation suggests that depressed individuals are simply 'later' than anxious individuals to allocate resources. One important implication for future studies is that anxious and depressed subjects may display a difference in their efficiency to shift attention or reallocate resources from one task to another, and this may be independent of processing efficiency.

### Efficiency of Processing

There were two indicators of processing efficiency in the present investigation. The first indicator was the relative response times to the target trial on the second task. Depressed subjects were slower to identify a nonword in the presence of negative distractors compared to positive. This would suggest that depressed individuals are not efficient processors because they are unable to inhibit negative distracting information. Anxious subjects appeared to "overinhibit" negative distractors relative to positive, which might also be construed as an inefficiency.

Secondly, there is also some tentative evidence from the negative priming trials that both anxious and depressed subjects are more efficient in their ability to inhibit positive distracting information than negative. In contrast, control subjects showed some indications of being less efficient in their ability to inhibit positive information.

It should also be noted that the two memory tasks indicated that depressed subjects (and to a lesser extent, anxious subjects) recalled fewer positive words than control subjects, resulting in a relative advantage for negative words over positive. The memory tasks do not necessarily measure efficiency of processing, but they do provide some indication of the relative extent of processing the different types of information. Thus, depressed subjects may not be efficient processors, but they do disproportionately allocate processing resources towards negative information when compared to controls.

### Clinical Implications

The results from the present investigation supports the view that anxiety and depression are related disorders. In fact, it suggests that both anxious and depressed individuals will show advantages for recognizing negative anxious information, and a disadvantage for recognizing negative information unrelated to either mood. The fact that speed of processing seems to be the main difference between these two groups on the lexical decision task supports Barlow's (1988; 1991) view that both anxiety and depression may be placed on the same continuum. There is no information from the present investigation to clarify what this continuum may be, but it is likely that speed of processing is an associated dimension.

This raises the possibility that both the style and speed of processing may prove useful as an assessment tool for discerning relative levels of anxiety and depression, or for differentiating these disorders from other conditions. If the nonclinical sample can truly be considered as milder forms of these disorders, there is evidence from the nonclinical responses to the lexical decision task to argue that as individuals develop depression or an anxiety disorder, the relative ease with which they can recognize various types of negative information becomes disproportionate. Furthermore, the extent that depression outweighs anxiety can be determined by the relative increase in response times.

The role that these information processing bias might play in the development or maintenance of emotional disorders was not examined in the present investigation. There is equivocal evidence elsewhere (e.g., MacLeod *et al.*, 1990) as to whether or

not these styles constitute a vulnerability or concomitant for emotional disorders.

There are some indications from this study that the characteristic attentional response styles of anxious and depressed individuals are associated with the function of the mood, and thus less likely to be sole contributing factor. In support of Barlow (1988), these processing biases could be the result of biological or psychological vulnerabilities. It has been argued in this paper (and elsewhere, see Scherer, 1984) that emotions represent a bridge between physiology and cognition. It is likely that the central emotions in anxiety (fear) and depression (sadness) modulate behaviours, including information processing, according to the function of that emotion. Thus, the patterns of information processing may also be representative of behaviours at other levels. Some evidence for this relationship was found by Derryberry and Rothbart (1988). They found a correlation between the ability in children to focus attention and their ability to modulate negative emotions.

### Future Investigations

The results from this study provides several implications for future investigations. Nonclinical samples, while important to study in their own right in terms of mild anxiety or depression, should not be used in place of clinical samples. Comparison of nonclinical and clinical samples in the present investigation showed that nonclinical samples showed similar, but incomplete biases relative to their clinical counterparts. Biases for clinical samples were more pervasive than for nonclinical samples. For example, although mildly anxious and depressed subjects showed some

similar effects as clinically anxious and depressed subjects on the lexical decision and probe task, no similar findings were observed on the target trial of the second task. The lexical decision task demanded that subjects process the content of the stimuli, and so attention was endogenously directed to that location. However, on the target trials of the second task, attention was directed away from the distractors and so any evidence of distraction reflects exogenous control of attention. Since endogenous control of attention is more closely related to voluntary or strategic control of attention and exogenous control is more closely related to external and automatic control of attention, it can be argued that attentional biases are more pervasive or extensive for clinical samples than for nonclinical samples.

Secondly, most studies of cognitive biases in emotional disorders have assumed that any information related to the cognitive content of a mood will be selectively processed. To a large extent, the impetus for this view comes from cognitive models which view emotion as a byproduct of cognition (e.g., Beck, 1976; Mandler, 1981). However, the results from the present investigation suggest that mood is not only related to the content of cognition, but also to cognitive processes. Future research will need to take into account the extent to which the task allows for processing of stimuli as well as any subsequent responses, since their relative combination can produce different effects. Also, the amount of delay following the presentation of mood relevant stimuli can determine whether or not anxious and depressed subjects are attending that location. Furthermore, tasks that direct attention towards the stimulus (e.g., Stroop task, lexical decision task) may not be measuring



the same kind of attentional process or response as tasks that direct attention away from the stimulus. Finally, the relative differences in accessibility of the various types of stimuli seem to disappear after several presentations, but the characteristic responses to such stimuli tend to build up over trials. Thus, in future studies the number of trials or presentations of the same stimuli must be considered in accordance with the type of process being measured (i.e., recognition or response).

Finally, the present investigation also suggests that the type of stimuli chosen as "mood congruent" may need to be very specific, depending on the nature of the task. Simple categorizations such as positive and negative may wash out effects on tasks that are aimed at recognition only. However, these categories may be still be useful on tasks that are aimed at measuring processing responses to the recognition of stimuli.

### Concluding Remarks

Empirical investigations have only begun to examine the role of attention and other processes in emotional disorders. Whereas it is highly unlikely that emotional disorders as complex as anxiety or depression are simply the result of some peculiar attentional processes, it is very possible that the myriad of cognitive deficits that accompany these disorders are indeed the result of attentional biases. For example, an attentional bias towards depressive information should produce a memory bias towards depressive information because attention guides what information is stored in memory in the first place. Thus, it is possible that some pathological factor (either

cognitive, physiological, affective, or some combination) elicits an attentional bias which then produces a variety of cognitive deficits.

There has been some debate as to whether or not the cognitive biases displayed in anxious and depressed individuals represent a predisposing condition, a maintenance factor, or simply a concomitant of mood. Given the interactive relationship between cognition and emotion, it is just as likely that cognitive biases are the result of sustained mood as they are a causal factor. They may, however, play some role in maintaining the disorder. For example, the fact that certain types of negative information are more accessible to anxious and depressed individuals than controls does not necessarily indicate that this characteristic constitutes a vulnerability factor predisposing such individuals to their disorder. In fact, Christie and Klein (1995) have shown that familiar stimuli are more noticeable than unfamiliar stimuli. Thus, the recognition advantage (or enhanced priming effect) for negative stimuli displayed by anxious individuals (and in this investigation, by depressed individuals as well) may simply reflect that such information is familiar to these individuals. However, the characteristic responses of anxious and depressed individuals to negative stimuli may contribute to some degree to the maintenance of the disorders. For depressed individuals, this would likely be related to the disproportionate allocation of processing resources to negative stimuli, either due to tendency for attention to remain at the location of such stimuli or a failure to inhibit this information. This in turn may make negative information more noticeable in the future. Anxious subjects show an attentional avoidance of negative stimuli which seems to occur in response to little

information at times. It is possible that this tendency perpetuates an unrealistic perception of the environment since perceived threats have less of a chance to be discounted.

Barlow (1988) has suggested that anxiety is produced from perceived feelings of uncontrollability and a physiological vulnerability to anxious feelings. Barlow has also speculated that depression shares a similar, if not common, diathesis. This would suggest that both anxious and depressed individuals would exhibit an attentional bias towards mood congruent stimuli. The results from the present investigation support Barlow's hypothesis that both anxiety and depression share a common diathesis. In particular, anxious and depressed individuals tend to show the same processing biases towards negative information, except that depressed subjects are slower in general to process information.

Of particular interest to clinical psychologists is the type of factors that might produce an attentional bias in anxious or depressed individuals. Neufeld (1994) suggests that general or selective performance decline (or facilitation) may be due to the effects of either capacity depletion, arousal effects, or intrusive associations. Stochastic modelling provides avenues for testing each of these possibilities. Both clinical theory and experimental precision can be enhanced by such an approach.

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## APPENDIX A: BARLOW'S MODEL OF ANXIETY

Barlow's (1988) model of anxiety suggests that cognitive and affective processes interact to bring about anxiety. According to this interactive view, cognitive dysfunctioning is analogous to Beck's (1976) notion of negative schemata. However, the affective processes include physiological conditions that can modify and be modified by cognitive processes. Barlow defines anxiety as a "diffuse cognitive-affective structure". He refers to this structure as "anxious apprehension" to discriminate anxiety from panic and fear, which are often categorized under the general term of anxiety. The essential components of this structure are high negative affect, perceptions of lack of control (concerning future events), and shifts in attention to self-evaluative concerns. Barlow refers to this structure as being "diffuse" because it spans a variety of autonomic systems. As a result, its development and specific associations with situations or events can vary from one individual to another. The theory suggests that these components are organized in a negative feedback cycle that perpetuates the process of anxious apprehension.

The elements of the negative affect are stored in memory in the form of stimulus and response propositions, as well as meaning propositions. These can be activated or triggered by cues in the environment. Thus, the mere mention of an upcoming speaking engagement can produce an anxious mood. Also, certain response characteristics (eg. arousal from other sources) may be capable of activating the propositions of anxiety, resulting in negative affect.

According to Barlow, this negative affect is associated with perceptions of lack of control over future events (ie. inability to predict or obtain desired results). In essence, these perceptions constitute a cognitive set or schema which Barlow refers to as an "apprehensive hypervalent cognitive schema" (p. 248). This schema leads to attentional shifts away from task-relevant processing towards self-evaluative processing. Furthermore, this schema leads to increases in arousal, a narrowing of attention, and hypervigilance towards the source of apprehension. Consequently, at some level of intensity, the process disrupts concentration and/or performance, and ultimately results in avoidance of the source of apprehension.

Barlow (1988) also presents a model of the etiology of this cycle. He postulates that there are three important factors which interact to generate the cycle of anxious apprehension: 1) a biological vulnerability, 2) a psychological vulnerability, and 3) stressful environmental events. Barlow suggests that the biological vulnerability is triggered by stressful life events. In other words, an individual may have a sense of arousal, fear, or even panic as a response to certain events. The response may or may not be warranted by the situation (Barlow refers to these as "true alarms" and "false alarms", respectively). According to Barlow (1988) this biological vulnerability makes an individual prone to more false alarms than non-vulnerable individuals. Psychologically vulnerable individuals perceive the stressful event as being uncontrollable or unpredictable (e.g., "what if I can't cope?" or "what if this happens again?"). Psychological vulnerability is the result of prior experiences with uncontrollable events and an inability to cope. This vulnerability may be

moderated by social support or some perceived sense of control. Barlow states that if a situation is perceived as uncontrollable or unpredictable, it will elicit negative affect and entry into the cycle of anxious apprehension.

Interestingly, Barlow (1988, 1991) has argued that the perception of uncontrollability is also at the core of depression. He suggests that both anxiety and depression share common physiological vulnerabilities. Experiences with lack of control may contribute to a psychological vulnerability to anxiety or depression. According to Barlow, depression represents a more extreme condition that resembles a 'learned helplessness'. Whereas anxious individuals focus on trying to be ready for some uncontrollable, negative event, depressed individuals have essentially given up trying. Barlow has suggested that both anxious and depressed individuals experience a sense of helplessness, but depressed individuals also experience a sense of hopelessness.

Barlow's model implicates both cognitive and affective processes as interactive processes that contribute to both the development and maintenance of anxiety and depression. Such a model has advantages over Beck's unidimensional (cognitive) model of anxiety and depression because it allows for complex interactions between physiology and cognitive processes. For example, within the realm of emotion research, it has long been known that cognitive processes can evoke the physiological changes that accompany a particular emotion. This can easily be demonstrated by reading a book about some sad story. However, Barlow's model also allows for the possibility that physiological states can affect cognitive processes. One example of



this has been proposed by Revelle and Loftus (1990) who suggest that the speed of information transfer varies according to the degree of physiological arousal.

Barlow's model makes predictions regarding the specific processes that should demonstrate a bias in individuals vulnerable to anxiety. In particular, negative affect produces an attentional shift towards a self-evaluative focus. The main implication here is that attention (and optimal processing) is shifted away from task oriented information. Furthermore, there is attentional narrowing on the source of apprehension. Thus, instead of processing information that is relevant to the task at hand, vulnerable individuals experience enhanced processing and hyper-vigilance towards information related to the source of threat. For example, if some performance situation was the source of apprehension for an anxious individual, his or her attention would shift towards an evaluation of the performance rather than concentrating on the task. Furthermore, attention would narrow on to cues that might represent a bad performance. Barlow suggests that this process often inhibits successful performance, which adds to negative affect and worrying about "what might go wrong". It is not clear from Barlow's account how attention may be affected in depressed individuals. However, one might speculate that depressed individuals differ from anxious individuals more in their response to negative situations than in their perceptions of them.

#### Empirical Evidence of Barlow's Model

Barlow's model developed from research in the area of sexual dysfunction.

Anxiety has long been thought to play an important role in sexual dysfunction (e.g., Fenichel, 1945; Kaplan, 1974). However, the supposition that anxiety inhibits sexual arousal has been contradicted by reports of male rape victims who were able to perform sexually despite extremely anxious conditions (Sarrel & Masters, 1982). Also, Beck and Barlow (1984) report a strong association between fear and sexual arousal in some sexual deviates. In an examination of the effects of induced anxiety on sexual arousal, Barlow, Sakheim, & Beck (1983) measured sexual arousal in male subjects who were watching an erotic film. Anxiety was induced by the threat of a shock during the film. Subjects were either told that there was a 60 percent chance that they would be arbitrarily given a shock (non-contingent shock threat), or that there was a chance they would receive a shock if their sexual arousal was less than average (contingent shock threat). A third control group was told that no shock would be given. The results indicated that subjects under conditions of shock threat (and anxiety, presumably) actually displayed increased sexual arousal compared to control subjects. Furthermore, subjects in the contingent shock condition exhibited the highest level of sexual arousal. Utilizing the same paradigm, Beck, Barlow, Sakheim, and Abramson (1984; 1987) demonstrated that sexually dysfunctional males experienced less arousal in the shock conditions than in the no shock condition.

Barlow has suggested that it is not anxiety itself that interferes with performance, but rather a response to the anxiety once it has developed distracts attention away from performance relevant cues. For example, a series of studies investigated the effect of distraction on sexual arousal (e.g., Beck *et al.*, 1987; Beck

& Barlow, 1986). In these studies, subjects were required to listen to audio tapes while watching an erotic film under varying shock threat conditions. Subjects were also tested on sentence recognition from the audio tape immediately afterward. The results indicated that performance on the sentence recognition task was inversely proportional to the experienced levels of sexual arousal. Thus, Barlow (1988) argues that sexually dysfunctional individuals are distracted by performance related concerns when presented with erotic cues and that this distraction decreases sexual arousal.

Barlow extends this dysfunctional process to a general model of anxious apprehension in which the key aspects include negative affect (including negative schemata) and an attentional shift away from performance relevant cues and towards self-evaluation. This results in a narrowing of attention, or hypervigilance towards the content of the apprehension (e.g., the content for sexually dysfunctional individuals would be concerns about performance). Another result of the attentional shift is that it is self-focussed, which is thought to intensify emotional experience (Carver, Blaney, & Scheier, 1976). Thus, for anxious individuals, the self-focussed attention intensifies the "distress associated with arousal and the sense of uncontrollability characterizing the negative affect state" (Barlow, 1988, p. 259). The consequences of this attentional shift lead to disruptions in concentration and performance, which may lead to more negative affect. As a result, a vicious cycle is set up in which anxious apprehension is self-perpetuating.

### Summary of Barlow's Model

Barlow points to two conditions of certain individuals which interact with stressful life experiences to produce anxious apprehension: a biological vulnerability, and a psychological vulnerability. Biologically vulnerable individuals are more likely to experience physiological changes that often accompany the feelings of fear or panic (e.g., arousal, tension) when these feelings are not warranted by the situation (Barlow refers to these as "false alarms"). Barlow also argues that this physiological vulnerability predisposes an individual to develop anxiety and/or depression. Psychologically vulnerable individuals are more likely to perceive stressful situations as being uncontrollable or unpredictable, and experience a sense of helplessness (hopelessness in extreme conditions). Barlow suggests that there is a critical difference between how psychologically vulnerable and non-vulnerable individuals deal with stressful or anxious situations. In particular, vulnerable individuals will tend to shift their attention towards self-evaluation (e.g., feelings of anxiety) whereas non-vulnerable individuals attend to the task at hand. Furthermore, for vulnerable individuals attention narrows on negative content and sources of danger or threat. This narrowing of attention leads to intense worry and dysfunctional performance if performance is required.

Barlow argues that anxious and depressed individuals differ according to their patterns of perceptions and responses. In particular, Barlow (1988) argues that it is the response style that discriminates between anxiety and depression.

**APPENDIX B: CONSENT AND DEBRIEFING FORMS**  
**LETTER OF INFORMATION FOR PARTICIPANTS**

**Information processing in anxiety and depression:**

**Attentional responses to mood congruent stimuli.**

You are being asked to participate in a study being carried out by Glen Berry (Predoctoral Intern, Valley Health Services Association). There are two stages to this study. The first stage includes a short interview and a few questionnaires that involve questions about your feelings and moods. You may refuse to answer or leave blank any questions that you would rather not answer. The second stage involves two recognition tasks on a computer. For example, you may have to decide if a string of letters is a real word or not, or decide if an "X" or a "Y" has been displayed on the screen. The entire session should last about 60 to 80 minutes.

The purpose of this research project is to investigate how a person's mood affects the way that person thinks and reacts. Some researchers have suggested that people who experience anxiety or depression for long periods of time will start to perceive and interact with the world around them in a different way.

In order to compensate people for their time and inconvenience, I am holding a \$100 lottery. Your participation in this project is completely voluntary and you may withdraw from the experiment at any point. Refusal to participate or withdrawal from the study will have no effect on the health services being provided to you. All information collected from you in this study will be kept confidential, and will be used for research purposes only.

Sincerely,

Glen Berry, M.A.

**Information processing in anxiety and depression:  
Attentional responses to mood congruent stimuli.**

The relationship between emotions and thoughts (e.g., attention, memory) is not well understood, but most research indicates that both emotions and thoughts can affect each other.

The purpose of this research project is to investigate how a person's mood affects the way that person thinks and reacts. Some researchers have suggested that people who experience anxiety or depression for long periods of time will start to perceive and interact with the world around them in a different way. According to this theory, the perceptions of these people will actually prolong their feelings of anxiety or depression.

I am interested in testing this idea by seeing how easily people can perceive different types of information ( in this case, different types of words). For example, do people who are feeling anxious, or depressed, or happy notice words faster if the words are related to how they are feeling? We are also interested in testing how a person's mood affects the way a person will respond after noticing mood-related words. In this study, I want to measure how quickly a person can complete a second task just after finishing a task involving mood-related words.

This kind of research is important in understanding the effects of moods such as anxiety and depression, and hopefully can lead to new insights for treatment and prevention. If you have any questions or comments, do not hesitate to contact me.

Sincerely,

Glen Berry, M.A.