THE RELATIONSHIP BETWEEN ANXIETY VULNERABILITY AND STRESS
IN THE COGNITIVE PROCESSING OF THREAT-RELATED INFORMATION

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ABSTRACT

In order to clarify the relationship between anxiety vulnerability and clinical anxiety, information-processing models have been employed to examine the cognitive biases of anxious individuals for threat-related information. At the core of these models are research findings indicating that anxiety-linked attentional biases render high trait anxious individuals disproportionately vulnerable to the effects of stress. The current research, following the model of Williams, Watts, MacLeod, and Mathews (1988), tested the hypothesis that attention to threat-related information is due to the interaction of trait anxiety and state anxiety.

Five comparable studies employed emotional Stroop and probe-detection paradigms to assess the attentional biases of high and low trait anxious individuals to threat-related words in response to elevations of stress. Four of the studies assessed the preconscious and conscious attentional biases of adults and one study investigated the attentional biases of children. This focus allowed developmental comparisons that had not been undertaken previously. The studies were comparable to each other and to previous research. The studies sought to clarify the effects of different forms of stress on the anxiety-linked attentional biases and to assess the effects of these stressors on domain-specific stimuli. The hypotheses were that, in response to elevations in state anxiety, high trait anxious individuals show increased attention to threat and low trait anxious individuals show avoidance of threat. It was expected that these threat-related attentional biases are identified at both preconscious and conscious levels of
processing, and more when the stimuli are related to the individuals’ domain of concern.

Contrary to expectations, only one study found the predicted pattern and this result occurred at a conscious level of processing. In addition to the lack of support for the hypotheses, a counter-intuitive alternative pattern that was the converse of predictions was identified in four of the five studies. In this pattern, in response to elevated stress, there was a trend for high trait anxious individuals to show decreased attention to threat and low trait anxious individuals to show increased attention to threat. The pattern was identified, in various studies, at conscious and preconscious levels of processing, and more in response to domain-specific stimuli. Adults and children showed similar levels and types of attentional biases.

The results of the current studies show some convergence with previous research. The findings are discussed in the context of a proposed model that incorporated aspects of Williams et al.’s theories (1988; Williams, Watts, MacLeod, & Mathews, 1997) and Mogg and Bradley’s (1998) theory. This model suggests that high and low trait anxious individuals’ patterns of threat-related attentional biases vary according to their different levels of reactivity to stress, which affects their threat threshold. Due to differences in this threat threshold, high and low trait anxious individuals show divergent attentional responses under the same level of external stress. The model incorporates the avoidance effects identified in previous research and theory. This model may explain both the current counter-intuitive findings and past inconsistencies in the literature. It may also clarify how individuals with different levels of anxiety
vulnerability show divergent attentional responses to stress elevations. It is suggested that inclusion of the notion of subjective stimulus threat value into the cognitive processing paradigm may clarify some of the unresolved issues raised in this research.
PREFACE

Research into cognitive processing and emotional vulnerability has proliferated in the last decade and particularly over the course of this research. The course and design of this series of experiments was established in 1992, before the publication of a substantial amount of research and theory that modified views in this area. Consequently, several recent theoretical contributions could not be incorporated into the design of the studies. The course of the studies was as follows. Experiment 1 was carried out in late 1993, Experiment 2 in 1994, and Experiment 3 in early 1995. Experiments 4 and 5 were carried out in mid-late 1995. The pilot studies to Studies 4 and 5 were carried out in 1994-95. Experiment 3 was designed by and carried out under the supervision of the author, who completed the analysis and interpretation of the data. The data collection was carried out by Marie Dineen and Loren Semaan in an undergraduate research project in the Bachelor of Social Science (Family Studies) degree at Australian Catholic University in 1995. They presented alternative versions of the results, substantially different from those presented in Chapter 5, as part of the requirements of their projects.

DECLARATION

This declaration is to certify that the thesis comprises only my original work undertaken for this degree, that due acknowledgement has been made in the text to all other material used, and that the thesis is less than 80,000 words in length, exclusive of tables, figures, references, and appendices.

Simon G. Kennedy
March, 2000
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I would like to acknowledge the many individuals who have contributed to this research.

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March, 2000
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CHAPTER 1

COGNITIVE MODELS OF ANXIETY
CHAPTER 1

COGNITIVE MODELS OF ANXIETY

This chapter discusses theoretical models related to anxiety vulnerability and the cognitive processing of threatening information. Section 1.1 introduces the notion of anxiety vulnerability and Section 1.2 outlines cognitive models of anxiety. Theoretical questions arising from these models are presented in Section 1.3.

1.1 The Construct of Anxiety

Anxiety has been consistently conceptualised as having temporary, situational state components and more permanent, trait components (Cattell & Scheier, 1961; Spielberger, 1966). Spielberger, Gorusch, Lushene, Vagg, and Jacobs (1983) have described trait anxiety as a personality characteristic that predisposes responding to certain situations with a stress syndrome of responses. Personality traits are relatively enduring individual differences in specific tendencies to perceive the world in a particular way and to react in a specified manner with predictable regularity. Trait anxiety refers to relatively stable individual differences in anxiety proneness. Anxiety proneness refers to differences between individuals in the tendency to perceive stressful situations as dangerous or threatening and to respond to such situations with elevations in the intensity of their state anxiety reactions. State anxiety has been conceptualised as “apprehension, tension or uneasiness that stems from the anticipation of danger, which may be internal or external” (American Psychiatric Association, 1987, p. 392), and “an unpleasant emotional state or condition which is characterised by subjective feelings of
tension, apprehension, and worry, and by activation or arousal of the autonomic nervous system" (Spielberger, 1972, p. 29). State anxiety has adaptive roles in ensuring readiness for threat through the detection of danger and promoting fight or flight behaviours to deal with the threat. It may also become maladaptive in clinical anxiety. Vulnerability to clinical anxiety has generally been considered related to high levels of trait anxiety (Eysenck, 1992; Williams et al., 1988).

Various theorists have proposed that anxiety vulnerability refers to the individual variation associated with responding to stressful events (Ingram & Kendall, 1992; MacLeod, 1991a; Turner, Beidel, & Epstein, 1991). Spielberger et al. (1983) have suggested that high trait anxious individuals exhibit state anxiety elevations more frequently than do low trait anxious individuals because they interpret a wider range of situations as threatening. The level of state anxiety may be determined more by the perception of threat than the actual danger associated with the situation. High trait anxious individuals are more likely to experience state anxiety increases in situations that involve interpersonal relationships and threaten self-esteem. Spielberger et al. (1983) have indicated that situations where failure is experience or personal adequacy is evaluated (e.g. test taking) are generally more threatening for high trait anxious individuals than for low trait anxious individuals. Threat from physical dangers, such as electric shock, does not differentiate between high and low trait anxious individuals. In this thesis, anxiety vulnerability is considered as synonymous with trait anxiety and is
defined as individual differences in the tendency to experience elevations in state anxiety in response to exposure to threatening stimuli.

The relationship between anxiety vulnerability and clinical anxiety is central to this domain of research. A defining feature of clinical anxiety is that emotional distress is may be present in the absence of an external stressor. High trait anxious individuals are less likely to demonstrate such anxiety elevations without the catalyst of an external stressor. For the purposes of this thesis, clinical anxiety is defined as an unexpected clinically significant behavioural or psychological pattern or syndrome related to anxiety that is associated with present distress and disability.

In the last two decades of research into cognitive aspects of psychopathology, research has indicated that clinically anxious individuals show distinct cognitive processes that selectively favour the processing of threatening information (Williams et al., 1988). The research regarding non-clinically anxious individuals has been less clear. There has been mixed evidence for whether high trait anxious individuals share the same attentional biases to threatening stimuli and how high trait anxious individuals are affected by different types of stress. Threat-related attentional biases in high trait anxious individuals have been addressed by various theoretical frameworks, which are discussed in Section 1.2.
1.2 Attentional Factors in Anxiety

In experimental psychopathology, cognitive factors have been considered to have important roles in the etiology and maintenance of emotional disorders in general and of anxiety disorders in particular. Recently, there has been increased interest in the relationship between individuals’ attention to anxiety-related aspects of their environment and their vulnerability to anxiety. Disproportionate attention to threatening information, also referred to as vigilance for threat or threat-related attentional bias, has been proposed as central in the maintenance and development of anxiety states and anxiety disorders. Beck and his colleagues (1976; Beck, Rush, Shaw, & Emery, 1979) proposed that irrational thinking and over-estimates of danger are essential features of anxiety disorders. It was further suggested that irrational anxiety is the emotional consequence of unrealistic thinking about threat to self (Beck, 1985; Beck, Emery, & Greenberg, 1985). Beck proposed that vulnerability to anxiety is the extent to which the individual tends to engage in such unrealistic thinking and have cognitive structures that lead to the selective processing of anxiety-related information. The following sections review models that have attempted to explain the relationships between individual vulnerability to anxiety, stress, and the cognitive processing of threatening information. The focus of these reviews is the attentional characteristics associated with this processing.

A distinction has been made between automatic cognitive processes, those occurring rapidly outside conscious awareness, and strategic cognitive processes, those occurring
slowly and with conscious awareness (MacLeod, 1991b; Schneider & Shriffrin, 1977). Automatic cognitive processes are considered rapid, effortless, not to require attention, to occur outside awareness, and to be independent of cognitive capacity. In contrast, strategic or controlled processes are considered to be slow, effortful, to require attention, occur with conscious awareness, and to be dependent on cognitive capacity (Williams et al., 1988). Various terms have been used for different levels of attentional processes. In this thesis, faster attentional processes are referred to as conscious and slower attentional processes as preconscious. It is recognised that these terms have other meanings in earlier writings in psychology. Similarly, following current convention, the term attentional bias is used to represent the enhanced processing of stimulus content. This commonly used term has been adopted despite the fact that in the preconscious domain, such processing should not require attention.

Williams et al. (1988) proposed that attentional bias occurs when there is a discrete change in the direction of a person’s attention, so that they become aware of a particular part of their environment. They also suggested that this change in attentional direction (1) could take place in any sensory modality; (2) is perceived as being passive or involuntary but can operate autonomously; and (3) is normally perceived to be contingent on a discrete change in the ‘internal’ or ‘external’ environment of the person.

Williams et al. (1988) illustrated the concept of attentional bias with the image of attention as a narrowly focused beam of light. If attention is narrow, the light is more
concentrated or brighter. If attention is broader, the light is dimmer or less concentrated. Some monitoring also takes place outside the bright focus. In the analogy, brightness indicates the degree to which information is processed. If stimuli related to one's domain of concern occur in the dim light, the peripheral light is brightened at the expense of the 'focused' beam, or the light may shift to bring stimuli of concern into the bright light. In this shifting of attention from one set of stimuli to another, individuals may differ from each other and/or individuals may differ over time.

This shifting of attention also illustrates how attention to some stimuli may occur in conjunction with avoidance of other stimuli that are presented simultaneously. It is necessary to prioritise information at or before encoding. Therefore, it is likely that avoidance occurs after some attention to threat establishes a table of priorities for the stimuli. Information that is more central to the individual's current concerns is located within the bright light, and information less relevant to the individual is allocated to the dim light. If two types of stimuli compete for space in the encoding system, one of the types of stimuli may be ignored. Consequently, less light is allocated to these stimuli than neutral stimuli. Neutral stimuli do not necessarily compete with threatening stimuli. The degree of threat represented by stimuli in the periphery varies, as does the tendency of individuals to shift attention to non-central stimuli.

Attention is only one part of the cognitive system where selective processing of information occurs. Once encoding occurs, material can be subsequently elaborated to a
greater or lesser degree. Elaboration has been defined by Williams et al. (1988) as occurring when schemas are activated in the presence of other mental events. This activation makes further new relationships with those events or reactivates established relationships.

1.2.1 Beck’s Schema Model

In an attempt to explain cognitive characteristics seen in clinical anxiety, Beck et al. (1985) proposed a schema model of anxiety. A schema refers to a structure of stored knowledge and experience which influences the processing of information by guiding attention, interpretation, elaboration, and memory. Beck proposed that the cognitive system filters information from the external environment through pre-existing memory representations or schemas. Beck and his associates (Beck, 1976; Beck & Clark, 1988; Beck et al., 1979) have proposed that depression is associated with individuals having dysfunctional schemas that are concerned with loss or failure. In contrast, anxious individuals have schemas related to threat or danger. Beck’s notions have been supported in research. A variety of studies have demonstrated that adults and children with anxiety disorders engage in thinking that is excessively threat oriented (Beck, Lunde, & Bohnert, 1974; Hibbert, 1984; Rapee & Heimberg, 1997). In addition, ambiguous situations are interpreted as more threatening by individuals with anxiety disorders than by non-clinically anxious individuals (Butler & Mathews, 1987; Mathews, Richards, & Eysenck, 1989).
Once these schemas are activated by schema-congruent environmental cues, associated information is selectively processed over information unrelated to those schemas. Beck suggested that schemas evolve through the interaction of biological factors and life events. Irrespective of their etiology, schemas are considered to be representative of trait characteristics and therefore, are relatively fixed factors in individual functioning.

This selective processing of threat-related information is proposed to lead to increases in state anxiety. Subsequently, high trait anxious individuals experience regular elevations of state anxiety. These elevations lead to further processing of threat-related stimuli. Therefore, the attentional characteristics maintain a self-maintaining cycle of anxiety. Beck's schema theory has been seen as complementary to Bower's network model of anxiety, presented in the next section, as they emphasis trait and state dimensions of anxiety respectively.

1.2.2 Bower's Network Model

Bower and his colleagues (1981; Bower & Cohen, 1982) emphasised the importance of mood and memory in anxiety-related attentional biases. Bower (1981) proposed that information in long-term memory is stored as nodes in a network and that each emotion has a specific emotional node. To access information, appropriate nodes are activated. This process leads to the partial activation of related information through associative connections and makes this information disproportionately available. Bower (1981)
further suggested that each emotional state (e.g. anxiety) is represented by a node that shares strong associative connections to other nodes containing mood-congruent information (e.g. rejection). Therefore, the model is applicable to emotions other than anxiety, but anxiety is considered central for survival reasons. Emotions activate their corresponding nodes and this activation then spreads to partially activated mood-congruent information in the network. For example, exacerbation of an anxious mood increases activation of danger-relevant information in memory. Thus, greater attention and more extensive processing occurs for mood-congruent information in comparison to neutral or positive information. It was implied in this model, as in Beck's, that processing occurs largely at a preconscious level. Similar to Beck's model, Bower (1981) suggested that individuals who experience state anxiety elevations have more extensive links in their memory network for anxiety. Both models also predicted that anxiety and depression are associated with emotion-relevant cognitive biases at all levels of the information-processing system, including attention, memory, and the interpretation of ambiguous information.

These models have predicted that information that is congruent with current mood is processed preferentially throughout the information-processing system. For example, when experiencing high state anxiety in response to situational stress, individuals often notice a variety of dangers. Beck's model emphasised the influence of trait characteristics in the process of preferentially selecting this information from the wide array of information available to the individual. Bower's model emphasised the
influence of state characteristics in the process. However, several joint predictions can be drawn from the consideration of these models: 1. Anxiety influences all aspects of cognition, 2. Trait anxiety and state anxiety are associated with the functioning of biased cognitive operations, and 3. Anxiety-linked attentional biases occur with and without cognitive awareness.

Several early studies addressing the predictions of Beck and Bower’s models showed attentional biases for threatening information in anxiety (MacLeod, Mathews, & Tata, 1986) and memory biases for negative information in depressed individuals (Bradley & Mathews, 1983; Clarke & Teasdale, 1982). In contrast to expectations, there have also been contradictory findings, where cognitive biases in anxiety and depression have not been identified. Some studies failed to find attentional biases in depression (MacLeod et al., 1986) or a recall bias in anxiety (Mogg, Mathews, & Weinman, 1987). Such results indicate that information-processing biases may operate differently depending on the cognitive process and the emotional state considered. Anxiety appears most closely associated with attentional biases to threat-related information. In contrast, depression appears related to memory biases for negative self-relevant information.

1.2.3 Williams, Watts, MacLeod and Mathews’ Interactional Model

Williams et al. (1988) integrated the schema and network models of Beck and Bower. They postulated that at a preconscious level of processing, the Affective Decision Mechanism evaluates the affective valence (threat value) of stimuli. The role
of this mechanism is the uptake of information and identification of the degree of stimulus threat. The level of threat experienced depends on the specific features of the stimulus and the state anxiety of the individual. Higher levels of state anxiety increase the threat value of the stimuli. The individual's level of state anxiety increases the vulnerability to perceive the stimuli as stressful or threatening. Therefore, judgement of stimulus threat value is determined by the state-modified appraisal of threat. After the stimuli are identified with high or low threat value to the individual, the Resource Allocation Mechanism orients resources towards or away from the stimuli. However, this decision is affected by the individual's level of trait anxiety. According to the model, high trait anxious individuals tend to orient towards threatening stimuli. In contrast, low trait anxious individuals tend to orient away from the location of the threat. The possible role of avoidance is to allow the maintenance of homeostasis. As the threat value of the stimuli increases, the difference in threat orientation between high and low trait anxious individuals also increases. The bias in the Resource Allocation Mechanism reflects relatively stable vulnerability to anxiety, which is represented by levels of trait anxiety.

Once the individual attends to a negative stimulus, there is an increase in stimulus priming. Priming refers to facilitation or inhibition of performance caused by individuals receiving advanced information about a task or stimulus. Irrespective of the extent the stimuli are processed later in the elaboration stage, stimulus representation is more likely to be produced when it is only partially presented. This effect is due to the
earlier priming through the attentional capture of the negative material. In addition to this effect, negative stimuli (thoughts, images) may come into consciousness without any environmental trigger. This process is due to negative stimuli or associated stimuli being primed previously, which causes the negative interpretation of neutral stimuli. The individual need not be consciously aware of the priming. The model proposed that, in this preconscious stage of encoding, high trait anxious individuals attend towards threat and low trait anxious individuals orient away from threat. It also predicted that stimuli that have been identified as threatening are allocated attentional resources by anxious individuals.

A similar mechanism has been proposed to explain encoding at the conscious or strategic level of processing. Once a stimulus is identified, connections between the stimulus and its associations are activated. Elaboration of the stimulus begins, which involves "the activation of representation in relation to other associated representations to form new relationships between them and to activate old relationships" (Williams et al., 1997, p. 279). At this stage, the Affective Decision Mechanism assesses the threat value of the stimulus. Resource allocation depends on the identification of the stimulus threat level. If a high level of threat is identified, resources are allocated for close attention to the stimulus. Subsequently, the stimulus is encoded more completely if attention is directed towards the threat than if it is avoided. The model has suggested that this encoding process may assist in later recognition and recall of the information.
Williams et al. (1997) revised their 1988 model, drawing on the Parallel Distribution Model (PDP) of Cohen, Dunbar, and McClelland (1990) in the context of attentional processing of threat. Within this framework, the processes involved in the Affective Decision Mechanism were further examined. ‘Input units’ (representing stimuli, such as words in the Stroop task) are activated by acquiring an affective ‘tag’, based on their threat value to the individual. The role of input units is similar to the purpose of the Affective Decision Mechanism, which is to assess the threat value of the stimuli to the individual. The revised model no longer assumed that there is a stable internal mechanism involved in the decision making of whether stimuli are threatening. Rather, the revised model suggested that stimuli need only be ‘tagged’ as threatening. The identification of threat in this fashion may reflect prior learning or biological pre-wiring. State anxiety changes are translated biologically through specific neurotransmitters that affect units with an associated negative tag. As in their earlier model, this threat evaluation process is dependent on the subjective valence of the threat and the state characteristics of the individual. Information regarding the threat valence is identified by the ‘Task Demand Unit’. This mechanism is individualised to the task at hand. The role of the unit is much the same as the Resource Allocation Mechanism in the earlier model. This unit allocates the direction of attentional resources towards or away from the stimuli that have been identified as threatening to the individual. The model conceptualised conscious and preconscious attentional processes on a continuum and therefore, the processes described are relevant at different levels of attention.
The predictions of Williams et al.'s (1997) model were substantially the same as for their earlier model. In both models, they predicted that trait predisposition determines a permanent tendency to react to the increased activation of tagged stimuli. This reaction involves switching task demands (or attentional resources) towards or away from the threat. The model proposed that high trait anxious individuals show a permanent tendency to react to increased activation of such stimuli at a preconscious level. This occurs by switching their attentional resources towards the source of threat. Low trait anxious individuals are thought to show a tendency to avoid the source of the threat. The patterns of avoidance may differ if stimuli are evaluated as negative at a conscious level of processing.

Williams et al. (1988) proposed that state anxiety acts as a catalyst to trait-linked attentional processes. As state anxiety increases, high trait anxious individuals show a greater tendency to allocate attentional resources towards threatening stimuli. Consequently, such stimuli will be more completely elaborated. Any period of emotional disturbance will be exacerbated and prolonged. In contrast, the low trait anxious individual may allocate fewer attentional resources to the processing of threat as state anxiety increases. As such, the information may be incompletely encoded, leading to lower levels of emotional disturbance.

The model of Williams et al. (1988) has been integral to the recent research focusing on anxiety-linked attentional biases in high trait anxiety. They hypothesised that
selective attention to threatening information is characteristic of clinically anxious individuals and is a function of the interaction of trait and state anxiety factors in non-clinical samples. In summary, they proposed the following:

1. Different emotional disorders are related to different patterns of cognitive biases. Anxiety is characterised by a bias that favours threat stimuli at preconscious (prior to awareness) and conscious levels of attention.

2. Individuals with a permanent tendency to attend to threatening information at a preconscious level are more likely to show disproportionate increases in anxiety under stress. They are more vulnerable to the development of anxiety disorders.

3. Trait anxiety influences the manner in which individuals attend to threatening information at conscious and preconscious levels of processing. High trait anxious individuals have a tendency to attend towards threatening stimuli, whereas low trait anxious individuals avoid threatening information. State anxiety acts as a catalyst for these processing biases. Under stress elevations, high trait anxious individuals show greater attention towards threatening information during under low stress, whereas low trait anxious individuals show greater avoidance of threat. Based on the interaction hypothesis, conscious and preconscious attentional biases are a result of an interaction between state and trait anxiety.

4. The tendency of high trait anxious individuals to attend disproportionately to threatening information in comparison to non-threatening
information is modified by intervention with methods drawn from cognitive behaviour therapy.

There has been theoretical convergence with other models addressing the relationship between cognition and emotion and that of Williams et al. (1988). The models addressing these issues will be presented to clarify the theoretical issues central to this research.

1.2.4 Mathews’ Model

Mathews (1990) proposed that each primary emotion imposes a specific mode of operation within the cognitive system that serves to determine processing priorities. His notions are similar to those of Oatley and Johnson-Laird (1987), who suggested that basic emotional states maintain behaviour by setting cognitive processors into characteristic modes. However, Mathews also suggested that anxiety is processed through a hypervigilant mode where the individual scans the environment for stimuli. This cognitive mode prioritises the initial automatic encoding of threat, but not the subsequent elaboration that biases recall for anxiety-related information. He further suggested that there are dispositional differences in the tendency for this vigilant processing mode for threat. This vigilant processing is most likely to be identified in anxious individuals in stressful life situations. Subsequently, this model made the same prediction as the model of Williams et al. (1988); biases for threatening information are a function of an interaction between state and trait anxiety factors. It was suggested that
anxious mood is representative of the cognitive system entering the vigilant mode, where priority is allocated to cognitive operations designed to detect danger.

Mathews (1990) addressed the fact that low trait anxious individuals have been found to avoid threat under stress. This phenomenon has also been well described by Williams et al. (1988). Mathews proposed that, although individuals continually monitor threat, there may be a threshold for the detection of threat. Until the threshold is reached where danger is imminent, the cognitive system does not allocate resources to that stimulus. Below the threshold, attention is directed away from threat to allow completion of other tasks without a loss of attention. Once the threshold is reached, the vigilance mode assumes priority. The individual then attends to external or internal threat cues and may experience anxiety or worry. This prediction is suggestive of a U-shaped function on the standard graphs demonstrating attentional bias. Threat is initially avoided under low threat levels, but once a critical level of threat is identified, attention is directed towards threat. Mathews (1990) has suggested that this process accounts for the pattern where low trait anxious individuals shift their attention away from threat cues under conditions of low stress, before reaching the stress threshold.

Mathews (1990) also proposed that low trait anxious individuals have a threshold that is set relatively high and so that their cognitive operations are typically in ‘defensive’ mode. For evolutionary reasons, even non-anxious individuals should attend to threat when the stimuli become sufficiently dangerous. High trait anxious individuals,
in contrast, have thresholds set low and move into vigilance mode rapidly on the presentation of threatening stimuli. Mathews (1990) suggested that the extended operation of this vigilance mode leads to a greater storehouse of information about potential threat. More memory for threat leads to easier access to this information and consequently, higher anxiety. Such cognitive patterns have been proposed as leading to anxiety-related avoidance, which contributes to the development of anxiety disorders.

1.2.5 Eysenck's Hypervigilance Model

Eysenck (1992) advanced a similar theoretical position to Mathews (1990) regarding attentional biases and anxiety, but has addressed the relationship between trait anxiety and clinical anxiety more explicitly. Eysenck's (1988; 1992; 1997) hypervigilance model placed generalised anxiety disorder and high trait anxiety on the same continuum with respect to the processes inherent in attention to threat. He suggested that high trait anxious individuals possess a selective attentional bias and an interpretive bias for threat. The selective attentional bias involves preferential attention to threat stimuli and a tendency to interpret ambiguous situations in a threatening fashion.

Eysenck (1992) assumed that high trait anxious individuals experience more anxiety than do non-anxious individuals, in part because of the existence of these cognitive biases. He proposed that high trait anxious individuals are more vulnerable to attend preferentially to threat (specific hypervigilance) and to attend to task-irrelevant stimuli (general hypervigilance or distractibility). He suggested that high trait anxiety is
associated with an increased rate of environmental scanning, a broader attentional focus before the detection of threat, and a narrowed focus of attention on the identification of the threat. Extent or width of attentional focus appears to be a dimension of attention that is different from the threat content of attentional bias.

The model assumes that most components of the hypervigilance inherent in high trait anxiety are latent and become active only during state anxiety elevations. This aspect of the model is very similar to the predictions of Williams et al. (1988). Thus, Eysenck (1992) considered hypervigilance a cognitive vulnerability factor for high trait anxious individuals for the development of an anxiety disorder. The perception of the environment as threatening and the increased intake of threatening information during stress renders high trait anxious individuals vulnerable to further elevations in anxiety. Eysenck (1992) has proposed that high trait anxiety and generalised anxiety disorder share the same hypervigilance, and has conceptualised these anxiety states as on a continuum. There may be functional differences, as high trait anxiety requires elevations in state anxiety for the components of the hypervigilance to become active. The model has indicated that the understanding of the attentional processes of high trait anxious individuals will contribute to the understanding of clinically anxious individuals.
1.2.6 Beck and Clarke's Preconscious Orienting Mode

A complementary model to that of Williams et al. (1988) has expanded theoretical notions of the role of information processing at a preconscious level in the processing of anxiety-related stimuli. Beck and his colleagues have extended the original schema model (Beck, 1996; Beck & Clark, 1997; Beck et al., 1985). They proposed that the information-processing system can be separated into three distinct stages; initial registration, immediate preparation, and secondary elaboration. This elaboration reflects a recent trend in the literature towards a more detailed analysis of the processes involved in attention. Beck (1996) has labeled the mechanism responsible for the early recognition of stimuli within the initial registration, the orienting mode. This stage of processing is characterised by rapid, involuntary, automatic processing, with no conscious involvement in the processing of information. Three processes are involved in this stage; stimulus orientation, stimulus evaluation, and allocation of attention. The role of the orienting mode is to focus on stimuli that may prove potentially threatening and then allocate increased attentional resources to the threat. There are obvious adaptive functions associated with such a role. Processing of threat is triggered by the stimuli in an automatic fashion. Beck and Clarke (1997) suggested that the orienting mode is "more perceptually than conceptually driven" (p. 51), however there must be some conceptual analysis of the stimuli if the mode identifies stimuli that are threatening to the individual.
Beck and Clarke (1997) have argued that the processing of information in this orienting mode is relatively undifferentiated. It operates at a basic level of identifying whether the stimulus is threatening and has personal relevance for the individual. Thus, preconscious attentional biases are expected to be evident in response to threat stimuli but not highly specific stimuli (e.g. phobia-related words). McNally (1995) added weight to this position in his review of studies that have focused on preconscious attentional biases to threat. He concluded that at a preconscious level, attention is biased towards general rather than specific forms of threat. Mathews and MacLeod (1994) broadly supported Beck and Clarke's notions in a review of the empirical literature. Based on the results of numerous studies, they suggested that information is first analysed based on threat content and intensity. Analysis of more subtle dimensions occurs later. Their review focused on studies that have found attentional biases towards general negative information, but not specific anxiety-related information. These results appear to relate equally to clinically anxious and high trait anxious individuals. While the concept of an orienting mode is intuitively appealing, empirical studies have yet to directly test the functioning of the mechanism. The validation of its presence in future studies may prove more difficult than the implication of its presence. Evidence of preconscious attentional biases to threat-related stimuli in the absence of biases to general emotional stimuli would imply the operation of such an orienting mode.
1.2.7 Mogg and Bradley’s Cognitive-Motivational Model

Mogg and Bradley’s (1998) cognitive-motivational model has also addressed the relationships between trait anxiety, stress, and threat-related attentional biases. The model is complementary to those of Williams et al. (1988) and Mathews (1990).

Mogg and Bradley have suggested that a series of psychobiological and personality theories have identified at least two primary factors that may explain the functioning of normal and abnormal emotions. These factors have been presented as relatively stable individual vulnerability features, connoting personality-like variables. Various constructs have been proposed; Neuroticism and Extraversion (Eysenck & Eysenck, 1969), Anxiety and Impulsivity (Gray, 1985; Gray, 1990), emotional variables such as Valence and Arousal (Lang, Bradley, & Cuthbert, 1990; Lang, Greenwald, Bradley, & Hamm, 1993), and Negative and Positive Affect (Watson & Clark, 1984; Watson & Tellegen, 1985). Mogg and Bradley suggested that, despite some minor differences between the models, the factors described in each model can be conceptualised as sharing a two-dimensional framework. This framework comprises the two orthogonal variables of emotional valence and goal engagement (Lang et al., 1990; Tellegen, 1985). They argued that such conceptual convergence indicates the presence of basic motivational systems that mediate cognitive and behavioural responses to emotional stimuli. This concept is discussed further by Fowles (1994). They have proposed that the two systems, Valence Evaluation and Goal Engagement Systems, have conceptually distinct functions and in combination play an essential role in mediating anxiety.
Mogg and Bradley (1998) proposed that each primary emotional state is associated with its own cognitive mode and response tendencies. Therefore, some cognitive differences between anxiety and depression may be explained in relation to the dimensions of valence and engagement (Tellegen, 1985). Anxiety, in the absence of marked depression, is commonly associated with a future-oriented externally-focused cognitive mode. Anxious individuals scan the environment for threat and anticipate possible danger (negative valence and external goal engagement). In contrast, in depression there is a past-oriented, internally-focused cognitive mode. There is a lack of pleasure and interest in the external world (negative valence and disengagement from external goals). Positive affect is associated with pleasant anticipation and an exploratory mode (positive valence and external goal engagement).

Mogg and Bradley suggested that this model can account for findings where non-depressed individuals with generalised anxiety disorder showed attentional biases for threat at a preconscious level (Bradley, Mogg, Millar, & White, 1995; Mogg, Bradley, & Williams, 1995; Mogg, Bradley et al., 1993a). In each of these studies, depressed individuals showed no such attentional biases despite high anxiety levels. The cognitive-motivation model explains such findings in the following way. Biases at a preconscious level and initial orienting to emotional stimuli depend on the combined functioning of both the valence engagement system and the goal engagement system. An anxious but non-depressed individual shows preconscious biases for external threat (i.e. negative valence + engagement → attention to threat). When external goal
engagement is low, as in the depressed individual, the preconscious bias for external threat cues are absent (i.e. negative valence + disengagement $\rightarrow$ no attentional bias for threat).

In the cognitive-motivational model, the Valence Evaluation System is responsible for assessing stimulus threat value. It evaluates information at a gross, preconscious level. It also integrates information that is more detailed, drawing on slower conscious processing. The system is influenced by the nature, content, and context of the stimuli. It is also influenced by biological feedback about the individual's arousal level and previous learning. Trait anxiety reflects the reactivity of this system to potential threat, with the system more sensitive in anxiety prone individuals. In these high trait anxious individuals, stimuli within their domain of concern are tagged with a high threat value.

Output from the Valence Evaluation System feeds into a Goal Engagement System. This system, in turn, determines the allocation of resources for cognitive processes and action. If high threat is detected, the recognition of this threat in the Valence Engagement System interrupts other activities and leads to an increase of processing resources towards threat. If stimuli are detected as having minimal threat, current goals are pursued as normal. Positive stimuli are given priority over threat stimuli, although not equally for all individuals. The attentional biases to emotional stimuli are largely determined by the appraisal of whether the stimuli are threatening. This appraisal is influenced by stimulus characteristics and context, state anxiety, and trait anxiety.
Therefore, the cognitive processes for high and low trait anxious individuals are not markedly different. Rather the appraisal of threat is the determining factor.

Mogg and Bradley (1998) suggested that the subsequent relationship between subjective stimulus threat value and attentional biases is curvilinear in nature. In a hypothetical model of this relationship, they proposed that if stimuli presented no threat value, there would be no attentional bias to threat. If threat is evaluated as mild, then attention is directed away from the stimuli. This attentional avoidance minimises the allocation of resources to relatively benign stimuli. This process allows attention to be focused on stimuli that are salient to the individual. It also avoids the triggering of negative affective states through increased processing of trivial negative stimuli.

As the subjective evaluation of threat increases, attention is progressively allocated towards the threatening stimulus. As previously noted, this subjective evaluation is dependent on trait and state anxiety. Both interact to determine the appraisal of the level of threat of the stimulus. High and low trait anxious individuals begin to attend to threat at about the same level of subjective evaluation of threat, but state anxiety tends to be greater for high trait anxious individuals. Therefore, high trait anxious individuals tend to process more threat information than do low trait anxious individuals. This tendency is due to the triggering role of their more labile anxiety response to stress. However, these are issues to be clarified at an empirical level. Currently, the model remains conceptually based. Nevertheless, it implied that high and low trait anxious individuals
have different patterns of vigilance for and avoidance of threat. High trait anxious individuals avoid and attend to threat at lower levels of stress than do low trait anxious individuals. Like Williams et al. (1988), Mogg and Bradley (1998) implied that domain-specific stimuli produce greater subjective stimulus threat value and hence greater attentional biases.

This proposed curvilinear relationship between subjective stimulus threat value and attentional biases is similar to the U-shaped model of Mathews (1990). Both models have proposed that attention to threatening information is dependent on individual internal evaluation of the stimuli as threatening. They have proposed that once an internal subjective threshold is reached, indicating that the stimulus is sufficiently threatening for further attentional resources to be deployed, attentional biases to threat will be observed. Before reaching this threshold, few attentional resources will be allocated to the stimulus so that normal tasks are given priority. During exposure to mild threat, it is expected that avoidance of threat will be observed. Both models suggested that the setting of the threshold at high or low is determined by the interaction of trait anxiety and state anxiety.

Mogg and Bradley (1998) have suggested that high and low trait anxious individuals operate under similar contingencies in their models. However, Mathews (1990) was less explicit in his prediction of whether all individuals avoid mild threat, irrespective of anxiety vulnerability level. Mathews’ proposal was that vigilance for and avoidance of
threat are a function of an interaction of trait and state anxiety. Therefore, it can be assumed that the model predicts that avoidance may be the initial response of both high and low trait anxious individuals to mild threat. Despite the use of different terminology for cognitive constructs and processes and some differences in how attentional biases are explained, the models have similar predictions in their accounts of attentional biases and anxiety.

Mogg and Bradley (1998) have suggested that the Cognitive-Motivation framework offers some advantages in the understanding of attentional responses in anxiety. First, it suggested that there is a distinction between stimulus appraisal processes and those involved in goal oriented cognitive and behavioural processes. Second, this distinction explains the differences between anxiety and depression. Third, it suggested that the differential sensitivity of the threat appraisal process underlies trait anxiety. Therefore, trait anxiety differences involve high trait anxious individuals' appraising benign stimuli as threatening and subsequently attending more to those stimuli. In contrast, low trait anxious individuals appraise the same stimuli as having low threat value and subsequently disregard it in favour of stimuli that are more positive.

Mogg and Bradley's (1998) model differs slightly in emphasis from that of Williams et al. (1997). Mogg and Bradley (1998) proposed that high and low trait anxious individuals differ more in their appraisal of threat stimuli than in the direction of the allocation of resources. Subsequently, the model placed high and low trait anxious
individuals on the same continuum and proposed that avoidance of threat is evident in all individuals. Williams et al. (1988) suggested that high trait anxious individuals show generalised attention to threat and low trait anxious individuals display increased avoidance of threat with the progressive increase of subjective threat. In contrast, the cognitive-motivational model suggested that high and low trait anxious individuals begin to show attentional biases to threat once a threshold for threat is reached. At this point, the threat is appraised to be of sufficient intensity to require vigilance. Based on the notion that subjective appraisal of a stimulus is differentially threatening depending on trait anxiety, low and high trait anxious individuals respond based on the same curvilinear structure but demonstrate a different response. High trait anxious individuals tend to appraise environmental stimuli as more threatening than do low trait anxious individuals. Thus, it is expected that avoidance patterns vary based on trait anxiety differences. If high and low trait anxious individuals are presented with the same stimuli (e.g. a series of social threat words with increasing threat value), high trait anxious individuals avoid fewer threat words than do low trait anxious individuals. Threat appraisal and state anxiety interact as proposed in this and other models (Mathews, 1990).

There is insufficient evidence to evaluate whether threat-appraisal mechanisms function in a graduated manner or are all-or-none processes. In order to address this issue, alternative methods to those employed in this research domain may be required. Thus, the predictive value of this model is yet to be established. Studies that have
addressed the model are yet to be published but recent research efforts have been
directed at using alternative methods to assess these issues (C. MacLeod, personal
communication, 11th November, 1998).
1.3 Theoretical Questions

As demonstrated in this review, there is theoretical convergence in the models that have addressed anxiety vulnerability and the processing of threat-related information. Recent models have built on Williams et al.'s (1988) model, which provided the basic theoretical concepts in this research addressing threat-related attentional biases in high trait anxious individuals. Williams et al.'s (1988) model was developed with specific clinical aims. It was designed to explain the relationship between high trait anxiety and clinical anxiety. Eysenck (1992) has drawn the parallel between high trait anxiety and generalised anxiety disorder in terms of possible similar processing structures for threat-related information. As high trait anxious individuals are more prone to distressing elevations of anxiety and are predisposed to the development of clinical anxiety disorders. Thus, it is important to clarify the cognitive mechanisms associated with anxiety vulnerability and to identify whether these mechanisms are influenced by the type and level of stress experienced. If Williams et al.'s (1988) model is to be explanatory rather than descriptive, it is important that the functioning of these mechanisms is determined to be more than symptoms of emotional distress and vulnerability.

Williams et al. (1988) distinguished between initial priming and subsequent elaboration in processing of threatening information. They argued that the association between certain emotions and cognitive processes was not arbitrary. Rather, they
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considered that the association was driven by the social and biological processes that are served by different emotions, as was suggested by Oatley and Johnson-Laird (1987).

At an evolutionary level, anxiety plays a protective role in increasing the chances of an individual avoiding danger in the environment. It is adaptive for the anxiety system to respond rapidly to partial representations of threat. Further elaboration of the stimulus through another system may prevent the required immediate action. For this reason, it is logical that an automatic system may lead to the disproportionate processing of threat-related information at a preconscious level. It seems most adaptive that physically threatening information takes processing priority in such attentional processes. However, physical and social safety may be intertwined at an evolutionary level. Social safety may have facilitated physical safety through encouraging individual traits (such as interpersonal sensitivity) that encourage social cohesion. Thus, social threat may have developed equivalent potency to physical threat. Socially focused threat (e.g., disapproval, anger) is also an important precursor to physical threat. Attention to anxiety is not solely related to avoidance of immediate danger. Individuals become anxious in response to many sub-types of stimuli over a longer time-course. For some clinically anxious individuals, as in generalised anxiety disorder, the focus of anxiety is broad. In these individuals, the stimuli are extensively elaborated over a longer time-period than in situations where there is rapid processing of potentially threatening stimuli.
Although the issue at hand relates to cognitive processing of anxiety rather than depression, depression and anxiety are closely linked. Depression also represents a multi-component system, probably designed to deal with loss of the goal or life plan that has failed (Oatley & Johnson-Laird, 1987). From research to date, depression is less associated with biased encoding and more associated with biased elaboration. This elaboration of negative material is related to the encoding of events into memory so that it can be retrieved later. If depression is related to the increased accessing of information from such memories, such processes are adaptive as part of problem solving. In contrast, in anxiety, attentional biases are designed to facilitate more immediate responses to perceived threat in the environment. Depressive cognitive processes are adaptive to ensure access to negative past events in the process of problem solving for the future. Thus, past negative events that may predispose depression are seen as likely to develop a negative expectancy for future events, which in turn may increase likelihood of this information being accessed.

Various models have been developed in attempts to map the relationship between vulnerability to anxiety, stress, and attentional biases to threatening stimuli. Williams et al. (1988) suggested that attentional biases to threat-related information are determined by an interactive function of trait anxiety and state anxiety. They proposed that it is adaptive for anxiety-related stimuli to be rapidly and preconsciously processed and that anxiety vulnerability is most clearly identified by attentional biases to threat at a preconscious level.
Several questions have been addressed by past studies and are important in this research.

1. In what ways do high and low trait anxious individuals differ with respect to attentional biases to threat?

2. To what extent does anxiety vulnerability implicate selective encoding biases that give priority to emotionally threatening material (MacLeod, 1990; Mathews & MacLeod, 1987)?

3. To what extent do selective attentional biases occur at a preconscious level, in that they do not reflect the influence of conscious strategies?

4. To what extent is trait anxiety related to attentional biases for threatening stimuli, which are automatically elicited by elevations in state anxiety (Williams et al., 1988)?

In summary, this chapter has reviewed the central theoretical models related to anxiety vulnerability and the cognitive processing of threatening information. The models have demonstrated a considerable degree of theoretical convergence and have triggered a number of experimental evaluations of these theories. Chapter 2 addresses these experiments and evaluates the empirical evidence for these models. In this review, studies that have addressed the model of Williams et al. (1988) are emphasised.
CHAPTER 2

EMPIRICAL EVALUATION OF INFORMATION-PROCESSING PARADIGMS
CHAPTER 2

EMPIRICAL EVALUATION OF INFORMATION-PROCESSING PARADIGMS

This chapter addresses the evidence for attentional biases to threat and examines under what conditions these attentional biases have been found in non-clinically anxious individuals. The chapter identifies that there has been mixed support for the predictions of the models presented in Chapter 1. The chapter initially addresses the measurement of emotional interference in Section 2.1 and then Section 2.2 discusses the mechanisms involved in emotional interference. A review of the empirical support for cognitive models in anxiety is presented in Section 2.3 and Section 2.4 attempts to integrate evidence regarding anxiety-related attentional biases for high trait anxious individuals.

2.1 Measurement of Emotional Interference

In addressing whether the predisposition to anxiety is related to a tendency to selectively encode threatening information, various methodologies have been employed. Interference tasks present emotionally threatening words (e.g. death), requiring individuals to ignore the content of the words while completing another task. Performance on the other task is dependent upon the extent to which individuals are able to ignore the threat words or focus on other stimuli. In general, these tasks have relied on verbal stimuli. More recently, there has been more variation in stimuli used in interference tasks, such as pictorial threat (Bradley et al., 1997) and ‘real life’ threat stimuli (Thorpe & Salkovskis, 1998).
The emotional Stroop task (MacLeod, 1991b; Williams, Mathews, & MacLeod, 1996) has been adapted from the standard Stroop colour-naming task. It assesses attentional interference by presenting emotional words written in different colours, with the task being to name the colours in which the words are presented. The semantic content, if salient to the individual, interferes with the colour naming.

The probe-detection paradigm involves a task where the effect of emotional stimuli is assessed by its potential to both facilitate and disrupt performance on another task. Threat and neutral word-pairs are presented on the computer screen at the same time. Both words disappear from the screen, with one of the words replaced by a dot-probe. Subjects press a key on the computer keyboard to indicate that they have identified the location of the probe. The latency between the presentation of the probe and the individual’s response indicates the effect of the words, which demonstrates whether they focused on the emotional or neutral word.

Dichotic-listening tasks also represent interference tasks. Individuals are presented with emotional and non-emotional words in different ears and required to ignore emotional words while undertaking a competing task. Performance on these tasks depends on the extent to which individuals are able to ignore the threat words, in the same way that they are required to ignore the semantic content of words in the emotional Stroop and probe-detection tasks.
To measure attentional responses at a preconscious level, the emotional Stroop task and the probe-detection task use masked visual presentation of stimuli. This involves presenting the stimuli for a short period of time (e.g. 20 milliseconds) and then replacing the stimuli with a visual mask, which prevents conscious recognition of the stimuli. Measurement of attentional biases at a conscious level occurs with the presentation of the stimuli without a mask to allow conscious recognition of the stimulus content.

2.1.1 The Emotional Stroop Paradigm

The standard Stroop task involves presenting individuals with a series of words written in several colours, where the colour of the word and the semantic content are incongruent (Stroop, 1935). For example, the subject views the word ‘red’, written in the colour blue. The emotional Stroop task requires individuals to verbally identify the ink colour of threat and non-threat words that are presented with or without a mask (Williams et al., 1996). Latency in response indicates the degree to which the individual is attending to the word content rather than the word colour. A word masking procedure can be used in conjunction with brief presentations times to enable assessment of patterns of preconscious attention. The words are displayed without a mask to allow assessment of biases at a conscious level.

The efficacy of the emotional Stroop as a measure of interference for emotional material has been demonstrated in a broad range of studies over 50 years. Interference
effects have been found in studies that have employed the original card presentations, tachistoscope, and computerised presentation. Williams et al. (1996) carried out an exhaustive review of studies that utilised the emotional Stroop as the central indicator of emotional processing. Their review indicated that card presentations have generally produced greater interference than have the computerised or tachistoscope versions. Nevertheless, these methodologies have produced replicable effects. Emotional Stroop interference has been produced across many clinical disorders. For individuals with specific clinical disorders, emotional Stroop interference is specific to their disorder. Colour-naming interference is specific to words that thematically represent the clinical concerns of the individual. Conscious processing has been assessed by presenting words so that they can be identified. Preconscious processing has been assessed by using letter masking to prevent conscious recognition of the stimuli.

Studies reviewed by Williams et al. (1996) involving individuals without clinical disorders have implicated the involvement of trait anxiety and state anxiety effects on emotional Stroop interference. In individuals without clinical disorders, trait emotion differences (e.g. anxiety) require activation by emotion or environmental stress for Stroop interference to become evident. The research findings in the review suggested that stress elevations lead to increases in the processing of specific emotional material in high trait anxious individuals. These individuals ruminate more on negative events, situations, and other life experiences. Domain-specific information is primed more fully in these individuals and can be more readily accessed. The review further indicated that
greater levels of interference have been found in individuals with post traumatic stress disorder than in individuals with other disorders. The content of the interference relates to the individual’s domain of concern. Individuals with generalised anxiety disorder are far more likely than non-anxiety disordered individuals to access words such as ‘dangerous’ and ‘die’. Individuals with obsessive-compulsive disorder tend to access words such as ‘dirt’ and ‘germs’.

Williams et al. (1996) have addressed various issues related to the Stroop task that could indicate that attentional biases represent methodological artifacts. Priming from one item to the next item of the same theme potentially amplifies interference. This priming can occur, irrespective of whether the words are presented randomly or in a blocked format. In a blocked format, words with the same theme are presented after each other. Controls for such possible inter-category priming effects have been implemented by using categorised neutral words (e.g. furniture) as a contrast to target emotional words. This control ensures that target and neutral words are presented in distinct categories. In one of these studies, more interference was still identified for emotional words than neutral and positive words (Cassiday, McNally, & Zeitlin, 1992). Another study found evidence of greater interference using a blocked presentation format in the Stroop task (Holle, Neely, & Heimberg, 1997). Other research has indicated that habituation to the semantic content of threat cues may occur over the course of a series of presentations (McNally, Amir, & Lipke, 1996). Therefore, with mixed findings in this area, it is unlikely that interference can be explained adequately
by the mode of stimulus presentation alone, but the results demonstrate the need for further examination of these issues.

Williams et al. (1996) proposed that the strength of interference was determined by the frequency and intensity of the rumination on the themes associated with their emotional vulnerability. They suggested that the strength of association effects may be due to the extent to which individuals are exposed to the relevant emotional material, either through external sources or internal rehearsal. They postulated that the strength of the interference may be associated with the amount of exposure to the stimuli in question. Individuals with specific emotional concerns are more likely to use and rehearse the particular words that are employed in the emotional Stroop paradigm. If attentional bias is simply related to overexposure to specific words, this may represent an artifact of the experimental methodology. These individuals with emotional concerns will use certain emotional words in private and public speech more than will those who do not have those concerns. They use these domain-specific words more than do other individuals, irrespective of testing with the Stroop methodology. This rehearsal and use of domain-specific materials may be one of the ways the schema is reinforced.

Repetition of target emotional words has been considered another possible artifact by Williams et al. (1996). Most studies reviewed have used a small number of target and control words and repeated them several times. As each emotional and neutral word is repeated an equal number of times, it is unlikely that repetition of words determines an
interference effect. Furthermore, two studies have shown interference using three types of words, with 50 words of each type, and with none of the words repeated (Gotlib & Cane, 1987; Gotlib & McCann, 1984). These studies showed significant levels of interference for depressive words with depressed individuals, suggesting that repetition of items alone is not an adequate explanation of Stroop interference effects.

Williams et al. (1996) also suggested that conscious recognition of target words could explain high levels of interference to these stimuli. They noted that several studies have used preconscious presentation of target words and found significant emotional interference effects (MacLeod & Hagan, 1992; MacLeod & Rutherford, 1992; Mogg, Bradley et al., 1993a; Mogg, Kentish, et al., 1993b). These results, in combination with research reviewed by Williams et al. (1996), indicate that it is highly unlikely that the emotional Stroop can be explained adequately by considering the effects methodological artifacts.

2.1.2 The Probe-Detection Paradigm

The probe-detection paradigm determines attentional patterns by providing a measure of the allocation of visual attention. The task involves a series of brief presentations of emotionally valenced (social threat, physical threat, positive) and neutral word pairs on a computer screen. The emotional and neutral word pairs are generally presented with one word in the upper half and one word presented in the lower half of the screen. Some studies have also employed an approach of presenting
the words on the left or right half of the screen. Depending on the position of the threat word and subsequent probe position, the latency of the individual’s response to the probe indicates the distribution of visual attention to threat. As in the Stroop task, conscious processing has been assessed by presenting words so that they can be consciously identified. Preconscious processing has been assessed by using letter masking to prevent conscious recognition of the stimuli.

Some probe-detection studies have used a task that randomly presents probes with either one or two dots. This task requires individuals to push different keys depending on which icon presented on the screen. The task involves some decision making, requiring careful attention to the task. This decision making increases the validity of the task. It allows for identification of errors in individuals who use random responding or a response set.

Williams et al. (1988) have indicated that the probe-detection task has proven a sensitive measure of visual attention. Individuals have impaired probe-detection performance if their attention is directed away from one of the words and facilitated performance if their attention is directed towards one of the words. Threat and non-threat word pairs are presented briefly on the vertical axis of a computer screen, with threat and non-threat words alternating randomly from top to bottom position. Immediately following the presentation of the two words, individuals attempt to locate a dot that appears where one of the words was positioned. Assuming that visual probes
are detected faster when presented to areas of the display to which attention is being given, the task directly tests to what extent individuals attend to emotionally charged words.

These attentional tasks, the emotional Stroop, the probe-detection task, and the dichotic-listening task have been used in studies aimed at detecting patterns of anxiety-related attentional biases. The Stroop and probe-detection tasks have been used more frequently in this area. For this reason, discussion will be limited mostly to the emotional Stroop and probe-detection tasks.
2.2 Explanations for Emotional Interference

Williams et al. (1996; 1997) have reviewed explanations for emotional interference and so that review will be summarised in this section. Their review primarily used the emotional Stroop to illustrate the functioning of attentional biases. Most research to date has conceptualised emotional interference as due to the capture of attentional resources. Emotional stimuli have been thought to capture more attentional resources than non-emotional stimuli due to the activation of schemas that represent personal threat. These danger schemas, seen in high trait anxious individuals, have been associated more reliably with emotional interference than have temporary state anxiety elevations (Williams et al., 1996; Williams et al., 1988). Thus, the production of interference may be determined more by long-term threat schemas than short-term, current arousal. However, as the findings regarding attentional biases and stressors in non-clinical samples have not been consistent, Williams et al. (1997) argued that any explanatory model should also incorporate interference caused by long- and short-term stressors.

Williams et al. (1997) have also evaluated several alternative explanations of emotional interference apart from the notion of preferential activation of schemas. As the interpretation of empirical support for cognitive models of anxiety rests on the understanding of emotional interference, these alternative explanations will be addressed in Sections 2.2.1-2.2.4.
2.2.1 Task Irrelevant Processing

Interference has been seen as related to task-irrelevant processing, caused by the disturbing effect of processing negative stimuli. Dawkins and Furnham (1989) proposed that emotional stimuli cause interference by activating task-irrelevant self-preoccupying processes that take up attentional capacity. Williams et al. (1997) noted that this explanation supports the finding that positive stimuli can cause emotional interference. The finding showed that any emotional stimuli could produce interference if it is congruent with state emotion. They also indicated that the notion was compatible with findings that showed a high correlation between interference and intrusion of traumatic thoughts and memories in rape victims with post traumatic stress disorder (PTSD) (Cassiday et al., 1992).

However, Williams et al. (1997) proposed that Stroop interference is not due to negative words triggering task-irrelevant processes. If this is the case, blocked presentations (where all the negative words are presented together, followed by another word type) would elicit more intense responses than would randomised word presentations. A comparison of blocked and randomised presentations of threat words in the study by Cassiday et al. (1992) showed no differential effects based on the mode of word presentation. Thus, there appears insufficient support to suggest that emotional interference is explainable by the effects of task irrelevant processing.
2.2.2 Cognitive Effort in Repression/Avoidance

Ruiter and Brosschot (1993) proposed that the interference identified in the emotional Stroop may be due to the cognitive effort required to avoid the emotional content of the stimuli presented. Williams et al. (1997) argued that such a proposition does not readily account for the wide diversity of interference that occurs for positive and threatening material, as has been identified in the literature.

2.2.3 Difficulty in Maintaining Attentional Focus

A broad range of studies has found that anxious individuals show higher levels of interference for threatening stimuli than do non-anxious individuals. This evidence raises the possibility that there may be another factor that accounts for interference. Eysenck (1992) proposed that these individuals may have more general difficulty in the maintenance of attention, rather than a tendency to selectively attend to threat. Some studies have found that under certain conditions, anxious individuals may have greater difficulty than non-anxious individuals inhibiting distracting information (Fox, 1994; Mathews, May, Mogg, & Eysenck, 1990). A study that employed a lexical decision task cast doubts on the distraction inhibition hypothesis (Mogg et al., 1991). With threat and non-threat words presented vertically on a computer screen, anxious individuals showed attentional biases when the threat words were presented in the lower position, but not when they were presented in the upper position. If there is a general tendency for anxious individuals to have difficulty in inhibition of attention, this difference in the effect of the spatial location of stimuli would not have been a factor. Thus, it appears
that there are inconsistent findings with respect to this issue. In summary, while general
distractibility is an important confounding variable in attentional bias research that
requires further examination, it does not currently explain emotional interference.

2.2.4 Emotionality Hypothesis

Williams et al. (1988) and Martin, Williams, and Clarke (1991) have suggested that
the processing biases in anxiety may not be restricted to threatening stimuli. The
emotionality hypothesis suggests that anxious individuals show attentional biases to
threatening and positive stimuli of equivalent valence. The Stroop paradigm has been
used with positive words, threat-related, and neutral words to distinguish threat and
emotionality effects. If anxious individuals show more interference for threat stimuli
than for positive stimuli, the interference effect is attributed to stimulus threat content
rather than stimulus emotionality. If interference is due to the emotionality of the words,
anxious individuals’ interference for threat and positive words is equivalent and greater
than for neutral words.

Several studies have investigated this issue in non-clinically anxious individuals and
showed mixed results. Most have indicated that high trait anxious individuals showed
greater attentional biases to threatening words than to positive words. Some have found
no interference for positive words (Richards, French, Johnson, Naparstek, & Williams,
1992; Richards & Millwood, 1989) and some have found that increased anxiety was not
associated with selective processing of positive information (Mogg, Kentish, et al., 1993b).

Other studies have found some evidence for the emotionality hypothesis. Mogg and Marden (1990) reported that high trait anxious adults showed no difference in interference between physical threat and social threat words or between threat and positive words. Dalgleish (1995) found interference for threat-related words in high-trait anxious adults. When the blocked-presentation Stroop task was used, anxious adults showed Stroop interference for emotional words, and greater biases for positive words than for neutral words. Riemann and McNally (1995) found that anxious adults were slower in naming the colours of highly negative and highly positive words related to their current concerns. Reaction times for low negative and low positive words related to their concerns and neutral words were relatively faster. These findings are consistent with the concern-relatedness hypothesis and are partially consistent with the emotionality hypothesis.

Clinical studies have also tested the emotionality hypothesis. The prediction that clinically anxious individuals attend as much to positive as negative material has been supported in one study with individuals with generalised anxiety disorder (Martin et al., 1991). However, some studies have shown either attentional effects for negative information only or greater attentional biases for threat than for positive stimuli. These effects have been seen in various clinical disorders (Mogg, Bradley et al., Bryant &
Harvey, 1995; Kaspi, McNally, & Amir, 1995; Mathews, Mogg, Kentish, & Eysenck, 1995; McNally, Kaspi, Riemann, & Zeitlin, 1990a; 1993a; Thrasher, Dalgleish, & Yule, 1994).

In summary, of the central studies in the area, the emotionality hypothesis has been endorsed in only four non-clinical studies. Several other studies have produced results that are probably consistent with the emotionality hypothesis. However, importantly, the majority of studies have not reported emotionality effects, as is shown in Section 2.3. The limited evidence for the emotionality hypothesis suggests that the selective processing of positive stimuli may occur in individuals with high-trait anxiety and generalised anxiety disorder. Therefore, a positive emotional Stroop effect may be associated with generalized anxiety states, although it is uncertain under what conditions.

In summary, alternative explanations for emotional interference have not provided substantial opposition to the explanation of emotional interference as related to capture of emotional stimuli due to the activation of threat-related schemas. Thus, the next section addresses empirical support for cognitive models of anxiety.
2.3 Support for Cognitive Models in Anxiety

This section reviews research that has focused on the link between emotional interference and anxiety. This section evaluates the extent to which the theoretical models in this domain have been supported by empirical findings and highlights unresolved theoretical issues. Research involving clinically anxious individuals is considered initially and then evidence involving non-clinically anxious individuals is evaluated.

2.3.1 Clinical Anxiety

As anxiety vulnerability and clinical anxiety have been considered by various theorists to be related (Eysenck, 1992; Williams et al., 1988), the evidence for attentional biases in clinical anxiety is particularly relevant to cognitive models in anxiety. The diagnostic literature has considered that clinical and normal anxiety can be differentiated (American Psychiatric Association, 1994). However, some theorists have argued that individual differences in anxiety, more than many other emotional states, are quantitative rather than qualitative in nature (Hamilton, 1988). Eysenck (1992) is among the theorists who have located non-clinical and clinical anxiety on the same continuum. He has proposed that high trait anxiety and generalised anxiety disorder share the same characteristics and mechanisms, and differ only in the extent of cognitive elaboration of anxiety and the subsequent degree of emotional disorder.
Despite the varied theoretical positions regarding what constitutes clinical anxiety, there is considerable evidence that clinically anxious individuals show schema-related and stress-linked biases to congruent emotional material (Williams et al., 1988). These studies have been reviewed extensively elsewhere (Eysenck, 1992; MacLeod, 1990; McNally, 1999; Williams et al., 1996; Williams et al., 1997, MacLeod and Mathews, 1991). Therefore, the empirical evidence for the presence of attentional biases in clinical anxiety will be reviewed in a limited fashion.

Several studies have demonstrated interference for emotional words in individuals with generalised anxiety disorder (Golombok et al., 1991; Martin et al., 1991; Mathews et al., 1995; Mogg, Bradley et al., 1993a). Other studies showed interference in anxious individuals who were not allocated a formal diagnosis of generalised anxiety disorder. However, these individuals were considered ‘patients’. They were described variously as anxious, anxiety state, and anxiety neurosis (MacLeod et al., 1986; Martin et al., 1991; Mathews & Klug, 1993; Mathews & MacLeod, 1985; Mogg, Mathews, & Weinman, 1989). Although it not possible to allocate these individuals a diagnosis from the descriptions, it is possible that they presented with an anxiety disorder.

Several studies have found interference effects in individuals with PTSD for trauma-related words (Bryant & Harvey, 1995; Bryant & Harvey, 1997; Cassiday et al., 1992; Creamer & Kelly, 1997; Foa, Feske, Murdock, Kozak, & McCarthy, 1991; Kaspi et al., 1995; Litz et al., 1996; McNally et al., 1996; McNally, English, & Lipke, 1993;

In summary, there is ample evidence of attentional biases related to domain of concern in various anxiety disorders. Although the relationship between high trait anxiety and clinical anxiety is yet to be determined, the presence of attentional biases in clinical anxiety suggests that such processing biases are evident in higher levels of non-clinical anxiety. The following sections address the evidence for this proposal.
2.3.2 High Trait Anxiety and Manipulation of Stress Levels

As indicated in Section 2.3.1, interference effects have been demonstrated with various clinically anxious samples. However, results from high trait anxious individuals have been more varied and at times, contradictory (Logan & Goetsch, 1993; MacLeod, 1991b; Williams et al., 1996). Many studies have demonstrated interference effects. Fewer studies of non-clinically anxious individuals have provided conclusive support for the interactional model of attentional biases.

To highlight the areas relevant for further comparative research, the more prominent attentional studies of non-clinical samples are reviewed in this section. These studies illustrate the differences in paradigms and identify convergent evidence for the model of Williams et al. (1988). Consideration of the findings in this area leads to predictions that can be made for future research. Comparison of the findings of the studies proves difficult due to the methodological differences between the studies examined.

Ray (1979) tested non-clinically anxious adults, using an emotional card Stroop with examination related and neutral words. These individuals were tested using proximity to examinations as the only high stress condition. Three groups were established, based on levels of state anxiety. As predicted, interference was greater for examination words than for neutral words. Attentional biases for exam related threat words were greater for individuals with higher levels of state anxiety. Ray proposed that the findings implicate state anxiety as a causal factor in the attentional bias differences due to the high
correlation between state and trait anxiety measures used. Alternatively, with the high intercorrelation of the two constructs, the result may be interpreted as due to an interaction of trait anxiety and state anxiety.

Dawkins and Furnham (1989) made the more common prediction that differences in trait anxiety, rather than state anxiety, are associated with enhanced processing of threat words. Their study employed a card emotional Stroop task using neutral and mixed emotional words with physical and social threat content. There was no stress manipulation and no state anxiety scores were provided. High trait anxious adults, in comparison with low trait anxious adults, produced more attention to threat words than neutral words. These findings were complicated by the inclusion of four high trait anxious individuals who were receiving therapy. Richards and Millwood (1989) also tested high and low trait anxiety groups on an emotional Stroop task in which threat, neutral, and pleasant words were presented. The studies found differences between the high and low trait anxious groups in their performance on this task. High trait anxious individuals showed greater interference for threat words than for neutral or positive words. Thus, these studies indicated the presence of trait-linked attentional biases to threat.

MacLeod and Mathews (1988) used a probe-detection paradigm to parallel the study of MacLeod et al. (1986). They assessed attentional biases to threat at a conscious level of processing in low and high trait anxious adults in low and high (chronic) stress. High
trait anxious individuals showed increased attentional bias towards exam-related threat stimuli under high stress. Low trait anxious individuals showed decreased attention to exam threat under high stress. These data supported the hypothesis that attentional capture of situation-relevant stimuli is dependent on the interaction between specificity of the threat stimuli, trait anxiety, and state anxiety. The findings showed that the predicted patterns can be seen at a conscious level of processing.

In a similar study, MacLeod and Rutherford (1992) employed a Stroop paradigm to examine high and low trait anxious adults under periods of low and high examination-related stress, assessing preconscious and conscious attention to threat. At a preconscious level, high trait anxious individuals showed increased attention to threat words from low to high stress. In contrast, low trait anxious individuals showed decreased attention to threat from low to high stress. No such interactions between trait anxiety and state anxiety were evident at a conscious level. Their results supported the interactional model at a preconscious level of processing.

MacLeod and Hagan (1992) addressed whether attentional biases were predictive of future emotional reaction to stress. They used a longitudinal design, utilising the chronic, naturalistic stressor of a negative medical diagnosis. Women who presented for examination for cervical pathology were pre-tested on standard measures for anxiety and depression. Their conscious and preconscious attentional biases to general threat words were assessed on a modified Stroop task. Reassessment took place 8 weeks later,
following the negative diagnosis. Those who showed the greatest level of attention to threat-related information at a preconscious level in initial assessment showed the greatest level of dysphoria when assessed at the end of the 8-week period. The same predictive power was not present in their initial attention to threat at a conscious level. The study is important both because it supports the interactional model and because of its high level of ecological validity. In response to a real (rather than analogous) stressor, vulnerability, as identified by the initial attentional biases to threat, was predictive of subsequent distress. Those results have been supported in a replication study with high trait anxious individuals, where the single best predictor of vulnerability to life stress was interference to masked stimuli on the Stroop task (van den Hout, Tenney, Huygens, & Merckelbach, 1995).

Mogg, Kentish, et al. (1993b) found some support for previous research. High and low trait anxious adults were allocated to either a stressful or a relaxation mood induction procedure before exposure to a modified Stroop task. Positive, categorised neutral, uncategorised neutral, and threat words were presented to assess conscious and preconscious levels of processing. Correlational results indicated that high trait anxious individuals showed greater colour-naming interference for masked threat stimuli, suggesting the existence of preconscious anxiety-related biases. Experimentally induced positive mood was associated with attentional biases to mood-congruent positive words at a preconscious level. These data supported Bower's (1981) network model of emotion and MacLeod and Mathews' (1988) findings.
Richards et al. (1992) produced similar results using a mood manipulation task with high and low trait anxious adults, using a modified Stroop task that assessed only conscious processing. For high trait anxious individuals, the elevation in state anxiety was associated with increased attention to threat words. For low trait anxious individuals, increased state anxiety led to decreased attention to threat.

However, several studies have found conflicting results. Mogg, Bradley, and Hallowell (1994) assessed high and low trait anxious adults using a probe-detection task under no stress, lab induced stress, and exam-related stress. In the unmasked exposure condition under exam stress, high trait anxious individuals shifted their attention to threat and low trait anxious individuals shifted their attention away from threat. This effect was not evident under the lab stress or the no stress conditions. In the masked exposure condition, high trait anxious individuals attended to threat and low trait anxious individuals avoided threat. This effect occurred only in the no stress condition and not under the lab stress or exam stress conditions. Only results involving conscious processing supported the predictions of Williams et al. (1988). The reasons why high trait anxious individuals did not attend to preconscious threat stimuli under exam stress are not clear, as the build-up in stress should have elicited concerns at a basic level of information processing.

Mogg, Mathews, Bird, and Macgregor-Morris (1990) used laboratory based mood induction procedures, and followed the probe-detection paradigm and many of the
procedures employed by MacLeod and Mathews (1988). They found that attentional biases could be elicited by the experience of an acute stress situation, irrespective of trait anxiety, and only at a conscious level of processing. This finding contrasted with the interactional hypothesis and the prediction that anxiety-linked attentional biases are found at the level of preconscious processing.

Mogg and Marden (1990) compared high and low trait anxious adults' conscious attentional biases on a modified card Stroop task. They found that high trait anxious individuals showed more attention to emotional words than to low trait anxious individuals, but no specificity effect for positive or threat words. Fox (1993) reported attentional biases with high and low anxious adults, presented in a card Stroop with a visual distractor task with neutral, threatening and incongruent colour words. High trait anxious individuals had significantly greater difficulty ignoring distractor information for both threat and incongruent colour words. This result suggested that the effect was due to a general difficulty in these individuals ignoring distractor information of all types, not specifically threatening information. These studies suggest that contextual factors associated with stimulus presentation may affect reactions to threat.

Some studies have also reported findings that conflict directly with the interactional model. As part of four studies, Martin et al. (1991) studied high, medium, and low trait anxious adults and their attentional responses to threatening information presented in an
emotional card Stroop task. The study did not manipulate stress. No relationship was found between levels of trait anxiety and attention to threat.

In the first of three studies reported, Mogg et al. (1991) assessed high and low trait anxious adults under no stress and high stress for conscious attentional biases to general threat, achievement threat, and positive words. There were no interactions between attentional biases to emotional stimuli and trait or state anxiety. In the second study, individuals with generalised anxiety disorder produced similar null findings. In the third study, low state anxious individuals attended to positive material and avoided negative material. Trait anxiety did not significantly predict attentional biases to positive or negative material. This study did not manipulate state anxiety and hence did not fully assess the interactional model. Overall, the studies showed that state anxiety alters the patterns of attentional biases for both high and low anxious individuals. They also showed that in non-clinically anxious groups, results of studies investigating attentional biases to threat material have been somewhat inconsistent and may have been affected by factors associated with the stimulus context.

Theoretically, trait anxiety differences in attentional processing of threat-related information are most likely to occur when activated by chronic rather than acute stress conditions. Incubation of current concerns is more likely when stress has been accumulating over an extended period than if the stress is brief. While this proposition appears reasonable, few controlled experiments have specifically assessed this
conclusion. Fewer studies still have addressed the issue in a single experiment. In those studies, mixed findings have been produced. Thus, the evidence for this notion is relatively limited and indicates the need for more comparison of the effects of acute and chronic stressors on attentional biases.

2.3.3 High Trait Anxiety and Situational Specificity of Effects

Emotional interference effects may be influenced by situational factors. The effects of situational specificity on threat-related attentional biases is central to understanding the varied responses of high trait anxious individuals but are not well understood as yet. In the previously discussed study of Mogg et al. (1990), students completed a task following failure. The increased stress led to increased interference for achievement related words. The result supports the notion proposed by Williams et al. (1988) that stressors specific to current concerns induce greater interference for stimuli related to that concern.

In some studies with non-clinical samples, unexpected suppression of attentional biases has been found. Mathews and Sebastian (1993) conducted three studies comparing adults with specific fears and controls. In the initial study, high and low snake-fearful individuals, in the presence of a snake, were tested with a card Stroop with words related to snakes, general threat, and neutral content. In contrast to predictions, there was a trend for the snake words to produce attentional biases more in the low fearful group than in the high fearful group. In Study 2, in the absence of a snake, high
snake-fearful individuals, in comparison to low fearful individuals, attended more to snake words than to general threat and neutral words. In the Study 3, high snake-fearful individuals named the snake, general threat, and neutral words with a spider present or absent. With the spider present, there were no differences in attentional biases to the different types of words. With the spider absent, snake words and to a lesser extent, neutral words produced greater attentional biases than did general threat words.

These studies found conscious avoidance or suppression effects in adults with specific fears under high stress. They also showed attentional biases for stimuli specific to individuals' concerns under low stress. Most importantly, the attentional biases seen when the snake was absent were replaced by a suppression effect when the snake-fearful individuals were presented with the snake. Cohen et al.'s (1990) PDP model has predicted that when the task demand unit associated with colour naming is increased, as in this study, interference and overall latency is reduced. Williams et al. (1997) suggested that Mathews and Sebastian's (1993) results supported the predictions of the PDP model. Williams et al. (1997) have also proposed that suppression effects are less available when pre-conscious processing is employed in the task. They further proposed that avoidance or speeded responses in attentional bias tasks are evidence that similar forms of threat suppression are operating. Such suppression effects, if dependent on increases in the task demand units, are most likely to occur when acute stress tasks are the form of stressor.
These suppression effects are not necessarily consistent under elevated stress. Chen et al. (1996) examined emotional Stroop latencies to unmasked stimuli after exposure to a spider (approach condition) and a neutral condition. Spider-fearful adults showed attentional biases to spider words across the stress conditions. They showed greater attention to spider words in the approach condition than in the neutral condition. The findings suggested that increases in state anxiety enhance existing interference effects for threatening information in highly anxious individuals. Similar results were also revealed for positive words. This result suggested an emotionality effect was evident during heightened state anxiety. It is uncertain whether these findings can be generalised to high trait anxious individuals. If generalisation is possible, avoidance responses may be more likely when multiple threats are present simultaneously due to the competition for attentional resources.

Other studies have suggested that attentional biases are influenced by contextual factors. For instance, Fox (1996) found attention to threat information presented in a preconscious mode in high trait anxious adults, but only under certain conditions. This effect was found when distractors were randomly intermixed or masked trials were presented after unmasked trials. In a negative priming study, Fox (1994) also found that high trait anxious individuals had difficulty inhibiting threat-related information under conditions of attentional search. They also had difficulty inhibiting non-threat-related distracting information. There was no consistent relationship between high trait anxiety and attentional biases to threat. In addition, individuals with a repressive coping style
were more likely to inhibit threat-related information. Similar results have been produced in other studies that have addressed the relationship between attentional avoidance and avoidant coping styles (Bonanno, Davis, Singer, & Schwartz, 1991; Lavy & van den Hout, 1994). Fox's (1994) results led to the proposition that high trait anxious individuals have a general difficulty in inhibiting distracting information, not only when the information is threat-related. Although this issue may have important implications for this area, it is yet to be resolved.

In summary, research to date has demonstrated mixed situational specificity effects. Although stressors specific to current concerns appear to induce greater interference for stimuli related to that concern, specific stressors have triggered counter-intuitive effects in anxious individuals. Future studies need to examine high trait anxious individuals under both acute and chronic stress to establish consistency of responses under such conditions.

2.3.4 High Trait Anxiety: Emotional Specificity and Domain of Concern

Williams et al. (1988) have suggested that high trait anxious individuals attend more to information within their domain of concern. The studies that have shown the predicted trait anxiety by state anxiety interaction effect most clearly have addressed domain-of-concern factors (MacLeod & Mathews, 1988; MacLeod & Rutherford, 1992; Mogg et al., 1994; Richards et al., 1992). These studies, by manipulating stress factors
Chapter 2  Empirical Evidence  2.3 Support for Cognitive Models in Anxiety

with high and low trait anxious individuals, also have increased the concerns of the individuals in specific areas.

However, as in the research involving situational specificity, domain-specific stimuli have produced mixed results. In investigating the role of stimulus specificity in attentional biases, Mathews and Klug (1993) produced results that contrasted with Williams et al.'s (1988) prediction. Anxious adults and controls were tested using a card emotional Stroop task. Stimuli included positive and negative anxiety-related words, and positive and negative non-anxiety-related words. Anxious individuals, compared to controls, did not show greater attentional biases to negative than positive words. Rather, slightly more attention to negative stimuli was shown by controls than by anxious individuals. Interestingly, anxious individuals did show significantly greater attentional biases towards anxiety-related information than non-anxiety-related material, irrespective of whether it was positive or negative in quality.

This result indicated that such responses to domain-specific stimuli may be evident at a conscious level of processing. These responses involve anxious individuals attending disproportionately to domain-specific stimuli, irrespective of whether the stimuli are judged positive or negative. Mathews and Klug (1993) proposed that attention to non-threat stimuli in anxious individuals may be due to some positive words containing negative meanings for anxious individuals. This effect is more likely if the positive words are near antonyms of negative words. In their study, the emotionality of the
words did not predict attentional biases. However, attentional biases were predicted by the extent to which stimulus words were rated as congruent with individuals’ concerns. Thus, it was proposed that the semantic association between anxious individuals’ threat-related concerns and positively valenced words may produce interference for those stimuli. This explanation differs from Martin et al.’s (1991) account of their similar data. They proposed that attention to positive words was a function of the emotionality of the stimuli. As has been outlined in Section 2.2.4, the evidence for the emotionality hypothesis is not consistent enough to fully explain threat-related attentional effects. It is more conceivable that anxious individuals show hypervigilance for signals of threat and safety. Threat and safety represent the dual needs of anxious individuals: minimal threat and maximum safety.

Some research has highlighted the possibility that conscious decision making about the meaning of threat stimuli may not closely predict the processes involved in attentional biases. Mathews and Milroy (1994) assessed the lexical decision making of anxious and non-anxious adults in each of three experiments. There was no evidence of anxious individuals making faster affective decisions for congruent (threatening) words. The result was similar irrespective of priming in some individuals. Mathews and Milroy argued that there may be little overlap between cognitive processes involved in automatically processing threat stimuli and those involved in the conscious evaluation of threat or its meaning. They also concluded that cognitive models may be flawed in their proposals that emotion has similar consequences at all stages of cognitive
processing. This study also highlighted the need to independently assess data at the levels of encoding and interpretation of threat.

Some studies have examined whether expertise with the stimuli, irrespective of the content, is the central component of attentional biases to emotional stimuli. Mathews and Klug (1993) showed that the magnitude of the attentional biases to emotional stimuli in clinically anxious adults was predicted more by the degree of personal relevance of the material than by its valence.

Riemann and McNally (1995) found similar results in the investigation of the effects of specific personal concerns on attentional biases. Stimuli were chosen for each adult based on self-reports of their current concerns. Individuals identified the two most positive and negative areas currently relevant for them. The words used in their explanations assessed the extent to which those words were relevant to their concerns. Individuals were exposed to one of three mood induction procedures; anxiety film, elation film, and neutral film. They showed Stroop interference for negative and positive information related to their current concerns but not for information weakly related to their concerns or for neutral words. The findings indicated that processing can be affected by the extent to which emotional stimuli represent current concerns.

In contrast, Mogg and Marden (1990) found no emotional Stroop interference effect for rowing words (e.g. oarswoman) among a group of rowers. Thus, they concluded that
stimulus expertise was unrelated to attentional response. However, subjects were university medical students who had been involved in rowing for at least one year. Therefore, the results may have been influenced by variable expertise for the stimuli across individuals.

To address these methodological shortcomings perceived in Mogg and Marden's study, Dalgleish (1995) tested ornithologists on bird-related stimuli using an emotional Stroop task. The results showed significant interference for bird words but not for neutral words. He concluded that stimulus expertise or familiarity may be a factor where differing clinical groups respond to stimuli that are familiar to one group but not the other (e.g. McNally et al., 1990b). However, in the attempt to isolate stimulus familiarity and emotionality factors, this study highlighted the close relationship between the two factors. Most individuals who are highly familiar with specific types of verbal stimuli also have strong emotional associations to that content. It is also likely that the converse is true. Just as ornithologists are more familiar with bird-related stimuli, individuals with strong emotional attachment to anxiety-related words use these words overtly and covertly more often. Subsequently, they will be more familiar with such words. Thus, in future research clarification is required regarding what aspects of attentional biases relate to familiarity and what aspects relate to valence.
In summary, despite some conflicting findings and unresolved theoretical issues, the available evidence indicates that high trait anxious individuals tend to show vigilance responses to stimuli within their domain of concern.
2.4 Integration of Data from High Trait Anxious Adults

The next section aims to integrate findings from studies with non-clinical samples and assess evidence for Williams et al.'s (1988) interactional model.

Based on the review of relevant studies in this chapter, at least nine studies have found that high trait anxiety is associated with attentional biases to threat and some in response to the elevation of state anxiety. Five studies have found threat-related attentional biases for high trait anxious individuals under high stress. Thus, these results were not related to trait-linked attentional biases in isolation of other variables. Several studies have found attentional biases to threat in high trait anxious individuals at a preconscious level of processing. Four studies have found attentional biases to threat in high trait anxious individuals at a conscious level of processing. Four studies have found the predicted divergent patterns of attentional biases to threat in high and low trait anxious individuals under high stress, with high trait anxious individuals attending to threat and low trait anxious individuals avoiding threat. Of these studies, three found these patterns at a conscious level of processing and one at a preconscious level of processing. In addition, the findings of several studies differed from the central predictions of Williams et al.'s (1988) model, despite having produced some results that supported aspects of the model. Several studies also produced results that contrasted substantially with the predictions of the models.
Chapter 2  Empirical Evidence  2.4 Integration of Data from High Trait Anxious Adults

These central experiments indicated that the hypothesis, that attentional biases are determined by interactions of trait by state anxiety, is worthy of further investigation. Based on the available evidence, under state anxiety elevations, high trait anxious individuals allocate increased attention to threat and low trait anxious individuals decrease their attention threat. However, research has not consistently supported the proposition that attentional biases are identified more at a preconscious than conscious level of processing, as attention biases have been found at both levels. Despite some evidence of suppression responses, the available evidence indicates that high trait anxious individuals tend to show vigilance responses to stimuli within their domain of concern. In addition, the level of threat and the personal relevance of the stimuli is more important than is the level of emotionality.

To date, there has been no adequate explanation of the inconsistency of experimental evidence in the non-clinical domain for Williams et al.'s (1988) interactional model. This issue may have been underemphasised because most studies find attentional biases to threat, despite the varied support for the model. While there is consensus that elevation in stress is required for eliciting of the predicted patterns of attentional biases in non-clinical samples, there have been greater discrepancies regarding the effect of different forms of stress. Some studies have demonstrated the predicted patterns in response to acute stress, others in response to chronic stress. Theoretically, more extensive processing of threat should be elicited by chronic stress than acute stress. Few studies have employed controlled comparisons of an identical study with acute and
chronic stress conditions, and those that have compared the stress types have shown mixed findings. Therefore, it is difficult to make conclusions regarding the effect of the chronicity of stress.

Several factors complicate the interpretation of the inconsistency in the past research. Attentional biases are probably less differentiated in high trait anxious individuals than in clinically anxious individuals. Despite the obvious comparability of the methods of the research reviewed, subtle differences may have contributed to the inconsistencies identified.

It is conceivable that the inconsistencies in the literature may be explained by other methodological limitations of the studies. As attentional biases in non-clinical samples may be modest in size, it is possible that their responses are particularly vulnerable to methodological variations across the studies, such as low sample size. To avoid such limitations, it was considered that studies should be undertaken that are directly comparable with previous research and each other.

However, it is also possible that the variation in findings in the research relates to the interdependence of the factors that are central to the eliciting of attentional biases in non-clinical samples. Williams et al.'s (1988) model and the research to date has implicated stress elevation, the assessment of preconscious or conscious processes, and the domain specificity of stimuli as factors that are central to the eliciting of threat-
related attentional biases. However, relatively few studies have considered the
interdependence of these factors. The inconsistencies in the research to date may relate
to this oversight in the literature. Further examination of the cognitive processing of
non-clinical samples, with these factors taken into account, may elicit a more consistent
pattern of results and a clearer understanding of threat-related attentional biases in non-
clinically anxious individuals.

This chapter addressed the empirical evidence for attentional biases to threat in non-
clinically anxious individuals. Chapter 3 presents an overview of the current series of
studies undertaken to address predictions drawn from the review of theory and empirical
literature.
CHAPTER 3

OVERVIEW OF THE CURRENT STUDIES
CHAPTER 3

OVERVIEW OF THE CURRENT STUDIES

The purpose of Chapter 3 is fourfold. First, this chapter presents the experimental hypotheses drawn from theory and evidence presented in Chapters 1 and 2. Second, this chapter presents an overview of the designs and paradigms employed in the five studies designed to test the predictions. Third, as similar approaches to data analysis were adopted across all five studies, a description and rationale for these approaches is provided. Fourth, the central constructs are operationalised and other essential issues in this research are addressed.

3.1 Aims and Theoretical Hypotheses

The aim of the present studies was to evaluate Williams et al.'s (1988) interactional model with high trait anxious individuals. As part of this aim, the studies were designed to clarify findings of previous research. This previous research has investigated the extent to which attentional biases to emotional or threatening information are dependent on the interaction of trait anxiety and state anxiety factors. As indicated previously, as the design of the studies was set before the publication of recent theoretical contributions to this area, the current hypotheses were not able to reflect these recent proposals.

Based on the research and theory addressed in the initial two chapters, three broad theoretical hypotheses were generated and employed consistently across all the studies.
1. Attentional biases to threat-related information will be dependent on an interaction of trait anxiety differences and by elevations in state anxiety. More specifically, in response to state anxiety elevations, high trait anxious individuals will attend to threatening information and low trait anxious individuals will allocate attention away from threatening information.

2. These trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified at preconscious and conscious levels of processing.

3. These trait anxiety-related attentional biases will be identified more for threatening information in the individuals’ domain of concern than for information unrelated to their domain of concern.

A series of studies aimed to address the current experimental hypotheses by assessing conscious and preconscious threat-related attentional biases, targeting both adults and children. No study has reported comparative research assessing threat-related attentional biases for children and adults, using comparable designs and information-processing tasks. It was anticipated that once a baseline had been established for adults with respect to their responses to threat-related information, a valid comparison could be made between adults and children.
3.2 Design and Paradigms

All of the studies employed mixed quasi-experimental designs. The studies involved the measurement of threat-related attentional biases in high and low trait anxious individuals under high and low stress conditions.

Experiments 1-3 employed an emotional Stroop paradigm and Experiments 4-5 used a probe-detection paradigm to measure attentional biases. The reaction time of the subject to the different types of words was the dependent variable for those experiments. In the Stroop studies, the response times (in milliseconds) were the latencies of verbally naming the colour of each of the words presented. In the probe-detection studies, the response times were the key pressing latencies of the identification of the probe, measured in milliseconds. The probe replaced threat and neutral word pairs.

Several independent variables were used. The consistent between-subjects variable was trait anxiety (high vs low trait anxiety groups). In each study, subject groups were determined by levels of trait anxiety, using the selection of the highest and lowest scorers on the measure of trait anxiety. In Studies 1-2, subjects (Ss) were then randomly allocated to a high or low stress condition and hence four groups were formed. Thus, in the initial two studies, trait anxiety (high vs low trait anxiety groups) and stress condition (high vs low stress condition) were between-subjects factors. In these studies, Ss undertook testing only in one stress condition. In Study 3, each subject undertook testing in all three stress conditions and therefore, stress was a within-subjects variable.
For Studies 1-3, within-subjects factors were; (a) stimulus threat (threat vs non-threat words), (b) stimulus specificity (exam vs non-exam content), and (c) exposure (masked vs unmasked presentation of words).

In Studies 4-5, Ss also undertook testing in all three stress conditions, low, high and chronic stress. Therefore, stress represented a within-subjects variable. For Studies 4-5, within-subjects factors were; (a) stress condition (low vs high vs chronic stress), (b) word-type (social threat vs physical threat vs positive words), (c) exposure (masked vs unmasked presentation of words), (d) word-position (word presented on the top half of the screen vs word presented on the bottom half of the screen), and (e) probe-position (probe presented on the top half of the screen vs probe presented on the bottom half of the screen).

In Studies 4-5, word-type represented the equivalent of specificity in Studies 1-3, with social, physical and positive words used in Studies 4-5 as opposed to exam and non-exam related words in the Studies 1-3. In Studies 1-3, threat operated as a further factor, where words with neutral and threatening content were presented. In Studies 4-5, social threat words, physical threat words, and positive words were paired with a neutral word at each presentation and presented in the top and bottom halves of the computer screen. Word-position and probe-position were counterbalanced so that each word pair was presented in each of the four possible combinations. Patterns of attentional biases were determined by interactions of these factors.
Chapter 3  The Current Studies  3.2 Design and Paradigms

The current studies used established software programs that had been used in experiments of similar types. Studies 1-3 used the same program as used by MacLeod and Rutherford (1992), which operated from the Acorn Archimedes system personal computers. Studies 4-5 used DMASTR software (Forster & Forster, 1975) operating from IBM compatible personal computers. The program used was based on similar studies and adapted for the specifics of Studies 4 and 5.

Study 3 was designed by and carried out under the supervision of the author, who also completed the analysis and interpretation of the data. The experimental testing was carried out by Marie Dineen and Loren Semaan as part of an undergraduate research project for completion of a Bachelor of Social Sciences (Family Studies) degree at Australian Catholic University. Earlier versions of the results, substantially different from what is presented in this chapter, were presented as part of the requirements of their projects (Dineen, 1995; Semaan, 1995).

The studies were approved by the research ethics committee from a Victorian University, and informed consent was obtained for all Ss (Appendices A-E). All studies employed an acute stress mood induction procedure (MIP), designed to elevate state anxiety (see example of protocol for MIP: Appendix F). Subjects were informed of the purpose of the MIP at the end of testing in Studies 1-3, and in Studies 4-5 were told of the purpose in advance (see debriefing narrative for Studies 1-3: Appendix G). It was considered that deception tasks held too many ethical difficulties to apply them to a
Chapter 3   The Current Studies   3.2 Design and Paradigms

child sample. Standard debriefing procedures were employed. No subject reported concerns or consistent elevations in anxiety following the debriefing. Subjects were given minor compensation for their participation.
3.3 Sampling

3.3.1 Sample Homogeneity

In cognitive studies, there is the possibility that marked group differences in IQ may influence responses on RTs tasks. For instance, the Stroop task has been employed as an indicator of cognitive deficits (MacLeod, 1991b; Williams et al., 1996). Matching Ss for IQ was impractical in the current studies. Comparable samples were studied in the five experiments. In the initial four studies, adult undergraduate students were drawn from the same university. In the final study, children were drawn from the same year level of the same secondary school.

In all the university samples, females were over-represented, reflecting the demographics of the courses targeted. There was no attempt to control for this factor. No consistent sex effects have been identified in studies involving the Stroop paradigm (MacLeod, 1991b) and there been no consistent evidence of a sex bias for trait anxiety or state anxiety (Spielberger et al., 1983). No positive correlations were found between sex and either trait anxiety or state anxiety in any of the current studies. These correlations were checked in each analysis but not reported.

Language competence may influence performance on the Stroop and probe-detection tasks, as they involved semantic processing. Subsequently, individuals for whom English was not their first language were excluded. In Study 5, children whose reading comprehension was more than one year behind the class reading level, based on their
most recent evaluation, were identified by class teachers and were not recruited for the study. As the emotional Stroop task involved identifying the colours in which words were written, in Experiments 1-3, individuals were not recruited if they were colour-blind. Individuals were also not recruited if they had uncorrected visual acuity difficulties. Experiments 3, 4, and 5 used low, high, and chronic (examination) stress conditions. Subsequently, only individuals who had end-of-semester examinations were recruited in those experiments. Subjects targeted for pre-testing of stimulus words were drawn from equivalent educational settings and courses as those targeted for the testing proper.

3.3.2 Trait Anxiety and State Anxiety Levels

To ensure that the trait anxiety levels of the two trait anxiety groups were significantly different, paired t-tests were undertaken. One way analyses of variance were used to test the levels of trait anxiety when the two groups were further divided, based on whether they completed the high or low stress condition. Analyses of variance were also employed to test whether there were significant differences in levels of state anxiety of high and low trait anxious groups across high and low stress.

In order to measure trait and state anxiety in the studies with adults, the State Trait Anxiety Inventory-Trait (STAI-T) and the State Trait Anxiety Inventory-State (STAI-S) (Spielberger et al., 1983) were used. The STAI-T and the STAI-S have 20 items each and are rated on 1-4 scale, ‘always’ to ‘never’, in response to anxiety-related statements.
The minimum score possible is 20 and the maximum is 80. In each of the adult studies, Ss scoring 20-24 on the STAI-T were excluded. Scores at this level indicate minimal endorsement of trait anxiety. It is likely that individuals with such low scores in a University sample are responding in part out of social desirability, drawing into question the validity of responses on anxiety questionnaires. While this is an issue beyond the scope of this study, there is evidence to suggest that low trait anxiety scores and high social desirability scores are strongly positively correlated (Singer, 1990). The STAI scales have alpha reliability coefficients above .90, and concurrent, convergent, divergent and construct validity has been established (Spielberger et al., 1983). In addition to these measures, a simple analogue scale was used to measure current mood during the testing sessions. These results were not reported as they did not contribute different information to that available from the STAI-S. The State-Trait Anxiety Inventory for Children (Spielberger et al., 1983), an equivalent scale to the STAI-T and STAI-S, was used in Study 5 and is discussed in Chapter 7.
3.4 Rationale for Data Analysis

The following section outlines the rationale and general statistical procedures adopted in this series of studies. Similar analyses were employed in all studies, since the designs and hypotheses were similar throughout.

3.4.1 Analyses

Mixed-design analyses of variance were employed in the analyses of RT data in all the studies. The General Linear Model function in SPSS 8.0 (SPSS, 1995) was used to carry out the analyses of variance in each study. As the stress factor had several levels (Ss were tested with identical stimuli on more than one occasion), repeated-measures analyses were utilised. In the probe-detection studies, there were two further within-subjects factors, word position and probe position. All of the studies were focused on testing the prediction common to all the studies: colour-naming responses (Studies 1-3) and probe-detection responses (Studies 4-5) are a function of the interaction between trait anxiety, stress condition, and threat. In these studies, threat represented the construct attentional bias.

Threat was determined in the analyses by comparing responses to threat words and non-threat words in Studies 1-3, and in Studies 4-5, by the interaction of word-position and probe-position. Therefore, presence or absence of attentional biases depended on the significant interaction of threat with other factors in the analyses of variance. Specifically, confirmation of the hypotheses depended on significant interactions
involving trait anxiety, stress, and threat. The hypotheses were specifically focused on
the divergent responses of high and low trait anxious Ss. It was also considered that
non-clinical samples, with lower levels of responding than clinically anxious samples,
might not produce response levels that were significant despite being involved in
significant interactions. Therefore, post hoc analyses were still undertaken to determine
whether the attentional responses of the groups were significantly different from zero, to
determine the magnitude of individual effects.

Correlations were carried out in each study to investigate the relationship between
the indices of attentional biases to threat, trait anxiety, and state anxiety. These were
undertaken to determine if there were relationships identified between the variables that
could clarify the questions raised in the studies. As none of the results contributed
different information from that identified in the analyses of variance, they were not
reported.

3.4.2 Testing of Assumptions

The assumptions of the studies were tested before analyses involving RTs were
undertaken. The central assumptions tested were that the MIPs were effective and that
masking prevented conscious awareness of stimuli.
3.4.3 Masking

To verify that masking was effective in preventing conscious awareness of the word stimuli, Ss were tested on lexical decision tasks using masked presentations. The sample’s mean percentage of correct responses on the lexical decision tasks was compared in a single sample $t$ test against the 50% correct expected by chance. The null hypothesis was predicted, because if the masking is effective, there is no difference between the sample’s mean percentage of correct responses and 50%. High and low trait anxious Ss’ responses to lexical decision tasks were compared across high and low stress conditions to test whether identification of the content of masked stimuli was influenced by trait anxiety or stress conditions. Similar to the previous prediction, it was expected that there would be no differences in responses on the lexical decision task based on group or stress conditions.
3.5 Reaction Time Data

The RT data were subjected to analyses of variance (repeated-measures). All the factors outlined in the design were included in the analyses to test the central research prediction that attentional biases will be dependent on the interaction of trait anxiety and stress. Although significant main effects were reported, emphasis was placed on the interactions that involved trait anxiety, stress, and threat. Interactions outside those predicted were also identified to determine if such interactions were consistent across studies.

Some studies produce results that involve the interaction of these three factors and one or more variables. Four and five-way interactions prove difficult to explain without breaking down the analyses into separate analyses, isolating one of the factors and carrying out further analyses using the different levels of the factor in separate analyses. In general, the approach to examining these four and five-way interactions was to separate factors other than trait anxiety, stress, and threat. Subsequent analyses identified the effects of the different levels of the other variable on the factors that were central to the predictions of the studies.

Raw RTs have been the most commonly used measure in studies of the type undertaken in this series. Some researchers have argued that this practice may be problematic as raw latencies fail to control for inter-subject variability in overall colour-naming speed within subject groups. Using raw scores may artificially add to the overall
error variance (Etling & Hope, 1995). Some studies have dealt with this problem and
the complexity of analyses with raw latencies by using computed threat or emotional
indices as the dependent variables in the analyses (e.g. Stewart, Conrod, Gignac, & Pihl,
1998). The threat indices are converted scores that are computed by subtracting the RTs
of non-threat stimuli from RTs to threat stimuli. The result is a score that indicates the
extent to which the subject is attending to threat stimuli. Tabachnick and Fidell (1996)
have argued that using converted scores as dependent variables may cause problems
with ceiling or floor effects if groups systematically vary in colour-naming speed to the
neutral stimuli. It may be possible to limit this problem by ensuring that subject groups
do not differ in their latencies to neutral stimuli. The current studies used raw latencies
rather than converted scores. Inter-cell variance was carefully monitored for these and
other issues related to intra and inter-subject variation.

Specific comparisons across factors, through planned contrasts at the level of the
analyses of variance were carried out. When analysing data where three forms of stress
were employed, it was necessary to determine if the levels of stress produced
significantly different patterns of attentional biases. The analyses also addressed the
direction of the attentional biases. All the studies contained hypotheses involving the
specificity of the word stimuli. Subsequently, the word stimuli were isolated and
analyses undertaken for each word-type. This approach was due to the need to
determine whether threat and positive stimuli produced significant interactions
involving trait anxiety and stress.
The current studies employed relatively complex designs with multiple factors that needed to be addressed in the analyses. Such designs increase the chances of identifying intervening variables, and allow for examination of complex interactions between variables. Such an approach avoids the acceptance of the influence of a single factor on a dependent variable, when in fact, interactive functions may be largely determining the effects in question. A limitation of such inclusive designs involving analyses of variance is the complexity of the analyses, and loss of power and increased risk of Type I errors inherent in such designs (Tabachnick & Fidell, 1996). The central model addressed in this thesis is interactional and multi-factorial in nature, and so more complex analyses are inevitable in these studies.

It is recognised that, even when considering planned comparisons, employing multiple analyses of variance to address the same hypotheses increases the Type I error rate, and that the usual method to address such difficulties is to employ more stringent alpha levels to examine the multivariate data. Breaking down analyses where significant higher order interactions are identified into secondary analyses offers the most logical approach to analyses of this type. However, it is also reasonable to approach a larger design with a series of a priori, planned comparisons that are central to the theoretical questions at hand. The cost of using more stringent alpha levels in studies such the current series, involving non-clinically anxious individuals, where small effects are anticipated, is that these may be obscured inadvertently by this approach. If such an
approach is not employed so as to allow for the identification of more subtle effects, as in the current studies, it is necessary to consider these analyses as more exploratory and tentative than if a more stringent approach is employed. It is recognised that this approach is not entirely orthodox, and holds some element of risk. Subsequently, it is recognised that caution needs to be taken in accepting findings based on multiple analyses of variance with uncorrected alpha levels. This issue will be reiterated within the body of the thesis.

3.5.1 Data Screening

Tabachnick and Fidell (1996, p. 87) produced a list of general tasks to undertake prior undertaking the central analyses of each study when employing analyses of variance, which was applied in the series of studies to deal with problematic data before analysis. In the interpretation of inferential data in analyses of variance, violations of sphericity were examined and if no such difficulties were identified, within-subjects effects were drawn from the univariate statistics where sphericity was assumed. Where there were violations of sphericity, multivariate tests were used as the reference point.

3.5.2 Reaction Time Outliers

A difficulty in the analyses of this series of studies has been issues related to RT outliers. The theoretical issues and the varied methods of dealing with outliers have been addressed comprehensively by Ratclifffe (1993). Outliers are a consistent feature of most RT studies. The application of response time methodologies to the understanding
of emotional response to threat has necessitated the use of methods to counteract problems of this type. Even one or two extreme outliers included in an analysis can significantly alter the pattern of the results. The variance of such data and the viability of using analyses that rest on assumptions of normality of variance.

With respect to the issue of homogeneity of variance-covariance, there is also some benefit in ensuring relatively equal sample sizes and few discrepancies in within-cell variances. Tabachnick and Fidell (1996, p. 445) have suggested that sample sizes of 20 in the smallest cell ensures robustness. Lower-than-optimum sample sizes were evident in some of the current series of studies. To offset this factor, the extreme scorers on trait anxiety measures were chosen with the aim of approaching equal group sizes.

Tabachnick and Fidell (1996, p. 445) have also suggested that if these factors are maintained, then the ‘overly sensitive’ Box’s M test need not be consulted. They suggested that the cell variances be close in value, with a largest to smallest cell ratio of no greater than 20:1. They argued that univariate $F$ is robust to modest violations of normality as long as the violations are not due to outliers. They argued that analysis of variance in general is robust to modest violation of normality if the violation is caused by skewness rather than outliers. The current studies took particular care to avoid violations to the assumptions of analyses of variance.
Chapter 3  The Current Studies  3.5 Reaction Time Data

A problem in probe-detection and Stroop studies is that some Ss tend to produce excessively long RTs in comparison to others in the sample. Very short RTs are less problematic. They are also less common than long RTs in studies where the mean RT is greater than 500 milliseconds (ms) (Ratcliff, 1993), as in the current series. It is more difficult to set an exclusion limit for long RTs in advance. Individuals may have a general pattern of responding slowly to the stimuli. In the current studies, Ss were exposed to a relatively large number of trials in both paradigms. Despite the inclusion of rest periods in the studies, the normal effects of fatigue and boredom may have caused some Ss to break their concentration and produce long RTs and errors. Subsequently, for the Stroop and probe-detection paradigms, there was a need to exclude data that were due to these or other factors unrelated to the experimental stimuli. To deal with obvious outliers, in the probe-detection studies, RTs shorter than 200 ms and longer than 2000 ms were excluded. These exclusion criteria were also contained in the Stroop program.

The current studies used median rather than mean reaction times as dependent variables. The use of median RTs is one of the many methods proposed by Ratcliff (1993) for dealing with high and low RTs. Some other methods focus exclusively on high outliers. Using median rather than mean RTs reduces the variance of the distribution in the current studies, and power in analyses of variance increases through this reduction in the variance. Such increases in power have been demonstrated in Ratcliff's (1993) study.
The current RT data involved Ss responding to 12 different trials for each type of word. In Studies 1-3, the software used (designed for Rutherford, 1994) automatically calculated the median of the 12 RTs of each subject to each of the word types. In Studies 4-5, DMASTR (Forster & Forster, 1975) used in the probe-detection paradigm was unable to calculate the median scores in the manner required for the analyses. Subsequently, the median was computed from the raw RTs of each subject. The median of the RTs of the 12 presentations of each word type was calculated in SPSS. A customised SPSS syntax file was written to manipulate the raw RTs into a form that could be used in the data analysis proper, and to calculate the medians of the raw RTs. Manual checks of the data were undertaken to ensure the SPSS program had accurately calculated the medians from the raw RTs before the use of the file for Studies 4 and 5. For the 144 presentations of words in the masked and unmasked conditions, there were 12 presentations of 12 different word types. Subsequently, for each subject, the 12 medians of each of the 12 response times were employed in the group analyses.

It was expected that the use of median scores minimises the variance caused by individual outliers and this proved to be the case. However, some individuals produced a substantial number of long RTs, raising into question the validity of these scores. For instance, in Study 1, the majority of the median RTs for word categories produced by three individuals was greater than 2 SDs from the corresponding group mean RT and a substantial proportion of these medians were greater than 1000 ms. In an exploratory initial analysis in Experiment 1 with these individuals included, diverse cell variances
were found. Before exclusions, there was a highest: lowest cell variance ratio of 83:1. Consequently, such inequality of cell variance led to violations of tests of homogeneity of variance-covariance in analyses of variance. With the three individuals excluded from the analysis, the inequality of cell variance and the violations of assumptions were resolved. The patterns of the results were not substantially altered by exclusions.

Therefore, the following criteria for exclusion of an individual were adopted: 1. The mean of their total RTs was greater than 2 SDs from the mean of the total RTs of the sample, 2. The majority of the individual's median RTs for the word categories was greater than 2 SDs from the group mean RT for corresponding word categories, and 3. A substantial proportion of their median RTs for the word categories was greater than 1000 ms. In practice, individuals who were excluded satisfied more than one of the criteria. Exclusions are noted in each study. Data were also considered for the percentage of errors made by Sx, which was evidence of random responding or response sets. An exclusion criterion was set for individuals with consistent errors in their data. Individuals would be excluded if more than 10% of their responses were errors in the majority of the 12 word categories. Only those individuals who were excluded from the studies due to excessive outliers were found to have substantial percentages of errors on the task, and no individual was excluded due to excessive errors.
3.5.3 Inferential Data

Masked and unmasked data have been seen as tapping different levels of information processing (Williams et al., 1996; Williams et al., 1988). Consequently, the current studies analysed the data with masked and unmasked data together initially. Masked and unmasked data were then separated in the next level of analysis to assess the predictions at each level of processing.

In addition to the use of analyses of variance to address a priori predictions, the current studies carried out comparisons to test if attentional responses were significant at an inferential level. Threat indices were computed scores generated by subtracting the RT for a neutral stimulus from the RT for its corresponding target stimulus. The threat indices were compared to zero to test if significant attentional biases were present. Zero represented the theoretical point where there no attentional bias has been produced (Mogg et al., 1994). The t tests comparing attentional biases to zero carried out in each study were post hoc in that it was not possible to determine in advance which indices would be tested as they followed from the results of the analyses of variance.

The practice of undertaking a series of t tests necessitated the use of a Bonferroni adjustment of the alpha level, due to the increased chances of Type-I errors. For each series of t tests, the standard alpha level of .05 was divided by the number of t tests undertaken.
3.5.4 Summary

This chapter has provided an overview of the design and paradigm issues and has addressed experimental factors in the studies. Emphasis was placed on reducing variance in the RT data in the studies to increase the validity of the results. The designs and the paradigms employed in the studies were developed to allow the meaningful comparison of findings across these experiments and with past research. Chapter 4 presents the initial experimental study.
CHAPTER 4

EXPERIMENT 1
CHAPTER 4

EXPERIMENT 1

4.1 Introduction

This study aimed to test Williams et al.’s (1988) model and clarify findings of research that have drawn on this model. This study also aimed to address whether threat-related attentional biases are similarly elicited by the elevation of state anxiety through acute rather than chronic stress. To facilitate such comparisons, this study employed the basic methods of MacLeod and Rutherford (1992) but used acute stress rather than chronic stress.

4.1.1 Experimental Hypotheses

Following from the summary of the theoretical issues and previous findings in Chapters 1 and 2, the theoretical hypotheses for this study were as follows:

1. Attentional biases to threat-related information will be dependent on an interaction of trait anxiety differences and by elevations in state anxiety. More specifically, as the result of increased stress, high trait anxious individuals will attend to threatening information and low trait anxious individuals will allocate attention away from threatening information.

2. These trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified at preconscious and conscious levels of processing.

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3. These trait anxiety-related attentional biases will be identified more for threatening information in the individuals' domain of concern than for information unrelated to their domain of concern. The predicted pattern of attentional biases, outlined in Hypothesis 1, will be observed more for examination-related threat words than non-examination threat words.
4.2 Method

4.2.1 Design

To ensure comparability with the results of MacLeod and Rutherford (1992), identical software and equivalent hardware were employed in this study. In each testing session, Ss undertook the emotional Stroop task, naming the colour of single words presented on a computer screen. The RT of Ss’ vocal response to the word was the dependent variable. The testing session consisted of 384 experimental trials. High and low trait anxious individuals were randomly allocated to either the high or low stress condition. Thus, trait anxiety (high vs low) and stress condition (high vs low) were the between-subject independent variables. The condition of the experimental trials varied across three within-subject independent variables: (a) Specificity: Half the words had examination / academic-related performance content and half had non-exam content; (b) Threat: Half the words had threat-related content (threat condition) and half were not threat-related in content (non-threat condition); (c) Exposure mode: Each class of stimulus was presented with equal frequency under the two exposure conditions. In the masked condition, the word was presented for 20 ms. The word was then replaced with a pattern mask of an equivalent colour, which remained on the screen until the subject's vocal response was detected. In the masked condition, it was assumed that conscious identification of word content was not possible. A lexical decision task with masked stimuli tested this assumption. In the unmasked presentation condition, the stimulus word remained on the screen until terminated by the subject’s vocal response.
Following research that used laboratory-based tasks to elevate state anxiety (Gerrards-Hesse, Spies, & Hesse, 1994; Martin, 1990; Mogg, Kentish, et al., 1993b), this study used similar MIPs to manipulate state anxiety. Subjects in each of the low and high trait anxiety groups were randomly allocated to one of two conditions, a high stress academic MIP or a low stress MIP.

4.2.2 Subjects

A sample of 60 adults was drawn from a larger initial sample of 150 undergraduates from a Victorian University. Subjects were chosen based on their scores on the STAI-T (Spielberger et al., 1983). The 30 Ss with the highest and the 30 Ss with the lowest STAI-T scores were included in the study. Table 4.1 shows data for age, state anxiety level, and trait anxiety level.

Subjects completed the Stroop task under either low or high stress conditions. They were subsequently excluded if their level of state anxiety was inconsistent with the stress condition for that group. In such cases, the MIP had not proven effective. Subjects were excluded if their STAI-S scores were more than 1.5 SDs greater than the group mean in the low stress groups, or more than 1.5 SDs smaller than the group mean in the high stress groups. Four Ss were excluded from high trait-low stress group, 2 Ss from the high trait-high stress group, 2 Ss from the low trait-low stress group and 5 Ss from the low trait-high stress group. These exclusions resulted in a sample across the four groups of 47 Ss (36 females, 11 males). These results reflect an unintended effect of the
MIP. From the results and from verbal feedback from these Ss, those excluded in the low stress condition found the task relatively stressful and those excluded in the high stress condition did not find the task stressful.

A further 3 Ss were eliminated from the final sample because the mean of their RTs were greater than 2 SDs from the mean of the RTs of the sample, and a substantial proportion of their RTs for the word categories were greater than 1000 ms. Descriptive data are presented in Table 4.1. In this final sample of 44 Ss, the ratio of females (f) to males (m) in each group was: high trait/low stress: 7f: 3m; high trait/high stress: 8f: 3m; low trait/high stress: 9 f: 4m; low trait/low stress: 9f: 1m
Comparisons between STAI-T scores showed significant differences in levels of trait anxiety between high and low trait anxious Ss (high and low stress condition groups considered together), $F(1,40) = 244.82, p < .001$. There was no significant difference in STAI-T scores across the high and low stress groups, $F(1, 40) = 1.19, ns$. There was no significant trait anxiety by stress interaction for trait anxiety scores, $F(1, 40) = 0.41, ns$. Therefore, trait anxiety was not significantly different for high and low trait anxious Ss in different high and low stress conditions. There was no significant trait anxiety by stress interaction for state anxiety scores, $F(1, 40) = 0.02, ns$. This finding showed that elevations in state anxiety were equivalent for high and low trait anxious Ss.
Comparisons of the mean age of Ss across the trait anxiety groups revealed no significant differences, $F (1, 40) = 1.36, ns$.

### 4.2.3 Materials

As this study was designed to mirror that of MacLeod and Rutherford (1992), the stimulus words used were identical to those employed in their study. These stimuli can be seen in Table 4.2. The four classes of words were (1) exam-related/threat (e.g. test, failure) (2) exam-related/non-threat (e.g. merit, intelligent) (3) non-exam-related/threat (e.g. coffin, lonely) and (4) non-exam-related/non-threat (e.g. button, sleepy). Twelve words were used from each class. MacLeod and Rutherford (1992) matched the 12 exam-related/threat words on average length and frequency of use with the 12 exam-related/non-threat words. The 12 non-exam-related/threat words were matched with the 12 non-exam-related/non-threat words. These were originally matched using the American Heritage Frequency Norms (Carroll, Davies, & Richman, 1971). There was no significant difference between the mean length of the exam threat and exam non-threat words, $t (11) = 0.75, ns$, or between the non-exam threat and the non-exam non-threat words, $t (11) = 1.09, ns$. There was no significant difference in frequency of use of the exam threat and exam non-threat words in the English language, $t (10) = 0.13, ns$, or the between the non-exam threat and non-exam non-threat words, $t (11) = 1.09, ns$.

These trials tested whether Ss were able to consciously recognise words in the masked presentation of stimuli, assessing the adequacy of the masking procedure. The
awareness-check stimulus set included the 48 words drawn from the stimulus word list, together with 48 non-word letter strings. Each non-letter string was developed by randomly rearranging the letters from one of the stimulus words. The full set of stimulus words employed is presented below in Table 4.2.

**Table 4.2.** Experiment 1. Stimulus words

<table>
<thead>
<tr>
<th>Academic-related</th>
<th>Non-Academic-related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threat</td>
<td>Non-Threat</td>
</tr>
<tr>
<td>stupidity</td>
<td>intelligent</td>
</tr>
<tr>
<td>disgraced</td>
<td>optimism</td>
</tr>
<tr>
<td>incompetent</td>
<td>successfully</td>
</tr>
<tr>
<td>failure</td>
<td>careful</td>
</tr>
<tr>
<td>inferior</td>
<td>scholarly</td>
</tr>
<tr>
<td>test</td>
<td>proficient</td>
</tr>
<tr>
<td>inept</td>
<td>accomplishment</td>
</tr>
<tr>
<td>discredited</td>
<td>achievement</td>
</tr>
<tr>
<td>inadequate</td>
<td>fortunate</td>
</tr>
<tr>
<td>careless</td>
<td>prestige</td>
</tr>
<tr>
<td>unsuccessful</td>
<td>merit</td>
</tr>
<tr>
<td>examination</td>
<td>praiseworthy</td>
</tr>
</tbody>
</table>

The practice stimulus word set was comprised of 48 neutral words that were not used as test stimuli. These 48 words were also used for the practice awareness-check trials,
with 48 non-word letter strings, each created by rearranging the letters from one word in the practice stimulus set.

The *STAI-T* was used for allocation of *Ss* to high and low trait anxious groups. As indicated in Chapter 2, the *STAI-T* is a 20 item scale designed to measure the individual stable anxiety-proneness (Spielberger et al., 1983). High trait anxious individuals tend to interpret a wider range of stimuli on the questionnaire as threatening than do low trait anxious individuals. High scorers are more likely to respond to situations that involve social interactions with an increase in state anxiety (Spielberger et al., 1983). The *STAI-T* has a 4-point response scale ranging from ‘almost never’ to ‘almost always’ on items such as ‘I feel like a failure’, regarding how they feel generally.

The *STAI-S* was used to measure state anxiety during the two testing conditions. The *STAI-S* consists of 20 four-point response items (e.g., I feel nervous) designed to measure the level and intensity of state or transitory anxiety, characterised by subjective feelings of tension and nervousness experienced by the individual at a given time (Spielberger et al., 1983). Although there were checks carried on the consistency of state anxiety levels across the testing sessions, only those measures taken after the *MIP* were presented.
Presentation Hardware

The stimuli were presented by an Acorn Archimedes 310 personal computer, on a high resolution Archimedes colour monitor, in letters 1 cm high. Colour-naming responses were detected by a voice-activated relay, transmitted by a microphone fitted to each subject’s throat. A custom made response box containing a pair of buttons, labeled ‘word’ (right button), and ‘non-word’ (left button) was connected to the computer for use in the awareness-check trials.

Presentation Software

The software controlled stimulus presentation on the colour-naming trials and the awareness-check trials, and recorded colour-naming latencies and lexical decisions. On each of the colour-naming trials, a row of white asterisks was presented in the screen centre. Subjects fixated on these asterisks. After 500 ms, the asterisks were replaced by a stimulus word, presented in red, green, yellow, or blue. In the unmasked condition, the word remained on the screen until the subject’s response was detected, at which time the screen was made blank. In the masked exposure condition, the stimulus word was replaced after 20 ms by a patterned mask displayed in the same colour as the previously presented word. The mask remained on the screen until the subject’s verbal response was detected; at which time the screen was made blank.

The mask consisted of inverted and rotated letter fragments, as employed in studies employing masking procedures (Holender, 1986; Marcel, 1983). After each
experimental trial, the screen remained blank for 1000 ms before the next trial began. The presentation software recorded the colour-naming latency on each trial. The latency was the time interval between the onset of the stimulus item and the computer detection of a vocal response. Across the 384 trials, each of the 48 stimulus words appeared four times in the masked exposure condition and four times in the unmasked exposure conditions. On each of the four conditions, the words were presented in a different colour. The order of the word presentations was random.

Awareness-checks trials were distributed through the test sessions. The trials tested the assumption that masking prevented conscious awareness of the stimuli. In these awareness trials, Ss were presented with one of the experimental stimulus words or a random string of letters that did not make a word. The backwards-masking procedure described above followed each word presentation. Subjects were asked to identify whether or not a word had been presented. Chance performance on the discrimination task suggested that they were unaware of the semantic content of the words presented in this condition, and that the masking was effective in preventing conscious awareness. After each block of 24 colour-naming trials were completed, there was a message that word decision trials would follow, which then began 3 seconds after the message. Six awareness-check trials were then presented. These were followed by a three-second message, indicating that the colour-naming trials were about to continue. Colour-naming trials then recommenced.
The start of the awareness-check trials was under Ss' control to ensure they were prepared. The awareness-check task began when Ss gave a verbal response to indicate their readiness to proceed. These trials were identical to those in the masked exposure condition on the colour-naming trials apart from containing both words and non-words. Subjects pressed the 'word' or 'non-word' button on the response box to indicate whether they had observed a word or a string of letters before the masking. They were presented with 16 blocks of 6 awareness-check trials across each experimental session, with a total of 96 trials. Each item in the awareness-check stimulus set (48 words and 48 non-words) was presented only in one trial, with the order of presentation of words and non-words randomised.

Three rest periods divided the presentation of stimuli. In between the rest periods, 96 colour-naming trials and 24 awareness-checks were presented. Total testing time for the colour-naming task was approximately 40 minutes. Reaction time data were produced automatically for each subject. The computer software calculated the median of the RT responses to the 12 words in each word type.

4.2.4 Procedure

Recruitment of Subjects

Students were recruited through lectures and laboratory classes. Students received a written outline of the aims, procedures, and completed an informed consent form (Appendices A & B).
Experimental Session

Subjects were tested individually in an experimental room (approximately 3 metres by 5 metres) with minimal distractions. This room or an equivalent room was employed in all the studies.

Stress Conditions

The experiment had two conditions, with different MIPs operating in each condition. The instructions for each condition are outlined in Appendix F.

Testing took place in the first 6 weeks of the semester (7-9 weeks before examinations), a period of low stress. Subjects were seated 75 cm from the computer screen, with the microphone attached. The button pressing apparatus was positioned within easy reach on a table in front of them. Subjects proceeded through five stages of the experiment: practice for the colour-naming task, the IQ test-anagram ability test, the STAI-S, the colour-naming task, debriefing. At the beginning of the experiment, Ss were informed that a further part, a more comprehensive IQ test, would be undertaken if they passed fewer than 5 of the 10 anagrams in part two of the experiment. In fact, no subject was given the second anagram test. This deception was explained to Ss in the high state anxiety condition following the completion of the experiment. In the high anxiety condition, Ss received anagrams that were difficult to solve in the 30 seconds provided for each anagram. Two easier items were included to help maintain motivation for the task. In the low anxiety condition, the anagrams were simple. Each anagram was
presented on a separate page to allow Ss to focus on each word without distraction. These anagrams are presented in Table 4.3.

<table>
<thead>
<tr>
<th>HIGH STRESS CONDITION</th>
<th>LOW STRESS CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>royoonmx (oxymoron)</td>
<td>wodo (wood)</td>
</tr>
<tr>
<td>piatn (paint)</td>
<td>chari (chair)</td>
</tr>
<tr>
<td>slippyooh (philosophy)</td>
<td>orod (door, odor)</td>
</tr>
<tr>
<td>sengiodui (indigenous)</td>
<td>limk (milk)</td>
</tr>
<tr>
<td>hesskhi (sheikhs)</td>
<td>odgs (dogs, gods)</td>
</tr>
<tr>
<td>batel (table)</td>
<td>nfeik (knife)</td>
</tr>
<tr>
<td>punghasm (sphagnum)</td>
<td>sopon (spoon)</td>
</tr>
<tr>
<td>yhmrht (rhythm)</td>
<td>rca (cars, scar, cras)</td>
</tr>
<tr>
<td>erpmcust (spectrum)</td>
<td>aplm (palm, lamp)</td>
</tr>
<tr>
<td>tecsnuclu (succulent)</td>
<td>rolof (floor)</td>
</tr>
</tbody>
</table>

Subjects were then given the anagram task, after which they were given feedback of the score out of ten. Subjects in the high anxiety condition were informed that they were required to complete the second IQ test later in the experiment. Subjects in the low anxiety condition, once they passed the initial anagram task, were informed they would not be required to complete the later IQ test. Following debriefing, Ss were asked not to speak to others about the stress induction procedure until the end of the testing period. Subjects were to be excluded if they had had prior knowledge of the procedures, as the
MIP would not have been effective in such circumstances, although in practice none had prior knowledge of the MIP.

Colour-naming and awareness-check trials followed. In the colour-naming trials, Ss were instructed to name the colour in which the words were written, to do so as quickly as possible, and to ignore the content of the words. For the awareness-check trials, they were informed that letter strings were presented very briefly, then covered by a random pattern. Subjects were instructed to make a decision whether the letter string was a word or a non-word, and to press the appropriate button to indicate their decision. They were instructed to make a response on every trial, even if their response was a guess. A practice session was given first, using neutral stimuli not used in other sessions. This practice consisted of 48 colour-naming trials and 16 awareness-check trials.

Colour-naming and awareness-check trials followed. Finally, Ss were debriefed. They were informed of the nature of the MIP, and the aims and the nature of the experiment. Care was taken to ensure that any effects of the experiment were temporary.
4.3 Results

Three aspects of the data are presented. First, the validity of the state anxiety manipulation is established by comparing the mood scores across low and high trait anxiety groups. Second, the validity of the backward masking procedure is examined to ensure that conscious awareness of the stimuli was prevented. If these two assumptions are validated, the colour-naming RT data can be evaluated in the light of the experimental hypotheses.

4.3.1 State Anxiety Manipulation

State anxiety scores can been seen in Table 4.1. As has been noted in Section 4.2.2, several Ss found the low stress task anxiety provoking and some in the high stress task did not find the task anxiety provoking. Before analysis of the efficacy of the MIP, 13 Ss were excluded from the sample based on the criteria outlined in Section 4.2.2.

Levels of state anxiety were significantly greater under high stress than under low stress, $F (1, 40) = 26.14, p < .001$, and for high trait anxious compared to low trait anxious Ss, $F (1, 40) = 15.73, p < .001$. An analysis of variance found no significant interaction between trait anxiety group and state anxiety condition for state anxiety scores, $F (1, 40) = 0.02, p = .89, ns$. Thus, state anxiety elevations from low to high stress were not significantly different for high and low trait anxious Ss.
In summary, the MIP proved effective in producing elevations of state anxiety from the low to high stress condition, verifying the assumption that the differences in stress conditions produce significant differences in state anxiety. Thus, high and low trait anxious Ss showed equivalent elevations in state anxiety from low to high stress.

4.3.2 Masking Procedure

Subjects reported they were unable to identify whether they had been exposed to a word or a random string of letters during the masked presentations. The analyses involving the lexical decision task found no effect for group and no significant difference between the observed percentage correct on the task and that expected by chance. An analysis of variance revealed nonsignificant effects for the lexical decision task as a function of stress condition, $F(1, 40) = 0.01, \text{ns}$, and trait anxiety, $F(1, 40) = 0.79, \text{ns}$, and a nonsignificant effect for the interaction between trait anxiety and stress condition, $F(1, 40) = 2.98, \text{ns}$.

A mean percentage of correct responses of 49.96\% ($SD = 2.91$) across all Ss indicated the accuracy of responses was not significantly different to the 50\% expected by chance, $t(43) = 0.97, \text{ns}$. This result validated the effectiveness of the masking procedure in preventing conscious awareness of masked stimuli.

In summary, the two experimental assumptions in these studies were supported. The high stress condition produced significantly greater levels of state anxiety than did the
low stress condition. The masking procedure was effective in preventing conscious awareness of stimuli presented at a preconscious level of processing. Thus, with the assumptions validated, the colour-naming responses were addressed.

4.3.3 Colour-Naming Latency Data

Hypotheses 1 and 2: Trait Anxiety by Stress Interaction; Preconscious and Conscious Processing

For each subject, the software produced a median colour-naming RT for each group of twelve words in each experimental condition. The group means of these data are summarised in Table 4.4.
### Table 4.4. Experiment 1. Mean colour-naming latencies in milliseconds

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>Stress Condition</th>
<th>Stress Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Trait Anx</td>
<td>Low Trait Anx</td>
</tr>
<tr>
<td></td>
<td>High Stress</td>
<td>Low Stress</td>
</tr>
<tr>
<td>Masked Exam Threat</td>
<td>638 (67)</td>
<td>617 (86)</td>
</tr>
<tr>
<td>Masked Exam Non-Threat</td>
<td>653 (64)</td>
<td>606 (99)</td>
</tr>
<tr>
<td>Masked Non-Exam Threat</td>
<td>650 (93)</td>
<td>613 (87)</td>
</tr>
<tr>
<td>Masked Non-Exam Non-Threat</td>
<td>641 (74)</td>
<td>625 (100)</td>
</tr>
<tr>
<td>Unmasked Exam Threat</td>
<td>665 (71)</td>
<td>632 (109)</td>
</tr>
<tr>
<td>Unmasked Exam Non-Threat</td>
<td>669 (84)</td>
<td>643 (109)</td>
</tr>
<tr>
<td>Unmasked Non-Exam Threat</td>
<td>657 (86)</td>
<td>622 (101)</td>
</tr>
<tr>
<td>Unmasked Non-Exam Non-Threat</td>
<td>665 (78)</td>
<td>634 (88)</td>
</tr>
</tbody>
</table>

These RTs were analysed in a mixed-design analysis of variance, which analysed two between group factors and three within group factors. The between group factors were trait anxiety (high vs low), and stress condition (high vs low); the within group
factors were exposure mode (masked vs unmasked condition), threat (threat vs non-threat words), and specificity (exam vs non-exam-related words).

There was an initial significant five-way interaction between trait anxiety, stress condition, exposure mode, threat and specificity, $F(1, 40) = 4.26, p < .05$. To examine this interaction, the patterns of RTs in response to masked and unmasked stimuli were explored by separating the two levels of the exposure factor in the subsequent analyses.

In addition to the significant interaction involving trait anxiety and stress, there was also a significant main effect for exposure, $F(1, 40) = 23.19, p < .001$, which reflected greater RTs for unmasked than masked stimuli. For all groups under all conditions, $S$s' mean masked RTs were 631 ms ($SD = 75$ ms) and mean unmasked RTs were 650 ms ($SD = 86$ ms). There was also a significant main effect for stress, $F(1, 40) = 4.71, p < .05$. This reflected greater RTs under high stress than low stress for all $S$s in all groups across the high and low trait stress conditions. Under low stress, $S$s produced mean RTs of 616 ms ($SD = 85$ ms) and under high stress, they produced a mean RT of 667 ms ($SD = 65$ ms).

Table 4.5 shows the values for the threat indices, which are then demonstrated in Figures 4.1 and 4.2. These figures show the patterns of attentional biases for masked and unmasked exam and non-exam related RT variables, under low and high stress.
Figure 4.1 shows a significant interaction at a preconscious level that is addressed in Section 4.3.4.

Table 4.5. Experiment 1. Threat indices for high and low trait anxious adults across exposure and stimulus specificity

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>High Stress</th>
<th>Low Stress</th>
<th>High Stress</th>
<th>Low Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>(SD)</td>
<td>Mean</td>
<td>(SD)</td>
</tr>
<tr>
<td>High Trait Anxious</td>
<td>-15.00</td>
<td>(20.74)</td>
<td>11.70</td>
<td>(38.62)</td>
</tr>
<tr>
<td>Low Trait Anxious</td>
<td>.50</td>
<td>(17.71)</td>
<td>-12.31</td>
<td>(42.65)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stress Condition</th>
<th>High Risk</th>
<th>Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masked Exam Threat Index</td>
<td>8.64</td>
<td>(28.38)</td>
</tr>
<tr>
<td>Unmasked Exam Threat Index</td>
<td>-4.09</td>
<td>(23.98)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stress Condition</th>
<th>High Risk</th>
<th>Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masked Non-Exam Threat Index</td>
<td>-8.64</td>
<td>(32.72)</td>
</tr>
<tr>
<td>Unmasked Non-Exam Threat Index</td>
<td>12.50</td>
<td>(30.02)</td>
</tr>
</tbody>
</table>
4.3.4 Colour-Naming Latencies on Masked Exposure Trials

Hypotheses 1, 2 & 3: Trait Anxiety by Stress Interaction; Preconscious Processing

Colour-naming latencies for masked presentations were analysed using a mixed-design analysis of variance that compared two between subject variables (trait anxiety and stress condition) and two within subject variables (threat and specificity). There was a significant four way interaction that emerged between trait, stress, threat and specificity, $F (1, 40) = 4.58, p < .04$. Figure 4.1 displays the interaction. There was also a significant main effect for stress, $F (1, 40) = 4.74, p < .04$. 
Figure 4.1. Experiment 1. Interaction of trait anxiety, stress, specificity, and threat in the masked exposure condition
Figure 4.1 illustrates the patterns of attentional biases across the two word groups. This figure shows that when the masked variables was considered alone, the interaction between trait anxiety and stress was influenced by the specificity of the words. The effect differed depending on whether the words displayed were exam-related or non-exam-related. This four-way interaction is described in this section, and then the specificity factor is examined in the next section.

In response to masked exam threat words, from low to high stress, high trait anxious Ss shifted from vigilance to avoidance of threat and low trait anxious Ss shifted from avoidance to marginal levels of attention to threat. In response to non-exam threat words, high trait anxious Ss shifted from avoidance to vigilance of threat and low trait anxious Ss showed marginal levels of avoidance.

4.3.5 Masked Examination and Non-Examination Related Stimuli

Hypothesis 3: Specificity

The specificity factor was isolated to test the specificity hypothesis at a preconscious level. Separate analyses of variance were undertaken for RTs for masked examination related words and masked non-examination related words. When RTs for masked examination words were compared, there was a main effect for stress, $F(1, 40) = 5.21$, $p < .05$. More important, there was an interaction between trait anxiety, stress, and threat, $F(1, 40) = 4.01$, $p = .05$. This finding bordered on significance. Examination of the tests of the assumption of the analysis of variance in this case allowed confidence in
this finding and therefore, the interaction was accepted as significant. This pattern can be seen in Figure 4.2. In response to masked exam threat words, from low to high stress, high trait anxious Ss shifted from vigilance to avoidance of threat and low trait anxious Ss increased attention to threat.

![Graph showing interaction of trait anxiety, stress, and threat for masked examination threat words](image)

**Figure 4.2.** Experiment 1. Interaction of trait anxiety, stress, and threat for masked examination threat words
To clarify the statistical significance of these patterns of attentional biases, post hoc analyses were undertaken. These were carried out to determine if the threat indices seen in Figure 4.5 were significant. Although the interaction involving masked exam words was significant, no significant attentional biases were identified. At the adjusted alpha level of .01, there was a trend for an avoidance response in high trait anxious Ss under high stress in response to masked exam threat, t (10) = 2.4, p < .05.

When masked non-examination variables were compared in analyses of variance, there were no main or interactional effects found, F (1, 40) = 1.0, p = .32, ns. Therefore, the trend identified in Figure 4.1 for non-exam words was not statistically significant.

4.3.6 Colour-Naming Latencies from Unmasked Trials

Hypotheses 1 and 2: Trait Anxiety by Stress Interaction; Conscious Processing

The analyses of variance involving unmasked presentations of stimuli revealed no interactions involving trait anxiety and stress. They did reveal a significant main effect for stress, F (1, 43) = 5.36, p < .03, and an interaction between trait anxiety and specificity, F (1, 40) = 5.46, p < .03. As these results did not directly address the hypotheses, they were not explored further. Figure 4.3 shows the nonsignificant trends for unmasked variables in Study 1.
4.3.7 Unmasked Examination and Non-Examination Related Stimuli

Hypothesis 3: Specificity

Further analyses of variance were undertaken to test the effect of stimulus specificity on attentional biases at a conscious level. When unmasked examination variables were compared, there were no interactions involving trait anxiety and stress found. There was a main effect for stress, $F(1, 40) = 4.95, p < .05$.

When unmasked non-examination variables were compared, no significant main or interaction effects were found. There was main effect for stress that was marginally beyond significance, $F(1, 40) = 3.86, p < .06$, *ns*. Trends are represented in Figure 4.3.
Figure 4.3. Experiment 1. Interaction of trait anxiety, stress, specificity, and threat in the unmasked exposure condition.
4.4 Discussion

4.4.1 Summary of Findings

_Hypothesis 1: Attentional biases to threat will be determined by an interaction of trait anxiety and stress, with high trait anxious individuals showing increased attention to threat and low trait anxious individuals allocating attention away from threat from low to high stress._

There was no support for the first prediction. In response to masked stimuli, there was a significant four-way interaction involving trait anxiety, stress, stimulus specificity, and threat. Preconscious attentional biases to threat were a function of trait anxiety and state anxiety, and the type of threat words. However, the predicted interaction was not supported and a significant alternative interaction was shown. In this pattern, high trait anxious individuals showed vigilance for specific (exam) threat words under low stress and avoidance under high stress. Low trait anxious individuals showed avoidance under low stress and marginal levels of attention to threat under high stress.

_Hypothesis 2: Trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified at preconscious and conscious levels of processing._

This hypothesis was not supported. Although there was a significant interaction at a preconscious level involving trait anxiety, stress, and threat, as previously indicated, this was the converse of expectations. No attentional biases were identified at a conscious level involving interactions of state anxiety and trait anxiety, and no significant interactions involving attention to threat.
Hypothesis 3: Trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified more for threatening information in the individuals' current domain of concern.

This prediction was not supported. As discussed in Hypothesis 1, the sole significant pattern for domain-specific stimuli was the converse of hypotheses, involving an interaction between trait anxiety, stress, and threat for masked exam threat words. From low to high stress, high trait anxious individuals avoided threat and low trait anxious individuals showed increased attention to threat.

As indicated in Section 3.5, due to the use of multiple analyses of variance without correction of the alpha levels in the examination of the central hypotheses in this study, caution is required in the interpretation of the current findings.

4.4.2 Implications of Findings for Hypotheses

These results contrasted with those of MacLeod and Rutherford (1992) in several ways. The interaction did not show high trait anxious individuals attending to threat due to elevated stress. In addition, the interaction of trait anxiety, stress, and threat was further mediated by stimulus specificity. MacLeod and Rutherford (1992) found that high and low trait anxious individuals produced divergent preconscious responses to threat, but with no differentiation between responses to general and specific threat.
This divergent pattern of preconscious attentional biases in high trait anxious individuals was counter-intuitive, as the responses to general and specific threat words differed across stress conditions, even though only data for specific threat were significant. Williams et al. (1997), drawing on PDP model (Cohen et al., 1990) have proposed that specificity effects may occur at a conscious or preconscious level of processing. This model offers possible explanations for such responses.

It may be possible to explain the findings through considering the nature of suppression effects in high and low acute stress tasks. Few suppression effects have been found in studies involving high trait anxious individuals. However, the suppression or ‘override’ effect reported by Mathews and Sebastian’s (1993) study involving fearful individuals was found when an acute stress task was in operation. When a snake was present, an attentional effect was found when the stressor was absent. In this study, the suppression of attention to masked exam-related stimuli occurred under high acute stress, an academic failure MIP. This MIP, particularly salient for students, raised concerns that were semantically represented by examination-related words, the words that were suppressed. Apart from raising state anxiety, this MIP should have increased academic concerns, particularly for high trait anxious individuals who are sensitive to failure. Under low stress, high trait anxious individuals attended to exam-threat and showed a trend for avoidance of general threat. As was shown by Mathews and Sebastian (1993), low stress may be associated with increased attention to specific concerns.
High trait anxious students may be consistently sensitive to academic concerns. Thus, this information may be activated in the absence of high state anxiety. In addition, the nature of this low stress *MIP* may have influenced the divergent responses of high trait anxious individuals. The low stress *MIP* contained evaluative features, requiring individuals to complete anagrams, albeit easy items. Even when stress levels were low, the domain-specific task may have triggered emotional concerns for examination-related materials in high trait anxious individuals and hence induced attentional biases for exam-related concerns. When the domain-specific stress increased, individuals avoided the material in a similar fashion to the high stress condition in Mathews and Sebastian’s (1993) study. Despite the parallels between the studies and the possibility that such preconscious effects could occur, it is unclear why this pattern was identified at a preconscious level rather than at a conscious level.

This study mirrored that of MacLeod and Rutherford (1992) in all major design features, apart from using acute stress instead of chronic stress. However, following the general predictions of Beck and Clarke (1997) regarding the functioning of the orienting mode, this difference between the two studies in stress conditions may have contributed to these findings. It is possible that acute stress acts as a catalyst both for a general threat bias and for avoidance of specific threat. Initial preconscious processing of specific threat information in acute stress may not be adaptive when the source of the stress has not been well established. Rather, it may be more effective to attend broadly to threat in the environment to allow scanning for possible dangers. The failure task in
this study produced significant increases in state anxiety. However, more prolonged activation of the exam schema may be required to produce selective attention to both general and exam concerns at a preconscious level of functioning. It is possible that a more consistent period of domain-specific state anxiety is required in non-clinical populations before individuals display attention to specific threat at the preconscious level.

General and specific schemas may be activated sequentially, with the more general threat schema being activated before a more specific schema. It is likely that both specific and general threat schemas were activated by the stimuli in MacLeod and Rutherford’s (1992) study. This may have occurred because the more specific threat (exam proximity) had been relevant for some time and had been gradually increasing in significance. Although individuals are affected by acute anxiety, the source of the stress may be unclear in acute stress situations. Thus, in such acute state anxiety, at a preconscious level, the stimuli are threatening in a general, undifferentiated way.

This study was limited by the stress tasks producing variable effects across individuals. Several individuals were excluded because either the low stress task increased state anxiety or the high stress task failed to increase state anxiety. As these individuals were excluded, it is unlikely that this problem affected the results. Nevertheless, in subsequent studies, there was a need to control for this factor. In addition, with the exclusions, the sample size was smaller than optimum. It was
considered that this factor may have reduced the power of the effect observed. It also reduces confidence in the finding.

Therefore, this study required replication to determine the consistency of the findings. The results also point to the need for more complete replication of previous findings, particularly at the level of the chronicity and type of stressors employed.
CHAPTER 4

EXPERIMENT 2

4.5 Introduction

Due to the discrepancies between the results of Experiment 1 and those of MacLeod and Rutherford (1992), the initial study required replication. Few studies have reported such replications. Thus, a study to mirror Experiment 1 was designed with the aim of establishing a consistent pattern of results. In addition, it was considered that the use of a larger sample would more fully address Williams et al.'s (1988) model and clarify the role of attention in reactivity to different types of stress.

4.5.1 Experimental Hypotheses

The predictions were identical to those in Experiment 1 and are reiterated in the summary of the results.
4.6 Method

4.6.1 Design

Experiment 2 employed a similar design to that used in Experiment 1. Low and high trait anxious Ss were randomly allocated to either a high or low stress condition. The two stress conditions were induced by a high stress MIP or a low stress MIP. Under high stress, Ss attempted to solve difficult anagrams and subsequently received negative feedback regarding their academic abilities. In this study, in contrast to Study 1, under low stress, Ss experienced a relaxation procedure.

This study used identical software program and hardware to that used in Experiment 1. Each testing session involved Ss naming the colour of single words presented on a computer screen. The testing session consisted of 384 experimental trials. Trait anxiety (high vs low) and stress condition (high vs low) were the between-subject independent variables. The condition of the experimental trials varied equally across three factors: (a) specificity: examination and non-examination-related content; (b) threat: threat-related and non-threat-related content; (c) exposure mode: masked and unmasked exposure conditions.

4.6.2 Subjects

A sample of 104 adult students was drawn from a larger initial sample of 300 undergraduates. Subjects were chosen based on their level of trait anxiety. The 52 Ss
with the highest and the 52 Ss with the lowest STAI-T scores were randomly allocated to either the low or high stress conditions.

The data of 9 Ss from the original sample were excluded. A substantial amount of these Ss’ RT data were missing due to the malfunctioning of the equipment involved in translating voice responses to the computer in the early stages of the testing. Once the problem was rectified, no similar data losses occurred. These exclusions resulted in a total sample across the four groups of 95 Ss (78 females; 17 males). Mean age was 19.52 years. In this sample of 95 Ss, the ratio of females (f) to males (m) in each group was: high trait/low stress: 17f: 2m; high trait/high stress: 20f: 4m; low trait/high stress: 20f: 6m; low trait/low stress: 21f: 5m. Descriptive data are presented in Table 4.6.

**Table 4.6. Experiment 2. Subject Characteristics**

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th></th>
<th></th>
<th></th>
<th>Sample Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Stress Condition</strong></td>
<td><strong>Group Total</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>High</strong></td>
<td><strong>Low</strong></td>
<td><strong>Total</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Stress</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>High</strong></td>
<td><strong>Low</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td><strong>Mean</strong></td>
<td>19.08</td>
<td>19.47</td>
<td>19.26</td>
</tr>
<tr>
<td></td>
<td><strong>SD</strong></td>
<td>1.06</td>
<td>1.26</td>
<td>1.16</td>
</tr>
<tr>
<td></td>
<td><strong>N</strong></td>
<td>24</td>
<td>19</td>
<td>43</td>
</tr>
<tr>
<td><strong>Trait Anxiety</strong></td>
<td><strong>Mean</strong></td>
<td>49.88</td>
<td>50.84</td>
<td>50.30</td>
</tr>
<tr>
<td><strong>(STAI-T)</strong></td>
<td><strong>SD</strong></td>
<td>7.75</td>
<td>5.04</td>
<td>6.63</td>
</tr>
<tr>
<td></td>
<td><strong>N</strong></td>
<td>24</td>
<td>19</td>
<td>43</td>
</tr>
<tr>
<td><strong>State Anxiety</strong></td>
<td><strong>Mean</strong></td>
<td>51.96</td>
<td>39.05</td>
<td>46.26</td>
</tr>
<tr>
<td><strong>(STAI-S)</strong></td>
<td><strong>SD</strong></td>
<td>13.50</td>
<td>7.71</td>
<td>12.94</td>
</tr>
<tr>
<td></td>
<td><strong>N</strong></td>
<td>24</td>
<td>19</td>
<td>43</td>
</tr>
</tbody>
</table>
Comparisons between STAI-T scores showed significant trait anxiety differences between high and low trait anxious Ss (high and low stress condition groups considered together), $F (1, 91) = 346.25, p < .001$. As expected, there were no significant trait anxiety differences between the high and low stress groups, $F (1, 91) = .05, p = .83, ns$.

Comparisons of STAI-S scores found no significant interaction between trait anxiety and stress condition for state anxiety, $F (1, 91) = 0.56, p = .46, ns$. Thus, elevations in state anxiety were equivalent for high and low trait anxious Ss. There were no significant differences in the mean age of Ss across the groups, $F (1, 91) = 0.004, p = .95, ns$.

4.6.3 Materials

The materials employed in this experiment were identical to those used in Experiment 1. Stimulus items for the awareness-check trials were identical to Experiment 1. Informed consent forms (Appendices A & B) were identical except for an explanation that Ss would be involved in one of two testing sessions, under relaxation conditions or completing an academic task.

Presentation Hardware

The experimental hardware employed was identical to that used in Experiment 1.
Presentation Software

The presentation of the stimuli was identical to Experiment 1.

4.6.4 Procedure

Stress Conditions

As in Experiment 1, state anxiety measures were taken with the STAI-S following the MIP in the high and low stress conditions. Testing took place in weeks 7-9 weeks before examinations, a period of low stress. As in Experiment 1, in the high stress MIP, Ss received difficult anagrams and false feedback on their scores. In addition, to maximise their levels of anxiety, Ss were encouraged to think about the final anagram task during their break periods, to think of ways that they might improve their performance on the task. Debriefing and checks to ensure naivete for the procedures were carried out.

The low stress MIP was modified to circumvent the problems of Experiment 1 related to unexpectedly high state anxiety scores in the low stress condition. In the low stress MIP, the easy anagram task was replaced with a relaxation task. Subjects experienced a 5-minute relaxation session where they were encouraged to relax and breathe deeply. The verbal narrative is presented in Appendix H. To maximise relaxation, Ss were reminded during breaks to continue to stay relaxed.
4.7 Results

Three aspects of the data are presented. First, the validity of the stress manipulation is established by comparing the state anxiety scores across low and high trait anxiety groups. Second, the validity of the backward masking procedure is examined to ensure that conscious awareness of the stimuli was prevented. If these two assumptions are valid, the colour-naming RT data can be evaluated in the light of the experimental hypotheses.

4.7.1 State Anxiety Manipulation

State anxiety measures were completed by each subject immediately before commencement of the colour-naming task. Mean STAI-S scores can be seen in Table 4.6. An analysis of variance indicated that state anxiety levels were significantly different depending on the Ss' stress condition, $F(1, 91) = 29.37, p < .001$, and trait condition, $F(1, 91) = 28.84, p < .001$. There was no significant interaction involving trait anxiety and stress condition, $F(1, 91) = 0.56, p = .46, n.s$. Anecdotal feedback from some Ss indicated that the perceived difficulty of the anagrams in the high stress condition induced them to give up.

4.7.2 Masking Procedure

Subjects were not able to determine the lexical content of the masked presentations. The analysis of variance revealed no significant effects for the lexical decision task as a function of group: stress (Ss exposed to high or low stress condition), $F(1, 91) = 0.58, p$
= .45, ns; trait anxiety group (high or low trait anxiety), $F(1, 91) = 1.88$, $p = .17$, ns; or the relationship between trait anxiety group and stress, $F(1, 91) = 0.06$, $p = .8$, ns. A mean percentage of correct responses of 49.87% ($SD = 3.53$) across all $S$s indicated the accuracy of responses was not significantly different to the 50% expected by chance, $t(94) = 0.35$, $p = .73$, ns. Thus, masking was effective in preventing conscious awareness of the word stimuli.

As these assumptions were upheld, reaction-time data were then considered.

### 4.7.3 Colour-Naming Latency Data

**Hypotheses 1 and 2: Trait Anxiety by Stress Interaction; Preconscious and Conscious Processing**

For each subject, the software produced the median colour-naming RT for each group of twelve words in each experimental condition. The group means of these data are summarised in Table 4.7.
Table 4.7. Experiment 2. Mean colour-naming latencies in milliseconds

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>High Trait Anxious</th>
<th>Low Trait Anxious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress Condition</td>
<td>High Stress</td>
<td>Low Stress</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Masked Exam Threat</td>
<td>668 (62)</td>
<td>651 (84)</td>
</tr>
<tr>
<td>Masked Exam Non Threat</td>
<td>665 (76)</td>
<td>657 (74)</td>
</tr>
<tr>
<td>Masked Non Exam Threat</td>
<td>672 (68)</td>
<td>648 (66)</td>
</tr>
<tr>
<td>Masked Non Exam Non Threat</td>
<td>668 (75)</td>
<td>652 (77)</td>
</tr>
<tr>
<td>Unmasked Exam Threat</td>
<td>679 (83)</td>
<td>663 (82)</td>
</tr>
<tr>
<td>Unmasked Exam Non Threat</td>
<td>693 (75)</td>
<td>675 (88)</td>
</tr>
<tr>
<td>Unmasked Non Exam Threat</td>
<td>686 (68)</td>
<td>669 (87)</td>
</tr>
<tr>
<td>Unmasked Non Exam Non Threat</td>
<td>696 (77)</td>
<td>667 (72)</td>
</tr>
</tbody>
</table>
These RTs were subjected to a mixed-design analysis of variance. The factors considered were trait anxiety group, stress condition, exposure mode, threat, and stimulus specificity. When all RT variables were considered together, there was a main effect for trait anxiety group, $F (1, 91) = 4.56, p < .05$. This finding reflected longer colour-naming latencies for high trait anxious $S$s ($M = 670 \text{ ms}, SD = 71 \text{ ms}$) than for low trait anxious $S$s ($M = 639 \text{ ms}, SD = 64 \text{ ms}$). The analyses also revealed a main effect for exposure, $F (1, 91) = 50.42, p < .001$. This result reflected longer colour-naming latencies for unmasked stimuli ($M = 662 \text{ ms}, SD = 73 \text{ ms}$) than masked stimuli ($M = 644 \text{ ms}, SD = 67 \text{ ms}$).

There was a significant 4-way interaction effect involving trait anxiety, stress, threat, and exposure, $F (1, 91) = 5.36, p < .05$. Table 4.8 shows the values for the threat indices, which are represented in Figures 4.4 and 4.5. These figures show the patterns involving masked and unmasked data.
### Table 4.8. Experiment 2. Threat indices for high and low trait anxious groups across exposure and stimulus specificity

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th></th>
<th>Stress Condition</th>
<th></th>
<th>Stress Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Stress</td>
<td>Low Stress</td>
<td>High Stress</td>
<td>Low Stress</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>MASKED EXAM THREAT INDEX</td>
<td>2.92 (30.29)</td>
<td>-6.32 (31.69)</td>
<td>-3.65 (21.38)</td>
<td>.77 (33.49)</td>
</tr>
<tr>
<td>MASKED NON-EXAM THREAT INDEX</td>
<td>4.79 (38.29)</td>
<td>-3.88 (32.95)</td>
<td>1.35 (22.39)</td>
<td>-7.50 (26.62)</td>
</tr>
<tr>
<td>UNMASKED EXAM THREAT INDEX</td>
<td>-12.62 (32.40)</td>
<td>-16.58 (35.28)</td>
<td>-3.46 (25.68)</td>
<td>-12.12 (26.65)</td>
</tr>
<tr>
<td>UNMASKED NON-EXAM THREAT INDEX</td>
<td>-10.63 (24.46)</td>
<td>1.84 (36.56)</td>
<td>14.23 (24.77)</td>
<td>-5.96 (27.24)</td>
</tr>
</tbody>
</table>
4.7.4 Colour-Naming Latencies on Masked Exposure Trials

Hypotheses 1 and 2: Trait Anxiety by Stress Interaction; Preconscious Processing

To examine the significant 4-way interaction involving trait anxiety, stress, threat, and exposure, masked and unmasked variables were analysed separately. When the masked variables were compared, the sole effect was an interaction between trait anxiety group, stress, and specificity, which bordered on significance, $F(1, 91) = 3.96, p = .05$. As this interaction did not include threat in the interaction and hence did not address the hypotheses, it was not explored further. No significant interactions involving trait anxiety, stress, and threat were observed for the masked data.

4.7.5 Masked Examination and Non-Examination Related Stimuli

Hypothesis 3: Specificity

To address this hypothesis, masked exam and non-exam related variables were analysed separately in two further analyses of variance. For exam related variables, there was no significant interaction between trait anxiety group, stress, and threat, $F(1, 91) = 1.13, p = .29, ns$. There was a sole between-subjects effect for trait anxiety group, $F(1, 91) = 4.43, p < .05$. When non-exam variables were analysed separately, no significant interaction was found between trait anxiety, stress, and threat, $F(1, 91) = 0.001, p = .98, ns$. There was a main effect for trait anxiety, $F(1, 91) = 4.43, p < .05$. In summary, for masked data, no interaction involving trait anxiety, stress, and threat was identified and no specificity effect was shown. Figure 4.4 shows the nonsignificant trends.
Figure 4.4. Experiment 2. Interaction of trait anxiety, stress, specificity, and threat in the masked exposure condition.
4.7.6 Colour-Naming Latencies on Unmasked Exposure Trials

Hypotheses 1 and 2: Trait Anxiety by Stress Interaction; Conscious Processing

Figure 4.5 shows the threat indices for unmasked trials.

Figure 4.5. Experiment 2. Interaction of trait anxiety, stress, specificity, and threat in the unmasked exposure condition
For unmasked threat words, there was a significant interaction involving trait anxiety, stress, and threat, $F(1, 91) = 5.78, p < .05$. This interaction is shown in Figure 4.6. The unmasked words also showed a main effect for trait anxiety $F(1, 91) = 4.36, p < .05$, and an interaction between specificity and threat, $F(1, 91) = 7.29, p < .01$.

Figure 4.6. Experiment 2. Interaction of trait anxiety, stress, and threat in the unmasked exposure condition
Figure 4.6 shows that the low and high trait anxious groups produced distinctly different responses at a conscious level in response to increased stress. Low trait anxious Ss showed increased attention to threat from low to high stress, and high trait anxious Ss showed increased avoidance of threat from low to high stress. Low trait anxious Ss showed some avoidance of threat under low stress and a minimal level of attention to threat under high stress. In contrast, high trait anxious Ss showed a minimal level of avoidance of threat under low stress and greater avoidance under high stress. These patterns represent a suppression response for high trait anxious Ss. They showed a clear decrease in allocation of attention to threat words from low to high stress.

To clarify the statistical significance of these patterns of attentional biases, post hoc analyses were undertaken. At the adjusted alpha level of .01, the avoidance response of high trait anxious Ss under high stress was significant, $t (23) = 2.93, p < .01$, and there was a trend for avoidance in low trait anxious Ss under low stress, $t (25) = 2.41, p < .05$. Thus, the suppression response in high trait anxious individuals represented a significant level of avoidance of threat words.

4.7.7 Unmasked Examination and Non-Examination Related Stimuli

Hypothesis 3: Specificity

To address the specificity hypothesis, unmasked examination and non-examination related variables were analysed separately in a further analysis of variance. The patterns of these variables can be seen in Figure 4.5. At a descriptive level, the pattern identified
for examination related variables was somewhat similar to that identified for non-examination variables, although non-examination words produced significant responses. For unmasked examination related variables, there was no significant interaction between trait anxiety group, stress, and threat, $F(1, 91) = 0.39, p = .53, ns$. There was a sole between-subjects effect for trait anxiety group, $F(1, 91) = 4.26, p < .05$, and a within-subjects effect for threat, $F(1, 91) = 14.03, p < .001$.

For unmasked non-examination variables there was a significant interaction was found between trait anxiety, stress, and threat, $F(1, 91) = 7.91, p = .01$. The significant interaction between trait anxiety, stress, and threat produced divergent patterns for low and high trait anxious Ss. There was also a main effect for trait anxiety group, $F(1, 91) = 4.21, p < .05$. These effects can be seen in Figure 4.7.
Figure 4.7. Experiment 2. Interaction of trait anxiety, stress, and threat in the unmasked exposure condition

The significant interaction for unmasked non-exam threat is seen in Figure 4.7. Low trait anxious Ss showed minimal levels of avoidance under low stress and some attention to non-exam threat under high stress. In contrast, high trait anxious Ss showed minimal attention to threat under low stress and some avoidance of threat under high stress. Thus, high trait anxious Ss showed a suppression response and low trait anxious Ss showed increased attention to threat from low to high stress. It is likely that the
divergent responses of high and low trait anxious Ss to unmasked non-exam related 
words influenced the pattern for unmasked threat, seen in Figure 4.6.

Post hoc analyses were undertaken to determine the significance of the threat indices. 
At an adjusted alpha level of .01, the vigilance response for non-exam threat in low trait 
anxious Ss under high stress was significant, $t (23) = 2.13, p < .01$, and there was a trend 
for avoidance of non-exam threat in high trait anxious Ss under high stress, $t (23) = 
2.13, p < .05$. These results can be seen in Figure 4.7. Thus, only low trait anxious Ss' 
vigilance for general threat under high stress was significant.
4.8 Discussion

4.8.1 Summary of Findings

*Hypothesis 1*: Attentional biases to threat-related information will be dependent on an interaction of trait anxiety differences and by elevations in state anxiety. More specifically, as the result of increased stress, high trait anxious individuals will attend to threatening information and low trait anxious individuals will allocate attention away from threatening information.

There was no support for the initial prediction. For unmasked data, there was a significant interaction between trait anxiety, stress, and threat. However, the result involved a reversal of the predicted pattern. From low to high stress, high trait anxious Ss showed decreased attention to threat and low trait anxious Ss showed increased attention to threat.

*Hypothesis 2*: These trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified at preconscious and conscious levels of processing.

The second hypothesis was not supported. For masked data, the predicted interaction involving trait anxiety, stress, and threat was not identified. The two significant interactions, involving trait anxiety, stress, and threat were found at a conscious level of processing. In both interactions, high trait anxious individuals showed decreased attention to threat from low to high stress, and low trait anxious individuals showed increased attention to threat. This pattern was the opposite of predictions.
Hypothesis 3: These trait anxiety-related attentional biases will be identified more for threatening information in the individuals' domain of concern than for information unrelated to their domain of concern. The predicted pattern of attentional biases, outlined in Hypothesis 1, will be observed more for examination-related threat words than non-examination threat words.

At a preconscious level, there was no trait-linked response to threat or a specificity response within individuals' domain of concern. At a conscious level of processing, there was a significant interaction between trait anxiety, stress, and threat. However, the pattern was the reverse of predictions, and involved a suppression effect in high trait anxious individuals and increased attention to threat in low trait anxious individuals. A similar significant pattern was found in response to unmasked general threat words. Therefore, the prediction was not supported. In contrast, this suppression effect identified for high trait anxious individuals indicated that high trait anxious individuals were not attending to stimuli in their domain of concern related to examination threat words.

As indicated in Section 3.5, it should be noted that the current findings should be interpreted in the light of issues related to the use of multiple analyses of variance without correction of the alpha levels in the examination of the central hypotheses in this study. Thus, caution is required in the interpretation of these findings.
4.8.2 Implications of Findings for Hypotheses

These findings differed somewhat from those of the initial study. Study 1 found an avoidance effect for high trait anxious individuals for specific threat words at a preconscious level, triggered by stress elevation. Low trait anxious individuals showed little difference in their attention to threat across the stress conditions or across the different forms of threat. The results of Experiment 2 also differed from those of MacLeod and Rutherford (1992) and the predictions of Williams et al. (1988). The current study found none of the predicted effects in the masked exposure condition and consequently showed no further support for the Beck and Clarke’s (1997) notion of a preconscious orienting mode.

The current results also contrasted with those of several studies that supported Williams et al.’s (1988) model (MacLeod & Mathews, 1988; Mogg et al., 1994). However, Mogg et al. (1994) and Mogg et al. (1990) failed to show that attentional biases for threat were dependent on an interaction between trait anxiety and acute stress. The current study did show a conscious suppression effect involving an interaction of trait anxiety by stress interaction. This study was similar to but not identical to these previous studies in design.

The current results supported Beck et al.’s (1985) notion that attention to threat may be characterised by avoidance of threat-related information under high stress. Beck et al. (1985) argued that trait characteristics may disproportionately increase the processing of
schema-congruent information. Initially under low stress, high trait anxious individuals may attend somewhat to threat-related information. As stress increases, high trait anxious individuals may attend away from threat in a mood counter-regulatory fashion. Once the stress becomes chronic or too intense, they may be unable to avoid processing threatening information. Subsequently, they begin attend to threat once the stress threshold is crossed.

Mathews (1990) proposed that low trait anxious individuals divert their attention away from threat information under high stress until a threshold is reached. At this point, they revert to attending to threat, presumably to monitor the impending danger. The results of this study indicated that, although not seen in low trait anxious individuals, the pattern may describe the response of high trait anxious individuals. This U-shaped pattern may occur in the interaction between trait anxiety and stress. High trait anxious individuals shift their attention towards threat under low stress. They avoid threat under moderately high or temporary stress and increase attention towards threat under high acute or chronic stress. At one level, the pattern appears somewhat divergent from the central predictions of the interactional model of Williams et al. (1988). However, the pattern identified in Studies 1 and 2 may represent suppression effects, where high trait anxious individuals suppress aspects of responsiveness under temporary stress conditions.
The current findings generally supported those of Mathews and Sebastian (1993), which demonstrated the suppression of attentional biases in normal samples. Their studies showed that in individuals with specific fears, conscious suppression effects were found under high stress. Attentional bias effects were found primarily for stimuli specific to their concerns under low stress. Most importantly, the attentional bias effect seen when the stressful stimuli were absent was contrasted by a suppression effect when the fearful individuals were presented with the stressful stimulus. Similarly, in this study, the conscious suppression effect shown by high trait anxious individuals occurred as a result of acute stress.

The suppression effect found in the current study, as that found in Mathews and Sebastian's (1993) study, may be explicable through the \textit{PDP} model. The \textit{PDP} model (Cohen et al., 1990) predicted that interference will be reduced when the task demand unit associated with colour naming is increased, as was the case in this study under acute stress conditions.

The current study and that of Mathews and Sebastian (1993) both found the suppression effect at a conscious level of processing. The \textit{PDP} model suggested that suppression effects may be identified when conscious or pre-conscious processing is employed in the task. Based on this model, avoidance or speeded responses in attentional bias tasks are evidence that similar forms of threat suppression are operating.

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Such suppression effects, if dependent on increases in the task demand units, would be most likely to occur when acute stress tasks were evident as the form of stressor.

Williams et al. (1996) proposed that avoidance responses in attentional bias tasks are evidence that threat suppression is operating. Such suppression effects, if dependent on increases in the task demand units, are most likely to occur when acute stress tasks were evident as the form of stressor. The suppression response in this study was relatively weak, in the sense that no attention biases were developed under low stress for high trait anxious individuals. However, the result is more interesting as both exam and non-exam threat produced avoidance under high stress. This result indicates the convergence between the two studies, as both have produced suppression effects.

4.8.3 Experiments 1 and 2: Conclusions

These studies addressed whether high and low trait anxious individuals show divergent attentional biases when the type of stress experienced is acute, rather than chronic. They mirrored the investigation by MacLeod and Rutherford (1992) and differed primarily in the assessment of the threat-related attentional biases under acute, rather than chronic stress.

The findings of Experiment 1 did not support the prediction that attentional biases are dependent on the interaction of trait anxiety and state anxiety. High trait anxious individuals avoided masked examination words under high stress, even though the acute
stress MIP was related to academic concerns. In contrast, low trait anxious individuals showed general avoidance of threat at a preconscious level of functioning.

Experiment 2 showed a significant interaction involving trait anxiety, stress, threat, and specificity, but at a conscious level of processing. Contrary to predictions, high trait anxious individuals showed increased avoidance and low trait anxious individuals showed increased attention to threat from low to high stress. A similar pattern was identified for non-exam related words.

The divergent findings from these identical studies raised concerns regarding the consistency of the data drawn from these methods. The results pointed to the need for more complete replication of previous research to investigate more fully the differential effects of the chronicity and type of stressors on threat-related attentional biases. Therefore, the forthcoming studies aimed to address the attentional patterns of individuals experiencing stress at low, acute and chronic levels. It was considered that examining attentional patterns of individuals under chronic stress would allow more complete comparison with previous research and provide a more complete test of the model of Williams et al. (1988). Chapter 5 describes the study designed to address these issues.
CHAPTER 5

EXPERIMENT 3
CHAPTER 5

EXPERIMENT 3

5.1 Introduction

Following Experiments 1 and 2, this experiment sought to establish more consistent findings. Experiments 1 and 2 demonstrated an alternative pattern that raised questions regarding the effects of different forms of stress on threat-related attentional biases in high trait anxious individuals. Few studies to date have addressed trait-linked attentional biases in response to low, high acute, and chronic stress. Study 3 aimed to follow the basic design of the initial two studies. It maintained the use of the modified Stroop task and the low and high acute stress conditions. It included a chronic stress condition to extend on the previous two studies and to allow further direct comparison with past research.

5.1.1 Experimental Hypotheses

The predictions were similar to those of the previous two studies. However, the first hypothesis has been extended to incorporate the use of chronic stress, as follows. Despite theoretical positions regarding the likely differences between acute and chronic stressors, there was insufficient evidence to indicate that chronic stress elicits different patterns of attentional biases to those elicited by acute stress. Hypotheses 2 and 3 are affected by the change to initial hypothesis and hence are reiterated.
1. Attentional biases to threat-related information will be dependent on an interaction of trait anxiety differences and by elevations in state anxiety. More specifically, as the result of state anxiety elevations triggered by both acute and chronic stress, high trait anxious individuals will attend to threatening information and low trait anxious individuals will allocate attention away from threatening information.

2. These trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified at preconscious and conscious levels of processing.

3. These trait anxiety-related attentional biases will be identified more for threatening information in the individuals' domain of concern than for information unrelated to their domain of concern. The predicted pattern of attentional biases, outlined in Hypothesis 1, will be observed more for examination-related threat words than non-examination threat words.
5.2 Method

5.2.1 Design

This study employed a mixed-design, similar to that used in Experiments 1 and 2 but with minor modifications. In this study, each subject completed the colour-naming task under low, high acute, and high chronic stress. These will be subsequently termed low, high, and chronic stress. Trait anxiety was the between-subjects independent variable and stress was a within-subjects independent variable in this study. The condition of the experimental trials varied equally across three other independent variables: (a) specificity: examination and non-examination-related content; (b) threat: threat-related and non-threat-related valence; (c) exposure mode: masked and unmasked exposure conditions.

5.2.2 Subjects

Forty adults were selected from a larger initial sample of 150 undergraduate students, based on their scores on the STAI-T. The 20 Ss with the highest and the 20 Ss with the lowest STAI-T scores were included in the study.

Subjects were tested under the three stress conditions, low, high and chronic stress. Four Ss, 2 from the high trait anxious group and 2 from low trait anxious group were excluded. This was because the majority of their median RTs for the word categories was greater than 2 SDs from the group mean RT for corresponding word categories and a substantial proportion of their median RTs for the word categories was greater than
1000 ms. These exclusions resulted in a total sample across the two groups of 36 Ss (31 females, 5 males). Mean age was 18.78 years. In this final sample, the ratio of females (f) to males (m) in each group was: high trait: 18f: 0m; low trait: 13f: 5m. Descriptive data are presented in Table 5.1.

Table 5.1. Experiment 3. Subject Characteristics

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Anxiety</td>
<td>High</td>
<td>Low</td>
<td>Sample</td>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trait</td>
<td>Trait</td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td>Age</td>
<td>Anxious</td>
<td>Anxious</td>
<td>Mean</td>
<td>18.61</td>
<td>2.91</td>
<td>18</td>
</tr>
<tr>
<td>Trait Anxiety (STAI-T)</td>
<td></td>
<td></td>
<td></td>
<td>51.44</td>
<td>5.06</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.78</td>
<td>2.39</td>
<td>36</td>
</tr>
</tbody>
</table>

Comparisons between STAI-T scores showed high trait anxious Ss had higher levels of trait anxiety than low trait anxious Ss, $F (1, 34) = 200.00, p < .001$. Comparisons of Ss’ mean ages revealed no significant differences between the groups, $F (1, 34) = 0.17, p = .68, ns$.

5.2.3 Materials

The materials employed in this experiment were identical to those used in Experiments 1 and 2, apart from the materials used in the mood induction procedures.
Chapter 5  

Experiment 3  

5.2 Method

The high stress *MIP* used difficult anagrams of the same type as Experiments 1 and 2, but altered the anagrams to appear easier than those in the previous experiments (see Appendix I). Anecdotal comments from some *Ss* in these experiments indicated that the perceived complexity of the anagrams in the high stress condition induced some *Ss* to give up, which may have reduced the effectiveness of the MIP. Subsequently anagrams were devised that appeared less difficult than those in Experiment 2 but that still prevented *Ss* from obtaining the criterion score. The low stress *MIP* employed the same relaxation instructions on audiotape as in Experiment 2 (Appendix H). Informed consent forms (Appendices A & B) were identical to Experiment 1, except for an explanation that *Ss* would be involved in three testing sessions: under relaxation conditions, completing an academic task, and in close proximity to their exams.

**Presentation Hardware**

As in Experiments 1 and 2, the stimuli were presented by a microcomputer, colour-naming responses were transmitted by a microphone fitted to each subject’s throat. A response box with a pair of buttons was used in the awareness-check trials.

**Presentation Software**

The colour-naming task and awareness-check task were identical to that used in Studies 1 and 2.
5.2.4 Procedure

Stress Conditions

As experimenters other than the author carried out the testing, a series of checks were used to ensure that the procedures were administered in a standardised fashion. As indicated, each subject undertook testing under low, high, and chronic stress. Testing in the low and high stress conditions took place 7-9 weeks before examinations, a period of low stress. There was at least one week separating the high and low stress testing sessions. Testing for the chronic stress condition took place within one week of the Ss beginning examinations, with an attempt to test Ss as close as possible to their exams. It was not possible to fully counter-balance the order of testing. Subjects undertook low and high stress conditions in random order, but all Ss completed chronic stress last.
5.3 Results

As in the initial two studies, three aspects of the data are presented. First, the validity of the stress manipulation is established by comparing the state anxiety scores across low and high trait anxiety groups. Second, the validity of the backward masking procedure is examined to ensure that conscious awareness of the stimuli was prevented. If these two assumptions are valid, the colour-naming RT data can be evaluated in the light of the experimental hypotheses.

5.3.1 State Anxiety Manipulation

Somewhat unexpected results were found in the state anxiety manipulation. As can be seen in Table 5.2, there was only a marginal difference in the increase in state anxiety scores from low to chronic stress, and a decrease from high to chronic stress.
Table 5.2. Experiment 3. State anxiety scores across low, high, and chronic stress

<table>
<thead>
<tr>
<th>State Anxiety (STAI-S)</th>
<th>Trait Anxiety Group</th>
<th>Both Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Trait Anxious</td>
<td>Low Trait Anxious</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Low Stress</td>
<td>37.39 (10.78)</td>
<td>26.61 (4.13)</td>
</tr>
<tr>
<td>High Stress</td>
<td>50.94 (8.97)</td>
<td>38.33 (5.62)</td>
</tr>
<tr>
<td>Chronic Stress</td>
<td>38.06 (8.74)</td>
<td>29.67 (5.90)</td>
</tr>
</tbody>
</table>

To determine if increases in state anxiety had been elicited by elevated stress, a repeated-measures analysis of variance was undertaken using state anxiety scores as the dependent variables, with trait anxiety group and stress condition as independent variables. There was a significant effect of trait anxiety group, $F (1, 34) = 42.01, p < .001$, with high trait anxious $S$s having higher levels of state anxiety in all conditions than did low trait anxious $S$s. There was also a significant main effect of stress, $F (2, 68) = 31.53, p < .001$, but no significant interaction between stress and trait anxiety group, $F (2, 68) = 0.14, p = .76, ns$. Thus, there were equivalent state anxiety changes across the three stress conditions for high and low trait anxious $S$s.
Comparisons of state anxiety scores across low, high and chronic stress were carried out through Helmert’s contrasts. There was a significant decrease in state anxiety from high to chronic stress, $F(1, 34) = 41.89, p < .001$. State anxiety scores under high and chronic stress conditions, considered together, were significantly greater than those produced under low stress, $F(1, 34) = 22.35, p < .001$. There was no significant difference in state anxiety scores between the low stress and chronic stress conditions, $F(1, 34) = 1.39, p = .25, ns$. State anxiety levels under chronic stress were also significantly less than those produced under high stress, and the expected difference in state anxiety from low to chronic stress was not demonstrated.

In general, the different stress conditions produced different results than were expected. The results of the *STAI-S* suggest that high stress produced greater state anxiety than did chronic stress. While high stress appears to have induced substantial elevations in state anxiety, chronic stress does not appear to have done so. In this study it should be recognised that the assumptions of the study were not met with respect to this stressor. These results will be considered in greater detail in Section 5.4.

### 5.3.2 Masking Procedure

As in the previous two studies, $S$s were unable to identify whether they had been exposed to a word or a random string of letters. There were no effects based on the trait anxiety group, or a significant difference between the observed percentage correct on the lexical decision task and that expected by chance. Repeated-measures analyses of
variance revealed no significant effects for the lexical decision task as a function of: stress condition (low, high or chronic), $F(2, 68) = 0.71, p = .50, ns$; trait anxiety (high or low), $F(1, 34) = 0.001, p = .92, ns$; or the relationship between trait anxiety and stress, $F(2, 68) = 0.09, p = .92, ns$. A mean percentage of correct responses of 50.08% ($SD = 2.3$) across all $S$s for all stress conditions indicated the accuracy of responses was not significantly different to the 50% expected by chance, $t(35) = 0.21, p = .83, ns$. Thus, masking was effective in preventing conscious awareness of the stimuli.

With the assumptions substantially upheld, apart from the issue noted related to chronic stress, RT data were then considered.

### 5.3.3 Colour-Naming Latency Data

For each subject, the Stroop program software produced the median colour-naming RT for each group of twelve words in each experimental condition. The group means of these data are summarised in Table 5.3. The threat indices are presented in Table 5.4.

Figures 5.1 and 5.2 show the patterns of attentional biases for masked and unmasked exam and non-exam related RT variables under low, high and chronic stress.
Table 5.3. Experiment 3. Mean colour-naming latencies in milliseconds

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>High Trait Anxious</th>
<th>Low Trait Anxious</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Low Stress Masked Exam Threat</td>
<td>603 (70)</td>
<td>621 (94)</td>
</tr>
<tr>
<td>Low Stress Masked Exam Non-Threat</td>
<td>596 (69)</td>
<td>618 (84)</td>
</tr>
<tr>
<td>Low Stress Masked Non-Exam Threat</td>
<td>599 (62)</td>
<td>614 (94)</td>
</tr>
<tr>
<td>Low Stress Masked Non-Exam Non-Threat</td>
<td>599 (67)</td>
<td>618 (81)</td>
</tr>
<tr>
<td>Low Stress Unmasked Exam Threat</td>
<td>614 (76)</td>
<td>633 (89)</td>
</tr>
<tr>
<td>Low Stress Unmasked Exam Non-Threat</td>
<td>628 (91)</td>
<td>630 (88)</td>
</tr>
<tr>
<td>Low Stress Unmasked Non-Exam Threat</td>
<td>632 (81)</td>
<td>641 (85)</td>
</tr>
<tr>
<td>Low Stress Unmasked Non-Exam Non-Threat</td>
<td>632 (86)</td>
<td>641 (95)</td>
</tr>
<tr>
<td>High Stress Masked Exam Threat</td>
<td>612 (65)</td>
<td>619 (82)</td>
</tr>
<tr>
<td>High Stress Masked Exam Non-Threat</td>
<td>600 (68)</td>
<td>621 (84)</td>
</tr>
<tr>
<td>High Stress Masked Non-Exam Threat</td>
<td>608 (77)</td>
<td>618 (79)</td>
</tr>
<tr>
<td>High Stress Masked Non-Exam Non-Threat</td>
<td>611 (66)</td>
<td>620 (75)</td>
</tr>
<tr>
<td>High Stress Unmasked Exam Threat</td>
<td>648 (137)</td>
<td>637 (76)</td>
</tr>
<tr>
<td>High Stress Unmasked Exam Non-Threat</td>
<td>629 (103)</td>
<td>647 (66)</td>
</tr>
<tr>
<td>High Stress Unmasked Non-Exam Threat</td>
<td>631 (89)</td>
<td>651 (78)</td>
</tr>
<tr>
<td>High Stress Unmasked Non-Exam Non-Threat</td>
<td>635 (88)</td>
<td>649 (75)</td>
</tr>
<tr>
<td>Chronic Stress Masked Exam Threat</td>
<td>600 (88)</td>
<td>602 (75)</td>
</tr>
<tr>
<td>Chronic Stress Masked Exam Non-Threat</td>
<td>608 (90)</td>
<td>606 (81)</td>
</tr>
<tr>
<td>Chronic Stress Masked Non-Exam Threat</td>
<td>609 (88)</td>
<td>614 (99)</td>
</tr>
<tr>
<td>Chronic Stress Masked Non-Exam Non-Threat</td>
<td>611 (94)</td>
<td>607 (82)</td>
</tr>
<tr>
<td>Chronic Stress Unmasked Exam Threat</td>
<td>625 (97)</td>
<td>634 (112)</td>
</tr>
<tr>
<td>Chronic Stress Unmasked Exam Non-Threat</td>
<td>598 (115)</td>
<td>629 (123)</td>
</tr>
<tr>
<td>Chronic Stress Unmasked Non-Exam Threat</td>
<td>624 (93)</td>
<td>636 (97)</td>
</tr>
<tr>
<td>Chronic Stress Unmasked Non-Exam Non-Threat</td>
<td>621 (92)</td>
<td>626 (82)</td>
</tr>
</tbody>
</table>
Table 5.4. Experiment 3. Threat indices for high and low trait anxious adults across exposure and stimulus specificity

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>Mean</th>
<th>(SD)</th>
<th>Mean</th>
<th>(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW STRESS MASKED EXAM THREAT</td>
<td>7.78</td>
<td>(21.02)</td>
<td>3.61</td>
<td>(20.92)</td>
</tr>
<tr>
<td>HIGH STRESS MASKED EXAM THREAT</td>
<td>11.94</td>
<td>(26.24)</td>
<td>-1.11</td>
<td>(34.24)</td>
</tr>
<tr>
<td>CHRONIC STRESS MASKED EXAM THREAT</td>
<td>-8.06</td>
<td>(22.44)</td>
<td>3.61</td>
<td>(24.42)</td>
</tr>
<tr>
<td>LOW STRESS MASKED NON-EXAM THREAT</td>
<td>.28</td>
<td>(23.79)</td>
<td>-4.17</td>
<td>(30.35)</td>
</tr>
<tr>
<td>HIGH STRESS MASKED NON-EXAM THREAT</td>
<td>-2.78</td>
<td>(32.32)</td>
<td>-1.94</td>
<td>(25.27)</td>
</tr>
<tr>
<td>CHRONIC STRESS MASKED NON-EXAM THREAT</td>
<td>-1.61</td>
<td>(22.68)</td>
<td>7.22</td>
<td>(32.32)</td>
</tr>
<tr>
<td>LOW STRESS UNMASKED EXAM THREAT</td>
<td>-13.89</td>
<td>(43.17)</td>
<td>2.50</td>
<td>(20.74)</td>
</tr>
<tr>
<td>HIGH STRESS UNMASKED EXAM THREAT</td>
<td>18.61</td>
<td>(73.26)</td>
<td>-10.28</td>
<td>(31.51)</td>
</tr>
<tr>
<td>CHRONIC STRESS UNMASKED EXAM THREAT</td>
<td>26.67</td>
<td>(67.21)</td>
<td>5.00</td>
<td>(32.13)</td>
</tr>
<tr>
<td>LOW STRESS UNMASKED NON-EXAM THREAT</td>
<td>.39</td>
<td>(21.18)</td>
<td>-5.56</td>
<td>(26.40)</td>
</tr>
<tr>
<td>HIGH STRESS UNMASKED NON-EXAM THREAT</td>
<td>-4.17</td>
<td>(21.85)</td>
<td>1.67</td>
<td>(36.42)</td>
</tr>
<tr>
<td>CHRONIC STRESS UNMASKED NON-EXAM THREAT</td>
<td>2.50</td>
<td>(23.22)</td>
<td>10.56</td>
<td>(34.97)</td>
</tr>
</tbody>
</table>
Colour-naming RTs seen in Table 5.3 were subjected to a mixed-design analysis of variance. The one between group factor was trait anxiety (high vs low), and the four within group factors were stress condition (low vs high vs chronic), exposure mode (masked vs unmasked condition), threat (threat vs non-threat word), and specificity (exam vs non-exam-related words).

When masked and unmasked variables were considered together, there were no interactions involving trait anxiety and stress, and no other interactions. There was a main effect for exposure, $F(1, 34) = 29.37, p < .001$. The data were then analysed separately at masked and conscious levels to examine whether the predicted interactions involving trait anxiety, stress, and threat were evident at masked or conscious levels of processing.

5.3.4 Masked Variables

Hypotheses 1 and 2: Trait Anxiety by Stress Interaction; Preconscious Processing

When masked RTs were considered in a mixed-design analysis of variance, no main effects or interactions were evident. Further analyses focused on Hypothesis 3. Figure 5.1 displays the attentional trends for masked variables.
Figure 5.1. Experiment 3. Interaction of trait anxiety, stress, specificity, and threat in the masked exposure condition

5.3.5 Masked Examination and Non-Examination Related Stimuli

Hypothesis 3: Specificity

To address the hypothesis involving specificity, masked examination and non-examination related variables were considered separately in a further analysis of variance. For examination related variables, there was no significant interaction between trait anxiety group, stress, and threat, $F(2, 68) = 0.99, p = .38, ns$, and no other main effects or interactions.
Although there was no significant interaction in response to examination related words, Figure 5.1 demonstrates an interesting trend. Low trait anxious Ss showed a slight decrease in attention to exam words from low to high to chronic stress. High trait anxious Ss showed a slight increase in attention to exam words from low to high stress. From high to chronic stress, high trait anxious Ss showed attention to threat under high stress and then avoidance of threat under chronic stress. It is interesting to note also that in this study, state anxiety reduced from high to chronic stress. Although the overall pattern was not significant, the suppression effect of high trait anxious Ss represented a trend that was similar to effects seen in the previous studies.

When masked non-examination variables were analysed separately, no significant interaction was found between trait anxiety, stress, and threat, $F(2, 68) = 0.50, p = .61$, ns. No other main effects or interactions were found.
5.3.6 Unmasked Variables

Hypotheses 1 and 2: Trait Anxiety by Stress Interaction: Conscious Processing

When unmasked variables were considered, there was a significant interaction between trait anxiety, stress, threat, and specificity, $F(2, 33) = 3.31, p < .05$. Figure 5.2 displays the interaction.

![Graph showing interaction between unmasked exam and non-exam threat](image)

**Figure 5.2.** Experiment 3. Interaction of trait anxiety, stress, specificity, and threat in the unmasked exposure condition
5.3.7 Unmasked Examination and Non-Examination Related Stimuli

Hypothesis 3: Specificity

To clarify this interaction involving all unmasked variables, the specificity factor was isolated, and examination and non-examination related variables were examined separately through two analyses of variance. For unmasked examination-related variables, the predicted interaction of trait anxiety, stress, and threat was identified, $F(2, 33) = 3.68, p < .05$. This interaction was not subsumed by a significant two-way interaction between trait anxiety and stress. This interaction is demonstrated in Figure 5.3.
Figure 5.3. Experiment 3. Interaction of trait anxiety, stress, and threat in the unmasked exposure condition, for examination words

Figure 5.3 demonstrates this interaction, where high trait anxious Ss showed avoidance of threat under low stress, attention to threat under high stress, and a greater level of attention to threat under chronic stress. In contrast, low trait anxious Ss showed minimal attention to threat under low stress, avoidance of threat under high stress, and a minimal level of attention to threat under chronic stress.
To clarify the statistical significance of these patterns of attentional biases, post hoc analyses were undertaken. None of the threat indices represented statistically significant attentional biases. It is likely that these results were affected by somewhat higher than normal variance in the responses that indicated higher levels of vigilance or avoidance.

Further analyses were undertaken to clarify whether the patterns of attentional biases differed significantly across the three stress conditions. The comparisons, using Helmert's contrasts, indicated that the interaction between trait anxiety group and threat was significant when the comparison was made between low stress and the combination of high and chronic stress, $F(1, 34) = 7.22, p < .05$. As can be seen in Figure 5.3, high and low trait anxious $S$s produced divergent patterns of attentional biases from low to high stress, which would have nullified a main effect for stress.

To identify whether the patterns of attentional bias were significant across conditions when the group data were considered separately, further comparisons of the unmasked exam-related threat indices were undertaken using Helmert’s contrasts. Two repeated-measures analyses of variance were carried out across low, high and chronic stress, with high and low trait anxious $S$s’ data considered separately. For high trait anxious $S$s, no main effect for stress was evident. However, the contrasts of attentional biases across stress conditions showed some significance. The comparison between low stress and the combination of high and chronic stress proved significant, $F(1, 17) = 6.36, p < .05$. 

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Thus, the pattern seen in Figure 5.3 for high trait anxious Ss was significant. High trait anxious Ss showed avoidance of unmasked exam threat words under low stress and showed a significant increase in attention to threat under elevated stress. For low trait anxious Ss, no main effects for stress were evident and the contrasts of attentional biases across stress conditions did not show significance. Unmasked non-examination-related variables were then considered and showed no main or interactional effects.
5.4 Discussion

5.4.1 Summary of Findings

*Hypothesis 1:* Attentional biases to threat will be determined by an interaction of trait anxiety and stress, with high trait anxious Ss showing increased attention to threat and low trait anxious Ss allocating attention away from threat in response to stress elevations.

Partial support was found for this initial prediction. A significant interaction between trait anxiety, stress, and threat was found for unmasked exam-related words. From low to high to chronic stress, high trait anxious Ss increased attention to unmasked exam threat. Low trait anxious Ss showed increased avoidance of threat from low to high stress and increased attention threat from high to chronic stress.

*Hypothesis 2:* Trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified at preconscious and conscious levels of processing.

There was partial support for the second hypothesis. As discussed, in response to unmasked data, the predicted interaction involving trait anxiety, stress, and threat was found. No similar interactions were found at a preconscious level.

*Hypothesis 3:* Trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified more for threatening information in the individuals' current domain of concern.
This prediction was partially supported. The predicted pattern was found for unmasked examination related words but not for masked examination words.

As identified in Section 3.5, it should be noted that the current findings should be interpreted with caution due to the use of multiple analyses of variance without correction of the alpha levels in the examination of the central hypotheses in this study.

5.4.2 Comparison of the Results of Experiments 1, 2 and 3

The three experiments produced conflicting findings. The hypotheses were not supported in Experiments 1 and 2. In Experiment 3, the hypotheses were partially supported. In Experiment 1, a pattern that was the converse of predictions was identified in the masked condition, and in Experiment 2, in the unmasked condition. In Experiment 3, the predicted pattern was identified in the unmasked condition, but not in the masked condition.

The specific interactions produced in the three studies were also different. In Experiment 1, high trait anxious individuals showed a suppression response to masked specific threat words under high stress. In Experiment 2, from low to high stress, high trait anxious individuals showed increased avoidance for unmasked threat words and low trait anxious individuals showed increased attention to threat. A similar pattern was also found for non-exam threat words. In Experiment 3, high trait anxious individuals showed attention to domain-specific threat words under stress elevation, and low trait
anxious individuals showed avoidance under high stress and increased attention under chronic stress.

5.4.3 Comparison of the Results of Study 3 with Previous Research

There was some convergence between the results of Study 3 and those of other studies. The current findings reflect those found in MacLeod and Mathews' (1988) and Mogg et al.'s (1994) studies in the presence of the predicted pattern of attentional biases in response to chronic stress. This supports the fact that threat-related schemas may be triggered by chronic stressors. The findings also converged with those of Richards et al. (1992) in the predicted pattern of threat-related attentional biases at a conscious level of processing. This convergence supports the notion that trait-linked threat-related attentional biases are observed at a conscious level of processing. The presence of the predicted pattern, elicited by acute stress, supports the notion that threat-related schemas may be activated by both temporary and chronic stressors in non-clinical samples.

Although the findings supported the findings of some studies, they conflicted with the results of others. Contrary to expectations, the findings of Study 3 did not converge with those of MacLeod & Rutherford (1992) and Mogg, Kentish, et al. (1993b), whose results were at a preconscious level of processing. In addition, the findings did not fit with those of Mogg et al. (1990). In contrast to their results, the current results showed a differential pattern of attentional biases for high and low trait anxious individuals. Although these results demonstrate that attention to threat may occur at various level of
processing, these discrepancies indicate the variability of the effects in non-clinical samples.

Study 3 also demonstrated attentional biases are related to individuals' domain of concern. This result was similar to findings outlined in Chapter 2, where interference has been found for stimuli related to domain of concern or expertise (Dalgleish, 1995; Mathews & Klug, 1993; Riemann & McNally, 1995). This convergence supports the notion of Williams et al. (1988) that processing of threat is most within individuals’ domain of concern.

However, these results have not resolved issues regarding the replicability of this type of research with non-clinically anxious individuals. Although the results supported the predictions, they also amplified the discrepancies across the studies.

The notion proposed in previous research that greater attentional biases are produced by chronic stress than high stress was not supported by Study 3. High trait anxious individuals showed similar levels of attentional biases under high and chronic stress. This finding contrasts with the previous suggestions that high and chronic stress conditions may produce different types of attentional biases due to the prolonged or immediate nature of the stress.
The three studies found that the attentional patterns of non-clinical individuals are influenced by the type of the threat, not simply the presence or absence of threat. All three found attentional biases for specific forms of threat. Interestingly, the domain-specificity hypothesis was only supported in Study 3, indicating the need for further exploration in future studies. The differences in results between the current studies and MacLeod and Rutherford's (1992) study are difficult to explain. However, the fact that very similar studies produced significant interactions between trait anxiety and stress, but at different levels of exposure, cannot be explained easily. The results point to the need to explore attentional patterns with individuals experiencing stress at low, high and chronic levels using an alternative paradigm.

In these initial three studies, there was a possible confounding feature of the stimuli. MacLeod and Rutherford (1992) originally devised examination and general threat-related words as the target stimuli, and these were used in the current studies. To measure attentional biases, response times to these target words and matched non-threat words were compared. The non-threat exam-related words were near antonyms of the exam-related threat words. The significant effect for masked exam words in Study 1, seen in Figure 4.2, could have been caused by reactions to stimuli that can be considered non-threatening, but are also exam-related and may have elicited domain-specific attentional biases. Examination of the mean RTs in Study 1 (Table 4.4) for the high trait anxious individuals shows that the masked non-threat exam-related materials produced the highest mean level of interference for all the masked word types. To
explain the response to these words, it could be proposed that attentional biases to positively valenced material of any type, related or unrelated to the domain of concern, may represent an emotionality effect. As discussed in Chapter 2, there is insufficient evidence to date to suggest that emotionality effects are found predictably in non-clinical samples. Therefore, the pattern found in Study 1 has not been interpreted from this standpoint. However, considering the data of Mathews and Klug (1993), these results suggest that neutral stimuli may produce attentional effects. Therefore, the nature of the stimuli may have represented a limitation of Studies 1-3. This issue should be addressed further in future research.

Unexpectedly, levels of state anxiety were lower under chronic stress than under high stress. As such, the assumptions of the study were not fully met. Comparisons with other studies, such as MacLeod and Rutherford’s (1992) study, indicated that these levels of state anxiety produced by proximity to examinations were also somewhat lower than in previous research. The reasons for such differences are unclear, as ostensibly the samples were exposed to similar examination-related stresses. For this reason, caution needs to be used in the interpretation of the results of this study, particularly with respect to those findings involving the chronic stress condition. This result could not have been foreseen, as the method involving Ss being tested in proximity to end of university semester examinations followed the design of many similar studies in the field. It is possible that Ss involved in this study were more exposed to continuous assessment than Ss in previous research, and as such, were less
anxious about the examinations at the time of testing than would be normally expected. Although all Ss were tested within the week prior to their examinations, it is possible for the current sample were not tested close enough to their examinations, and as such, had lower levels of state anxiety than would be expected. Thus, particular emphasis would need to be made on assessing Ss in further studies as close as possible to their end of semester examinations, if this form of stressor is seen as relevant for further studies.

The studies pointed to the need for further clarification of various factors. Attentional biases are determined by the interaction of trait anxiety and stress, but these patterns are influenced by stimulus specificity and the chronicity of stress. Therefore, the central factors that required further examination were: the effects of the chronicity of stress; the effect of positive stimuli in comparison to social and physical threat stimuli, and the effect of a probe-detection paradigm.

5.4.4 Conclusions

The studies showed an inconsistent pattern of threat-related attentional biases under masked and conscious levels of processing. The lack of convergence in results across studies pointed to the conclusion that these unresolved issues required further examination. In particular, the differential effects of chronic and acute forms of stress called for further exploration. The effects of threatening and positive words needed to be evaluated independently. In Studies 1-3, positive words were a separate stimulus type. To exclude the possibility that the attentional biases to threat are simply
emotionality effects, it was concluded that future studies should include positive words in an independent category.

It was also concluded that the reliability of the findings should be assessed under an alternative information-processing paradigm. It was considered that a developmental comparison of trait-linked threat-related attentional biases would be a novel contribution to the understanding of these processes. The probe-detection paradigm has been considered to be an appropriate measure of selective attention to threat in adults (Williams et al., 1988) and in children older than 9 years (Vasey, 1996). With younger children, it is uncertain to what extent words represent threat and therefore, testing children with well-established verbal knowledge and experience was considered most appropriate. The probe-detection task has been used in many of the central studies in this area to assess attentional biases to threat-related stimuli (MacLeod & Mathews, 1988; MacLeod et al., 1986; Mogg et al., 1994; Mogg et al., 1990; Mogg, Mathews, & Eysenck, 1992; Vasey, 1996). The Stroop paradigm has been thought to assess the interference of emotional stimuli. In contrast, the probe-detection paradigm has been considered to identify the extent to which individuals shift their attention based on the emotionality or threat of the stimuli. It was considered that the probe-detection task would allow comparisons between the two paradigms and identify whether reliability of these research findings was related to the paradigms.
CHAPTER 6

EXPERIMENT 4
CHAPTER 6

EXPERIMENT 4

6.1 Introduction

Studies 1-3 produced mixed support for the proposition that selective attention to threat is dependent on the interaction of state and trait anxiety. The interactions between trait anxiety and stress were different across studies, and the avoidance in high trait anxious individuals under stress was particularly unexpected. Several areas were highlighted for clarification. The differential effects of chronic and acute forms of stress required further exploration, as did the extent to which positive and threatening information produced different attentional effects. Thus, it was concluded that the effects of threatening and positive words should be evaluated independently, using a probe-detection paradigm. As both high and chronic stress produced similar attentional biases in Study 3, these conditions were expected to elicit similar effects in this study. It was considered that social threat, physical threat, and positive words should be employed. It was expected that social threat words would be linked to Ss’ domain of concern, particularly under elevated stress. Although the evidence for emotionality effects is mixed, most studies have not found such effects. As such, no specific experimental prediction was formulated for these stimuli.

6.1.1 Aims and Experimental Hypotheses

The aim of this study was to compare threat-related attentional biases across high and low trait anxious adults using a probe-detection paradigm. The study aimed to establish
a baseline for comparison with data from children (see Experiment 5) and so was
designed allow such comparisons. The same theoretical model addressed in the previous
studies was evaluated in this study. Therefore, the central predictions of this study
mirrored those of the initial three experiments. As this study used different stimulus
types from Studies 1-3, Hypothesis 3 incorporated this difference.

1. Attentional biases to threat-related information will be dependent on an interaction
   of trait anxiety differences and by elevations in state anxiety. More specifically, as
   the result of state anxiety elevations triggered by both acute and chronic stress, high
   trait anxious individuals will attend to threatening information and low trait anxious
   individuals will allocate attention away from threatening information.

2. These trait anxiety-related attentional biases, elicited by elevations in state anxiety,
   will be identified at unconscious and conscious levels of processing.

3. These trait anxiety-related attentional biases will be identified more for threatening
   information in the individuals’ domain of concern than for information unrelated to
   their domain of concern. The predicted pattern of attentional biases, outlined in
   Hypothesis 1, will be observed more for social threat words than physical threat
   words or positive words.
6.2 Method

6.2.1 Design

In this study, each subject completed the probe-detection task under all three stress conditions. Under low stress, Ss were exposed to a relaxation procedure. In contrast to the previous studies, under high stress, Ss completed a speeded arithmetic task and negative self-statements. Chronic stress was induced by the build up of academic concerns over an academic semester and proximity to examinations.

As Studies 4 and 5 were designed to allow comparison of data from adults and children, the acute stress mood induction procedures were required to be equally appropriate for adults and children. It was considered that the deception involved in the anagram task from the previous three experiments held ethical difficulties that precluded its use with children. Thus, alternative tasks that have been shown to produce increases in state anxiety were employed in these two studies, and are described the section on Mood Induction Procedures in this Chapter. The chronic stress task employed was proximity to examinations, despite the difficulties identified in the previous study. Few naturally occurring chronic stressors can be identified for adults and children that are as comparable or as appropriate for these studies as examinations. This stressor has been used widely in research in this area to date with general success. As indicated in the previous study, it is possible that there needs to be greater emphasis on ensuring testing occurs in very close proximity to the examinations. Subsequently, in Studies 4 and 5, Ss were tested as close as possible to their examinations.
Only partial counterbalancing of the order of the three testing conditions was possible. Subjects completed testing under chronic stress first, at the end of the first semester, in the week before their examinations. Students then completed the low and high stress conditions in random order in the first six weeks of the next semester (7-9 weeks before their examinations), a period of low stress. To match the descriptions of Studies 3, in describing changes in attentional biases or state anxiety across the studies, reference is made to changes from low to high to chronic stress.

In this mixed-design, the between-subjects independent variable was trait anxiety (high vs low). The within-subjects independent variables were stress condition (low vs high vs chronic), exposure mode (masked vs unmasked condition), word-type (social vs physical vs positive word), word-position (threat word presented on the top half of the screen vs threat word presented on the bottom half of the screen), and probe-position (probe presented on the top half of the screen vs probe presented on the bottom half of the screen). Word-type was equivalent to specificity in Studies 1-3. Social threat, physical threat, and positive words were used in Study 4, as opposed to exam and non-exam related words in the previous studies. These words were paired with the same neutral word at each presentation. Word-position and probe-position were counterbalanced so that each word pair was presented in each of the four possible combinations. Attentional bias was determined by the pattern of these factors. Interactions involving trait anxiety, stress, word-type, word-position and probe-position were equivalent to interactions involving trait anxiety, stress, and threat.
The dependent variable was the RT to visual probes appearing in screen locations previously occupied by stimulus words. Thus, the dependent variable was the latency (in ms) between the presentation of the dot probe (which replaced the stimulus words) and the subject pressing the appropriate key. This measured the time taken for Ss to shift their attention from one of the two stimulus words to the subsequent probe. Median (as opposed to mean) RTs of the words were calculated for each subject to minimise the effect of outliers. Each individual’s median RTs for the word groups were used in analyses of variance to determine the attentional patterns across the two trait anxiety groups. Emotional indices were created to assist in descriptions of the patterns. These were computed by subtracting the latencies to emotional words when the target words and the probe were presented in the same position, from the latencies recorded when the target words and the probe were displayed in different positions. Subsequently, positive latencies on the emotional index indicated attentional bias to the emotional words. Negative latencies indicated attentional biases towards the neutral words or avoidance of the emotional words.

The premise of the probe-detection paradigm is that it assesses RTs to emotionally neutral stimuli (the probes) and so avoids the methodological problems that result from the assessment of RTs to emotional information. If individuals have greater reactivity to particular target words, longer RT latencies to those words are observed when the target words and the probe are in different positions than when the target words and the probe are in the same position. When individuals attend more to the emotional word than the
neutral word, it takes longer to shift their attention to detect the probe when the emotional word and the probe are presented in different positions. When they attend more to the neutral word than the emotional word or avoid the emotional word, it takes longer to shift their attention to detect the probe when the emotional word and the probe are presented in the same positions.

The designs of the probe-detection and emotional Stroop tasks were matched. Stimuli were presented as often in each task. In the probe-detection task, there were 12 words used for each of the three target stimulus word-types. Each word was presented four times in the masked and unmasked formats. Neutral words were paired with emotional words. Apart from the use of the probe-detection paradigm instead of the Stroop paradigm, the central difference was the use of three forms of emotional words in Studies 4 and 5. The word stimuli were chosen to reflect the general categories of social and physical threat. Positive words were included to test for the presence of emotionality effects. The stress conditions were chosen to match the stimulus word list.

6.2.2 Subjects

A sample of 50 adults was drawn from a larger initial sample of 150 undergraduate university students. Subjects were chosen based on their STAI-T scores. Those with mid-range STAI-T scores of 35 to 44 inclusive were excluded to ensure that the two groups were substantially different in their levels of trait anxiety. Five of the initial 50 Ss were excluded as they did not complete testing under all three stress conditions. A
further five Ss were excluded because the mean of their RTs was greater than 2 $SD$s from the mean of the RTs of the sample and because a substantial proportion of their median RTs for the word categories was greater than 1000 ms. The remaining 40 adults (mean age = 18.23 years) completed the testing under the three forms of stress. In this final sample, the ratio of females (f) to males (m) in each group was: high trait anxious: 16 f: 4 m; low trait anxious: 18 f: 2 m. Descriptive data are presented in Table 6.1.

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>Sample Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Trait Anxious</td>
</tr>
<tr>
<td>AGE</td>
<td>18.05</td>
</tr>
<tr>
<td>Trait Anxiety (STAI-T)</td>
<td>50.05</td>
</tr>
</tbody>
</table>

Comparisons between STAI-T scores showed high trait anxious Ss had higher levels of trait anxiety than did low trait anxious Ss, $F (1, 38) = 236.98$, $p < .001$. Comparisons of the mean age of Ss revealed no significant differences between the groups, $F (1, 38) = 3.96$, $p = .054$, ns, although the result bordered on significance.
6.2.3 Materials

The STAI-T measured trait anxiety. The STAI-S measured state anxiety after the mood induction procedures in the high and low stress testing conditions.

Stimulus Words

Thirty-six emotional and neutral word pairs were selected (see Table 6.2). These words were drawn from a pilot study, which is described in full in Appendix J. In the pilot study, 114 emotional words were rated for valence by 146 individuals aged 12-18 years. Of these Ss, 65 were aged 18 years, 22 were aged 16 years, 25 were aged 14 years, and 34 were aged 12 years. None of the individuals in the pilot study were involved in the experimental studies. Subjects’ educational settings were similar to those of Ss in the current studies. The words were in three categories: social threat (e.g. fail), physical threat (e.g. war), and positive (e.g. relaxed). A list of categorised neutral words (house, furniture, and substance related) was also presented to these Ss for rating. Categorised neutral words were used to match the fact that emotional words were also categorised, and control for any possible effects associated with this factor. The 12 emotional words from each category that produced the highest ratings for all the age groups were chosen. The 12 neutral words from each category that produced mean emotionality ratings closest to neutral across all age groups were chosen. As can be seen in Table 6.2, the words in each category of neutral words were evenly allocated to pair with emotional words. When ratings of emotional and neutral word pairs were compared, each emotional word type (social, physical, and positive) showed
significantly more emotional valence than did their paired neutral words. Emotional and neutral words were equivalent in their frequency of use in written English. The groups of threat and neutral words were equivalent in the average length of the words.
Table 6.2. Experiment 4. Stimulus word pairs used in the probe-detection task (neutral words in italics)

<table>
<thead>
<tr>
<th>Physical Threat</th>
<th>Social Threat</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>war</td>
<td>fail</td>
<td>relaxed</td>
</tr>
<tr>
<td>tin</td>
<td>seat</td>
<td>picture</td>
</tr>
<tr>
<td>killed</td>
<td>hate</td>
<td>great</td>
</tr>
<tr>
<td>candle</td>
<td>coal</td>
<td>walls</td>
</tr>
<tr>
<td>molest</td>
<td>expelled</td>
<td>award</td>
</tr>
<tr>
<td>timber</td>
<td>concrete</td>
<td>desks</td>
</tr>
<tr>
<td>drown</td>
<td>pathetic</td>
<td>success</td>
</tr>
<tr>
<td>metal</td>
<td>bathroom</td>
<td>leather</td>
</tr>
<tr>
<td>accident</td>
<td>poor</td>
<td>cuddles</td>
</tr>
<tr>
<td>cupboard</td>
<td>roof</td>
<td>windows</td>
</tr>
<tr>
<td>crash</td>
<td>dumb</td>
<td>happy</td>
</tr>
<tr>
<td>table</td>
<td>lamp</td>
<td>rocks</td>
</tr>
<tr>
<td>die</td>
<td>lonely</td>
<td>prize</td>
</tr>
<tr>
<td>rug</td>
<td>cement</td>
<td>fence</td>
</tr>
<tr>
<td>dead</td>
<td>retarded</td>
<td>friend</td>
</tr>
<tr>
<td>step</td>
<td>chimneys</td>
<td>stones</td>
</tr>
<tr>
<td>bomb</td>
<td>moron</td>
<td>lucky</td>
</tr>
<tr>
<td>wood</td>
<td>brick</td>
<td>house</td>
</tr>
<tr>
<td>bushfires</td>
<td>reject</td>
<td>clever</td>
</tr>
<tr>
<td>verandas</td>
<td>carpet</td>
<td>mirror</td>
</tr>
<tr>
<td>kidnapped</td>
<td>bully</td>
<td>secure</td>
</tr>
<tr>
<td>buildings</td>
<td>bench</td>
<td>clocks</td>
</tr>
<tr>
<td>burnt</td>
<td>vomit</td>
<td>kind</td>
</tr>
<tr>
<td>chair</td>
<td>chalk</td>
<td>salt</td>
</tr>
</tbody>
</table>

The pilot study also developed practice words for the probe-detection task. The practice word set (Appendix K) comprised 4 words in each of 3 categories; social threat, physical threat, and positive words, with 12 target practice words in total. Each was paired with 1 of 12 neutral words. The target and neutral practice words were not used in the stimulus presentation.
Mood Induction Materials

This study employed the low and high stress \textit{MIPs} developed in a pilot study (see Appendix L). In the pilot study, 17 adult undergraduates (mean age = 18.71 years) completed the low and high stress mood induction procedures. In the high stress \textit{MIP}, two parts were presented on computer: Velten-like anxiety-related self-statements (Chartier & Ranieri, 1989; Martin, 1990; Slyker & McNally, 1991) and an increasingly difficult arithmetic task adapted from the \textit{PASAT} (Dyche & Johnson, 1991; Ward, 1997). The low stress \textit{MIP} involved a standard relaxation task (Appendix H). There has been some concern expressed by some researchers that Velten procedures may not be consistently effective as their transparency may increase demand effects. However, the pilot study (Appendix L) demonstrated that the combination of the two acute stressors produced significant increases in state anxiety without the use of deception-based methods. Subjects experienced the low and high acute stress conditions in a random order. Both high and low trait anxious Ss showed significant increases in state anxiety from low to high stress and the \textit{MIPs} were as effective with low trait anxious as high trait anxious Ss.

Presentation Hardware and Software

The mood induction procedures, probe-detection trials and masked word awareness-check trials were presented on 486 MHZ personal computers in letters 1 cm high on high resolution \textit{SVGA} colour monitors. \textit{DMASTR} software was used to control the stimulus presentation and record RTs in the probe-detection conditions and number of
errors made in the awareness-check trials. *DMASTR* was developed at Monash University and at the University of Arizona by K.I. Forster and J.C. Forster (1975).

**Measurement of Processing Biases**

This study employed a probe-detection task. A variation of the standard task was employed as it allows more confidence in the claim that selective attention is measured, and that the effects are not due to interference or simple awareness of threat. In this task, threatening and neutral words were displayed simultaneously. They were presented on the computer screen in two formats: for 28 ms followed by a mask for 472 ms (allowing only non-conscious processing), and for 500 ms (allowing conscious processing).

Following the presentation of threat and neutral words, a probe was presented where one of the words had been displayed. Subjects were required to identify whether a one or two dot probe replaced one of the stimulus words on the screen, and press an appropriate key on the computer keyboard. The latency is fastest when the subject has been attending to the word replaced by the probe. By measuring RT, dependent on word and probe position, the task demonstrates whether the subject was attending to threat-related words or avoiding threatening stimuli by focusing on non-threat words. Descriptions of and instructions for the probe-detection task are presented in Appendix M.
6.2.4 Procedure

Presentation of Stimuli

Each of the 12 emotional words in the three stimulus categories was presented in the masked and unmasked presentation modes, which consisted of 144 trials each. These trials presented the words in a predetermined, quasi-randomised order with respect to word type (social threat, physical threat and positive words), word-position (top or bottom section of the monitor), and probe-position (top or bottom section of the monitor). Each target word was presented with the corresponding paired neutral word. To minimise responses due to fatigue, both masked and unmasked trials included four rest periods that allowed Ss to take a break and return to the task when they were ready.

In studies similar to those undertaken in this series, masked and unmasked stimuli have been presented either in quasi-random formats, such as in the initial three studies, or in blocked formats, with masked and unmasked words presented separately. Quasi-random formats have been considered to deal effectively with possible order effects. To date however, order effects have not been routinely reported in studies that have used blocked or randomised presentations, and thus it appears to be more a theoretical issue than a practical issue in this domain. However, it has been considered by some researchers that the quasi-random presentation of masked and unmasked stimuli may increase priming for some words. Specifically, the presentation of unmasked words before masked words of the same content in a sequence of presentations, as seen in quasi-random formats, may lead to the increased priming of the word content.
Potentially, this increased priming may lead to masked words being more available to conscious recognition than if masked words were presented in a block before unmasked words, or to greater responsiveness to masked data due to the increased priming. Such a result would complicate the interpretation of data. Therefore, in Studies 4 and 5, it was considered that presentation of masked words, presentation of an awareness check, and then followed by unmasked words, was the most appropriate method to prevent such priming effects and this order of presentation was therefore employed.

Practice Trials

Before the unmasked and masked trials, practice trials took place to allow Ss to become accustomed to the task. For both masked and unmasked trials, 16 practice trials were presented before the onset of the probe-detection trials proper to allow Ss to become familiar with the task. Practice also allowed Ss time to establish some consistency in responses before the test trials. Two practice trials were inserted after each break, before the test trials, to allow for time in the re-establishing of consistency in responses. For the masked and the unmasked presentations, there were 24 practice trials in each form of stimulus presentation. Each of the 12 practice emotional and neutral word pairs was presented twice. The variations of stimulus presentation were presented in equal proportions: emotional word top + probe top, emotional word top + probe bottom, emotional word bottom + probe top, emotional word bottom + probe bottom.
Masked Presentations

The masked condition was presented first. A central fixation-cross appeared for 500 milliseconds at the beginning of each trial. The cross was replaced by a word pair, (one word presented 2 cm above and one 2 cm below the cross) for 28 ms. The word pair was followed by a mask of symbols, $&$&$&, which varied in length to match the length of the target and neutral words. The masks were displayed for 472 ms, to prevent conscious identification of the words. After 472 ms the masks were replaced with a one or two dot probe in the position where one of the words was displayed. Subjects responded to whether one or two probes had appeared by pressing the corresponding left or right shift keys on the computer keyboard as quickly as possible.

Awareness-Check Trials

Awareness-check trials were presented second to determine whether the Ss could consciously identify the words presented under masked exposure. In the awareness-check trials, Ss responded to whether the two words presented were the same or different from each other by pressing the corresponding left or right shift key. The DMASTR software identified incorrect responses by allocating them a negative RT, and a correct response with a positive RT. As there was half the number of trials in this section as in the masked section, the awareness-check trials included only two rest periods.
Seventy-two awareness-check trials were presented. The presentations involved an equal number of trials where the same word pairs were presented and trials where different word pairs were presented. In the trials where different words were presented, the stimulus word pairs were used. In 36 trials, these pairs were presented once each. In half, the emotional word was presented on the top half of the screen and in half, the emotional word was presented on the bottom half of the screen. In the other 36 awareness-check trials, two identical words were presented. These word pairs were constructed by taking a random selection of 18 emotional and 18 neutral words from the stimulus words (see Table 6.2). These individual words were repeated in a pair. In these trials, Ss were required to identify if two different words or two identical words were presented. All words were presented in the same format as in the masked presentations and identical masking was used.

The awareness-check items were presented in a block in the probe-detection task rather than being integrated, as in the Stroop task. The probe-detection task presented stimuli with the masked stimuli first, the awareness-check section second, and the unmasked stimuli last. This order was held constant to avoid the priming of the masked stimuli by showing the unmasked material at the start of the study.

Arguments for and against using the actual target stimuli in the awareness-check trials can be established. Using target words in the awareness-check trials allowed for confidence in the assessment of performance on the awareness-check task. However,
increased exposure to the stimuli may have also increased the priming of those words, which were presented at a later point in the unmasked trials. As Studies 1-3 used the test words in the awareness-check trials, it was considered that the comparability of the studies was essential and so the test words were employed in the awareness-check task.

Before the awareness-check trials, practice trials took place to allow Ss to become accustomed to the task. Twelve practice trials were presented before the onset of the trials to allow Ss to become familiar with the task and to allow time to establish some consistency in response before the test trials. The 12 practice trials were developed by using six word pairs drawn from the practice emotional and neutral word pairs (Appendix K), and using 3 emotional words and 3 neutral words from this list to construct trials where two identical words were presented. Two practice trials were inserted after each break, before the test trials, to allow for time in the re-establishing of consistency in responses. These four word pairs with similar themes were created independent of any other list of words.

Unmasked Presentations

The third section was the unmasked presentations. The trials of the unmasked word presentation followed a similar structure as the masked presentation, with the word pairs being presented for 500 ms without a mask, to allow conscious identification of each of the words. The unmasked words were replaced with either a one-dot-probe or a two-dot-probe. The probe was positioned 2cm above or below the centre point of the screen, and
replaced one of the words. The position of the target words and subsequent probes in the top or bottom half of the screen was randomised. Subjects responded to whether one or two probes had appeared by pressing the corresponding left or right shift keys as quickly as possible. Descriptions of and instructions for the probe-detection task are presented in Appendix M.

**Stress Conditions**

In this study, $S$s carried out testing under chronic stress first, and then undertook testing under the high or low stress condition. Under low stress, $S$s undertook the relaxation task for 5 minutes and were allocated a shorter time in each break to maximise their levels of relaxation.

During the high stress testing sessions, $S$s were asked to focus on and experience as intensely as possible 12 anxiety-related self-statements (e.g., I feel nervous) which were presented for 10 seconds each. Subjects then completed an arithmetic task that progressively increased in difficulty. The high stress $MIP$ lasted approximately 7 minutes. Subjects then completed the $STAI-S$. Subjects completed the masked trials and the awareness-check trials. They then completed a shortened version of the stress induction procedures, which included six anxiety self-statements that were presented for 10 seconds each, and 2 minutes of the arithmetic task. These were presented to maintain elevated levels of state anxiety. They then completed the unmasked probe-detection condition.
Testing was undertaken within one week of Ss examinations in the chronic stress conditions. Due to concerns raised in Study 3 regarding the lower-than-optimum levels of state anxiety in the chronic stress condition, Ss were tested as close as possible to their end of semester examinations.
6.3 Results

Three aspects of the data are presented. First, the validity of the stress manipulation is established. Second, the validity of the backward masking procedure is assessed. If these two assumptions are validated, the probe-detection RT data can be evaluated.

6.3.1 State Anxiety Manipulation

As can be seen in Table 6.3, despite an overall difference between groups in state anxiety scores in each stress condition, the increase in state anxiety scores from low to chronic stress was not as large as that from low to high stress. Unexpectedly, state anxiety levels were similar for high and low trait anxious individuals under high stress.

A repeated-measures analysis of variance of state anxiety scores was carried out, with trait anxiety group and stress constituting the independent variables. There was a significant effect of trait anxiety group, $F (1, 38) = 12.59, p < .01$, with high trait anxious Ss having higher levels of state anxiety in all conditions than did low trait anxious Ss. There was a significant main effect of stress condition, $F (2, 37) = 16.12, p < .001$, and a significant interaction between stress and trait anxiety group, $F (2, 37) = 3.5, p < .05$. Therefore, there was a differential pattern of state anxiety across the three stress conditions for the two trait anxiety groups. This is most likely related to the pronounced increase in state anxiety in low trait anxious Ss from low to high stress and their decrease from high to chronic stress. Although this pattern was observed in high trait anxious individuals, the pattern was less extreme.
Table 6.3. Experiment 4. State anxiety levels in high and low trait anxious adults under low, high, and chronic stress

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>Both Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>High Trait Anxious</td>
<td></td>
</tr>
<tr>
<td>State Anxiety (STAI-S) - Low Stress</td>
<td>45.40 (9.85)</td>
</tr>
<tr>
<td>Low Trait Anxious</td>
<td></td>
</tr>
<tr>
<td>State Anxiety (STAI-S) - High Stress</td>
<td>51.25 (10.17)</td>
</tr>
<tr>
<td>- Chronic Stress</td>
<td></td>
</tr>
<tr>
<td>State Anxiety (STAI-S)</td>
<td>47.35 (10.75)</td>
</tr>
</tbody>
</table>

Comparisons of state anxiety scores across low, high and chronic stress through Helmert's contrasts indicated that there were significant differences between state anxiety scores in high stress and chronic stress, $F(1, 38) = 14.58, p < .001$. The comparisons also showed that state anxiety scores in both of these stress conditions were greater than the scores under low stress, $F(1, 38) = 27.76, p < .001$. Despite the relatively small increases from low to chronic stress, these proved to border on statistical significance, $F(1, 38) = 4.08, p = .05$. Based on examination of the results of the analysis, it was reasonable to accept this result as significant. This result indicated
that the assumption regarding chronic stress producing higher levels of state anxiety than low stress was upheld, however the stressor produced lower levels of anxiety than would be expected. There was a trend for state anxiety levels for both groups to be higher in this study than in Study 3, although no formal comparisons were made across the studies.

In summary, the assumption that state anxiety would be elevated by the manipulation of stress conditions was supported. The different stress conditions produced findings that were slightly different to expectations, and were similar to those seen in Experiment 3. However, both high and chronic stress produced higher levels of state anxiety than low stress. The actual levels of state anxiety under chronic stress were somewhat higher in this experiment than in Experiment 3. This indicated that testing Ss as close as possible to their end of semester examinations may have led to Ss being tested under more appropriate levels of state anxiety.

6.3.2 Masking Procedure

A lexical decision task was undertaken to determine the efficacy of the masking procedure. The percentage of correct responses was calculated for each subject across the 72 trials. These data were subjected to statistical analyses to determine whether the percentage of correct responses was significantly different from chance.
Subjects were unable to identify whether the two words presented were the same or different from each other. A repeated-measures analysis of variance revealed nonsignificant effects for the lexical decision task as a function of stress condition (low, high or chronic), $F(2, 76) = 0.20, p = .82, ns$, or the interaction of trait anxiety and stress, $F(2, 76) = 0.46, p = .64, ns$. There was a significant main effect for trait anxiety (high or low), $F(1, 38) = 6.45, p < .05$. High trait anxious $S$s produced a mean percentage correct of 48.43 ($SD = 3.96$) and low trait anxious $S$s produced a mean percentage correct of 51.19 ($SD = 2.83$).

Across all $S$s for all stress conditions, the mean percentage of correct responses on the lexical decision task was 49.81 ($SD = 3.67$). The accuracy of responses was not significantly different to the 50% expected by chance, $t(39) = 0.33, p = .74, ns$. Therefore, masking was effective in preventing conscious awareness of the word stimuli.

With the assumptions upheld, probe-detection data were considered.

### 6.3.3 Probe-Detection Latency Data

For each subject, the software produced the individual RTs for each word pair presented. The median RT of the responses to each group of twelve words was then calculated for each experimental condition. The group means of these data are presented in Appendix N.
All RTs were initially subjected to a mixed-design analysis of variance, with trait anxiety group the between-subjects factor and the five within-subjects factors of stress condition, exposure mode, word-type, word-position, and probe-position. Word-type was the equivalent of specificity in Studies 1-3. There was no predicted interaction involving trait anxiety, stress, exposure, word-type, word-position, and probe-position, $F(1, 38) = 0.83, p = .51, ns$. Other main and interactional effects can be seen in Table 6.4.

The combined interaction of trait anxiety, stress, word-position, and probe-position was found. It indicated that the pattern extended across positive and threat words, and across both exposure conditions. High trait anxious Ss showed attention to emotional words under low stress ($M = 9.43, SD = 11.17$), and then a reduction in attention to emotional words under high stress ($M = 1.67, SD = 12.44$), and slight increase under chronic stress ($M = 3.69, SD = 10.14$). In contrast, low trait anxious Ss showed some avoidance of emotional words under low stress ($M = -2.95, SD = 18.89$), and then an increase in attention to emotional words under high stress ($M = 3.63, SD = 14.63$) and chronic stress ($M = 3.49, SD = 9.0$). This result indicated that under both exposure conditions, high and low trait anxious Ss showed a divergent pattern of responses to emotional words in general, irrespective of the valence and the word type.

High trait anxious Ss showed decreased attention to emotional words from low stress to higher forms of stress, whereas low trait anxious Ss generally increased their attention.
to emotional words from low to higher forms of stress. Importantly, the pattern of results also appears to reflect levels of state anxiety. Based on the results of the stress manipulation, high trait anxious Ss showed more attention to emotional words at lower levels of state anxiety (in the low and chronic stress conditions) and less attention to these words at higher levels of anxiety (in the high stress condition). In contrast, low trait anxious Ss showed more attention to emotional words under high levels of state anxiety (in the high stress condition) and less under the low levels of state anxiety (in the low stress condition). These emotionality responses demonstrate divergent patterns of attentional biases to generally emotional material, dependent on levels of trait and state anxiety, and indicates higher state anxiety in high trait anxious individuals generally leads to avoidance of emotional material. Conversely, higher state anxiety in low trait anxious individuals leads to attention to the emotional information. The presence of this emotionality effect may influence the interpretation of findings to specific word types, as it indicates that attention biases were not specific to threatening words, but that distinct patterns in high and low trait anxious individuals were seen to both threatening and positive words.

As in previous experiments, the masked and unmasked data were subsequently analysed separately and presented in the forthcoming sections.
Table 6.4. Experiment 4. Inferential data for reaction times from analysis of variance.

<table>
<thead>
<tr>
<th>EFFECT</th>
<th>DF</th>
<th>F</th>
<th>SIG.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress</td>
<td>1, 38</td>
<td>5.23</td>
<td>.028</td>
</tr>
<tr>
<td>Probe-position</td>
<td>1, 38</td>
<td>5.52</td>
<td>.024</td>
</tr>
<tr>
<td>Exposure x word-type</td>
<td>1, 38</td>
<td>10.77</td>
<td>.002</td>
</tr>
<tr>
<td>Stress x exposure x word-position</td>
<td>1, 38</td>
<td>5.05</td>
<td>.031</td>
</tr>
<tr>
<td>Stress x probe-position</td>
<td>1, 38</td>
<td>5.07</td>
<td>.03</td>
</tr>
<tr>
<td>Stress x exposure x probe-position</td>
<td>1, 38</td>
<td>5.29</td>
<td>.027</td>
</tr>
<tr>
<td>Exposure x word-type x word-position x probe-position</td>
<td>1, 38</td>
<td>8.44</td>
<td>.006</td>
</tr>
<tr>
<td>Word-type x word-position x probe-position</td>
<td>1, 38</td>
<td>7.64</td>
<td>.036</td>
</tr>
<tr>
<td>Trait anxiety x stress x word-position x probe-position</td>
<td>1, 38</td>
<td>4.72</td>
<td>.036</td>
</tr>
</tbody>
</table>

6.3.4 Masked Variables

Hypotheses 1 and 2: Trait Anxiety by Stress Interaction; Preconscious Processing

When masked RTs were considered separately in a mixed-design analysis of variance, the predicted interaction between trait anxiety, stress condition, word-type, word-position and probe-position did not prove significant, $F (4, 35) = 0.38, p = .82, ns$. However, there was a significant interaction involving trait anxiety, stress, word-position, and probe-position, $F (2, 37) = 4.4, p < .05$. Although there was evidence of a pattern, the pattern was not influenced by word-type. As in the previous finding, although the interactional pattern is suggestive of a possible emotionality effect, the pattern did not specifically address attention to threat but involved both threat and positive words. Thus, the result does not deal directly with the hypotheses but could be explored further outside this research.
In addition to this interaction, there were main effects for: stress, $F(2, 37) = 6.04, p < .01$; word-type, $F(2, 37) = 5.06, p < .05$; and probe-position, $F(1, 38) = 5.69, p < .05$. There were also interactional effects for word-position by probe-position, $F(1, 38) = 4.4, p < .05$, and word-type by word-position by probe-position, $F(2, 37) = 9.72, p < .001$.

The emotional indices for masked variables are shown in Table 6.5 and these data are then presented in Figures 6.1, 6.2, and 6.3. Analyses testing the specificity hypothesis then follow in Section 6.3.5.

**Table 6.5.** Experiment 4. Emotional indices for high and low trait anxious adults for masked emotional words

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>High Trait Anxious</th>
<th>Low Trait Anxious</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>LOW MASKED SOCIAL THREAT INDEX</td>
<td>25.98 (33.19)</td>
<td>1.64 (28.31)</td>
</tr>
<tr>
<td>HIGH MASKED SOCIAL THREAT INDEX</td>
<td>19.30 (31.48)</td>
<td>8.99 (43.81)</td>
</tr>
<tr>
<td>CHRONIC MASKED SOCIAL THREAT INDEX</td>
<td>10.13 (26.92)</td>
<td>11.36 (29.68)</td>
</tr>
<tr>
<td>LOW MASKED PHYSICAL THREAT INDEX</td>
<td>-18.34 (28.66)</td>
<td>-19.35 (33.29)</td>
</tr>
<tr>
<td>HIGH MASKED PHYSICAL THREAT INDEX</td>
<td>-20.30 (27.07)</td>
<td>-7.41 (43.81)</td>
</tr>
<tr>
<td>CHRONIC MASKED PHYSICAL THREAT INDEX</td>
<td>-11.51 (34.77)</td>
<td>-.57 (21.86)</td>
</tr>
<tr>
<td>LOW MASKED POSITIVE THREAT INDEX</td>
<td>24.96 (26.68)</td>
<td>5.59 (30.50)</td>
</tr>
<tr>
<td>HIGH MASKED POSITIVE THREAT INDEX</td>
<td>17.59 (28.85)</td>
<td>7.31 (39.83)</td>
</tr>
<tr>
<td>CHRONIC MASKED POSITIVE THREAT INDEX</td>
<td>19.40 (24.75)</td>
<td>10.46 (21.14)</td>
</tr>
</tbody>
</table>
Figure 6.1. Experiment 4. Emotional indices for masked social words for high and low trait anxious adults under low, high, and chronic stress.

Figure 6.2. Experiment 4. Emotional indices for masked physical words for high and low trait anxious adults under low, high, and chronic stress.

Figure 6.3. Experiment 4. Emotional indices for masked positive words for high and low trait anxious adults under low, high, and chronic stress.
6.3.5 Masked Social, Physical and Positive Stimuli

Hypothesis 3: Specificity

When all the masked variables were included in the analyses, there were no significant interactions involving word-type. To address the prediction concerning specificity, and to determine whether the predicted attentional biases to threat were present, masked social, physical, and positive words were subjected to separate analyses of variance. These analyses are equivalent to the planned comparisons undertaken in Studies 1-3 to address the specificity hypothesis. For masked variables, the predicted interaction involved masked social threat words, which is presented in Figure 6.4.

Masked Social Threat Words

When the responses to masked social words were considered alone, there was a significant interaction between trait anxiety, state anxiety, probe-position, and word-position, \( F (2, 37) = 5.09, p < .05 \). As shown in Figure 6.4, high and low trait anxious Ss produced the opposite pattern across the three forms of stress. In response to stress elevation, high trait anxious Ss showed decreased attention to social threat and low trait anxious Ss increased their attention to social threat. Both groups showed an equivalent level of attentional bias under chronic stress. There was also a main effect for probe-position, \( F (1, 38) = 8.35, p < .01 \), stress, \( F (2, 37) = 6.21, p < .01 \), and an interaction between word-position and probe-position, \( F (1, 38) = 10.93, p < .01 \).
Figure 6.4. Experiment 4. Interaction of trait anxiety, stress, probe-position, and word-position for masked social words.

To determine the significance of the responses to threat, post hoc analyses were undertaken. At the adjusted alpha level of .008, high trait anxious S's vigilance for masked social threat under low stress was significant, \( t(19) = 3.5, p = .002 \), and there was a trend for high trait anxious S's to show vigilance for masked social threat under high stress, \( t(19) = 2.74, p < .05 \). The pattern demonstrates that in high trait anxious S's,
there was vigilance for social threat words under low stress, but reduced attention to threat under high and chronic stress. In low trait anxious Ss, there was a trend for increased vigilance from low to high to chronic stress. Although demonstrating a significant counter-intuitive pattern, the results did not support any of the three predictions.

**Masked Physical Threat Words**

When masked physical words were considered alone, there were no interactions involving trait anxiety, state anxiety, probe-position, and word-position. There was a main effect for stress, $F(2, 37) = 5.09, p < .01$, and an interaction between word-position and probe-position, $F(2, 37) = 14.95, p < .001$. Although not significant, as seen in Figure 6.2, both groups avoided physical threat words under all conditions, but generally allocated more attention to threat from low to high to chronic stress.

**Masked Positive Words**

When masked positive words were considered alone, there were no interactions involving trait anxiety, state anxiety, probe-position, and word-position. When positive words were considered alone, there was a main effect for stress, $F(2, 37) = 6.49, p < .01$, and an interaction between word-position and probe-position, $F(1, 38) = 8.76, p < .01$. As can be seen in Figure 6.3, there was a nonsignificant pattern where both groups generally attended to positive words across stress conditions.
6.3.6 Unmasked Variables

**Hypotheses 1 and 2: Trait Anxiety by Stress Interaction; Conscious Processing**

When all unmasked RTs were considered separately in a mixed-design analysis of variance, the predicted interaction between trait anxiety, stress condition, word-type, word-position, and probe-position did not prove significant, $F (4, 35) = 1.16, p = .34$. There were no other interactions involving trait anxiety and stress, and no main effects. There was a significant interaction involving stress and probe-position, $F (2, 37) = 6.1, p < .01$. The emotional indices for unmasked variables are presented in Table 6.6 and these data are presented in Figures 6.5, 6.6, and 6.7.

### Table 6.6. Experiment 4. Emotional indices for high and low trait anxious adults for unmasked words

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>High Trait Anxious</th>
<th>Low Trait Anxious</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOW UNMASKED SOCIAL THREAT INDEX</strong></td>
<td>19.91 (34.89)</td>
<td>.86 (37.84)</td>
</tr>
<tr>
<td><strong>HIGH UNMASKED SOCIAL THREAT INDEX</strong></td>
<td>.83 (33.49)</td>
<td>6.49 (44.36)</td>
</tr>
<tr>
<td><strong>CHRONIC UNMASKED SOCIAL THREAT INDEX</strong></td>
<td>2.10 (31.20)</td>
<td>.44 (44.19)</td>
</tr>
<tr>
<td><strong>LOW UNMASKED PHYSICAL THREAT INDEX</strong></td>
<td>-10.86 (32.71)</td>
<td>-7.51 (30.28)</td>
</tr>
<tr>
<td><strong>HIGH UNMASKED PHYSICAL THREAT INDEX</strong></td>
<td>-1.49 (33.08)</td>
<td>-10.35 (48.48)</td>
</tr>
<tr>
<td><strong>CHRONIC UNMASKED PHYSICAL THREAT INDEX</strong></td>
<td>-3.78 (37.92)</td>
<td>-3.68 (47.75)</td>
</tr>
<tr>
<td><strong>LOW UNMASKED POSITIVE THREAT INDEX</strong></td>
<td>14.93 (29.98)</td>
<td>1.05 (42.39)</td>
</tr>
<tr>
<td><strong>HIGH UNMASKED POSITIVE THREAT INDEX</strong></td>
<td>-5.94 (34.12)</td>
<td>16.77 (52.25)</td>
</tr>
<tr>
<td><strong>CHRONIC UNMASKED POSITIVE THREAT INDEX</strong></td>
<td>5.83 (27.29)</td>
<td>2.93 (29.03)</td>
</tr>
</tbody>
</table>
Figure 6.5. Experiment 4. Emotional indices for unmasked social words for high and low trait anxious adults under low, high, and chronic stress.

Figure 6.6. Experiment 4. Emotional indices for unmasked physical words for high and low trait anxious adults under low, high, and chronic stress.

Figure 6.7. Experiment 4. Emotional indices for unmasked positive words for high and low trait anxious adults under low, high, and chronic stress.
6.3.7 Unmasked Social, Physical and Positive Stimuli

Hypothesis 3: Specificity

When all the unmasked variables were included in the analyses, there were no interactions involving word-type. Nevertheless, the trends seen in Figures 6.5, 6.6, and 6.7 required exploration of the levels of significance of these patterns to address the prediction concerning specificity. To determine whether the predicted interactions involving trait anxiety, stress, probe-position, and word-position could be detected for each word-type, unmasked social, physical, and positive words were subjected to separate analyses of variance. For unmasked variables, the predicted interaction was identified for unmasked positive words, which is presented in Figure 6.8.

Unmasked Social Threat Words

When unmasked social words alone were considered, there were no main or interactional effects found. Although not significant, Figure 6.5 shows a trend where high trait anxious Ss decreased attention of social words from low to high stress and low trait anxious Ss increased attention to these words from low to high stress.

Unmasked Physical Threat Words

When unmasked physical words were considered alone, there was a sole interaction between stress and probe-position, $F (2, 76) = 6.93$, $p < .01$, but no interactions involving trait anxiety and stress. Figure 6.6 shows the nonsignificant finding, where both high trait anxious and low trait anxious Ss generally avoided these words.
Unmasked Positive Words

Unmasked positive words produced a significant interaction between trait anxiety, stress, word-position and probe-position, $F(2, 76) = 3.35, p < .05$. There was also a main effect for probe-position, $F(1, 38) = 8.56, p < .01$. Figure 6.8 shows that high and low trait anxious Ss produced divergent patterns in response to positive words.

**Figure 6.8.** Experiment 4. Interaction of trait anxiety, stress, word-position, and probe-position for unmasked positive words.
As seen in this figure, high trait anxious Ss attended to positive words under low stress, showed avoidance under high stress, and showed increased attention to these words under chronic stress. In contrast, low trait anxious Ss showed increased attention to positive words from low to high stress, and decreased attention to these words from low to chronic stress.

To determine whether each of the threat indices was significant, post hoc analyses were undertaken. None were significant. At the adjusted alpha level of .008, high trait anxious Ss showed a trend for attention to unmasked positive threat under low stress, \( t(19) = 2.23, p < .05 \).

Although there was a significant interaction involving trait anxiety, stress, and threat for positive words, no specific prediction was proposed for these stimuli. The responses identified did not demonstrate the pattern predicted for threat words. However, this was an interesting feature of the data to be explored in another context.
6.4 Discussion

6.4.1 Summary of Findings

Hypothesis 1: Attentional biases to threat-related information will be dependent on an interaction of trait anxiety differences and by elevations in state anxiety. More specifically, as the result of state anxiety elevations, triggered by both acute and chronic stress, high trait anxious individuals will attend to threatening information and low trait anxious individuals will allocate attention away from threatening information.

The initial prediction was not supported. Masked social threat words alone produced a significant interaction involving trait anxiety, stress, and threat. In response to these stimuli, high trait anxious individuals showed decreased attention to threat from low to high to chronic stress. Low trait anxious individuals increased their attention to threat from low to high to chronic stress. This effect was the reverse of that predicted.

Hypothesis 2: Trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified at preconscious and conscious levels of processing.

This hypothesis was not supported. The significant pattern identified for social threat words was identified at a preconscious level of processing. High and low trait anxious Ss showed attention to threat across the three stress conditions. However, direction of the pattern identified was the reverse to predictions.
Hypothesis 3: These trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified more for threatening information that is in individuals' domain of concern.

This hypothesis was not supported. An interaction between trait anxiety, stress, and threat was found for masked social threat. However, the pattern identified across the stress conditions was the reverse of that predicted, and represented a decrease in attentional biases to social threat for high trait anxious adults. Rather than showing increased attention to threat with stress elevation, high trait anxious individuals showed decreased attention and low trait anxious individuals showed increased attention to threat. This was an intriguing counter-intuitive finding. Unmasked social threat showed a similar but nonsignificant pattern to that produced by masked social threat, with high trait anxious individuals showing decreased attention to threat from low to high stress.

Although unmasked positive words produced a significant interactional effect, the pattern differed both from that predicted and that identified for masked social threat. As there was no significant interactional pattern for masked positive words, it was determined that the finding for masked social words was not simply related to emotionality. Unmasked positive words produced a significant effect involving trait anxiety, stress, word-position, and probe-position.

At a descriptive level, there was general consistency across masked and unmasked stimuli in whether responses to different word types involved attention to or avoidance
of the emotional words. The interpretation of the results of individual word-types was affected by the presence of an emotionality effect. This effect indicated a divergent pattern for high and low trait anxious individuals for all emotional words. This pattern was largely of the same type as was identified for the social threat words, and represented an effect that indicates that high trait anxious individuals showed greater attention to emotional stimuli under lower levels of state anxiety, and greater avoidance under higher state anxiety. The reverse is the case for low trait anxious individuals, who showed greater attention to emotional material under higher levels of state anxiety. This pattern may assist in explaining the pattern of responses to masked social threat words in particular, as the pattern for that specific threat stimuli reflects the pattern identified for emotional stimuli in general. While the result does not negate the findings at an individual word-type level, it highlights that there were more general responses to emotional words that may have underpinned the responses of Ss to threat. This issue is considered further in the Discussion in Chapter 8.

To reiterate issues identified in Section 3.5, it should also be noted that the current findings should be interpreted with caution due to the use of multiple analyses of variance without correction of the alpha levels in the examination of the central hypotheses in this study.
6.4.2 Conclusions

Study 4 produced an unexpected stress-linked reduction in attention in high trait anxious individuals and a vigilance effect in low trait anxious individuals in response to masked social threat words. Although the findings contrasted with predictions, there was some convergence between these results and those of the previous four studies.

As previously discussed, Studies 4 and 5 were designed to compare the threat-related attentional responses of adults and children. Therefore, discussion of the theoretical implications of the findings of Study 4 is deferred to Chapter 8. Because of the counter-intuitive result in this study, it was particularly important to identify whether the pattern was consistent across adults and children before it was compared with the previous studies. Study 5 addresses the hypotheses of the studies with children in the forthcoming chapter.
CHAPTER 7

EXPERIMENT 5
CHAPTER 7

EXPERIMENT 5

7.1 Introduction

Relatively few studies have examined anxiety-related attentional biases in children. Subsequently, several questions remain insufficiently addressed and will be considered in this section. What is known about children’s reactivity on information-processing tasks focused on measuring attention? Can words be regarded as potential sources of threat-related stimuli for children, as they are for adults? What can be predicted about attentional biases to emotionally threatening information in children, based on knowledge of the developmental course of anxiety and research with adults?

7.1.1 Developmental Issues in Attentional Biases and Anxiety

Researchers in the cognitive-behavioural area (Kendall & Ronan, 1990) have proposed that childhood anxiety is dependent upon the operation of two threat schemas. The first schema involves attention to threat-related information that is self-evaluative. The second schema processes potential external threats in the environment. The first schema operates at all times and serves to guide the focus of attention during normal functioning. It orients the individual towards errors in their own behaviour that are then routinely noticed and modified. Barlow (1988) has argued that self-focused attention leads to a feedback loop that produces further anxiety by increasing the person’s sensitivity to bodily sensations and interfering with the normal tendency to habituate to external stimuli. The second, the external schema is activated by external stimuli, where
the possibility of external evaluation may occur. Similar hypotheses have been formulated with respect to the relationship of attentional bias and trait factors in child anxiety as adult anxiety. It has been proposed that anxious children will be more vigilant for threat-related information (Vasey, 1996).

However, there has been less investigation of this relationship between attentional processes and emotion in children than there has been in adults. In comparison to the adult literature, there has not been the equivalent investigation of the relationship between state anxiety and trait anxiety and the cognitive processing of threatening information. Some research has supported the basic trait by state anxiety hypothesis of attentional biases. This more recent research has diversified from interference tasks and has employed probe-detection tasks.

Kindt, Brosschot, and Everaerd (1997) have reported one of the few studies with children that has addressed the interactional hypothesis that is central to this research. The study investigated whether non-clinically anxious children, like anxious adults, favored the processing of threatening or concern-related information. Two experiments, using an emotional Stroop task, were carried out with high anxious and low anxious children aged 8 to 9 years to examine whether a medical stressor elicited a conscious processing bias. They found that, independent of the presence of the medical stressor, all children gave high priority to the processing of information related to physical harm. Moreover, like anxious adults in other studies, high anxious children showed a
conscious processing bias for generally threatening information. This bias was absent under acute stress, and it was significant only in girls, irrespective of trait anxiety. Both low anxious and high anxious girls showed this processing bias.

Other studies have considered the threat processing of individuals with more specific fears. Ribordy, Tracey, and Bernotas (1981) compared the performance of high and low trait test anxious 9-12 year old children on the standard Stroop task, which allowed conscious processing of word content. They found that high test-anxious individuals showed significantly greater interference of word content on colour naming, as compared with low test-anxious individuals, as measured by errors in word naming. Interestingly, these differences in errors were not present after the children were involved in attentional training. This result suggests that the strategic differences between the two groups can be influenced through intervention. In adult studies of anxiety and attentional biases, RT latency has been used more than error rates (MacLeod, 1991b; Williams et al., 1996). Thus, such results are not directly comparable to data from most of the adult studies. In addition, as has been indicated by Spielberger et al. (1983), there is little relationship between test anxiety and trait anxiety.

Vasey, Elhag, and Daleiden (1996) compared high and low test-anxious sixth and eighth graders (approx. 11-14 years), using a probe-detection task. The high test-anxious individuals showed attention towards threatening words. In addition, there was some evidence of avoidance of threatening words in low-test anxious individuals.
The relationship between shyness and cognitive control has also been studied by Ludwig and Lazarus (1983), who compared shy 8-11 year olds and controls on the standard Stroop task. Shy children showed greater interference for incongruent colour naming and so appeared to have greater difficulty suppressing distractor stimuli. The criteria for shyness were behavioural indices, rated by the child's school-teacher. While it is tempting to speculate about the children's trait anxiety status, the criteria used did not necessarily predict anxiety levels. The criteria were focused more on social skills and behavioural signs of assertiveness, rather than anxiety functioning per se. Nevertheless, as a link between shyness and anxiety has been proposed previously (Kagan, Reznick, Snidman, Gibbons, & Johnson, 1988; Klein & Last, 1988; Richman, Stevenson, & Graham, 1982), it seems likely that the shy children were more anxious than were controls.

Many of the studies reviewed have not used the more widely utilised method of group comparison in contrasting high and low trait anxious children and have not used mood manipulation procedures. Thus, as there is a general lack of comparability in the research with high trait anxious adults and children, it is uncertain whether there are differences between adults and children in the processing of threat. However, the results of these studies suggest that information-processing tasks such as the Stroop colour-naming task may allow for differentiation of children based on attentional characteristics. It is important to consider whether threat-related attentional biases have
been seen consistently at any level across the anxiety spectrum, and so the evidence for clinically anxious children is considered.

Some research has found processing biases in clinical anxious children. Vasey, Daleiden, Williams, and Brown (1995) compared a group of twelve clinically anxious 9-14 year old children with matched controls on a probe-detection task. Clinically anxious children showed attentional biases for threatening words when the probes were in the lower position. Controls showed no attentional biases, irrespective of the content of the stimulus words. These data provided some evidence to suggest that clinically anxious children allocate greater attentional resources to threatening information. There was no support for the hypothesis that non-clinically anxious children avoid threatening information. High anxious children did not necessarily show an attentional bias towards threat. They indicated that those with a monitoring coping style (those who focus on danger) show attentional biases to threat and those with a blunting coping style (those who focus away from danger) show attentional biases away from threat. They indicated these differences in responding style apply most when children are attending consciously to threat-related information. This finding provides support for a link between attentional biases and behavioural coping style, which has been found also in the adult literature (Bonanno et al., 1991; Fox, 1994; Lavy & van den Hout, 1994).

Despite a large body of research showing attentional biases in adults with PTSD, few studies have examined processing biases in children. In a recent study, 23 children and
adolescents with PTSD were assessed on the emotional Stroop to measure their attentional biases to threat (Moradi, Taghavi, Neshat-Doost, Yule, & Dalgleish, 1999). The children with PTSD, compared with controls, had longer colour-naming responses to trauma related words than to neutral words. Thus, there is some evidence of attentional biases in clinically anxious children.

Vasey and Daleiden (1996) have suggested that the variation in results with non-clinically anxious children across preliminary studies may be due to a variety of factors. They suggested that most research with children have relied on data drawn from presentations of stimuli where only strategic or conscious processing was possible. They also argued that clearer findings may be found when threatening information is presented out of awareness, using masked presentation to prevent the use of consistent conscious strategy. However, it is also likely that a larger number of well-controlled studies are required before conclusions can be drawn regarding the developmental continuity of attentional biases.

The generalisability of Williams et al.'s (1988) model is an important issue, particularly in the extent to which their predictions apply to children. As is expected considering the lack of research in this area, the effects of the mode of representation of threat on attentional processes in children have also been insufficiently considered. While most adult studies have used the presentation of words, some have presented stimuli such as pictures of faces (Bradley et al., 1997; Lundh & Oest, 1996; Winton,
Clark, & Edelmann, 1995) or ‘real life’ stimuli (Thorpe & Salkovskis, 1998). Although threat generally occurs in the context of non-verbal stimuli, the most consistent findings across adults and children have involved the use of words as stimuli. Therefore, for older children it is likely that verbal stimuli are representative of threat. This issue needs further examination, as reliance on verbal stimuli may prove problematic in the assessment of younger children, for whom the connections between actual threat and the verbal representation of threat may not well developed.

7.1.2 Developmental Studies

What can be predicted about attentional biases to emotionally threatening information, based on knowledge of the developmental course of anxiety? Due to the difficulty in correlating anxiety-like behaviours in early childhood and adult self-reports of anxiety, it is unlikely that there are linear relationships between childhood temperament and anxiety. However, some evidence has shown that children may be predisposed to anxiety. What constitutes temperament is open to various definitions. However, intensity of mood expression and approach/withdrawal from new stimuli, basic traits which could be seen as possible precursors to later anxiety, are dispositional characteristics from early infancy (Chess & Thomas, 1986; Goldsmith et al., 1987; Sanson, Prior, Oberklaid, & Smart, 1998).

Other research has investigated behavioural inhibition as a correlate of anxiety in children. Reznick et al. (1986), from a longitudinal study, have suggested that there is
relative stability in the inhibited and uninhibited behaviour of children from the age of 21 months to the age of 5.5 years. This result in itself does not confirm the developmental continuity of anxiety in children, as behaviours alone are not necessarily accurate predictors of clinical anxiety. However, this study also showed consistency in physiological measures over time that differentiated inhibited and uninhibited children. The physiological indicators of heart rate, heart rate variability, and pupillary dilation in novel situations increased more in inhibited children than in uninhibited children.

These data add weight to the possibility that high anxiety may remain relatively consistent over time across adulthood and childhood. It is also relevant to note that sub-clinical dispositions may render the individual more vulnerable to clinical anxiety disorders in later years. Shyness, for example, at age 3 has been found to be associated with neurotic disorders at age 8 (Richman et al., 1982). Once children present with anxiety disorders, there is a higher chance of these children becoming anxious adults. Although there have been mixed results from clinical populations when comparisons have been taken over time, there has been a trend for those with phobias in childhood to develop anxiety disorders in adulthood (Klein & Last, 1988). The extensive longitudinal research of the Australian Temperament Project (Sanson et al., 1998) has consistently shown a high level of continuity of both normal temperamental differences (such as anxiety-like temperamental features) and problematic presentations from early childhood to adolescence. Their research has indicated that childhood and later
adolescent anxiety problems can be partially predicted by early temperamental characteristics.

Research dealing with automatic information-processing biases has raised the possibility that information-processing characteristics associated with different levels of anxiety are biologically determined. Similarly, there is some evidence to suggest the presence of genetic or a familial link in anxiety disorders. Twin data have indicated that anxiety disorders in general may be transmitted genetically (Carey & Gottesman, 1982). A top-down family study (Weissman, Leckman, Merikangas, Gammon, & Prusoff, 1984) suggested that the existence of an anxiety disorder in the parent (mother) increases the risk of the child having an anxiety disorder over the parent having depression alone. A bottom-up family study (Klein & Last, 1988) found that the relatives of anxiety disordered children are more likely to also suffer from anxiety disorders. Such results suggest that, as is congruent with the broad diathesis-stress paradigm, individual vulnerability to anxiety and environmental factors contribute to the relatively stable levels of trait anxiety observed in adults.

7.1.3 Implications of Past Research

Relatively few studies have investigated anxiety-related attentional biases in children and so any predictions in this area must be tentative. While there are some dissimilarities in the specifics of adult and child anxiety, research suggest there is developmental continuity in anxiety. Thus, the disproportionate processing of threat-
related information should be similar for high trait anxious adults and children. If the adult research can act as a general guide, elevations in stress or arousal should increase the differences in attentional biases of high and low trait anxious children. Although the research in attentional biases with children is limited, there is sufficient evidence to suggest that the methodologies employed with adults are appropriate with older children. Vasey (1996) and Kindt et al. (1997) have shown that the Stroop and probe-detection paradigms are effective measures of selective attention with children. Vasey (1996) has argued that the emotional Stroop task is more appropriate with younger children and the probe-detection task is more suited to older children. However, with younger children, it is uncertain that words are sufficiently able to represent threat.

7.1.4 Aims and Experimental Hypotheses

This study aimed to investigate whether high and low trait anxious children display biases in attention to threat. The hypotheses adopted for earlier studies were retained in the current study.

1. Attentional biases to threat-related information will be dependent on an interaction of trait anxiety differences and elevations in state anxiety. More specifically, as the result of state anxiety elevations triggered by both acute and chronic stress, high trait anxious individuals will attend to threatening information and low trait anxious individuals will allocate attention away from threatening information.
2. These trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified at preconscious and conscious levels of processing.

3. These trait anxiety-related attentional biases will be identified more for threatening information in the individuals’ domain of concern than for information unrelated to their domain of concern. The predicted pattern of attentional biases, outlined in Hypothesis 1, will be observed more for social threat words than physical threat words or positive words.
7.2 Method

7.2.1 Design

The design for this study was substantially the same as Study 4. In this study, 44 twelve-year-old children completed the probe-detection task under low, high, and chronic stress. The three stress conditions were induced by a low stress $MIP$, high stress $MIP$, and chronic stress, induced by proximity to examinations. Each student carried out the task under the three stress conditions. Low stress and high stress took place 6-9 weeks before examinations and were undertaken in random order, with no less than one week between sessions. Subjects undertook testing last under the chronic stress condition. It was not possible to extend the study into the next year to fully complete the counterbalancing.

This study employed an identical design to that used in Study 4. The between-subjects independent variable was trait anxiety, and the four within-subjects factors were stress condition, exposure mode, word-type, word-position, and probe-position. Reaction times and threat latencies were calculated in the same manner as for Study 4.

7.2.2 Subjects

A sample of 55 twelve year olds were drawn from a larger initial sample of 90 year seven secondary school students. Subjects were recruited through letters sent to their parents/guardians, who returned informed consent forms with their child’s completed questionnaires. Children who were identified by class teachers in advance of the
selection process as having a reading standard below their age were not considered for the study, due to the verbal nature of the task. To allocate $S$s into the high or low trait anxiety group, $S$s were then selected based on their scores on the State Trait Anxiety Inventory for Children-Trait ($STAIC-T$) (Spielberger, 1970). Individuals with $STAIC-T$ scores of 32 to 36 inclusive were excluded to ensure that the two groups were substantially different in their levels of trait anxiety. Six $S$s were excluded as they did not complete testing under the three stress conditions. A further 5 $S$s were excluded as the majority of the individual’s median RTs for the word categories was greater than 2 $SD$s from the group mean RT for corresponding word categories and a substantial proportion of their median RTs for the word categories was greater than 1000 ms.

The remaining 44 children (mean age = 12.48 years) completed the testing under the three forms of stress. In this final sample, the ratio of females (f) to males (m) in each group was: high trait anxious: 13 f: 9 m; low trait anxious: 9 f: 13 m. Descriptive data are presented in Table 7.1.
Table 7.1. Experiment 5. Subject Characteristics

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>Sample Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>High Trait Anxious</td>
<td>12.59</td>
</tr>
<tr>
<td>Low Trait Anxious</td>
<td>12.48</td>
</tr>
</tbody>
</table>

Comparisons between STAIC-T scores showed that high trait anxious Ss had higher trait anxiety levels than low trait anxious Ss, F (1, 42) = 173.19, p < .001. Comparisons of the mean age of Ss revealed no significant age differences between the groups, F (1, 42) = 2.29, p = .14, ns.

7.2.3 Materials

The STAIC-T was used to measure trait anxiety. The State Trait Anxiety Inventory for Children-State (STAIC-S) (Spielberger, 1970) was used to measure state anxiety after the mood induction procedures in the high and low stress testing conditions. The STAIC-T and the STAIC-S have 20 items each and are rated on 1-4 scale, ‘always’ to ‘never’ in response to anxiety-related self-statements. The minimum score possible is 20 and the maximum is 80. As with the adult version, the STAIC-T and STAIS-S scales have alpha reliability coefficients above .80, and concurrent, convergent, divergent and construct validity has been established (Spielberger, 1970). Both have been used extensively as clinical and research instruments to measure trait anxiety and state anxiety in children and adolescents (Finch & Rogers, 1984; Spielberger et al., 1983).
Stimulus Words

The stimulus words employed in this experiment were identical to those used in Study 4.

Mood Induction Materials

This study used the same mood induction procedures as Study 4.

Stimulus Presentation

Presentation software used in this study was the same as in Study 4, and presentation hardware was equivalent. All aspects of the probe-detection task were identical to Study 4.

7.2.4 Procedure

The procedures used were identical to those used in Study 4. There was extra time allocated in the explanation of the task to the children to ensure Ss fully understood the task.

Stress Conditions

Low, high, and chronic stress conditions were identical to those in Study 4.
7.3 Results

Three aspects of the data are presented. First, the validity of the stress manipulation is assessed. Second, the validity of the backward masking procedure is examined. If these two assumptions are validated, the probe-detection RT data can be evaluated.

7.3.1 State Anxiety Manipulation

State anxiety measures were undertaken by each subject as in Study 4. As can be seen in Table 7.2, despite an overall difference between groups in state anxiety scores in each stress condition, there was only a marginal difference in the increase in state anxiety scores from low to chronic stress. In addition, there was a decrease in state anxiety scores from high to chronic stress.

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>Both Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Trait Anxious</td>
<td>Low Trait Anxious</td>
</tr>
<tr>
<td>State Anxiety (STAIC-S)-Low Stress</td>
<td>27.64 (3.96)</td>
</tr>
<tr>
<td>State Anxiety (STAIC-S)-High Stress</td>
<td>37.36 (7.46)</td>
</tr>
<tr>
<td>State Anxiety (STAIC-S)-Chronic Stress</td>
<td>33.27 (7.42)</td>
</tr>
</tbody>
</table>

Table 7.2. Experiment 5. State anxiety levels in high and low trait anxious children under low, high, and chronic stress
A repeated-measures analysis of variance using state anxiety scores as the dependent variables was carried out, with trait anxiety group and stress as independent variables. There was a significant effect of trait anxiety group, $F(1, 42) = 6.98, p < .05$, with high trait anxious $S$s having higher levels of state anxiety in all conditions than low trait anxious $S$s. There was a significant main effect of stress condition, $F(2, 84) = 27.79, p < .001$, and a significant interaction between stress and trait anxiety group, $F(2, 84) = 3.53, p < .05$.

There was a differential pattern of state anxiety across the three stress conditions for the two trait anxiety groups. The means presented in Table 7.2 indicated that the increase in state anxiety from low to high stress was greater for the high trait anxious group than for the low trait anxious group. The decrease in state anxiety levels from high to chronic stress was closer to levels produced in low stress for low trait anxious $S$s than high trait anxious $S$s.

Comparisons were made of state anxiety scores across low, high and chronic stress through Helmert’s contrasts. These showed that there were significant differences between state anxiety scores under high stress and chronic stress, $F(1, 42) = 13.51, p < .01$. State anxiety scores in both of these stress conditions were greater than under low stress, $F(1, 42) = 44.53, p < .001$. The interaction between trait anxiety and stress condition was significant when high and chronic stress conditions were compared with the low stress condition, $F(1, 42) = 7.53, p < .01$. Despite the lower state anxiety scores
than would be expected under chronic stress, there was a significant difference between state anxiety scores in the low and chronic stress conditions, $F(1, 42) = 17.04, p < .001$. When these two stress conditions were compared, there was also a significant interaction between trait anxiety group and stress condition, $F(1, 42) = 5.73, p < .05$. This result reflected the fact that high trait anxious individuals produced greater increases in state anxiety from low to chronic stress than did low trait anxious individuals, suggesting that the exam stressor was less effective in inducing state anxiety increases in low trait anxious individuals.

In summary, high stress conditions produced greater levels of state anxiety than did low stress conditions, and the experimental assumption was supported. The different stress conditions produced slightly different results than were expected but produced patterns somewhat similar to those in Experiments 3 and 4. Comparisons between the adult and child studies are difficult, due to the use of different state anxiety measures for adults and children, which have different norms. The results of the STAIC-S were supportive of a general increase in state anxiety from low to high stress, however there was less increase from low to chronic stress.

### 7.3.2 Masking Procedure

Subjects were unable to identify whether the two words presented were the same or different from each other. A repeated-measures analysis of variance revealed no significant main or interaction effects for the lexical decision task as a function of: trait
anxiety group, $F (1, 42) = 2.75, p < .11, ns$; stress condition, $F (2, 84) = 0.32, p = .72, ns$; and the interaction between trait anxiety and stress, $F (2, 84) = 0.77, p = .47, ns$.

Across all Ss for all stress conditions, the mean percentage of correct responses on the lexical decision task was 49.29% ($SD = 3.23$). The accuracy of responses was not significantly different to the 50% expected by chance, $t (43) = 1.47, p = .15, ns$. Thus, masking was effective in preventing conscious awareness of the word stimuli.

As these assumptions were upheld, probe-detection data were then considered.

### 7.3.3 Probe-Detection Latency Data

Details regarding measurement of probe-detection data were identical to Study 4. The group means of these data are summarised in Appendix O.

All RTs were subjected to a mixed-design analysis of variance, which used trait anxiety group (high vs low) as the between Ss factor and five within group factors. When masked and unmasked variables were considered together, despite predictions, there was no interaction involving trait anxiety, stress, exposure, word-type, word-position, and probe-position, $F (4, 39) = 0.95, p = .45, ns$. Other significant main and interactional effects can be seen in Table 7.3, and threat indices can be seen in Table 7.4. Masked and unmasked variables are examined separately in the next sections.
Table 7.3. Experiment 5. Inferential data for reaction times from analysis of variance

<table>
<thead>
<tr>
<th>EFFECT</th>
<th>DF</th>
<th>F</th>
<th>SIG.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure x word-type</td>
<td>1, 42</td>
<td>17.48</td>
<td>.000</td>
</tr>
<tr>
<td>Stress x exposure x word-type</td>
<td>1, 42</td>
<td>5.76</td>
<td>.021</td>
</tr>
<tr>
<td>Stress x exposure x word-type x word-position</td>
<td>4, 168</td>
<td>3.58</td>
<td>.008</td>
</tr>
<tr>
<td>Stress x exposure x probe-position x trait</td>
<td>1, 42</td>
<td>4.57</td>
<td>.038</td>
</tr>
</tbody>
</table>
7.3.4 Masked Variables

Hypotheses 1 and 2: Trait Anxiety by Stress Interaction; Preconscious Processing

When masked RTs were considered separately in a mixed-design analysis of variance, the predicted interaction between trait anxiety, stress condition, word-type, word-position and probe-position did not prove significant, $F (4, 168) = 1.48, p = .21$, ns. As Figures 7.1, 7.2, and 7.3 show, there was no pattern that clearly differentiated between the word-types. However, there was a significant interaction involving trait anxiety, stress, word-type, and probe-position, $F (4, 168) = 2.64, p < .04$. This result was suggestive of an emotionality effect. Despite the apparent differences in responses across the word-types, this result indicated that a pattern extended across positive and threat words. High trait anxious Ss showed attention to emotional words under low stress ($M = 2.39, SD = 14.01$), and then a reduction in attention to emotional words under high stress ($M = -0.11, SD = 15.55$), and slight increase under chronic stress ($M = 1.49, SD = 15.4$). Low trait anxious Ss showed attention to emotional words under low stress ($M = 3.71, SD = 16.93$), and then an decrease in attention to emotional words under high stress ($M = 1.35, SD = 14.52$) and chronic stress ($M = 4.98, SD = 20.42$). Under both exposure conditions, high and low trait anxious Ss showed a similar pattern of responses to emotional words in general, irrespective of the valence and the word type, although the response of low trait anxious individuals was more extreme. Both groups showed some reduction in attention to emotional words under higher levels of stress. The presence of this emotionality effect may influence the interpretation of findings to specific word types, as it suggests that attention biases were not specific to
threatening words, but that attentional patterns in high and low trait anxious individuals were seen to both threatening and positive words.

In addition to this interaction, there were main effects for: word-type, \( F(2, 84) = 3.3, p < .05 \), and an interactional effect for word-type by word-position by probe-position, \( F (2, 41) = 11.35, p < .001 \).

The threat indices are presented in Table 7.4 for masked words. To allow visual comparison of the threat indices, Figures 7.1, 7.2, and 7.3 show the patterns of attentional biases for masked RT variables, under low, high and chronic stress.

Table 7.4. Experiment 5. Emotional indices for masked emotional words for high and low trait anxious children

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>High Trait Anxious</th>
<th>Low Trait Anxious</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>LOW MASKED SOCIAL THREAT INDEX</td>
<td>19.11 (39.30)</td>
<td>6.22 (29.75)</td>
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<td>13.63 (47.35)</td>
<td>11.50 (25.12)</td>
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<td>8.05 (36.39)</td>
<td>19.26 (29.62)</td>
</tr>
<tr>
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<td>-17.01 (31.94)</td>
<td>-14.16 (35.08)</td>
</tr>
<tr>
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<td>-27.50 (43.42)</td>
<td>-15.68 (25.49)</td>
</tr>
<tr>
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<td>-9.02 (38.61)</td>
<td>-16.85 (38.50)</td>
</tr>
<tr>
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<td>5.08 (34.03)</td>
<td>19.08 (41.80)</td>
</tr>
<tr>
<td>HIGH MASKED POSITIVE THREAT INDEX</td>
<td>13.55 (30.40)</td>
<td>8.24 (32.46)</td>
</tr>
<tr>
<td>CHRONIC MASKED POSITIVE THREAT INDEX</td>
<td>5.45 (37.24)</td>
<td>12.53 (44.14)</td>
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</tbody>
</table>
Figure 7.1. Experiment 5. Emotional indices for masked social words for high and low trait anxious children under low, high, and chronic stress.

Figure 7.2. Experiment 5. Emotional indices for masked physical words for high and low trait anxious children under low, high, and chronic stress.

Figure 7.3. Experiment 5. Emotional indices for masked positive words for high and low trait anxious children under low, high, and chronic stress.
7.3.5 Masked Social, Physical and Positive Stimuli

Hypothesis 3: Specificity

To address the prediction concerning specificity, and to determine whether the predicted interactions involving trait anxiety, stress, probe-position and word-position could be detected for each word-type, masked social, physical, and positive words were subjected to a separate analysis of variance. For masked variables, the predicted interaction was identified for masked social threat words, which is presented in Figure 7.4.

Masked Social Threat Words

When masked social word variables were considered alone, there was a significant interaction between trait anxiety, state anxiety, probe-position, and word-position, $F(2, 37) = 5.09, p < .05$. This interaction reflects the fact that high and low trait anxious Ss produced the opposite pattern across the three forms of stress, as is seen in Figure 7.4. High trait anxious Ss showed decreased attention to social threat from low to high to chronic stress. Low trait anxious Ss increased their attention to social threat from low to high to chronic stress. There was also a main effect for probe-position, $F(1, 38) = 8.35, p < .01$; stress, $F(2, 37) = 6.21, p < .01$; and an interaction effect for word-position and probe-position, $F(1, 38) = 10.93, p < .01$. 

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Figure 7.4. Experiment 5. Interaction of trait anxiety, stress, word-position, and probe-position for masked social words

To determine the significance of the threat indices, post hoc analyses were undertaken. At an adjusted alpha level of .008, low trait anxious Ss' vigilance for masked social threat words under chronic stress was significant, \( t(21) = 3.05, p = .006 \), and they showed a trend for vigilance to masked social threat words under high stress, \( t(21) = 2.15, p < .05 \). There was also a trend for vigilance in high trait anxious Ss to
masked social threat under low stress, $t(21) = 2.28, p < .05$. Thus, only the attentional biases of low trait anxious $S$s to masked social threat under chronic stress was significant. The pattern demonstrates that in high trait anxious $S$s, there was a decrease in attentional biases to social threat under high and chronic stress. Therefore, this result did not support any of the three predictions.

**Masked Physical Threat Words**

When masked physical words were considered alone, the predicted interaction was not found. There was a main effect for stress, $F(2, 37) = 5.09, p < .01$, an interaction between word-position and probe-position, $F(2, 37) = 14.95, p < .001$. As can be seen in Figure 7.2, although nonsignificant, there was a trend where both groups avoided the physical words in all stress conditions. Low trait anxious $S$s showed increased avoidance from low to high to chronic stress. High trait anxious $S$s showed increased avoidance from low to high stress and decreased avoidance from high to chronic stress.

**Masked Positive Words**

When masked positive words were considered alone, the predicted interaction was not found. There was a main effect for stress, $F(2, 37) = 6.49, p < .01$, and an interaction between word-position and probe-position, $F(1, 38) = 8.76, p < .01$. As can be seen in Figure 7.3, although the trend was nonsignificant, both groups attended towards the positive words in all three stress conditions. Low trait anxious $S$s showed decreased attention to positive words from low to high stress and increased attention to
positive words from high to chronic stress. High trait anxious Ss showed increased attention to positive words from low to high stress and decreased attention to positive words from high to chronic stress.

7.3.6 Unmasked Variables

Hypotheses 1 and 2: Trait Anxiety by Stress Interaction; Conscious Processing

When unmasked RTs were considered separately in a mixed-design analysis of variance, no interaction was found between trait anxiety, stress condition, word-type, word-position and probe-position, $F(4, 39) = 0.52, p = .72, ns$. There was a main effect for stress, $F(2, 84) = 3.32, p < .05$, and significant interactions involving: word-type and trait, $F(2, 41) = 4.56, p < .05$; word-position and probe-position, $F(2, 42) = 8.14, p < .01$; and word-type, word-position, and probe-position, $F(2, 41) = 8.26, p < .01$.

Figures 7.5, 7.6, and 7.7 show the patterns of attentional biases for unmasked RT variables, under low, high and chronic stress. These patterns are then examined further in analyses of the responses to individual word types.
Table 7.5. Experiment 5. Emotional indices for unmasked emotional words for high and low trait anxious children

<table>
<thead>
<tr>
<th>Trait Anxiety Group</th>
<th>High Trait Anxious</th>
<th>Low Trait Anxious</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>LOW UNMASKED SOCIAL THREAT INDEX</td>
<td>15.44 (41.30)</td>
<td>15.05 (39.28)</td>
</tr>
<tr>
<td>LOW UNMASKED PHYSICAL THREAT INDEX</td>
<td>-21.26 (36.43)</td>
<td>-24.22 (39.19)</td>
</tr>
<tr>
<td>LOW UNMASKED POSITIVE THREAT INDEX</td>
<td>24.78 (33.43)</td>
<td>13.39 (40.11)</td>
</tr>
<tr>
<td>HIGH UNMASKED SOCIAL THREAT INDEX</td>
<td>11.45 (44.51)</td>
<td>17.91 (49.31)</td>
</tr>
<tr>
<td>HIGH UNMASKED PHYSICAL THREAT INDEX</td>
<td>-2.32 (35.40)</td>
<td>-10.26 (52.14)</td>
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<tr>
<td>HIGH UNMASKED POSITIVE THREAT INDEX</td>
<td>18.31 (56.40)</td>
<td>8.15 (49.67)</td>
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<td>CHRONIC UNMASKED SOCIAL THREAT INDEX</td>
<td>9.92 (47.06)</td>
<td>28.53 (40.83)</td>
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<td>CHRONIC UNMASKED PHYSICAL THREAT INDEX</td>
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<td>-23.14 (39.86)</td>
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<tr>
<td>CHRONIC UNMASKED POSITIVE THREAT INDEX</td>
<td>9.82 (34.12)</td>
<td>25.13 (41.39)</td>
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</tbody>
</table>
Figure 7.5. Experiment 5. Emotional indices for unmasked social words for high and low trait anxious children under low, high, and chronic stress

Figure 7.6. Experiment 5. Emotional indices for unmasked physical words for high and low trait anxious children under low, high, and chronic stress

Figure 7.7. Experiment 5. Emotional indices for unmasked positive words for high and low trait anxious children under low, high, and chronic stress
7.3.7 Unmasked Social, Physical and Positive Stimuli

Specificity: Hypothesis 3

When all the unmasked variables were included in the analyses, there were no significant interactions involving word-type. Nevertheless, the patterns seen in Figures 7.5, 7.6, and 7.7 require exploration at an inferential level. To address the prediction concerning specificity, unmasked social, physical, and positive words were subjected to separate analyses of variance. For unmasked variables, the predicted interaction was not found for any of the word types.

Unmasked Social Threat Words

When unmasked social words were considered alone, the predicted interaction was not found. There was a main effect for stress, \( F(2, 84) = 4.36, p < .05 \), and an interaction between word-position and probe-position, \( F(1, 42) = 13.43, p < .01 \). Figure 7.5 demonstrates a nonsignificant trend where high and low trait anxious Ss showed divergent patterns for low and high stress. Both groups attended to threat in all three stress conditions. This trend was similar to that identified for masked data but was not extreme enough to produce a significant interaction.

Unmasked Physical Threat Words

The predicted interaction was not found for unmasked physical words. Interactions were found between: stress and probe-position, \( F(2, 41) = 5.24, p < .01 \); probe-position and trait anxiety, \( F(1, 42) = 5.32, p < .05 \); and word-position and probe-position, \( F(1, 42) = 5.52, p < .05 \).
42) = 13.63, p < .05. Both groups showed avoidance of threat in the three stress conditions. As seen in Figure 7.6, there was a nonsignificant trend where both high and low trait anxious Ss showed less avoidance of threat from low to high stress and more avoidance from high to chronic stress.

**Unmasked Positive Words**

The predicted interaction was not found for unmasked positive words. There was an interaction between word-position and probe-position, $F (1, 42) = 12.72, p < .01$. Both groups attended to positive words in all stress conditions. Although a nonsignificant trend, high trait anxious Ss showed decreased attention to positive words from low to high to chronic stress. Low trait anxious Ss showed decreased attention to positive words from low to high stress and increased attention to positive words from high to chronic stress.
7.4 Discussion

7.4.1 Summary of Findings

*Hypothesis 1*: Attentional biases to threat-related information will be dependent on an interaction of trait anxiety differences and by elevations in state anxiety. More specifically, as the result of state anxiety elevations, triggered by both acute and chronic stress, high trait anxious children will attend to threatening information and low trait anxious individuals will allocate attention away from threatening information.

The results of study did not support the initial hypothesis. Rather, an effect was found that was the converse of predictions. High trait anxious individuals attended to masked social threat under low stress. They showed a decrease in attention from low to high to chronic stress. In contrast, low trait anxious individuals showed increased attention to threat from low to high to chronic stress. Both high and low trait anxious individuals attended to threat under all stress conditions. Neither group showed responses that represented avoidance of threat materials.

*Hypothesis 2*: Trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified at preconscious and conscious levels of processing.

Hypothesis 2 was not supported. The main interaction involving trait anxiety, stress, and threat for social threat words was found only at a preconscious level. As indicated in Hypothesis 1, the pattern of this interaction was the opposite of that predicted.
Hypothesis 3: Trait anxiety-related attentional biases, elicited by elevations in state anxiety, will be identified more for threatening information in the individuals' current domain of concern.

The third prediction involving specificity was not supported. High trait anxious individuals, more than low trait anxious individuals, were expected to show greater attention to social threat words than to physical or positive words under elevated stress conditions. Although the central interactional pattern involving trait anxiety, state anxiety, and threat was identified for masked social threat words, the direction of the pattern was the reverse of that predicted.

As in Study 4, the patterns for masked and unmasked social threat words were very similar, however only masked words produced a significant effect. Both showed decreased attention to social threat in high trait anxious individuals in response to state anxiety elevation and attention to threat in low trait anxious individuals. As in Study 4, there were similarities in the patterns for masked social and positive words, and for unmasked social and positive words.

In addition, it was also interesting that at a descriptive level, there was general consistency across masked and unmasked stimuli in whether responses to different word types involved attention to or avoidance of the emotional words. The direction of these trends varied somewhat, but the results are suggestive of similar responses to the different forms of stimuli, irrespective of exposure level.
The interpretation of the results of individual word-types was affected by the presence of an emotionality effect at a masked level. This effect indicated a distinct pattern for high and low trait anxious individuals for all emotional words. This pattern indicated that high trait anxious individuals showed greater attention to emotional stimuli under lower levels of state anxiety, and greater avoidance under higher state anxiety. A more extreme pattern was observed for low trait anxious individuals. While the result does not negate the findings at an individual word-type level, it highlights that there were more general responses to emotional words that may have underpinned the responses of Ss to threat, and indicates that caution needs to be taken in the interpretation of findings at an individual word-type level. This issue is considered further in the Discussion in Chapter 8.

As commented on in greater depth in Section 3.5, it should also be noted that the current findings should be interpreted with caution due to the use of multiple analyses of variance without correction of the alpha levels in the examination of the central hypotheses in this study.

7.4.2 Conclusions

Study 5 found a stress linked response in high and low trait anxious children for masked social threat. In contrast to predictions, high trait anxious individuals attended
less to masked social threat under stress and low trait anxious individuals attended more to masked social threat under stress. These findings mirrored those of adults in Study 4.

Specific questions were raised in this study concerning children's reactivity on information-processing tasks. Children follow similar patterns of anxiety-related attentional biases as adults. From these results, words can be regarded as a source of threat-related stimuli for children, as they are for adults. It appears that preconscious attentional biases to social threat information are as well established in children as they are in adults.

The effects identified across the two studies indicate that threat-related attentional biases are not limited to adults. However, the specific predictions of the interactional model may need to be reconsidered. The findings indicate that reduction in attentional biases under elevated stress may be regular feature of preconscious attentional responses in high trait anxious individuals. To explain this counter-intuitive pattern of results across the series of studies, the theoretical models are re-examined in Chapter 8.
CHAPTER 8

DISCUSSION
CHAPTER 8

DISCUSSION

An overview of the studies is presented in Section 8.1 and the findings of the experiments are then reviewed in Section 8.2. Methodological issues in the research are addressed in Section 8.3. The conclusions drawn from these experiments and comparisons with previous research are presented in Section 8.4. Discussion of the implications of these results for future research is in Section 8.5. Section 8.6 expands the theoretical discussion and outlines a reformulated model of anxiety vulnerability, stress, and attention to threat. Concluding comments regarding this research and the research domain are made in Section 8.7.

8.1 Overview of the Studies

This series of studies aimed to evaluate Williams et al.'s (1988) interactional model. The studies were designed to clarify the inconsistent findings of previous research by addressing the predictions in directly comparable experiments. These studies tested the experimental hypotheses through colour-naming and probe-detection paradigms, targeting adults and children. A response baseline for high and low trait anxious individuals was sought under different forms of stress. It was anticipated that this baseline would allow developmental comparisons, comparison across information-processing paradigms, and comparison with past research.
Inconsistent results were found across the studies. The research broadly supported Williams et al.'s (1988) notion that threat-related attentional biases are dependent on the interaction of trait and state anxiety. However, the specific predictions of this research and Williams et al.'s (1988) model were only partially supported. In contrast, an alternative pattern of attentional biases was more prominent. In this pattern, there was a trend for high trait anxious individuals to show decreased attention to threat and low trait anxious individuals to show increased attention to threat in response to increased stress. Similar patterns were identified for adults and children, and the alternative pattern was identified at conscious and preconscious levels of processing.

A reformulated model, which aims to incorporate aspects of Williams et al.'s (1988) model and Mogg and Bradley's (1998) model, is proposed. This model seeks to explain both the current counter-intuitive findings and discrepancies in the literature. The next section provides an overview of the findings of the research.
8.2 Review of the Findings

In this section, the findings are reviewed with particular reference to the three hypotheses that were consistent across the studies.

8.2.1 Attentional Biases and the Interaction of Trait and State Anxiety

It was expected that high trait anxious individuals would attend to threat and low trait anxious individuals would avoid threat in response to state anxiety elevations. Study 3 alone supported this prediction, showing attentional biases at a conscious level of processing. In contrast, in Study 1, in response to elevated stress, high trait anxious individuals decreased their attention to masked exam threat words and a low trait anxious Ss showed increased vigilance to these stimuli. The pattern of the results of Study 2 was similar to those of Study 1 but was found at a conscious level. In Study 2, in response to high stress, high trait anxious individuals showed an avoidance response and low trait anxious individuals showed a vigilance response to unmasked threat words. In Studies 4 and 5, there were significant interactions where high and low trait anxious individuals generally attended to masked social threat words across all stress conditions. However, the pattern of attentional biases was the reverse of that predicted. High trait anxious individuals showed decreased attention to threat and low trait anxious individuals showed increased attention to threat in response to stress elevation.
8.2.2 Attentional Biases to Threat: Conscious and Preconscious Processing

It was predicted that the pattern of threat-related attentional biases, outlined in the initial hypothesis, would be identified at preconscious and conscious levels of functioning. As previously outlined, Study 3 was the sole experiment to show the predicted pattern and did so only at a conscious level of processing. Studies 1, 2, 4, and 5, despite finding significant interactions involving trait anxiety, stress, and threat, demonstrated an alternative pattern of attention that were the reverse of those predicted. These interactions were found at a preconscious level for Studies 1, 4, and 5 and at a conscious level for Study 2.

8.2.3 Attentional Biases to Threat and Domain Specificity

The third hypothesis proposed that the state and trait-linked patterns of attention to threat would be identified for domain-specific stimuli. Study 3 alone demonstrated the predicted effect involving domain specificity. The other studies showed the alternative pattern. Study 1 showed this alternative pattern of results for domain-specific threat words. In Study 2, a significant response was identified that demonstrated the effects of general threat words. However, the response involved a suppression effect for high trait anxious individuals. In Studies 4 and 5, the major interactional effects involving trait and state anxiety were demonstrated for social threat words, but involved the alternative pattern. It should be noted that Studies 4 and 5, there were higher order emotionality effects observed that indicated that distinct patterns of attentional biases were observed for high and low trait anxious individuals. In Study 4, the emotionality effect was found
to be present across masked and unmasked stimuli, and in Study 5 the effect was observed only for masked stimuli. Although these effects do not invalidate the patterns identified at an individual word-type level, they indicate that caution needs to be taken in assigning weight to the findings observed for social threat words in particular, as they may well reflect the larger pattern of reponsiveness to generally emotional material.

8.2.4 Developmental Aspects of Attentional Biases

Studies 4 and 5 compared the attentional biases in children and adults. Similar attentional patterns were identified in children and adults. Both studies showed decreased attention to masked social threat in high trait anxious individuals in response to stress elevation and increased attention to threat in low trait anxious individuals.

8.2.5 Summary

Although there were mixed results for the predicted pattern of attentional biases, each study found that attentional biases were determined by the interaction of trait anxiety and stress. However, the predicted pattern was found in only one study, at a conscious level of processing. In four studies, the pattern of attentional biases was the opposite of that predicted. In response to elevated stress, high trait anxious individuals showed decreased attention to threat words and low trait anxious showed increased attention to threat. This pattern was identified at a preconscious level of processing in three studies and at a conscious level in one study. Thus, this alternative pattern was relatively consistent across the studies and is central to understanding the nature of the
effects in the experiments. The patterns observed for adults and children from the probe-detection studies were similar. The results raise important theoretical implications, which are discussed in Sections 8.4 and 8.5. As these results differ substantially from the predictions, it is appropriate to consider whether alternative theoretical or methodological explanations can incorporate the findings. Confidence in the results of Studies 4 and 5 was modified to some degree by evidence indicating the presence of emotionality effects, which indicating more general patterns of attentional responses to both threat and positive stimuli. Methodological issues raised by the research are considered first in the next section.
8.3 Methodological Issues

Before making conclusions and discussing the relationship between current results and previous research, it is important to highlight some methodological issues that may have influenced the findings to determine the level of influence of these factors. The findings will be addressed in light of these issues.

8.3.1 Stimulus Selection

Stimulus selection may have affected the findings of Studies 1-3 as positive words were used as comparisons for target words. Examination and general threat-related words were target stimuli. The words paired with exam threat stimuli, non-threat exam-related words, were near antonyms of the target words. Therefore, the non-threat exam-related words may have elicited domain-specific attentional biases and subsequently have been responsible for the apparent avoidance effect for exam threat words. Examination of the mean RTs in Study 1 for the high trait anxious individuals showed that masked non-threat exam-related materials produced the highest mean level of interference for all the masked word types. Attentional responses to positive material of any type may represent a form of suppression. The results of this study have not been interpreted as due to such effects. However, Mathews and Klug's (1993) findings showed that neutral stimuli may produce attentional effects due to their content similarity to the target words. Thus, the nature of the non-threat stimuli may have
represented a limitation in Studies 1-3. This issue of stimulus selection in the initial studies was addressed in the latter studies.

This limitation was resolved in neutral word selection for the probe-detection task. In addition, the stimuli used in Studies 4 and 5 were developed by surveying comparable samples to those tested in these studies. Stimuli developed in this manner may reflect the concerns of the sample to a greater extent than those chosen by experts. Studies 4 and 5 showed more consistent domain-specific patterns than Studies 1-3. It is unclear whether this difference in the consistency of findings is due to greater stimulus relevance or increased emotional valence of the stimuli in Studies 4 and 5. It is also uncertain to what extent the differences are due to the differences in the paradigms used, or some other feature.

It is possible that the social words in Studies 4 and 5 did not fully represent the domain of concern of individuals in these studies and were a form of threat that was too general. However, for students, academic concerns represent a particularly relevant subset of social concerns. The stressors used reflected the content of the social words, as one section was focused on self-evaluation and one related to academic concerns.

The differential effects of the different aspects of the high stress MIP were not assessed. Therefore, it is also conceivable that one part of the MIP was more effective than the other part. This may have led to some words being more salient than other
words. It is uncertain whether making discrete stimulus categories would have made a difference to the findings. The alternative pattern was also found in the initial three studies, which used the more specific category of examination-related threat. The valence of stimuli is central to this research domain, as has been suggested in Mogg and Bradley’s (1998) notion of subjective stimulus threat value. As social threat words differentiated the responses of high and low trait anxious individuals, it is likely that the words and stressors were matched appropriately, and tapped the concerns of high trait anxious individuals. While it is difficult to gauge the extent to which these issues influenced the results, they are clearly relevant to future studies.

It is uncertain to what extent pictures or words accurately represent threat in adults and children. Despite the reliance on words as stimuli and the greater consistency of results using words, there have been recent developments using pictures and real-life threats to elicit attentional biases (Bradley et al., 1997; Kindt et al., 1997; Thorpe & Salkovskis, 1998). Particularly for young children, pictorial or photographic representation of threat may prove more appropriate in attempting to evaluate whether their patterns of attentional bias to threat-related information differ from those observed in adults. Perhaps the most obvious stimulus class is that of faces, displaying different emotional poses. As there is a basic heightened sensitivity in humans to the disposition of the human faces, different emotional portrayals of faces may equate to verbal threatening information. Future research may need to address these issues further.
However, the current research shows that words differentiate anxiety-related attentional responses, and therefore, probably represent threat for both adults and children.

8.3.2 Stimulus Presentation

The random presentations of word stimuli may influence selective processing. Most previous studies have presented stimuli in a random format rather than a blocked format to avoid priming and order effects. However, random presentations may not represent the manner in which threatening information is normally experienced. It is uncertain whether threatening information is presented to individuals in random sequence in real life. In addition, in experimental presentations, the relatively large number of random presentations used in many studies may weaken rather intensify the effects. Attentional biases may be present in initial presentations but habituation and fatigue may reduce the effect after multiple presentations. These effects have been found in some research (McNally et al., 1996). Although some studies have addressed the effects of the form of stimulus presentation (Cassiday et al., 1992; McNally et al., 1996), there has been insufficient attention paid to this issue. Therefore, it is uncertain to what extent the issue has influenced this research. As most studies have used random presentation, the current findings are comparable to most other results in this area. However, this issue remains unresolved and requires further examination in future research.
8.3.3 Comparability of Paradigms

It is important to consider to what extent results of Stroop and probe-detection paradigms are equivalent. No trend for greater reliability in one task than another has been identified in the literature to date, although fewer studies have employed probe-detection tasks than Stroop tasks (Williams et al., 1997). In the current studies, there was slightly more convergence in the results of the probe-detection studies than the Stroop studies.

Leaving aside the significance of the attentional patterns, the trends identified for the probe-detection task, in comparison to the Stroop task, were also more consistent. There was consistency in data across adults and children, and across word-types. In general, across both masked and unmasked exposure conditions, social words produced vigilance, physical words produced avoidance, and positive words produced vigilance. The probe detection task also showed few results where groups shifted from vigilance to avoidance (or vice-versa) in response to different forms of stress. Rather, responses more often involved fluctuations in the degree of attention across stress conditions. In addition, in the interactions that were significant, the attentional shifts appeared greater in studies employing the Stroop task than those using the probe-detection task. Responses for the Stroop task involved greater shifts from vigilance to avoidance. It is difficult to explain such differences between the paradigms from a theoretical standpoint. While the differences in the paradigms may not fully explain the discrepancies in findings, future research should address this issue.
8.3.4 Stress Manipulation

Developing short- and long-term stressors that are meaningful and consistently elicit state anxiety elevations is a problem for many studies of this type (Martin, 1990). State anxiety was higher under acute stress than under chronic stress in the current research. In the studies employing three stress conditions, the direction of the attentional pattern continued in an almost linear fashion from low to high to chronic stress. These effects occurred despite chronic stress inducing lower levels of state anxiety than did high stress. This trend suggests that the chronicity of the stress may influence attentional biases more than does the absolute level of the stress.

The chronic stressor produced moderate levels of state anxiety, complicating the interpretation of such results. Comparisons with other studies show that the levels of state anxiety in Study 3 under chronic stress were somewhat lower than were found in some previous research and in Study 4. The reasons for such differences are unclear, as ostensibly the samples were exposed to similar examination-related stresses and testing conditions. However, temporary and chronic stress conditions have shown different levels of state anxiety in other studies. Levels obtained in each stress condition mirrored those identified in other research using comparable stressors (Spielberger et al., 1983). In addition, as noted in Chapter 1, high trait anxious individuals tend to show elevations in state anxiety in response to stressors that involve personal relationships and threaten self-esteem. In this sense, the chronic stressor employed in these studies was appropriate.
in type but may not have been of sufficient intensity to elevate state anxiety above moderate levels. If similar levels of state anxiety were produced for high and chronic stress, the interpretation of findings may be easier.

It is also possible that the high stress conditions involved semantic priming of the threat-related words encountered in the probe-detection task and the Stroop task. While this remains a possibility, this probably replicates what happens in real-life stressors. The tendency to be susceptible to semantic priming probably represents an aspect of schema-based vulnerability to threat-related information. Therefore, attentional biases may reflect such priming effects, but these effects are related to anxiety vulnerability and state anxiety factors.

To assess attentional responses under higher levels of state anxiety, future studies could use alternative stressors. Imminent and chronic social threat at an extreme level may increase the level of stress and the availability of resources for processing relevant information. However, as was the difficulty in the current studies, such stressors involve greater ethical dilemmas than do naturally occurring or lower level stressors, particularly for children. Alternative naturally occurring stressors may be more useful in dealing with these issues and increase the ecological validity of the methods used. Conversely, it is more difficult to control for extraneous variables using such methods. However, in summary, the use of naturalistic and higher level stressors is probably
indicated in this research domain, despite the need to contend with ethical dilemmas and possible loss of experimental control.

8.3.5 Masking Procedure Validity

The interpretation of results from masked and unmasked stimuli depends on satisfying assumptions regarding automaticity. In these studies, conscious recognition of masked stimuli was not possible. Using the ability to discriminate lexical content of stimuli as the awareness criterion, it is an overstatement to infer that the masked words were completely outside awareness. It is more reasonable to conclude that awareness was restricted and that faster attentional processes were used to detect stimuli. As comparable attentional patterns were identified at both conscious and preconscious levels in this research, there was no specific pattern that was restricted to either level of processing.

8.3.6 Sampling

Sample size remains a limitation in much experimental research of this type. As indicated in Chapter 3, the high variance of RTs within information-processing tasks can produce statistical problems that are partially resolved by larger samples. Although the current sample sizes were not substantially different from previous studies and few statistical problems were observed in the current research, larger samples allow more confidence in the results produced. It is possible that larger samples are required in this area of research to achieve consistent findings.
A second issue is that individuals may have variable responses to academic stresses. Vasey et al. (1996) suggested that among high trait anxious individuals, some avoid threat and some attend to threat. The presence of such a dimension would obviously affect results. The notion that there may be dichotomous differences in attentional style in high trait anxiety requires further examination before it can explain results in this domain.

8.3.7 Order Effects

It is possible that the order in which individuals undertook the testing caused an effect. Slightly different design features were used in Studies 3-5 than Studies 1 and 2. In Studies 3-5, individuals were exposed to all three stress conditions, in contrast to Studies 1 and 2 where each subject undertook the task under only one form of stress. In Study 3, individuals undertook the low and high stress tasks in random order and then undertook the task under chronic stress conditions. Undertaking the task under chronic stress following the other two testing sessions may have caused more priming for stimuli presented in this condition. However, the findings did not demonstrate the predicted pattern more clearly under chronic stress. Chronic stress and high stress induced similar effects for high trait anxious individuals for unmasked words. For low trait anxious individuals, the predicted avoidance response was more evident under high stress than chronic stress. Although the chronic stress task was undertaken first in Study 4 and last in Study 5, similar results were found in these two studies. Therefore, it is
unlikely that priming or order effects influenced the findings. Other studies in the field (MacLeod & Mathews, 1988; MacLeod & Rutherford, 1992) have drawn similar conclusions, suggesting that the order of presentation of stimuli is unlikely to substantially affect the pattern of results.

8.3.8 Statistical Issues

As identified in this thesis at various points, the use of multiple analyses of variance with uncorrected alpha levels increases the Type 1 error rate and as such, this approach holds inherent risks. For this reason, this approach to the analyses should be seen as both exploratory and tentative, and it is important to consider the results of these studies in that light. It is conceivable that if a more stringent approach were adopted, few of the studies would have demonstrated either the predicted effects or those that were not predicted. As this current approach was exploratory, it is all the more relevant to indicate that these findings require replication before being able to be fully adopted as reliable effects.

8.3.9 Conclusions

In this section, methodological issues that may have influenced the current findings were addressed and some implications of these issues for future research suggested. Although various issues were raised, it was considered that they were not sufficiently influential to explain the findings and that they played indeterminate roles in this research. Comparisons between the current and previous research findings, and conclusions from this research are made in the forthcoming section.
8.4 Conclusions and Comparisons with Previous Research

The following sections outline the conclusions of this series of studies. Comparisons of the current findings are presented with those of the previous research and theory as they relate to threat-related attentional biases and trait and state anxiety, stimulus exposure, stimulus domain specificity, and developmental continuity.

8.4.1 Attentional Biases: Trait and State Anxiety

The first and most obvious conclusion drawn from this series of studies is that attentional biases to threat in non-clinically anxious individuals do not necessarily follow the course predicted by the interactional model. The central hypothesis of the studies was supported in only one study. A counter-intuitive effect, the converse of predictions, was found in four of the five studies. While it may be possible to interpret this lack of confirmation of the interactional model as the failure of the studies, the consistency of data suggests that the results are representative rather than anomalous. Moreover, the convergence of the findings is supported by the fact that the five studies, despite minor design differences, tested the same model using very similar methods.

The second conclusion is that high trait anxious individuals differ from low trait anxious individuals in their processing of threat-related information and most under elevated stress. The direction of attentional biases does not necessarily follow the predicted pattern.
The relationship between the current and previous results can be considered from various perspectives that add to the understanding of the issues at hand. The first issue is whether the individual findings of the current research, considered separately, concur with those from previous research. The second is whether the results of the series of studies overall concur with the past research trends. The individual findings will be considered initially.

Study 3 supported the findings of some previous studies, reviewed in Chapter 2, which endorsed the central experimental predictions drawn from Williams et al.'s (1988) model. As the result involve conscious processing, they concur with two studies that also reported these patterns at a conscious level of processing (MacLeod & Mathews, 1988; Richards et al., 1992). Although the pattern of findings in Study 3 was similar to those found by MacLeod and Rutherford (1992) and Mogg et al. (1994), these studies found attentional biases at a preconscious level.

Although the current studies paralleled particular previous studies in their design, the results did not support their findings. Studies 1-3 mirrored MacLeod and Rutherford's (1992) study but did not find the predicted pattern at a preconscious level. Aspects of Mogg et al.'s (1994) design were incorporated into Studies 3-5 of the current studies. The result in Studies 1, 4, and 5, involving attentional biases for unmasked threat words in high trait anxious individuals under low stress, was also seen in Mogg et al.'s (1994) study. However, in the current studies, there was clearer divergence of responses for
high and low trait anxious individuals under high stress. In Mogg et al.’s (1994) study, under chronic stress, high trait anxious individuals attended to threat and low trait anxious individuals avoided threat. That effect was comparable to the results seen in Study 3. However, in this study, it was seen under both high and chronic stress. Interestingly, the avoidance response to unmasked threat words seen in high trait anxious individuals under high stress in Study 2 was similar to that seen in Mogg et al.’s (1994) study. The differences seen in their study in response to high and exam threat were not seen in Studies 3-5 in the current series. In these latter three studies, the influence of stress elevation was incremental, from low to high to chronic stress.

Thus, although a series of studies was undertaken that was comparable to past research, the interactional model was supported in only some of the studies. Although there was some concordance between the results of Study 3 and previous research, the effect identified in Study 3 was not found in the other four experiments. This inconsistency reflects the discrepancies across previous studies. These results also draw into question Williams et al.’s (1988) predictions with high trait anxious individuals.

As previously indicated, Study 5 is among the few studies that has addressed threat-related attentional biases in children. As discussed previously, Studies 4 and 5 found parallel results, although they involved the alternative rather than the predicted pattern. As far as can be ascertained in the literature, Studies 4 and 5 are the only studies
designed to directly compare of the attentional biases of children and adults. For this reason, there are limited possibilities for comparison with previous research.

The few relevant studies suggest that anxious children may show disproportionate attention to threat in comparison to non-anxious controls. Kindt et al.'s (1997) study is among the few that can be meaningfully compared to the current study. They found a processing bias in children for physical threat independent of a stressful medical procedure. Attention to general threat was identified in anxious girls. This effect was not present in the context of the acute stressor.

There is little similarity between the current findings and those of Kindt et al. (1997). Their decrease in attentional bias to general threat under acute stress is somewhat similar to the decrease in attention to masked social threat under elevated stress in Study 5. However, they found specific processing biases under no stress for both groups, whereas the Study 5 found differential patterns of responses for high and low trait anxious individuals under high stress. The current study did not analyse RT data according to the sex of the individuals and so it is not possible to assess convergence in this area.

In summary, across comparable studies with adults and children, although there are some similarities between the current and previous research findings with adults and children, no consistent pattern has emerged. The current findings appear marginally
more consistent than previous findings but offer no more support of Williams et al.'s (1988) model. Although attentional biases to threat-related information in high and low trait anxious individuals are related to the interaction of trait and state anxiety, patterns of the attentional biases are less predictable. Methodological factors examined in Section 8.3 considered alternative explanations for the results. However, these factors played indeterminate roles in the findings. Conclusions regarding the effects of stimulus exposure and domain specificity are outlined in the following sections.

8.4.2 Attentional Biases: Stimulus Exposure

The third conclusion is that attentional biases to threat may occur at either preconscious or conscious levels of processing. However, as previously indicated, these patterns are inconsistent. In the current research, only one of the five studies found any evidence for the predicted pattern and this effect was at the conscious level. As indicated previously, an alternative pattern of attentional biases was identified that was the converse of the predictions. This pattern was identified at a preconscious level of processing in three studies. Another study produced the alternative pattern at a conscious level. Therefore, the findings across the five studies indicate that, overall, patterns of attentional biases were identified somewhat more commonly at a preconscious level. No study showed significant attentional patterns for threat at both a preconscious and a conscious level of processing. Thus, threat-related attentional biases are not necessarily demonstrated at preconscious and conscious levels simultaneously.
Do the current findings concur with previous research findings regarding the effects of stimulus exposure? To allow meaningful comparison with the current studies, only past studies that manipulated stress are considered in this section. As discussed in Chapter 2, three previous studies have found the predicted attentional pattern at a conscious level of processing and one at a preconscious level of processing. None have found the predicted pattern at both preconscious and conscious levels of processing. Therefore, Williams et al.'s (1988) prediction that threat-related attentional biases are identified more at a preconscious level has not been clearly supported by previous research.

Thus, the lack of clarity and consistency in the current findings regarding the effect of stimulus exposure reflects the state of the research. Alternatively, the current studies indicate that threat-related attentional biases are present at conscious and preconscious levels of processing. Domain-specific attentional biases, in particular, are identified more at a preconscious level.

The current findings suggest that individuals exposed to the probe-detection paradigm are more likely to demonstrate threat-related attentional biases at a preconscious level than a conscious level of processing. However, in these studies, unmasked threat words produced similar trends to those seen for masked words. Given more extreme stressors or more clearly defined trait anxiety groups, these effects may have become significant. The findings from the Stroop task, as previously indicated,
were less consistent and showed attentional biases to masked and unmasked threat words. In summary, the results involving the effect of stimulus exposure have not clarified the issue. However, they have shown that, irrespective of the direction of the pattern, threat-related attention biases are identified at conscious and preconscious levels.

8.4.3 Attentional Biases: Domain Specificity of Stimuli

The fourth conclusion is that trait-linked attentional biases to threat may be elicited by domain-specific stimuli but these biases are not produced consistently. This issue was particularly demonstrated in Studies 4 and 5, where emotionality effects were found. These patterns, when produced, are elicited by stress elevations.

Did these results concur with those of previous research? Of the studies that demonstrated the predicted interaction, mixed results have been found for domain-specific stimuli. Several studies found that attention to domain-specific words are elicited in high trait anxious individuals by particular stressors (MacLeod & Mathews, 1988; Richards et al., 1992). In contrast, other studies (MacLeod & Rutherford, 1992; Mogg et al., 1994) found no differentiation in response to domain-specific and general threat words. In addition, several studies did not produce the expected interaction and hence did not show effects for domain-specific stimuli (Martin et al., 1991; Mogg et al., 1990; Mogg et al., 1991). In one of the few studies with children that is comparable to
Study 5 (Kindt et al., 1997), there was evidence of attention to domain-specific threat but the effect was not associated with stress elevation.

Some previous studies have also focused on emotional specificity and current concern. Mathews and Klug (1993), Riemann and McNally (1995), and Dalgleish (1995) found interference for stimuli related to domain of concern or related to area of expertise. In contrast, Mogg and Marden (1990) found no interference effect for words related to area of expertise. The studies that have shown the trait by state anxiety interaction effect most clearly also addressed domain-of-concern factors (MacLeod & Mathews, 1988; MacLeod & Rutherford, 1992; Mogg et al., 1994; Richards et al., 1992). These studies, by manipulating stress factors with high and low trait anxious individuals, also increased the concerns of the individuals in specific areas.

In specificity effects, the chances of high trait anxious individuals attending to positive or negative stimuli in their specific domain of concern are maximised. Mathews and Klug (1993) proposed that attention to non-threat stimuli in anxious individuals may be due to some positive words containing negative meanings for anxious individuals. This is particularly the case if the positive words are near antonyms of negative words. The semantic association between anxious threat-related concerns and the positively valenced words may produce interference for those stimuli. This explanation differs from that proposed by Martin et al. (1991) to account for similar results. They proposed that attention to positive words was a function of the
emotionality of the stimuli. In current studies, there was insufficient evidence to conclude that the attentional biases were due to the emotionality of the stimuli alone in all the studies, although it clearly may have influenced the results of Studies 4 and 5. The level of threat and the personal relevance of the stimuli was also relevant.

The findings seen in three of the current studies for domain-specific threat words have been reported elsewhere. Mathews and Sebastian (1993) found a conscious suppression effect for domain-specific stimuli in snake fearful adults under high stress. An alternative response was identified under low stress, where attentional biases were shown primarily for stimuli specific to their concerns. Although their study did not isolate trait anxiety as a factor, the results demonstrate that anxiety-linked suppression effects may be observed in response to stress elevations.

Suppression effects have been predicted by the PDP model when the task demand associated with the Stroop is increased (Cohen et al., 1990). Increases in task demand may occur through the increased difficulty in naming the colours of domain-specific words or when a feared object is present. This was the case in the Mathews and Sebastian's (1993) study. While there have been several studies that have reported avoidance responses in low trait anxious individuals, fewer have reported such responses in high trait anxious individuals. Nevertheless, the varied findings indicate that reduction in attentional biases in anxious individuals is possible under specific stress conditions. If the notions of the PDP model can be extrapolated to other
attentional paradigms, then the current findings could be interpreted in this light. In conjunction with previous research, the effects identified in Studies 1, 4, and 5 indicate that such effects may be identified at both preconscious and conscious levels, and using different attentional tasks. The broader consideration of alternative theoretical explanations of such effects will be addressed in Section 8.5.

In summary, the domain-specificity effects revealed in this research are counter-intuitive but reflect the variation observed in previous research findings. The deviation from the predictions was not limited to domain-specificity effects but was seen more broadly in the interactional pattern of attentional biases to threat in high trait anxious individuals. Nevertheless, the findings show that domain-specific attentional biases are observed in non-clinical samples and occur more at a preconscious level of processing.

8.4.4 Attentional biases: Developmental Continuity

The fifth conclusion is that there is developmental continuity for the processing of threat in non-clinical samples. In this research, adults and children showed comparable levels and patterns of vigilance to social threat words at a preconscious level of processing. The results for children differed from the study of Kindt et al. (1997). In their study, conscious processing biases were produced, which were not found in Study 5. They also found biases for physical threat words in all children, independent of a medical stressor. This result was also not found in Study 5, which found biases only in response to social threat words.
Kindt et al.'s (1997) failure to produce trait-linked attentional biases in response to a medical stressor is not surprising. Spielberger et al. (1983) have indicated that various studies have shown that physically threatening stressors, in contrast to social and evaluative stressors, do not differentiate the state anxiety responses of high and low trait anxious individuals. Thus, the stressor may not have been focused enough on social and evaluative concerns to elicit differential patterns across high and low trait anxious individuals. Kindt et al. (1997) did find biases for general threat in girls, in the absence of an acute stressor, and irrespective of trait anxiety. This result also differs from the current findings. In Study 5, there were divergent patterns for high and low trait anxious children under low stress and RT data were not analysed according to sex.

The current data broadly support the notion of an external schema in children that is activated by external stimuli, in the context of external evaluation (Kendall & Ronan, 1990). However, the data pose similar questions for this notion as they do for those of Williams et al. (1988), as the findings differ from their predictions. Nevertheless, there was a high degree of similarity between the results for adults and children in the current research. This convergence suggests that anxiety-related schemas in non-clinically anxious children may be developed to comparable levels as adults by the age of 12 years. Therefore, attentional processing of threat-related information may occur in a similar manner at different ages. These data also suggest that the cognitive processing of emotional information can be examined without the need to assume that there are
marked developmental differences for adults and children in this domain. Further discussion will address other unresolved issues in the research. Further research is required to replicate these findings and to examine developmental issues in the processing of threat-related information.

8.4.5 Summary

This section has summarised the conclusions drawn from the current research and made comparisons with previous research. The current and previous research findings show some similarities but also show discrepancies. Thus, this research has raised into question the theoretical models. However, the current research findings also show intriguing non-intuitive patterns that may assist in clarifying the inconsistencies in this research domain. The next section examines the patterns of threat related attentional biases identified in these unexpected results from various theoretical perspectives.
8.5 Theoretical Implications

The theoretical implications of the current findings are discussed in this section. Although attentional biases to threat-related information in high and low trait anxious individuals are dependent on the interaction of trait and state anxiety, the directions of the patterns of attentional biases are less predictable. Therefore, it is appropriate to consider whether theoretical models can explicate this divergence in research findings. With results that differed so markedly from the predictions, it is tempting to fit these discrepant findings into the existing theory, but it is more appropriate to address aspects of the theory that require reformulation. In addition, it is relevant to consider whether complementary theoretical models can explicate the findings.

8.5.1 Subjective Evaluation of Threat

Williams et al. (1988) proposed that as the threat value of the stimulus increases, the differences in threat orientation also increase. Williams et al. (1997), in their revised model, similarly suggested that threat evaluation is not controlled by a stable internal mechanism, the Affective Decision Mechanism. Rather, they proposed that stimuli need only be tagged as threatening. The threat evaluation process is dependent on the potency of the threat to the individual and the state characteristics of the individual. Thus, state anxiety will increase the likelihood of stimuli being tagged as threatening. The Task Demand Unit allocates the direction of attentional resources. As in their earlier model, they predicted that trait predisposition determines a permanent tendency to react to the increased activation of threatening or tagged stimuli. They proposed that high trait
anxious individuals show a permanent tendency to switch their attention to the source of threat and low trait anxious individuals to avoid the source of threat, particularly at a preconscious level. As indicated in the model, this switching is dependent on the threat evaluation process, which is influenced by state anxiety elevations.

Williams et al. (1997) have not made explicit proposals regarding the attentional patterns associated with the full range of threat value increases. Increased threat value will be usually associated with increased stress and subsequent elevated state anxiety. Theoretically, all individuals shift their attention towards threat once the stimulus threat value (with corresponding state anxiety elevations) reaches sufficiently salient levels. Mogg and Bradley (1998), expanding on Williams et al.’s (1997) theory, offered similar proposals but suggested that threat orientation may not be linear. This model is discussed later in this section.

In their revised model, Williams et al. (1997) drew on Cohen et al.'s (1990) PDP model to explain reductions in attentional biases, as are seen in these studies. The PDP model has predicted that when the task demand unit associated with colour naming is increased, interference for the threat and words is reduced. Although their model deals explicitly with the Stroop paradigm, Williams et al. (1997) have suggested the model can incorporate other information-processing paradigms. The implications of the PDP model are compelling. They have been shown by Williams et al. (1997) to partially explain the suppression response found by Mathews and Sebastian (1993). As the PDP
model has proposed that interference for both emotional and non-emotional words is
reduced, analysis of equivalent data from probe-detection studies would require further
work in future studies, as these words are presented together in the probe-detection task.
Nevertheless, this model appears promising in its predictions, and other theorists have
proposed comparable models to account for such suppression responses. Future research
could profit from working from the model to establish experimental predictions,
particularly to determine the specific conditions under which such effects are identified.
The current research suggests that both acute and chronic stress may elicit reduction in
attentional biases.

8.5.2 Conscious and Preconscious Processing

The findings at a preconscious level in the current studies show mixed support for
the theoretical notions of Eysenck (1992). Similar to Williams et al. (1988), Eysenck
predicted that vulnerability for attention to threat in high trait anxious individuals is
latent and becomes active only during elevations in state anxiety. As previously
discussed, the current findings were the converse of these predictions. The results
support the notion of increased state anxiety as an attentional catalyst, as state anxiety
elevations elicited the differential patterns in high and low trait anxious individuals.
Ohman (1996) proposed that preconscious analysis of stimuli elicits attentional
orientation to anxiety provoking stimuli. The current findings have demonstrated a trend
that supports this notion in high trait anxious individuals to some extent. This model
may explain this trend for high trait anxious individuals to attend to threat under low
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stress and at a preconscious level. The model suggests that the initial response to
domain-specific stimuli is vigilance, in order to evaluate the threat of the stimulus.

Beck and Clarke (1997) proposed the operation of an orienting mode, which
functions at a preconscious level to allow processing of general rather than specific
forms of threat. Similarly, Mathews and MacLeod (1994) proposed that information is
first processed based on content and intensity and later on more subtle dimensions.
McNally (1995) made similar proposals. The current findings at a preconscious level
involved attentional biases for domain-specific threat, in contrast to their predictions. In
addition, the alternative pattern does not fit with their predictions. Following Study 1, it
was considered that, if the trend for attention to masked general threat in high trait
anxious individuals was found to be significant in a further study, the notion of an
orienting mode would have received support. This was not the case in any of the other
studies, and therefore, across this research this notion received little support. However,
the presence of attention to threat at low stress levels, as found in several studies, may
be congruent with that notion. Such vigilance may act somewhat like an early warning
system for high trait anxious individuals.

Attentional biases were found at both preconscious and conscious levels. These
findings reflect the previous literature, where significant results have been found at both
preconscious and conscious levels. However, the most consistent finding involved the
alternative pattern at the preconscious level. These results suggest that the alternative
pattern may be seen more consistently at a preconscious level and the predicted pattern more at a conscious level. As alternative attentional patterns have only recently been raised in the literature (e.g. Mathews & Sebastian, 1993), more research is required to clarify this issue.

8.5.3 Attentional Biases, Anxiety Vulnerability, and Stress

A modified account of how individuals attend to threat, as the valence of the threat increases, may explain the alternative pattern identified in this study. This account may also clarify the discrepancies in past studies. Like Williams et al.'s (1997) predictions that followed the utilisation of the PDP model, Mogg and Bradley (1998) proposed that threat-related attentional biases are dependent on the subjective threat value of stimuli. Threat evaluation is dependent on the interaction of the level of stress and internal vulnerability factors, which determine the tendency to assign threat value to the stimuli. Threat evaluation is similar to the functioning of the affective decision mechanism in Williams et al.'s (1988) model. In Mogg and Bradley's (1998) model, the relationship between the subjective threat value and attentional biases is curvilinear. Thus, when the threat is perceived as only moderately threatening, avoidance responses are evident. As perceived threat increases, attentional biases to threat increase. These notions are very similar to those presented by Williams et al. (1997) in discussion of the suppression of attentional biases, as predicted in the PDP model.
Like Williams et al. (1988), Mogg and Bradley (1998) have proposed that attentional avoidance is an integral aspect of responses under stress. There are adaptive elements to decreases in threat-related vigilance for both high and low trait anxious individuals. The attentional system must prioritize different forms of threat in order to adapt to the requirements of stressful situations. This process is adaptive because it allows a changeable task focus during periods of stress. This alteration of task focus may also have a mood stabilising role, which in turn increases the ease of attending more broadly to the environment. It is probably important to allow vigilance for other information, including other forms of threat, in the environment during higher periods of stress. Attentional avoidance under elevated stress allows the individual to focus on other aspects of their environment, in a task-oriented fashion.

The model of Mogg and Bradley (1998) is not unique in its proposition of a curvilinear relationship between trait anxiety and stress. Williams et al. (1997) have made similar predictions in their revised model. Mathews (1990) proposed a similar model to that of Mogg and Bradley but suggested that this relationship is identified in low trait anxious individuals. He did not propose that the pattern is related to the subjective threat value of stimuli. Rather, the proposal was that low trait anxious individuals avoid attending to threat until a threshold for threat is reached. At this point, they attend to threat. In contrast, Mogg and Bradley (1998) proposed that both high and low trait anxious individuals operate within this framework. Based on the current findings, the tendency to divert attention away from threat may be present in high and
low trait anxious individuals under mild or moderate stress. According to Mogg and Bradley's (1998) model, the patterns for high and low trait anxious individuals are different due to the differences in their thresholds for threat.

Mogg and Bradley (1998) proposed that when the subjective value of threat is zero, there is no attention to threat. If their model is valid, the fact that low stress elicited attentional biases in the current research may indicate that the subjective value of threat is not at zero under low stress. The level of subjective threat value depends on the interaction of individual reactivity factors and the level of situational stress. The subjective value of threat under low stress is generally greater for high trait anxious individuals than for low trait anxious individuals. While there is no external stressor present, high trait anxious individuals may show vigilance for threat because of this tendency to appraise stimuli as threatening.

In Mogg and Bradley's (1998) model, when stimuli are evaluated as mild to moderately aversive and consequently have relatively low subjective threat value, attentional resources are allocated away from the stimuli. The role of such avoidance is homeostatic, operating as a mood regulation mechanism. In addition, the attentional avoidance of threat allows the maintenance of a task orientation to avoid distraction by mild-to-moderately aversive stimuli. As subjective appraisal of threat increases, so also does attention to aversive stimuli. Inherent in this model is the notion of a threshold for threat appraisal, which when reached, triggers vigilance for environmental threat.
Measuring subjective stimulus threat value is likely to be complex. Nevertheless, stimulus threat value may relate to the current research in several ways. First, this notion relates to the different types of stimuli presented. Presumably, different types of threat words had greater subjective threat value than did other types at particular times. However, the current studies were not designed to evaluate the idea of subjective stimulus threat value. Rather, the threat types were designed to be generally equivalent in valence. Future studies could develop stimulus categories of different threat values to test whether the predicted pattern was demonstrated.

Second, within the existing stimulus categories, threat words could have different threat values. The current stimuli were analysed in conjunction with the other words in the stimulus type, rather than specific words considered individually. Individual analysis of threat words of different levels of valence would test the notion of Mogg and Bradley (1998), but this was not the focus of this research.

Third, the subjective threat value of stimuli may vary as a function of the variations of the stimuli and the effects of increased stress. Based on interactional notions of threat evaluation inherent in Mogg and Bradley’s (1998) model, individuals progress from low to high subjective evaluation of threat in different ways. High trait anxious individuals are more reactive to stress elevations. They have a lower threshold for the perception of danger than do low trait anxious individuals. Therefore, the curvilinear patterns for high
and low trait anxious individuals differ most in their different rates of reactivity to threat, which are affected by their different responses to stress.

If the content of the threat stimuli was held constant across the groups, the levels and salience of stress may be determining factors in the subjective threat value of stimuli. However, few studies have assessed the valence of the threat stimuli for each individual. The current studies aimed to ensure that the levels of threat were equivalent across threat types. However, individual differences in responsivity for word types and specific words could have substantially influenced the results.

As previously indicated, high trait anxious individuals showed decreased attention to threat and low trait anxious individuals showed increased attention to threat under stress elevation. This pattern can be seen as the secondary response in this curvilinear function proposed by Mogg and Bradley (1998). In their model, avoidance occurs when the subjective threat value is mild to moderate. The threat value of the stimuli increases with stress, although this increase does not follow a linear pattern. Therefore, if the predictions of the model are valid and applicable to the current studies, it is possible that the acute laboratory stress and the chronic examination related stress were only mild to moderate in intensity. The current results support this notion. The levels of state anxiety in each of the studies in response to stress elevations were relatively moderate (see Chapters 4-7). These state anxiety levels are not surprising in hindsight, considering the transience of the acute stressors and the low valence of the chronic stressor. These
studies assumed low and high stress produced significant differences in state anxiety levels and this assumption was upheld. However, the nature of the stressors probably made it impossible to produce more than moderate stress conditions. This issue will require attention in future research.

Therefore, hypothetically, the relatively moderate state anxiety elicited by the higher stress conditions led to decreased attention to threat in high trait anxious individuals. If more extreme increases in stress were experienced, they may have been associated with high trait anxious individuals increasing their attention to threat. This model may explain the alternative pattern in the current results and the inconsistency of previous research findings. High trait anxious individuals show distinct attention to threat only if the stimulus threat value has crossed the individual’s threat threshold. The stressors employed in the current studies and some previous studies may have been insufficiently intense to cross this point.

It is unclear why low trait anxious individuals generally showed increased attention to threat under stress elevation in the current research. However, drawing on these models, there are several possible explanations. Firstly, the pattern of avoidance described in Mogg and Bradley’s (1998) model may apply more to high trait anxious than low trait anxious individuals. As has been indicated by Williams et al. (1988), there are relatively few emotional consequences for low trait anxious individuals in attending to threat. In contrast, high trait anxious individuals experience mood disturbance and
task-behaviour disruption through attending to threat. Several theorists (Mathews, 1990; Williams et al., 1988) have considered that low trait anxious individuals avoid threat to maintain a homeostatic balance and avoid anxiety elevations. This may well be the case under higher levels of stress. However, under moderate stress, vigilance for threat is not expected to elevate state anxiety to a substantial degree.

The second possible explanation for the stress related attentional response of the low trait anxious individuals concerns their threshold for subjective threat. Mogg and Bradley (1998) proposed that the avoidance response under mild-to-moderate stress occur once the stimulus threat value is sufficiently salient. As low trait anxious individuals have a threshold set higher for the perception of threat, greater stress may be required before avoidance occurs in low trait anxious individuals. It is expected that avoidance responses are not required until the threat interferes with task completion. The current findings demonstrate that the same stressors produce lower state anxiety in low trait anxious individuals than in high trait anxious individuals. Thus, stressful conditions are experienced as less aversive for low trait anxious individuals than high trait anxious individuals. Therefore, the moderate stressors employed in the current studies might not have elicited the crossing of this threat threshold.

If valid, Mogg and Bradley’s (1998) model may clarify previous research where the findings did not fit with predictions and where mild to moderate intensity stressors have been used (e.g. Mogg et al., 1994; Mogg et al., 1990). However, even if this model can
explain these negative findings, some previous studies (e.g. MacLeod & Mathews, 1988; MacLeod & Rutherford, 1992) have also shown the predicted avoidance in low trait anxious individuals in response to elevated stress. Various studies have implicated the chronicity of the stress as a determining factor in attentional responses, with chronic stressors predicted to produce greater attentional biases. The evidence for this position is mixed (e.g. MacLeod & Mathews, 1988; MacLeod & Rutherford, 1992; Mogg et al., 1994) As previously discussed, the current research does not clearly support this position, despite its theoretical appeal.

Therefore, the attentional responses of low trait anxious individuals in this study may be interpreted in the light of this model. Hypothetically, as low trait anxious individuals experience less state anxiety than do high trait anxious individuals under elevated stress, there is less reason for them to avoid the threatening information. The alternative pattern described for high trait anxious individuals may be equally applicable to low trait anxious individuals, however they require exposure to higher stress before they avoid threat words. Mogg and Bradley (1998) did not distinguish between the responses of high trait anxious individuals and those of low trait anxious individuals. However, the current findings indicate that the attentional response of high and low trait anxious individuals differ depending on the level of stress experienced. As low trait anxious individuals experience less state anxiety than do high trait anxious individuals in response to the same stressor, their response patterns may be identical in form but differ according to their reactivity to the stress level.
The theoretical analysis of the current research in this section is extended in Section 8.6 in an attempt to further explicate the findings. This research is examined in an alternative theoretical light. Alternative predictions are made regarding the attentional responses of high and low trait anxious individuals under different levels of stress.
8.6 Reformulated Model of Anxiety Vulnerability, Stress, and Attention to Threat

The current research findings can only be partially incorporated into Mogg and Bradley's (1998) model and Williams et al.'s (1988; 1997) models. Consequently, this research has highlighted the need for a reformulated model. To clarify the response of non-clinically anxious individuals to different levels of stress and to describe this within the paradigm used in these studies, an adaptation of the curvilinear relationship described by Mogg and Bradley is required. Mogg and Bradley, by using the notion of subjective stimulus threat value, integrated the notions of state anxiety (caused by external stress), individual reactivity to external threat (trait anxiety), and stimulus valence. The proposed model (Figure 8.1) is similar in certain ways to their model but has attempted to map the proposed relationships onto the factors highlighted in this research: trait anxiety, stress, and attentional biases to threat.
**Figure 8.1.** Hypothetical relationship between trait anxiety, stress, and attention to threat

The hypothetical model (Figure 8.1) shows the patterns of attentional biases of high and low trait anxious individuals in response to increasingly intense stress, based on the current results and past research. It is proposed that there is initially attention to threat
under lower levels of stress and as stress increases, avoidance occurs. As stress becomes extreme, it indicates higher threat, and both high and low trait anxious individuals attend to the threat for protective reasons. At what point avoidance and vigilance occurs in the stress elevation depends on the interaction of the intensity and type of stress with the individual’s threat threshold.

Although the basic premises of the model are similar to those proposed by Mogg and Bradley (1998), this model has used level of stress and trait anxiety as interacting variables rather than the unitary variable of subjective stimulus threat value. Level of stress does not refer to the individual’s experience of the stress but rather refers to stress intensity as externally defined. The actual stressors would require pre-testing with the relevant subject groups. The terms used for stress levels are somewhat arbitrary. For example, low stress could refer to a neutral experience such as relaxation, moderate stress to an examination related stressor, high stress to a threatening social situation, and extreme stress to public humiliation. The model also draws on rather than directly reflects the current results. Avoidance did not necessarily occur in each study. Some effects involved, for example, decreased attention to threat rather than avoidance.

In this model, no stress shows high trait anxious individuals minimally attending to threat and low trait anxious individuals avoiding threat to a minor degree. Although the pattern depicted for no stress is hypothetical, it represents responses at points of very low state anxiety. The two groups show some attention or avoidance of threat based on
their predisposition to respond to or avoid threat under minimal levels of state anxiety. The model has used the alternative pattern identified in the current studies to depict the patterns seen for low and moderate levels of stress. As has been argued, elevated stress conditions probably represented only moderate levels of stress in the current studies. Thus, the most common response from the current studies, the alternative pattern, has been depicted for low and moderate stress. Under moderate stress, high trait anxious individuals show decreased their attention to threat and low trait anxious individuals show increased attention to threat. The difference in their attentional response reflects the differences in their reactivity to the stress.

The patterns depicted for high and extreme stress are also hypothetical, but the responses of both groups for high stress have been found in previous research. Under elevated stress, as has been argued in the model of Williams et al. (1988), high trait anxious individuals attend to threat and low trait anxious individuals avoid threat. Based on the evolutionary need to attend to imminent danger, extreme stress produces vigilance in both groups.

The model depicts a similar pattern for high and low trait anxious individuals. The patterns of high and low trait anxious individuals are similar in form but vary in their responses to stress. Implicit in this model is that high and low trait anxious individuals have different reactivity to the same level of stress, with high trait anxious individuals experiencing higher levels of state anxiety than do low trait anxiety. The model assumes
that the shifts for avoidance and vigilance are triggered by the reaching of state anxiety thresholds, which vary across individuals. Avoidance responses occur under lower levels of stress for high trait anxious individuals than for low trait anxious individuals, as their state anxiety threshold is reached under relatively lower levels of stress. Similarly, the shift to vigilance occurs when individual thresholds are reached.

The patterns shown for low, moderate and high stress demonstrate how the current results and Williams et al.’s (1988) model may be integrated. Past studies that have shown the predicted pattern of Williams et al. (1988) may have shown the responses to low and high stress in this model. In these conditions, high trait anxious individuals attend to threat and low trait anxious individuals avoid threat. Those studies that have shown the alternative pattern, seen in the current research, may have demonstrated the responses to low and moderate stress.

This modification of Mogg and Bradley’s (1998) curvilinear model may shed light on previous research. The predicted pattern has been found in studies that have used chronic stressors (MacLeod & Mathews, 1988; MacLeod & Rutherford, 1992). Assuming exposure to chronic stressors allows greater processing of threat-related information and produced elevations in state anxiety, it is logical that high trait anxious individuals attend to threat and low trait anxious individuals avoid threat under stress. However, the model has not resolved the discrepancies in ostensibly similar studies. It is likely that non-clinically anxious individuals are relatively sensitive to subtle
differences in stress levels and conditions. Differences in higher stress conditions may
induce the variation in responses.

The relationship between the chronicity of stress and levels of state anxiety has not
been resolved in the current research. The current studies suggest that, despite lower
levels of state anxiety under chronic stress, the attentional patterns under chronic stress
and high stress follow a similar shift from the response produced under low stress. As
few studies have used graduated stress levels or state anxiety measures other than self-
report, it is difficult to assess the validity of this proposed variation to the model. As
indicated in reviews of experimental inductions of mood (Gerrards-Hesse et al., 1994;
Martin, 1990), there has been wide variation in experimental conditions for the
induction of stress and in the indicators of heightened affect. Further experimentation
with more graduations in stress, using more objective state anxiety measures, may assist
in testing the validity of this alternative pattern.

This model is somewhat limited by its reliance on the use of external stress as a
factor, as subjective threat evaluation will be determined by individual interpretation of
external stress, as has been shown in Mogg and Bradley’s model. Nevertheless, the
model clarifies the differential responses of high and low trait individuals in response to
increasing stress. The model, like this many models in this field, is also hindered by its
reliance on the use of the discontinuous categories of high and low anxiety to
differentiate responses. Trait anxiety is best seen on a continuum and so the use of
discrete categories does not allow for clarification of these findings. However, the model allows for the formulation of some predictions. Patterns identified for high and low trait anxious individuals represent the extremes. Those individuals with more moderate trait anxiety levels follow similar but less extreme patterns. This model awaits evaluation.

The model has proposed attentional avoidance is an adaptive response to stress. Its role includes decreasing vigilance for threat in both high and low trait anxious individuals. This avoidance reflects the changing priorities of the attentional system under stress, stabilizes mood, and allows broader attention for other threats. In addition, attentional avoidance complements selective processing of threat-related information.

It is interesting to speculate about the relationship between the attentional avoidance and the behavioural avoidance typically seen in anxious individuals. In elevated anxiety, behavioural avoidance is both a symptom of the anxiety and a maintenance factor of the anxiety and is complementary to hypervigilance for threat stimuli. Avoiding the source of the anxiety strengthens psychological links between the stimulus and the emotion, through negative reinforcement. In the clinical domain, anxiety-related behavioural avoidance is the considered the central symptom to be addressed in treatment of anxiety disorders (Barlow, Esler, & Vitale, 1998). In addition, there is some evidence for a relationship between attentional avoidance and avoidant coping styles (Bonanno et al., 1991; Fox, 1994; Lavy & van den Hout, 1994). Attentional avoidance, behavioural
avoidance, and avoidant coping styles may play adaptive roles in allowing the individual to scan the environment for alternative tasks and/or threats. However, it is possible that attentional and behavioural patterns combine to maintain and/or trigger anxiety states, and perpetuate elevations of anxiety in the long-term. How they contribute to each other’s functioning is an intriguing area for future research and may be usefully examined in conjunction with the models discussed in this section.

It is also possible to speculate on applying information-processing tasks to altering attentional responses to anxiety-related stimuli. If there is a link between attentional and behavioural avoidance in maintenance of excessive anxiety, graded presentation of such stimuli could operate in a similar fashion to covert exposure. Reducing reactivity at an attentional level may decrease the need to focus interventions on higher level cognitive processes. Similarly, if validation of the proposed model were to occur, attentional shifts may be considered evidence of changes in reactivity to anxiety-related stimuli, and therefore, therapeutic change. Such an application would be important both in treatment outcome studies and in research. Use of an objective measure to demonstrate changes in patterns of responsivity to anxiety may be a more valid indicator of change than self-report. Evidence of change at preconscious levels may allow identification of therapeutic methods that are able to alter the basic reactivity to threat stimuli.

More generally, the extent to which the proposed model contributes to the understanding of threat-related attentional biases in high trait anxious individuals
depends on future research. Further examination of this model and the other relevant models may further clarify the relationships between anxiety vulnerability and stress, and the possible links between anxiety vulnerability and clinical anxiety. Final conclusions are made in Section 8.7.
8.7 Conclusions

The application of cognitive paradigms in the area of experimental psychopathology has offered considerable promise to clinicians and psychopathologists in the last two decades. The possibility is that cognitive correlates of emotional disturbance and vulnerability can be objectively measured, both within and outside awareness. These anxiety-related attentional biases may elicit and maintain emotional distress. The measurement of emotional vulnerability has substantial implications in various clinical and applied domains in facilitating evaluation, prevention, and treatment.

The promise of these cognitive paradigms has been largely fulfilled in the clinical domain, with the positive results increasing the understanding of various disorders. However, results in the domain of anxiety vulnerability are more mixed and complex. The current research shows that aspects of Williams et al.'s (1988; 1997) models require further modification to incorporate recent empirical and theoretical contributions, despite the fact that their core theoretical notions appear valid. Based on this research, anxiety vulnerability influences the cognitive processing of threat. High and low trait anxious individuals show differential patterns of attention to threat, depending on the level of the stress. These patterns are seen at conscious and preconscious levels of processing. In addition, the current research produced novel results that suggest that schema-related attentional patterns are equivalent for adults and children, and that these patterns are observed most in individuals' domain of concern.
However, the specific patterns of threat-related vigilance and avoidance differ from those predicted in Williams et al.'s (1988) model. While it may be possible to fit the discrepant research findings into their existing theory, it is more parsimonious to suggest that aspects of the theory require reformulation. Therefore, an alternative model has been suggested in this thesis. It is proposed that both high and low trait anxious individuals show avoidance and vigilance for threat depending on levels of state anxiety experienced. Individuals show shifts in threat-related vigilance and avoidance in response to changes in stress levels. Individual levels of anxiety vulnerability influence the patterns of these shifts and these attentional shifts are triggered by the crossing of threat thresholds. The crossing of threat thresholds is hypothesised to be dependent on the interaction of levels of anxiety vulnerability and state anxiety.

However, a complex influence on cognitive processing, subjective stimulus threat value, may play a significant role in determining threat-related attentional patterns. The attentional paradigm employed in the current studies and in similar studies has not addressed this factor. The incorporation of this factor into the cognitive processing paradigm may clarify some of the unresolved issues raised in this research. The paradigm used in much of the research to date, with the use of trait anxiety and stress as interacting factors in determining attentional biases, may well have contributed to the discrepancies in the research. This paradigm may be insufficiently sensitive to the relationships between the subjective threat value of the stimuli, state anxiety, and anxiety vulnerability to fully map the cognitive processing of threat in non Clinically
anxious individuals. Subsequently, minor variations in experimental conditions may have elicited the discrepancies observed between studies. There are other unresolved dilemmas in the research. These include the need for more ecologically valid stressors and the need to clarify the modes of stimuli that most effectively represent threat. Future research may profit from addressing these conceptual and paradigm-specific issues to further clarify the relationship between the cognitive processing of threat, anxiety vulnerability, and clinical anxiety.
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Appendix A. Stroop Task Informed Consent Form

DEPARTMENT OF PSYCHOLOGY

INFORMED CONSENT FOR INVOLVEMENT IN A STUDY

IN VolVING A COLOUR NAMING TASK

This study is being undertaken under the supervision and coordination of Simon Kennedy, Lecturer, Department of Psychology. The study aims to investigate adult students' abilities on a colour naming task during the university year. The study has been approved by the Australian Catholic University Ethics Committee. The study is extremely important in the understanding of university students' responses to study.

In the first part of the study students will provide some basic personal information, and complete a short questionnaire, related to their usual feelings in everyday life, and this will take about 5 minutes. Not all students will be included in the other parts of the study. Some students will be asked to be actively involved in the other parts of the study, others will be asked to leave their details as they may be included at a later date. Inclusion or non-inclusion in the later parts of the study does not mean anything negative about students. Students will be contacted by telephone to arrange a suitable time for the study (with a reminder call the day before each session).

The second part of the study involves students spending less than 1 hour on one occasion doing the task. Students will complete questionnaires similar to the one completed in the first part of the study, do a short academic test, and do the main part of the study, which involves naming colours of words presented on a computer screen. The task is not difficult.

As with all studies, students are able to withdraw from the study at any time for any reason. All records, and results are entirely confidential, and all results are coded with a number rather than students' names. Questions, comments, or concerns can be directed at any time to Mr. Kennedy (Room 234, 2nd Level, Donovan Building; Phone: 563-3630).

Simon Kennedy
Lecturer
Department of Psychology

STATEMENT OF INFORMED CONSENT

I have read and understand the description of the study, and I wish to volunteer to be involved in the study. I understand that I can withdraw from the study at any time for any reason.

Name __________________________________________ Date __________________________
Signed ______________________________________________ Age ________________
Telephone (W) ____________________________ (H) ____________________________
Appendix B. Stroop Task Information Sheet

DEPARTMENT OF PSYCHOLOGY

INFORMED CONSENT FOR INVOLVEMENT IN A STUDY INVOLVING A COLOUR NAMING TASK TASK

Information about the study

Thank you for your involvement

This study is being undertaken under the supervision and coordination of Simon Kennedy, Lecturer, Department of Psychology. The study aims to investigate adults' abilities on a colour naming task during the university year. The study has been approved by the Australian Catholic University Ethics Committee. The study is extremely important in the understanding of both university students' responses to study.

In the first part of the study students will provide some basic personal information, and complete a short questionnaire, related to their usual feelings in everyday life, and this will take about 5 minutes. Not all students will be included in the other parts of the study. Some students will be asked to be actively involved in the other parts of the study, others will be asked to leave their details as they may be included at a later date. Inclusion or non-inclusion in the later parts of the study does not mean anything negative about students. Students will be contacted by telephone to arrange a suitable time for the study (with a reminder call the day before each session).

The second part of the study involves students spending less than 1 hour on one occasion doing the task. Students will complete questionnaires similar to the one completed in the first part of the study, do a short academic test, and do the main part of the study, which involves naming the colours of words presented on a computer screen. The task is not difficult.

As with all studies, students are able to withdraw from the study at any time for any reason. All records, and results are entirely confidential, and all results are coded with a number rather than students' names. Questions, comments, or concerns can be directed at any time to Mr. Kennedy (Room 234, 2nd Level, Donovan Building; Phone: 563-3630, Main Office 563-3600).

Simon Kennedy
Lecturer
Department of Psychology
Appendix C. Probe-Detection Task Informed Consent Form

DEPARTMENT OF PSYCHOLOGY

INFORMED CONSENT FOR INVOLVEMENT IN A STUDY

DOT PROBE VISUAL IDENTIFICATION TASK

This study is being undertaken under the supervision and coordination of Simon Kennedy, Lecturer, Department of Psychology. The study aims to investigate 17, 18, and 19 year old students' abilities on a computerised dot probe identification task, at 3 points of the university year. The study has been approved by the Australian Catholic University Ethics Committee. The study is extremely important in the understanding of both university and school students' responses to study, and later parts of the study will investigate 16, 14, and 12 year olds.

In the first part of the study students will provide some basic personal information, and complete a short questionnaire, related to their usual feelings in everyday life, and this will take about 5 minutes. Not all students will be included in the other parts of the study. Some students will be asked to be actively involved in the other parts of the study, others will be asked to leave their details as they may be included at a later date. Inclusion or non inclusion in the later parts of the study does not mean anything negative about students. Students will be contacted by telephone to arrange a suitable time for the study (with a reminder call the day before each session).

The second, third and fourth parts of the study involve students spending less than 1 hour on 3 separate occasions doing the task. Students will complete questionnaires similar to the one completed in the first part of the study, do a short academic test or a relaxation task, and do the main part of the study, which involves identifying a probe presented on a computer screen. The task is not difficult. One of the sessions will take place within 5 days of an examination.

As with all studies, students are able to withdraw from the study at any time for any reason. All records and results are entirely confidential, and all results are coded with a number rather than the student’s name. Questions, comments, or concerns can be directed at any time to Mr. Kennedy (Room 234, 2nd Level, Donovan Building, Phone: 363-3630).

Simon Kennedy
Lecturer
Department of Psychology

STATEMENT OF INFORMED CONSENT

I have read and understand the description of the study, and I wish to volunteer to be involved in the study. I understand that I can withdraw from the study at any time for any reason.

Name_________________________________________ Date____________________

Signed_________________________________________ Age____________________

Telephone (W)_________________________________ (H)____________________

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Appendix D. Probe-Detection Task Adult Information Sheet

DEPARTMENT OF PSYCHOLOGY

INFORMED CONSENT FOR INVOLVEMENT IN A STUDY

DOT PROBE VISUAL IDENTIFICATION TASK

Information about the study

Thank you for your involvement.

This study is being undertaken under the supervision and coordination of Simon Kennedy, Lecturer, Department of Psychology. The study aims to investigate 17, 18, and 19 year old students' abilities on a computerized dot probe identification task, at 3 points of the university year. The study has been approved by the Australian Catholic University Ethics Committee. The study is extremely important in the understanding of both university and school students' responses to study, and later parts of the study will investigate 16, 14, and 12 year olds.

In the first part of the study students will provide some basic personal information, and complete a short questionnaire, related to their usual feelings in everyday life, and this will take about 5 minutes. Not all students will be included in the other parts of the study. Some students will be asked to be actively involved in the other parts of the study, others will be asked to leave their details as they may be included at a later date. Inclusion or non-inclusion in the later parts of the study does not mean anything negative about students. Students will be contacted by telephone to arrange a suitable time for the study (with a reminder call the day before each session).

The second, third and fourth parts of the study involve students spending less than 1 hour on 3 separate occasions doing the task. Students will complete questionnaires similar to the one completed in the first part of the study, do a short academic test or a relaxation task, and do the main part of the study, which involves identifying a probe presented on a computer screen. The task is not difficult. One of the sessions will take place within 5 days of an examination.

As with all studies, students are able to withdraw from the study at any time for any reason. All records, and results are entirely confidential, and all results are coded with a number rather than students' names. Questions, comments, or concerns can be directed at any time to Mr. Kennedy (Room 234, 2nd Level, Donovan Building; Phone: 563-3630 Main Office 563-3600).

Simon Kennedy
Lecturer
Department of Psychology
Appendix E. Probe-Detection Task Child Informed Consent Form

AUSTRALIAN CATHOLIC UNIVERSITY

Dear Parents of Year 7 Students

I am a Clinical Psychologist and Lecturer in the Department of Psychology at Australian Catholic University, Oakleigh. I am currently undertaking research investigating stress and anxiety in children in conjunction with the Department of Psychology, The University of Melbourne. I am writing to you to ask for your help through you allowing your Year 7 child to be involved in the study, to be carried out in October 1995. As time is limited, I would appreciate it if you could read this letter and return it in the envelope provided before October 1, 1995

OVERVIEW

The aim of the study is to increase our understanding of stress in children, both the stress children experience on a daily basis and how they react when stressed in school environments. Children and teenagers from regular school environments need to be studied so as we can understand how stress works in the general population of children.

Your child’s involvement in the study allows a very important contribution to a new way of understanding stress and anxiety in children. Ultimately the findings may lead to new interventions and preventative programs for children in the area of stress and anxiety both within and outside educational settings, and the findings of the study may be published in journals and presented in professional forums, without reference to individuals.

Any involvement your child has in the study will be entirely confidential. This study involves little time and minimal disruption of normal classes for the children. This project has been approved by the Australian Catholic University Victorian Division Research Projects Ethics Committee. The results of the study do not suggest anything negative about students. Nevertheless, school personnel will not have access to any aspect of the results of the study. All students will be given a number code and so results will not be linked to any child by name, and naturally no child will be identified in any way in publications by name.

SPECIFICS

Children will initially fill out several short questionnaires in class, taking about 10 minutes in total, which will provide an indication of to what extent children tend to be stressed on a day to day basis. Not all children will be included in further testing. A cross section of less than 100 of the Year 7s will go on to do 3 sessions of 35 minutes on a simple computer task, to be carried out in lunchtimes in October.

The computer task involves students being presented with two words at a time on the screen; a positive word (eg. happy) and a negative word (eg. worried). The words are presented so that students are consciously aware of the content of the words, or at a speed which does not allow conscious awareness of the words, and they are then replaced by one or two dots where either the positive or the negative word was located on the screen. The student push buttons as quickly as possible when they see the dots. The task allows identification of whether students mainly paid attention to positive words or negative words.

Each student involved in the computerised testing would be required to do the task on three different occasions in the computer room at the school; firstly in a period of fairly low stress (i.e. not before a test), secondly, after having done a mildly difficult arithmetical task on the computer (which is connected to the testing), and thirdly, in close proximity to a class test (within a day or two if possible). The aim of the three testing periods is to test students under different forms of stress. The three testing periods need to be at least one week apart. They also fill out some questionnaires during testing.

Students who do the computer task would have contact with myself and a research assistant. The computer task itself is not stressful or upsetting. The arithmetical task, done prior to one testing session, is designed to be similar to a reasonably difficult test, however as would be expected, the effects of doing such a task are short lived. Students are fully informed in advance what to expect with each form of testing. All the normal debriefing procedures are followed.
Appendix E. Probe-Detection Task Child Informed Consent Form

I have included an information sheet and informed consent form for your child, which needs to signed by you and returned in the envelope provided along with your the form you are reading. Spare copies have been included for your reference. Your child, if they are to be involved, would sign the informed consent prior to filling out the initial questionnaires, and would be informed about the study at the same time.

If you have questions or concerns about any aspect of the study or your child’s involvement in the study at any time, please call me on 9563-3630. If you have concerns or queries about any aspect of the study which you feel I have not been able to satisfy, you can contact: The Chair, Research Projects Ethics Committee, C/- Victorian Division, Australian Catholic University, Albert St, East Melbourne, 3002. Any contact will be treated in confidence, investigated fully, and you would be informed of the outcome.

As time is limited, I would appreciate it if you could read this letter, complete the statement of informed consent below, even if you would prefer that your child was not involved, and return it in the envelope provided before October 1, 1995

Yours sincerely

Simon Kennedy
B.B.Sc, M.Psych., F.Homoeo., M.A.Psych.
Clinical Psychologist & Lecturer
Department of Psychology

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STATEMENT OF INFORMED CONSENT

(Please tick)

----------- I am willing for my child to be involved in the study.
----------- I am not willing for my child to be involved in the study.

I have read and understood the information above and any questions I have asked have been answered to my satisfaction. If I have agreed to participate in the study, I am aware that I or my child can withdraw at any time for any reason.

Name of Parent/Guardian..........................................................Signature of Parent.........................................................

Name of Year 7 Student..........................................................Date of Birth of Student..........................Age............

Telephone (AH) ..................................................(BH) ..................................................

I wish to speak to Mr. Kennedy personally about the study YES

---

THE STUDY IS TO BEGIN IN OCTOBER.
PLEASE RETURN THIS FORM BEFORE OCTOBER 1, 1995
IN THE ENCLOSED ENVELOPE.
Appendix F. Stroop Task and Mood Induction Procedure Protocol

Appendix F. Stroop Task and Mood Induction Procedure Protocol

WHEN SUBJECT ARRIVES:

i) Introduction

"This study is attempting to predict how well people can do on colour-naming tasks based on simple IQ or anagram ability tests. These IQ tests also may give you an indication of how well you may do in your studies at University, your exams, and your coursework. We wish to see if there is a relationship between how well you do on these tests and your abilities on a colour-naming task. If you do well on the first IQ test, you will not have to do the second IQ test, which is more difficult and is a more comprehensive indicator of your abilities. If you do not do well on the first test, you will be required to do the second IQ test after the colour-naming task."

ii) Introduction of the practice colour-naming trials:

"The first task is just a practice for the colour-naming trials. This task requires you to look at a word on the screen and tell us what colour the letters are written in. We want you to ignore the content of the words and just say the colour as quickly as possible. Sometimes a recognisable word will appear; remember to ignore the content and just say the colour. At other times, you may see only a meaningless line of symbols. On those occasions a word has been flashed up very quickly - so fast that you may not have been able to see it - and been replaced by the meaningless symbols. Again, just say the colour as quickly as possible.

It is important for us to know whether you can see the words that are flashed up very quickly. To check this out, the colour-naming trials will stop from time to time and there will be six "word recognition trials". For these, the task is to say whether there was a real word there or just a jumble of letters. If you think it was a real word, press "yes" on the box in front of you; if you think it was a jumble of letters, press "no". If you cannot decide (and most people find it very difficult or impossible to see the word) just guess.

All that sounds a bit complicated, but we're going to have a practice first, so you'll soon get used to it."

iii) Introduce voice key:
"This is a microphone that fits round your neck. You may find it a little tight, so try to adjust it so that it is comfortable - most people find that just to one side of your larynx is best. We use this to see how long it takes for you to respond. You'll notice that when you say something, the red light on the box up here flashes. Just say a few words so we can test it ".

(Demonstrate; adjust sensitivity dial on far left if necessary; usually, just under maximum is best)

"When you say the name of the colour, the word will disappear to be replaced by another; if it doesn't disappear, wait a few seconds before saying it again. Once we start the test, try not to move around too much, as it might trigger the microphone " (Demonstrate with red light).

"OK, let's try the practice ".

iv) Type the letter P; make sure the subject can differentiate the colours. Then press any key and take the subject through the practice. To stop at any time to talk to the client, turn the sensitivity dial right down to suspend the program or wait for word recognition trials; the mask will stay displayed until the "yes" or "no" button is pressed. When the practice is over (about 10 minutes), the screen will revert to PRACTICE (P) OR TEST (T)?

v) Introduce the anagram task:

"In this part, we would like you to try and solve 10 anagrams. These are jumbled letters that will make words if they are arranged correctly. (Show practice card to subject). For example, these letters can be rearranged to form the word "APPLE". You will have 30 seconds to solve each anagram before I take it away; please write the answer to each anagram on this sheet. You should find this test very easy. Most University students in their first year are able to solve at least 5 out of these 10 anagrams. If you solve less than 5 out of 10, we will give you a more comprehensive IQ test later in the session".

vi) Present each anagram card, one at a time, for a maximum of 30 seconds each. If they complete the anagram in less time, they can move straight on to the next one; if they do not complete it in the time, take the card away and present the next one. Note how many they complete successfully.

For the low state condition:

"You got ___ out of 10. That's a very good score. There will be no need for you to take a further IQ test later"
For the high state condition:

"You got ___ out of 10. This is below average, so it will be necessary for you to do a further IQ test later in the session. I will tell you about that test when we are ready to do it".

(NB: No reassurance to subjects who cannot complete the anagrams. Simply say that you are not allowed to discuss it at this point in the experiment, but that you will discuss it with them when they do the next IQ test after the colour-naming trials. If the subject is becoming very distressed and wishes to terminate, allow them to do so, debrief them as below, and terminate the experiment).

vii) Introduce the STAI State test:

"Next, we would like you to fill out a simple test with some questions about how you feel right now. Please read the instructions and then circle the best answer for each question".

viii) Give subject the STAI State. While the subject is completing the next part, score this and fill in the total under "STATE" on the recording sheet.

ix) Introduce the colour-naming test:

"Now we will do the colour-naming test, which you practiced before. Remember, we want you to ignore the content of the words and just say the colour as quickly as possible. This part takes about 35 minutes".

x) Type the letter T for test. On screen: "what will you call this data file?". Type in the subject number and press enter. Put in the data disk; take out the EXAM STROOP disk and put in the data disk. Press return.

Set up to run the test. The data are stored to disk automatically.

xi) Remove data disk; return both discs to the box. Recording sheet should be fully completed for that subject. Staple subject's STAI STATE to their STAI TRAIT and return to the file.
Appendix G. Debriefing Narrative for Stroop Task

After the test, thank subject profusely. Explain the purpose of the test:

High state subjects only:

"I'm afraid we weren't being entirely honest; most of the anagrams you did were actually impossible. We wanted to generate concerns about your academic ability to see if that affected the way you responded to particular words. We think that, if people are currently worried about their academic ability, they will be distracted by words that relate to that area. So, when you see a word like "failure" or "exam", you will take longer to name the colour because you have been distracted by the content of the word. We think that the same thing may happen unconsciously also. That is, even if the word is presented so fast that you cannot consciously read it (this is often called "subliminal perception") you will still respond to it because it is a threatening word. We had another group of subjects who were given very easy anagrams, so that they would not have current concerns about their academic ability. So, to reassure you, there is absolutely nothing wrong with your IQ. As it is important that others do not know about the stress task, we would appreciate it if you did not let others know about the details of the testing until after the end of the semester. Thank you very much again for your time".

Low state subjects:

"We wanted to see whether concerns about academic ability affect the way people respond to particular words. We think that, if people are currently worried about their academic ability, they will be distracted by words that relate to that area. So, when you see a word like "failure" or "exam", you will take longer to name the colour because you have been distracted by the content of the word. We think that the same thing may happen unconsciously also. That is, even if the word is presented so fast that you cannot consciously read it (this is often called "subliminal perception") you will still respond to it because it is a threatening word. The anagrams we gave you were very easy, so that you would not have current concerns about your academic ability. We had another group of subjects who were given impossible anagrams, so that they would have current concerns about their academic ability. We wanted to see if there were any differences between the groups. So, to reassure you, the tests had absolutely nothing to do with your IQ. Thank you very much again for your time".
Appendix H. Instructions for Relaxation Induction

Appendix H. Instructions for Relaxation Induction

Time: Approximately 5 minutes.
Lights were dimmed.

What I would like you to do during this session, is to try and relax as much as possible. To try and help you feel relaxed, I’m going to run through a brief relaxation exercise with you, that will most likely make you feel comfortable and at ease. I’d like you each to find a comfortable position in your chair, and when you’re ready, close your eyes.

We’ll start by relaxing your head and shoulders. Close your eyes or simply stare at the computer screen. Clear your mind of all that has happened today and just focus on the enjoyment simply relaxing. Breathing in through your nose and out through your mouth, gently slow your breathing down, taking deep breaths.

Now, move to your upper arms, allow them to relax and let the tension flow out. Slowly move down to your forearms, let them go limp. And now, move through your hands and down to your fingers, let them turn to jelly as they relax.

Work around to your back and feel your shoulder muscles sag as the tension flows out and they too begin to relax. Slowly, move down your spine feeling every muscle to the base until every muscle is almost asleep. Keep taking those slow even breaths, breathing in... and breathing out. By now, you should be feeling quite comfortable and relaxed.

Now for your tummy, breathe in and out, let it go loose. Feel it relax. Nice and slowly, work your way down to your upper legs. Feel your thighs relax. And let the tension flow out as they turn to jelly. Breathing deep and slowly, move on, down to your knees and lower legs, feel them go limp as they gently relax. Keep going, nice and easy, working on to your feet and toes. Let your feet collapse and your toes go limp. By now, your whole body should be feeling rested and relaxed. Don’t move, just let it stay that way as you remain in this state of relaxation.

Often when people try and relax, they like to imagine themselves in a place that they feel comfortable in. This may be at a quiet park, the beach, or at home in your favourite chair or lying in bed. Try and imagine yourself in a place that you feel nice and relaxed. (Pause).

I’d like you to now focus on your breathing, the sound and feeling of each breath going in and out. Try and slow down your breathing so that you are taking slow, deep breaths in and out. (Pause). Let other thoughts slowly float away so that all you notice is the sound and feeling of your breathing. (Pause).
Appendix H. Instructions for Relaxation Induction

Let each of your muscles slowly relax, as you breathe in and out, letting the tension flow away from your body. Start at your feet, letting them relax. (Pause). Feel the tension release from the muscles in your legs as you relax them. (Pause). Move up through your stomach, chest and back, letting each of the muscles relax. (Pause). Finally, let the muscles in your neck and shoulders relax. (Pause).

When you're ready, I'd like you to slowly open your eyes, taking with you the feelings of relaxation. Try and continue to feel as relaxed during the session. During each of the breaks, take a moment to relax by taking a few deep breathes, and perhaps close your eyes for a minute."

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Appendix I. Anagrams for High Stress Mood Induction Procedure-Study 3.

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<tr>
<td>rppea</td>
<td>paper</td>
</tr>
<tr>
<td>foececf</td>
<td>coffee</td>
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Appendix J: Word Stimulus Development Pilot Study

Introduction

MacLeod and Rutherford (1992) developed examination and general threat-related words as target stimuli and these were used in experiments 1-3. To determine attentional biases, response times to these target words and matched non-threat words were compared. However, the non-threat exam-related words employed were near antonyms of the exam-related threat words (e.g. intelligent). Attentional responses to positively words may represent a form of attentional bias. Thus, the attentional biases seen in Studies 1 and 3 in particular may have been caused by reactions to words that can be considered positively valenced examination-related stimuli. It was recognised during Studies 1-3 that the word stimuli used in these studies could not be clearly delineated as threat and neutral in valence.

Some researchers (Martin et al., 1991) have argued that the emotionality of stimuli may significantly alter attentional responses. Hence, it was considered that this limitation of the initial three studies should be addressed in Studies 4 and 5. It was considered that to determine whether the threat-related stimuli produced attentional biases due the specificity of the content, positive stimuli should be presented in conjunction with threat stimuli. For this reason, these words were included in the pilot testing, which was designed to identify words that would represent positive stimuli.
Appendix J: Word Stimulus Development Pilot Study

Few studies have pilot-tested stimulus materials with groups of individuals who are representative of those who will be targeted in testing. Most studies have drawn on lists of words employed in other experiments or have used experts to identify the words that are frequently used by these individuals (MacLeod & Mathews, 1988; MacLeod & Rutherford, 1992). This approach has merits in samples where domain of concern is clearly established.

Studies 4 and 5 aimed to compare adults and children in identical probe-detection studies. It was considered that the stimulus words employed would need to be identical for both age groups to allow meaningful comparison of data. To date, as best can be ascertained in the literature, no comparison studies of child and adult samples of this type have been undertaken. Consequently, the differential effects of emotional words on children and adults have not been established. Based on the existing literature, it was considered that their domains of concern were likely to be similar. However, the actual words that represent these concerns may be different. While the words identified may be exactly equivalent for older and younger individuals, it was anticipated that some words might hold little threat for one or the other group. Therefore, it was considered that the word stimuli to be employed should be generated from the responses of individuals who were representative of the samples to be assessed.

Three types of target emotional words were identified: social threat, physical threat, and positive words. Social and physical threat words were chosen as previous literature
Appendix J: Word Stimulus Development Pilot Study

has indicated that these concerns are basic to both adults and children (Eysenck, 1992; King et al., 1989; Ollendick, King, & Fraary, 1989). The majority of non-clinical studies reviewed in Chapter 2 that have used attentional bias paradigms have employed social and physical threat words. The aim of this pilot study was to ensure that the words were threatening at equivalent levels for the adult and children. To develop a stimulus list to pre-test Ss with respect to their level of anxiety regarding particular themes, previous literature regarding themes of childhood fears was reviewed.

Children and teenagers from USA and Australia have been assessed with the Fear Survey Schedule for Children-Revised (FSSC-R), and the 10 most common fears reported were independent of age, gender and nationality (Ollendick et al., 1989). From most to least common, these were: 1. Being hit by car/truck, 2. Not being able to breathe, 3. Bombing attack/being invaded, 4. Fire-getting burned, 5. Falling from a high place, 6. Burglar breaking into a house, 7. Earthquake, 8. Death-dead people, 9. Getting poor grades, 10. Snakes. While the list of the most common fears does not confirm that those listed represent the most intense fear for each child, it does implicate these fears as potentially the most intense.

In this study by Ollendick et al. (1989), five discrete factors of the FSSC-R were identified that were also robust across gender, nationality and age. These were: 1. failure and criticism (e.g. looking foolish), 2. the unknown (e.g. ghosts), 3. minor injury and small animals (e.g. blood, rats), 4. danger and death (e.g. fire), 5. medical fears (e.g.
going to the doctor). The first seven on the list of most common fears relate to fears of
danger or death, death relates to fear of the unknown, getting poor grades relates to fear
of failure, and snakes relate to fear of small animals. A further study examining similar
fears in children and adolescents revealed nuclear war as the most commonly endorsed
fear (King et al., 1989).

There have been different views of whether fear and anxiety are the same
phenomenon. These issues are outside the scope of this study. Irrespective of whether
the emotional experience is equivalent, it is highly likely that the themes associated with
fear also represent the central domains of concern in anxiety. This study aimed to
identify which social threat, physical threat, and positive words were most emotionally
powerful. The study used the self-report of 12 year olds, 14 year olds, 16 year olds, and
18 year olds. This sampling was used to test the consistency of ratings across the age
spectrum up to early adulthood. It was predicted that social threat, physical threat and
positive words would be significantly more powerful than paired neutral words.

Reaction time responses to emotional words may be influenced by S's familiarity with
the word. There have been mixed results in this area, as has been indicated by Williams
et al. (1996). Probably the most important issue in this literature relates to the fact that
individuals differ in their word usage. These differences in usage relate to individual
differences related to prior experience, expertise, trait factors, and state emotional
factors. Anxious individuals use threatening words more often than non-anxious
Appendix J: Word Stimulus Development Pilot Study

individuals. Lists of word usage, which cite the frequency of usage of words in written language, have been used to address word familiarity (e.g. Kucera & Francis, 1967). At best, these approximate the extent the entire population has been exposed to particular words in written forms. They do not address the extent to which the words are used in spoken language, or in private speech, in specific samples. Nevertheless, the word frequency in the written language addresses the basic level of familiarity with words in written form. To exclude responses that are due to familiarity alone, threat and neutral words should have equivalent levels of frequency in the language. To avoid any effects that due to word length, word lists should also have equivalent word lengths.

This study aimed to develop lists of social and physical threat words, and positive words of equivalent emotional valence. To match the three categories of target emotional words, and to avoid any effects of presenting categorised and uncategorised words, it was considered that three lists of categorised neutral words should be devised. It was predicted that threat and positive words would be rated as more emotional than neutral words. It was predicted that these emotional and neutral words would be used in written English as commonly as each other would. It was also predicted that emotional and neutral words would be equivalent in length.
Methods

Design

Three categories of 12 emotional words were evaluated: physical, social, and positive words. Three categories of 12 neutral words were devised and trailed with Ss. The three types of neutral words were related to furniture (e.g. table), houses (e.g. walls), and substances (e.g. coal). The neutral words were chosen to match the length of the emotional words. The neutral words from each category were spread equally across the three categories of emotional words.

Subjects

Adult Ss were drawn from the same University from which Ss were drawn for all five studies, but did not include any Ss who had been involved Studies 1-3, or Ss who would be involved in Study 4. Subjects from the 12, 14, 16, and 18-year-old groups were drawn from secondary schools with similar demographics to the school used in Study 5. None of the Ss involved in Study 5 were surveyed. Subjects comprised of 146 males and females aged 12-18 years. Of these 146 Ss, 65Ss were aged 18 years, 22 Ss were aged 16 years, 25 Ss were aged 14 years, and 34 Ss were aged 12 years. As it was anticipated Studies 4 and 5 would involve 12 and 18 year olds, only Ss of these ages were recruited.

Materials

A list of 114 words was presented to Ss aged 12, 14, 16, and 18 years to rate the level of emotionality of the words (Table J1). The words consisted of emotional words in
three categories: social threat (e.g. fail), physical threat (e.g. war), and positive (e.g. relaxed). Neutral words were included in the list as filler items to provide variation and to allow for identification of Ss responding in a stereotyped manner. A further list of categorised neutral words was presented to Ss aged 12, 14, 16, and 18 years for further rating (Table J2). The 7-point Likert-type questionnaire asked Ss to rate how the words made them feel, from 'great' to 'nothing', to 'terrible'. The words from each category that produced mean emotionality ratings closest to neutral across all age groups were chosen.
Table J1. Emotional stimulus words questionnaire

**HOW DO THESE WORDS MAKE YOU FEEL?**

Just seeing some words make us feel good; they seem like good words. Some words make us feel bad or worried when we think about them; they seem like bad, scary, or unpleasant words. Some of the words you see in these lists may name things you are frightened or worried about. Some words may make you feel good. Some words may make you feel nothing in particular: not good and not bad.

Circle the word which best describes how you feel about each word. There is no right or wrong answer.

Do the words quickly and put down your first feeling. Have a break after you complete each page.

Your Age........

Circle the word that describes best how each word makes you feel.

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<th>Word</th>
<th>How the word makes you feel</th>
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## Appendix J: Word Stimulus Development Pilot Study

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Appendix J: Word Stimulus Development Pilot Study

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Thank you for your help in filling out this questionnaire
Appendix J: Word Stimulus Development Pilot Study

Table J2. Neutral stimulus words questionnaire

**HOW DO THESE WORDS MAKE YOU FEEL?**

Just seeing some words make us feel good; they seem like good words. Some words make us feel bad or worried when we think about them; they seem like bad, scary, or unpleasant words. Some of the words you see in these lists may name things you are frightened or worried about. Some words may make you feel good. Some words may make you feel nothing in particular: not good and not bad.

Circle the word which best describes how you feel about each word. There is no right or wrong answer.

Do the words quickly and put down your first feeling. Have a break after you complete each page.

Your Age........

Circle the word that describes best how each word makes you feel.

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Results

Emotional Valence of Stimulus Words

Emotional and neutral words were expected to be significantly different in their level of emotional valence. In the valence ratings for threat and positive practice stimulus words, a rating of 1 indicated a highly positive evaluation of the word, 4 indicated a neutral rating, and 7 indicated a highly negative evaluation. For the positive words, a rating of 1 indicated a highly negative evaluation of the word, 4 indicated neutral, and 7 indicated a highly positive evaluation. Table J3 indicates the mean valence ratings for the threat and positive stimulus words. Table J5 shows the mean ratings for practice stimulus words.

Table J4 shows the ratings of the neutral words. These words have means around 4.0, which indicates a neutral rating. These words were paired with threat or positive words (Table J3). When Ss’ ratings of emotional and neutral word pairs were compared, emotional words showed significantly more emotional valence than neutral words. All three types of target words were rated as significantly more emotionally powerful than the paired neutral words; Physical threat words, $t(145) = 30.72, p < .001$; Social threat words, $t(145) = 21.85, p < .001$; and Positive words, $t(145) = 38.33, p < .001$.
Word Frequency in English

It was predicted that the emotional and neutral words would be used in written English at equivalent rates. The lists of words were compared, based on their frequency of use in written English. These comparisons were based on the norms of Kucera and Francis (1967). The norms reported the occasions each word was found per million words in written English in a variety of forms of text (tokens per million). This was the measure used when there is reference to ‘frequency’. Four emotional words and one neutral word were not identified in the word frequency norms. Table J8 shows the frequencies for emotional words and Table J9 shows neutral words. The physical threat words had a mean frequency of 80.54 ($SD = 137.11$) and physical neutral words had a mean frequency of 59.18 ($SD = 59.76$). There was no significant difference between physical threat words and the paired neutral words, $t (10) = 0.45, ns$. The social threat words had a mean frequency of 26.4 ($SD = 33.3$) and social neutral words had a mean frequency of 26.08 ($SD = 19.48$). There was no significant difference between social threat words and the paired neutral words, $t (9) = 0.33, ns$. The positive words had a mean frequency of 132.55 ($SD = 196.87$) and positive neutral words had a mean frequency of 87.50 ($SD = 164.15$). There was no significant difference between the positive words and paired neutral words, $t (10) = 0.50, ns$. Therefore, the emotional and neutral words were equivalent in their frequency of use in written English. Table 6.2 shows the lists of stimulus and neutral words. Appendix K shows the list of paired practice emotional and neutral words.
Length of Stimulus Words

It was also predicted that emotional and neutral words would be equivalent in length. Stimulus words were compared for their length, with comparisons undertaken between the target and the neutral words. Table J12 shows the mean word lengths for emotional words and neutral words. The physical threat words had a mean of 5.58 letters per word ($SD = 2.11$) and the physical neutral words had a mean length of 5.58 ($SD = 2.11$) letters per word. There was no significant difference in the mean length of the words of the lists, $t(11) = 0.00$, ns. The social threat words had a mean of 5.50 letters per word ($SD = 1.62$) and the social neutral words had a mean length of 5.58 ($SD = 1.62$) letters per word. There was no significant difference in the mean length of the words of the lists, $t(11) = 1.00$, ns. The positive words had a mean of 5.66 letters per word ($SD = 0.98$) and the positive neutral words had a mean length of 5.66 ($SD = 0.98$) letters per word. There was no significant difference in the mean length of the words of the lists, $t(11) = 0.00$, ns. Therefore, the groups of threat and neutral words were equivalent in the average length of the words.

Discussion

This study aimed to develop lists of social and physical threat words, and positive words of equivalent emotional valence, frequency of use in the English language, and word length. Three predictions were made: that threat and positive words would be rated as more emotional than neutral words, that emotional and neutral words would be used in written English as commonly as each other. It was also predicted that emotional and

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neutral words would be equivalent in length. All three predictions were supported. It was considered that the stimuli were particularly useful, as they were those words identified by both adults and children as representing the powerful emotional stimuli. Neutral and emotional words were used as often in written English and the words were equivalent in length. It was concluded that these stimuli were appropriate for use in the comparison of attentional biases in adults and children in Studies 4 and 5.
### Table J3.
Word stimulus development pilot study. Valence ratings of adults and children for threat and positive stimulus words (scale = 1-7. For threat words, 7 = highly negative. For positive words, 7 = highly positive).

<table>
<thead>
<tr>
<th>Physical Threat</th>
<th>Mean</th>
<th>SD</th>
<th>Social Threat</th>
<th>Mean</th>
<th>SD</th>
<th>Positive</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>war</td>
<td>6.11</td>
<td>1.06</td>
<td>hate</td>
<td>5.67</td>
<td>1.20</td>
<td>success</td>
<td>6.22</td>
<td>0.95</td>
</tr>
<tr>
<td>killed</td>
<td>5.97</td>
<td>1.32</td>
<td>fail</td>
<td>5.75</td>
<td>1.31</td>
<td>relaxed</td>
<td>6.16</td>
<td>0.87</td>
</tr>
<tr>
<td>molest</td>
<td>5.92</td>
<td>1.23</td>
<td>expelled</td>
<td>5.45</td>
<td>1.58</td>
<td>friend</td>
<td>6.16</td>
<td>0.95</td>
</tr>
<tr>
<td>drown</td>
<td>5.90</td>
<td>1.18</td>
<td>pathetic</td>
<td>5.41</td>
<td>1.07</td>
<td>happy</td>
<td>6.14</td>
<td>0.91</td>
</tr>
<tr>
<td>accident</td>
<td>5.79</td>
<td>0.93</td>
<td>poor</td>
<td>5.34</td>
<td>1.03</td>
<td>great</td>
<td>6.10</td>
<td>1.01</td>
</tr>
<tr>
<td>crash</td>
<td>5.68</td>
<td>1.08</td>
<td>lonely</td>
<td>5.18</td>
<td>1.08</td>
<td>award</td>
<td>6.09</td>
<td>0.89</td>
</tr>
<tr>
<td>die</td>
<td>5.66</td>
<td>1.50</td>
<td>dumb</td>
<td>5.16</td>
<td>1.07</td>
<td>clever</td>
<td>5.97</td>
<td>0.91</td>
</tr>
<tr>
<td>dead</td>
<td>5.58</td>
<td>1.41</td>
<td>bully</td>
<td>5.12</td>
<td>1.13</td>
<td>secure</td>
<td>5.93</td>
<td>0.96</td>
</tr>
<tr>
<td>bomb</td>
<td>5.54</td>
<td>1.26</td>
<td>retarded</td>
<td>5.12</td>
<td>1.40</td>
<td>lucky</td>
<td>5.92</td>
<td>0.99</td>
</tr>
<tr>
<td>bushfires</td>
<td>5.48</td>
<td>1.15</td>
<td>moron</td>
<td>5.08</td>
<td>1.10</td>
<td>prize</td>
<td>5.91</td>
<td>0.95</td>
</tr>
<tr>
<td>burnt</td>
<td>5.38</td>
<td>1.18</td>
<td>reject</td>
<td>5.05</td>
<td>1.27</td>
<td>kind</td>
<td>5.84</td>
<td>0.88</td>
</tr>
<tr>
<td>kidnapped</td>
<td>5.31</td>
<td>1.64</td>
<td>vomit</td>
<td>5.05</td>
<td>1.66</td>
<td>cuddles</td>
<td>5.80</td>
<td>1.02</td>
</tr>
</tbody>
</table>

### Table J4.
Word stimulus development pilot study. Valence ratings for neutral stimulus words used to match emotional words in the probe-detection task (scale = 1-7. 1 = highly positive, 4 = neutral, and 7 = highly negative).

<table>
<thead>
<tr>
<th>Physical Neutral</th>
<th>Mean</th>
<th>SD</th>
<th>Social Neutral</th>
<th>Mean</th>
<th>SD</th>
<th>Positive Neutral</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>tin</td>
<td>3.93</td>
<td>0.29</td>
<td>seat</td>
<td>3.78</td>
<td>0.95</td>
<td>picture</td>
<td>3.46</td>
<td>0.87</td>
</tr>
<tr>
<td>candle</td>
<td>3.80</td>
<td>0.58</td>
<td>coal</td>
<td>3.88</td>
<td>0.72</td>
<td>walls</td>
<td>3.93</td>
<td>1.09</td>
</tr>
<tr>
<td>timber</td>
<td>4.01</td>
<td>0.96</td>
<td>concrete</td>
<td>3.84</td>
<td>1.05</td>
<td>desks</td>
<td>3.42</td>
<td>0.90</td>
</tr>
<tr>
<td>metal</td>
<td>4.00</td>
<td>0.80</td>
<td>bathroom</td>
<td>3.65</td>
<td>0.74</td>
<td>leather</td>
<td>3.77</td>
<td>0.95</td>
</tr>
<tr>
<td>cupboard</td>
<td>3.71</td>
<td>0.90</td>
<td>roof</td>
<td>3.82</td>
<td>0.81</td>
<td>windows</td>
<td>3.64</td>
<td>0.74</td>
</tr>
<tr>
<td>table</td>
<td>3.84</td>
<td>0.91</td>
<td>lamp</td>
<td>3.64</td>
<td>0.74</td>
<td>rocks</td>
<td>3.85</td>
<td>0.84</td>
</tr>
<tr>
<td>rug</td>
<td>3.58</td>
<td>0.80</td>
<td>cement</td>
<td>3.47</td>
<td>0.87</td>
<td>fence</td>
<td>3.79</td>
<td>0.61</td>
</tr>
<tr>
<td>step</td>
<td>4.00</td>
<td>0.71</td>
<td>chimneys</td>
<td>3.70</td>
<td>0.95</td>
<td>stones</td>
<td>3.85</td>
<td>0.85</td>
</tr>
<tr>
<td>wood</td>
<td>3.84</td>
<td>0.74</td>
<td>brick</td>
<td>3.68</td>
<td>1.16</td>
<td>house</td>
<td>3.65</td>
<td>0.77</td>
</tr>
<tr>
<td>verandahs</td>
<td>3.90</td>
<td>0.93</td>
<td>carpet</td>
<td>3.60</td>
<td>0.92</td>
<td>mirror</td>
<td>3.70</td>
<td>0.68</td>
</tr>
<tr>
<td>buildings</td>
<td>3.69</td>
<td>0.75</td>
<td>bench</td>
<td>3.82</td>
<td>1.30</td>
<td>clocks</td>
<td>3.64</td>
<td>0.77</td>
</tr>
<tr>
<td>chair</td>
<td>3.73</td>
<td>1.07</td>
<td>chalk</td>
<td>3.96</td>
<td>1.17</td>
<td>salt</td>
<td>4.03</td>
<td>1.04</td>
</tr>
</tbody>
</table>
Appendix J: Word Stimulus Development Pilot Study

Table J5. Word stimulus development pilot study. Valence ratings of adults and children for threat and positive practice stimulus words (scale = 1-7, 1 = highly positive, 4 = neutral, and 7 = highly negative)

<table>
<thead>
<tr>
<th>Physical Threat</th>
<th>Mean</th>
<th>SD</th>
<th>Social Threat</th>
<th>Mean</th>
<th>SD</th>
<th>Positive</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>robber</td>
<td>5.29</td>
<td>1.13</td>
<td>dunce</td>
<td>4.86</td>
<td>1.12</td>
<td>safety</td>
<td>5.61</td>
<td>1.00</td>
</tr>
<tr>
<td>choke</td>
<td>5.22</td>
<td>1.07</td>
<td>nerd</td>
<td>4.95</td>
<td>1.19</td>
<td>good</td>
<td>5.69</td>
<td>0.93</td>
</tr>
<tr>
<td>Lost</td>
<td>5.28</td>
<td>0.92</td>
<td>fool</td>
<td>4.79</td>
<td>1.16</td>
<td>strong</td>
<td>5.67</td>
<td>0.98</td>
</tr>
<tr>
<td>nuclear</td>
<td>5.36</td>
<td>1.29</td>
<td>cretin</td>
<td>4.24</td>
<td>1.23</td>
<td>smart</td>
<td>5.84</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Table J6. Word stimulus development pilot study. Valence ratings for physical threat and social threat practice words that were paired with neutral words. (scale = 1-7, 1 = highly positive, 4 = neutral, and 7 = highly negative)

<table>
<thead>
<tr>
<th>Physical Threat</th>
<th>Mean</th>
<th>SD</th>
<th>Social Threat</th>
<th>Mean</th>
<th>SD</th>
<th>Positive</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>robber</td>
<td>5.29</td>
<td>1.13</td>
<td>dunce</td>
<td>4.86</td>
<td>1.12</td>
<td>safety</td>
<td>5.61</td>
<td>1.00</td>
</tr>
<tr>
<td>choke</td>
<td>5.22</td>
<td>1.07</td>
<td>nerd</td>
<td>4.95</td>
<td>1.19</td>
<td>good</td>
<td>5.69</td>
<td>0.93</td>
</tr>
<tr>
<td>lost</td>
<td>5.28</td>
<td>0.92</td>
<td>fool</td>
<td>4.79</td>
<td>1.16</td>
<td>strong</td>
<td>5.67</td>
<td>0.98</td>
</tr>
<tr>
<td>nuclear</td>
<td>5.36</td>
<td>1.29</td>
<td>cretin</td>
<td>4.49</td>
<td>1.14</td>
<td>smart</td>
<td>5.84</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Table J7. Word stimulus development pilot study. Valence ratings for neutral practice stimulus words used in the probe-detection task (scale = 1-7, 1 = highly positive, 4 = neutral, and 7 = highly negative)

<table>
<thead>
<tr>
<th>Physical Neutral</th>
<th>Mean</th>
<th>SD</th>
<th>Social Neutral</th>
<th>Mean</th>
<th>SD</th>
<th>Positive Neutral</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>garage</td>
<td>3.90</td>
<td>0.58</td>
<td>sand</td>
<td>3.78</td>
<td>0.71</td>
<td>cotton</td>
<td>4.16</td>
<td>1.29</td>
</tr>
<tr>
<td>brass</td>
<td>3.90</td>
<td>0.75</td>
<td>phone</td>
<td>3.75</td>
<td>0.73</td>
<td>boards</td>
<td>4.08</td>
<td>0.71</td>
</tr>
<tr>
<td>bins</td>
<td>4.13</td>
<td>0.94</td>
<td>soil</td>
<td>3.74</td>
<td>0.79</td>
<td>mats</td>
<td>3.94</td>
<td>1.11</td>
</tr>
<tr>
<td>cabinet</td>
<td>4.04</td>
<td>0.85</td>
<td>handle</td>
<td>3.54</td>
<td>0.93</td>
<td>nails</td>
<td>3.90</td>
<td>0.97</td>
</tr>
</tbody>
</table>

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### Appendix J: Word Stimulus Development Pilot Study

**Table J8.** Word stimulus development pilot study. Word frequency of emotional stimulus words used in the probe-detection task.

<table>
<thead>
<tr>
<th>Physical Threat Words</th>
<th>Word Frequency</th>
<th>Social Threat Words</th>
<th>Word Frequency</th>
<th>Positive Words</th>
<th>Word Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>war</td>
<td>464</td>
<td>fail</td>
<td>37</td>
<td>relaxed</td>
<td>14</td>
</tr>
<tr>
<td>killed</td>
<td>75</td>
<td>hate</td>
<td>42</td>
<td>great</td>
<td>665</td>
</tr>
<tr>
<td>molest</td>
<td>1</td>
<td>expelled</td>
<td>5</td>
<td>award</td>
<td>46</td>
</tr>
<tr>
<td>drown</td>
<td>3</td>
<td>pathetic</td>
<td>8</td>
<td>success</td>
<td>93</td>
</tr>
<tr>
<td>accident</td>
<td>33</td>
<td>poor</td>
<td>113</td>
<td>happy</td>
<td>98</td>
</tr>
<tr>
<td>crash</td>
<td>20</td>
<td>lonely</td>
<td>25</td>
<td>friend</td>
<td>133</td>
</tr>
<tr>
<td>die</td>
<td>73</td>
<td>dumb</td>
<td>13</td>
<td>lucky</td>
<td>21</td>
</tr>
<tr>
<td>dead</td>
<td>174</td>
<td>bully</td>
<td>4</td>
<td>clever</td>
<td>17</td>
</tr>
<tr>
<td>bomb</td>
<td>36</td>
<td>retarded</td>
<td>7</td>
<td>secure</td>
<td>30</td>
</tr>
<tr>
<td>bushfires</td>
<td>*</td>
<td>moron</td>
<td>*</td>
<td>cuddles</td>
<td>*</td>
</tr>
<tr>
<td>burnt</td>
<td>6</td>
<td>reject</td>
<td>10</td>
<td>prize</td>
<td>28</td>
</tr>
<tr>
<td>kidnapped</td>
<td>1</td>
<td>vomit</td>
<td>*</td>
<td>kind</td>
<td>313</td>
</tr>
</tbody>
</table>

Notes taken from: Kucera and Francis (1967). Each number refers to the frequency the word is identified per million words of written English. * words not identified in the word frequency norms of Kucera and Francis (1967)

**Table J9.** Word stimulus development pilot study. Word frequency of neutral stimulus words used in the probe-detection task.

<table>
<thead>
<tr>
<th>Physical Neutral Words</th>
<th>Word Frequency</th>
<th>Social Neutral Words</th>
<th>Word Frequency</th>
<th>Positive Neutral Words</th>
<th>Word Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>tin</td>
<td>12</td>
<td>seat</td>
<td>55</td>
<td>picture</td>
<td>162</td>
</tr>
<tr>
<td>candle</td>
<td>18</td>
<td>coal</td>
<td>32</td>
<td>walls</td>
<td>70</td>
</tr>
<tr>
<td>timber</td>
<td>19</td>
<td>concrete</td>
<td>48</td>
<td>desks</td>
<td>4</td>
</tr>
<tr>
<td>metal</td>
<td>61</td>
<td>bathroom</td>
<td>18</td>
<td>leather</td>
<td>24</td>
</tr>
<tr>
<td>cupboard</td>
<td>2</td>
<td>roof</td>
<td>59</td>
<td>windows</td>
<td>53</td>
</tr>
<tr>
<td>table</td>
<td>198</td>
<td>lamp</td>
<td>18</td>
<td>rocks</td>
<td>23</td>
</tr>
<tr>
<td>rug</td>
<td>13</td>
<td>cement</td>
<td>11</td>
<td>fence</td>
<td>30</td>
</tr>
<tr>
<td>step</td>
<td>131</td>
<td>chimneys</td>
<td>3</td>
<td>stones</td>
<td>12</td>
</tr>
<tr>
<td>wood</td>
<td>55</td>
<td>brick</td>
<td>18</td>
<td>house</td>
<td>591</td>
</tr>
<tr>
<td>verandahs</td>
<td>*</td>
<td>carpet</td>
<td>13</td>
<td>mirror</td>
<td>27</td>
</tr>
<tr>
<td>buildings</td>
<td>76</td>
<td>bench</td>
<td>35</td>
<td>clocks</td>
<td>8</td>
</tr>
<tr>
<td>chair</td>
<td>66</td>
<td>chalk</td>
<td>3</td>
<td>Salt</td>
<td>46</td>
</tr>
</tbody>
</table>

Notes taken from: Kucera and Francis (1967). Each number refers to the frequency the word is identified per million words of written English. * words not identified in the word frequency norms of Kucera and Francis (1967)
### Table J10. Word stimulus development pilot study. List of neutral words, in categories, used in the probe-detection task.

<table>
<thead>
<tr>
<th>Furniture</th>
<th>House</th>
<th>Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>seat</td>
<td>walls</td>
<td>tin</td>
</tr>
<tr>
<td>picture</td>
<td>bathroom</td>
<td>coal</td>
</tr>
<tr>
<td>candle</td>
<td>cupboard</td>
<td>timber</td>
</tr>
<tr>
<td>desks</td>
<td>roof</td>
<td>concrete</td>
</tr>
<tr>
<td>table</td>
<td>windows</td>
<td>metal</td>
</tr>
<tr>
<td>lamp</td>
<td>fence</td>
<td>leather</td>
</tr>
<tr>
<td>rug</td>
<td>step</td>
<td>rocks</td>
</tr>
<tr>
<td>carpet</td>
<td>chimneys</td>
<td>cement</td>
</tr>
<tr>
<td>mirror</td>
<td>brick</td>
<td>stones</td>
</tr>
<tr>
<td>bench</td>
<td>house</td>
<td>wood</td>
</tr>
<tr>
<td>clocks</td>
<td>verandahs</td>
<td>chalk</td>
</tr>
<tr>
<td>chair</td>
<td>buildings</td>
<td>salt</td>
</tr>
<tr>
<td>couches</td>
<td>insulation</td>
<td>cork</td>
</tr>
<tr>
<td>curtain</td>
<td>pipes</td>
<td>copper</td>
</tr>
<tr>
<td>tap</td>
<td>porch</td>
<td>iron</td>
</tr>
<tr>
<td>fan</td>
<td>paving</td>
<td>diesel</td>
</tr>
</tbody>
</table>

### Table J11. Word stimulus development pilot study. List of practice neutral words, in categories, used in the probe-detection task.

<table>
<thead>
<tr>
<th>Furniture</th>
<th>House</th>
<th>Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>phone</td>
<td>garage</td>
<td>sand</td>
</tr>
<tr>
<td>mats</td>
<td>boards</td>
<td>cotton</td>
</tr>
<tr>
<td>bins</td>
<td>nails</td>
<td>brass</td>
</tr>
<tr>
<td>cabinet</td>
<td>handle</td>
<td>soil</td>
</tr>
<tr>
<td>doors</td>
<td>gardens</td>
<td></td>
</tr>
<tr>
<td></td>
<td>terrace</td>
<td></td>
</tr>
<tr>
<td></td>
<td>gate</td>
<td></td>
</tr>
</tbody>
</table>
**Table J12.** Word stimulus development pilot study. Number of letters in each category of stimulus word in the probe-detection task.

<table>
<thead>
<tr>
<th></th>
<th>Physical threat</th>
<th>Physical neutral</th>
<th>Social threat</th>
<th>Social neutral</th>
<th>Positive threat</th>
<th>Positive neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total letters</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>68</td>
<td>68</td>
</tr>
<tr>
<td>Mean letters per word</td>
<td>5.58</td>
<td>5.58</td>
<td>5.58</td>
<td>5.58</td>
<td>5.67</td>
<td>5.67</td>
</tr>
</tbody>
</table>

**Table J13.** Word stimulus development pilot study. Number of letters in each category of stimulus word in the Stroop task.

<table>
<thead>
<tr>
<th></th>
<th>Exam threat</th>
<th>Exam non-threat</th>
<th>Non-exam threat</th>
<th>Non-exam non-threat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total letters</td>
<td>105</td>
<td>116</td>
<td>89</td>
<td>88</td>
</tr>
<tr>
<td>Mean letters per word</td>
<td>8.75</td>
<td>9.67</td>
<td>7.42</td>
<td>7.33</td>
</tr>
</tbody>
</table>
Appendix K. Practice Stimulus Words and Paired Neutral Words

**Word stimulus development pilot study.** Practice stimulus words used in the probe-detection practice task with paired neutral words in parentheses.

<table>
<thead>
<tr>
<th>Target Word</th>
<th>Physical Threat</th>
<th>Social Threat</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral Word</td>
<td>robber</td>
<td>fool</td>
<td>safety</td>
</tr>
<tr>
<td></td>
<td>garage</td>
<td>sand</td>
<td>cotton</td>
</tr>
<tr>
<td>Target Word</td>
<td>choke</td>
<td>dunce</td>
<td>strong</td>
</tr>
<tr>
<td>Neutral Word</td>
<td>brass</td>
<td>phone</td>
<td>boards</td>
</tr>
<tr>
<td>Target Word</td>
<td>lost</td>
<td>nerd</td>
<td>good</td>
</tr>
<tr>
<td>Neutral Word</td>
<td>bins</td>
<td>soil</td>
<td>mats</td>
</tr>
<tr>
<td>Target Word</td>
<td>nuclear</td>
<td>cretin</td>
<td>smart</td>
</tr>
<tr>
<td>Neutral Word</td>
<td>cabinet</td>
<td>handle</td>
<td>nails</td>
</tr>
</tbody>
</table>

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Appendix L. Development of Mood Induction Procedures

Introduction

This study aimed to develop and validate MIPs to be used in Studies 4 and 5 to manipulate state anxiety. The aim of the MIPs was to create procedures that could be integrated into the computerised probe-detection paradigm and could employ stress induction other than a failure task. To produce high state anxiety in the laboratory, previous studies have relied on failure tasks and other forms of mood manipulation which have inconsistent effects in practice (Gerrards-Hesse et al., 1994; Martin, 1990). Martin (1990) has suggested that some failure tasks that have been used as MIPs tend to induce dysphoria rather than anxiety. However, with the fact that high trait anxious individuals are most prone to elevations related to failure and social evaluation (Spielberger et al., 1983), tasks involving this group probably need to include some failure or evaluative component.

Many failure tasks require deception. These tasks involve unstable experimental procedures, which can be affected by a variety of extraneous factors. Subjects may inform each other of the nature of the deception, or may give up too easily due to the obvious difficulty of the task. There are also ethical dilemmas associated with using deception tasks with children. Thus, this pilot study sought to deal with the limitations of such methods by developing an alternative task. The study aimed to use a task to induce cognitive overload and anxiety associated with not being able to complete the
task in the allotted time. The self-statements were based on the Velten self-statement task, which has been widely used in MIP designed to induce anxiety (Martin, 1990). This task has consistent effects (Martin, 1990) and moods are affected beyond the mood induction period itself (Parrott, 1991). This study aimed to develop a task that could be carried out easily by Ss before the probe-detection task and could be integrated as part of the task. The emphasis in the MIPs was also on the development of tasks that facilitated the increase of arousal and cognitive concerns, or worry.

Consequently, in contrast to Studies 1-3, in this study it was decided to not use deception in the MIP. It was assumed that a series of tasks that activated cognitive concerns and elevated arousal should allow sufficient levels of state anxiety to generated without the use of deception. In addition, the use of non-deceptive tasks allowed for ‘booster’ tasks later in the testing session and regular reminders to focus on anxiety provoking themes. The pilot testing of this methodology was designed to assess these assumptions.

The self-statement and arithmetic tasks were designed for use in the high stress condition and the relaxation tasks were designed for the low stress task. It was predicted in the initial pilot study that greater levels of state anxiety would be elicited in the high stress condition than in the low stress condition for high and low trait anxious Ss.
Appendix L. Development of Mood Induction Procedures

Method

Design

In this pilot study, 17 eighteen year old Ss completed the low and high stress mood induction procedures subsequently used in Studies 4 and 5. The two stress conditions were induced by a low stress MIP and a high stress MIP. A speeded arithmetic task and negative self-statements were used in the high stress MIP, whereas the low stress MIP involved exposing Ss to a relaxation procedure. To parallel the later studies, the MIPs were assessed mid-academic semester. Subjects experienced the two stress conditions in a random order across the sample. This study required Ss to undertake the same probe-detection paradigm used in Study 4 and 5, although the data were not calculated for analysis.

Subjects

A sample of 17 university students was drawn from an undergraduate class. The mean age of Ss was 18.71 years (SD = 1.16). Subjects completed the testing under the two forms of stress. High and low trait anxious groups were determined by a median split based on their STAI-T scores. In this final sample, the ratio of females (f) to males (m) in each group was: high trait anxious: 6 f: 3 m; low trait anxious: 5 f: 3 m. There was no attempt to control for sex. Descriptive data are presented in Table L1.
Table L1. Mood induction procedure pilot study. Subject Characteristics

<table>
<thead>
<tr>
<th>Trait Anxiety Condition</th>
<th>Sample Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Trait Anxious</td>
<td>Low Trait Anxious</td>
</tr>
<tr>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>18.75</td>
<td>1.39</td>
</tr>
</tbody>
</table>

Comparisons of STAI-T scores showed significant differences in levels of trait anxiety across high and low trait anxious Ss, $F(1, 15) = 25.04, p < .001$; the low trait anxious Ss with a mean of 30.44 ($SD = 3.41$) and the high trait anxious Ss with a mean of 44.63 ($SD = 7.73$). Comparisons of the mean age of Ss revealed no significant differences between the groups, $F(1, 15) = 0.021, p = .89, ns$. Mean ages of the high and low trait anxious groups were 18.75 years ($SD = 1.39$) and 18.67 years ($SD = 1.00$) respectively, with a mean age of 18.71 years ($SD = 1.16$) across the sample.

Materials

Questionnaires

The STAI-T was used to measure trait anxiety. The STAI-S was used to measure the level of state anxiety after the mood induction procedures in the high and low stress testing conditions.
Materials for the Mood Induction Procedure

High Stress

The high stress MIP involved two parts: anxiety-related self-statements and an arithmetic MIP. The twelve anxiety-related self-statements (e.g., I feel like a failure) were presented first on the computer screen (Table L2). Subjects were asked to experience the feelings in the statements as much as possible.

Table L2. Mood Induction Procedure Pilot Study. Anxiety self-statements

The following instructions first appeared on the screen:

In this part we want you to try and feel as stressed as you can. To help you to do this, you will read a series of statements for several minutes, and we would like you to try and experience the emotions described in each of the statements as intensely as possible. Each statement will be on the screen for 10 seconds. You will then do an academic memory task. Push spacebar to begin reading the statements.

ANXIETY SELF-STATEMENTS

1. I feel nervous
2. I am tense
3. I am upset
4. I feel shaky
5. I feel insecure
6. I am unsure of myself
7. I feel uncomfortable
8. I feel uneasy
9. I am afraid
10. I am concerned about the future
11. I feel like a failure
12. I feel inadequate
Appendix L. Development of Mood Induction Procedures

Subjects then undertook the arithmetic MIP. A modification of the Paced Auditory Serial Addition Task (PASAT) (Dyche & Johnson, 1991; Sampson, 1956) was developed. In its standard uses in cognitive assessment, the PASAT has been routinely observed to induce anxiety. The task was adapted to be suitable for adults and children for computer administration. The task was presented to Ss as being related to non-verbal academic abilities. The task was a computer controlled, speeded arithmetic task. It was integrated into the same computer program as the probe-detection task.

In this task, Ss were required to add successive single digit numbers, presented individually. They immediately recorded their responses on the computer keyboard number pad. The program presented Ss with an extremely difficult arithmetic-memory task in which Ss were required to add together single numbers at increasing speed over 4 minutes while avoiding making errors. For example, the number 8 was presented, then 7; the subject keyed in 15 (then ‘enter’). Then 3 was presented and (7+3) 10 was keyed in. Then 9 was presented and (3+9) 12 was keyed in. Numbers continued to appear at set intervals irrespective of whether Ss had keyed in numbers, adding pressure to complete the task quickly. Subjects were instructed before and during the task to continue the task irrespective of whether they missed some items. An instruction and practice period lasted for one minute, with instructions presented on the computer monitor, included three practice trials. A break was included between the instructions and the arithmetic task so Ss could clarify the task with the experimenter if necessary.
Appendix L. Development of Mood Induction Procedures

Over the 4 minutes of the task, numbers were presented in the following format.

1. 10 presentations at one number per 3.5 seconds
2. 10 presentations at one number per 2.5 seconds
3. 25 presentations at one number per 2.0 seconds
4. 60 presentations at one number per 1.5 seconds
5. 40 presentations at one number per 1.0 second

The program did not record Ss' responses. It continued to present numbers irrespective of whether Ss had responded or had keyed in a correct or incorrect answer, as the aim was to induce anxiety rather than focus on accuracy. It was found in pre-trialing that Ss were not able to complete the task without errors. Subjects were closely monitored to encourage them to continue to work at the task. Subjects received a standard message on the screen at the end of the task. The message indicated that they had made several errors in the task and that they should attempt to do better in the task later in the session. In addition, Ss were prompted to focus on their own anxiety provoking thoughts.

Following completion of the high stress MIPs, Ss were prompted to complete the probe-detection task as quickly as possible. They were reminded to concentrate on anxiety provoking thoughts in the breaks in the task and to anticipate another arithmetic task later in the session.

Following the awareness-check trials in the probe-detection task, a one-minute booster of self-statement task was presented, with six statements presented for 10
Appendix L. Development of Mood Induction Procedures

seconds each. A two-minute booster of the arithmetic task then took place. Words were presented in the following format:

1. 60 presentations at one number per 1.5 seconds
2. 30 presentations at one number per 1.0 second

The low stress MIP involved a standard relaxation task (Appendix H). The pilot testing evaluated whether the high stress task produced significantly greater levels of state anxiety than the low stress task. Subjects also carried out the probe-detection task as in Experiments 4 and 5 to ensure that the test of the MIPs was identical to the presentation of the tasks under test conditions. The full description of the probe-detection task can be seen in Chapter 6.

Presentation Hardware and Software

The MIPs were presented on 486 MHz personal computers in letters 1 cm high on high resolution SVGA colour monitors. DMASTR software (Forster & Forster, 1975) was used to control the stimulus presentation and record RTs in the probe-detection conditions and number of mistakes made in the awareness-check task.

Procedure

High and Low Stress Conditions

During the high stress testing sessions, Ss were asked to focus on and experience as intensely as possible 12 anxiety-related self-statements (e.g., I feel nervous) which were presented for 10 seconds each, over a period of 2 minutes. Subjects then completed the
Appendix L. Development of Mood Induction Procedures

arithmetic memory task for 5 minutes. The high stress \textit{MIP} lasted 7 minutes in total. Subjects then completed the \textit{STAI-S}.

The probe-detection and awareness-check tasks were explained and \textit{Ss} completed the masked section of the presentations. Subjects then completed the awareness-check trials. To maintain elevated levels of state anxiety, \textit{Ss} completed a shortened version of the stress induction procedures. Six anxiety self-statements were presented for 10 seconds each and a 2-minute booster of the arithmetic task was then presented. Subjects then completed the unmasked condition.

The low stress \textit{MIP} involved a standard relaxation task (Appendix H), presented over 5 minutes. Subjects were encouraged throughout the testing to remain very relaxed and to practice the relaxation in the breaks.
Appendix L. Development of Mood Induction Procedures

Results

This section addresses the validity of the state anxiety manipulation.

State Anxiety Manipulation

STAI-S measures were undertaken by each subject immediately after the MIP in the high and low stress conditions. As can be seen in Table L3, both groups considered together showed a mean increase in state anxiety of 14.18 points on the STAI-S from low to high stress. A repeated-measures analysis of variance was undertaken, using state anxiety scores as the dependent variables. Trait anxiety group and stress were the independent variables. STAI-S scores did not differ significantly based on the trait anxiety of the Ss, $F(1, 15) = 1.48, p = .24, ns$, or based on an interaction between trait anxiety group and stress condition, $F(1, 15) = 0.47, p = .5, ns$. There was no main effect for trait anxiety group, or an interaction of trait anxiety group and stress. STAI-S scores did differ significantly depending on whether Ss were exposed to the low or high stress MIP, $F(1, 15) = 24.96, p < .001$. Thus, there was a significant increase in state anxiety for both trait anxiety groups from low to high stress condition.
Table L3. Mood induction procedure pilot study. State anxiety scores across low and high stress for high and low trait anxious adults.

<table>
<thead>
<tr>
<th>Trait Anxiety Condition</th>
<th>Both Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Trait Anxious</td>
</tr>
<tr>
<td>State Anxiety (STAI-S)</td>
<td>40.25 (17.44)</td>
</tr>
<tr>
<td>-Low Stress</td>
<td></td>
</tr>
<tr>
<td>State Anxiety (STAI-S)</td>
<td>56.50 (19.95)</td>
</tr>
<tr>
<td>-High Stress</td>
<td></td>
</tr>
</tbody>
</table>

The MIPs produced the predicted results. The results of the STAI-S were supportive of a general increase in state anxiety from low to high stress.

6.4 Discussion

This study aimed to develop and validate MIPs to be used in Studies 4 and 5 to manipulate state anxiety. It was predicted that the MIPs would differentiate between low and high stress conditions, and reliably increase state anxiety from the low to the high stress condition. Both high and low trait anxious Ss showed significant increases in state anxiety from low to high stress. The MIPs did not produce a differential response pattern in high and low trait anxious Ss. Therefore, the methods were as effective with low trait anxious as high trait anxious Ss.
Appendix L. Development of Mood Induction Procedures

The advantage of the MIPs was that there was no deception used. It was considered that it was unethical to employ deceptive MIPs with children. In addition, as noted by Martin (1990), experiences of failure and deception can induce emotions such as anger and sadness. While these emotions may coexist with anxiety, they do not necessarily lead to anxiety on their own. Subjects’ self-report indicated that the arithmetic task produced cognitive overload, a sense of being ‘jittery’, ‘revved up’, ‘nervous’, some frustration and a sense of failure in some Ss. The Velten-like self-statements have been used before in many other research contexts (Martin, 1990). Subjects reported they proved particularly effective in having Ss increase their anxiety. Despite the success of the MIPs in the pilot study, Experiments 4 and 5 tested the assumption that the MIPs would produce significant levels of anxiety.

The obvious limitation of this pilot study was that only adults were used to test the MIPs. It was considered that this task would induce anxiety in children at equivalent levels and this assumption was tested with children before examination of RT latencies in Study 5.
Appendix M. Description of the Probe-Detection Task

Masked Exposure Condition

<table>
<thead>
<tr>
<th>Screen 1 (500msec)</th>
<th>Screen 2 (28msec)</th>
<th>Screen 3 (472msec)</th>
<th>Screen 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Coffin</td>
<td>$&amp;$&amp;$&amp;$&amp;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Table</td>
<td>$&amp;$&amp;$&amp;$&amp;</td>
<td></td>
</tr>
</tbody>
</table>

1. A fixation cross was presented in the centre of the computer screen for 500 milliseconds.

2. Stimulus words (i.e. social threat, physical threat, positive) were paired with a neutral word and presented for 28 milliseconds, above and below the previous cross position. Stimulus words were presented randomly at the top or bottom of the screen.

3. Each word was replaced by a mask for 472 milliseconds to prevent conscious identification of the words.

4. After the masking either one or two dot probes appeared at the top or the bottom of the screen until the participants responded.

5. The participants were required to press either the left or the right shift key as quickly as possible in response to whether they saw one dot probe or two. Reaction times and error rates were recorded by the Dmaster software.

6. Two seconds after the participants' response, the next fixation cross was presented. If the participant did not respond, the next fixation cross appeared 4 seconds after the previous probe presentation and the lack of response was recorded as an error.
Appendix M. Description of the Probe-Detection Task

Explanation

This process was designed to measure the allocation of participants' visual attention towards the stimulus words. If the stimulus word and probe were presented in the same position (i.e. wordbottom-probebottom), the response time would be quicker if the participant was attending to the stimulus word as their visual attention was already on that area of the screen. However if the participant was attending to the neutral word, response time would be slower, as the participant would have to shift attention from one area of the screen to another before responding.

In contrast, if the stimulus word and subsequent probe were presented in different positions (i.e. wordtop-probebottom) and the participant was attending to the stimulus word, response time would be slower, as they would have to shift their attention from one area of the screen to the other before responding.

Unmasked Exposure Condition

Followed the same procedure as the masked condition, however the stimulus and neutral word pairs were presented on the screen for 500 milliseconds without a mask.

Awareness-Check For the Masking Procedure

<table>
<thead>
<tr>
<th>Screen 1 (500msec)</th>
<th>Screen 2 (28msec)</th>
<th>Screen 3 (472msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Coffin</td>
<td>$$&amp;$$$&amp;$$</td>
</tr>
<tr>
<td></td>
<td>Table</td>
<td>$$&amp;$$$&amp;$$</td>
</tr>
</tbody>
</table>

1. The fixation cross was presented for 500 milliseconds.
Appendix M. Description of the Probe-Detection Task

2. Two words that were either the same or different to each other were presented for 28 milliseconds.

3. Both words were covered by a mask for 472 milliseconds.

4. Participants were required to respond to whether they thought the words were the same (left shift key) or different (right shift key) to each other. The response errors were recorded by the Dmaster software.

5. The next fixation cross appeared 2 seconds after the participants responded. If the participant did not respond, the next fixation cross appeared 4 seconds after the previous masking display.

Explanation

This procedure was used to measure whether the participants could consciously identify the words presented with a mask. If the error rate in response was not significantly different to 50% (chance), it could be concluded that the masking procedure was effective.

Instructions in probe-detection task

“We will be asking you to complete three similar computer tasks, which are aimed at measuring the way people respond to different types of information, however each task varies slightly”.

Masked exposure condition

“During the first task, two words will be presented on the computer screen very briefly: for 28 milliseconds so you may or may not see them. The words will be covered by a
Appendix M. Description of the Probe-Detection Task

masking $&$&$&$, which you will see quite easily. These masks will be replaced by either one or two dots. Your task is to press the left shift key if one dot appears, or the right shift key if two dots appear on the screen. Try to respond as quickly as possible without making mistakes. If you do make a mistake, or if you can’t see the words, don’t worry just keep going. Focus on the dot(s) and ignore the words. You will have several breaks during the task, so continue when you are ready, and try and stay focussed on the task”.

Awareness-Check

“This task is quite similar to the first task. The words and masking will appear in a similar manner, however no dots will appear on the screen. Your task is to respond to whether you think the two words that appear on the screen are the same or different to each other. If you think the two words are the same press the left shift key, or if you think they are different to each other press the right shift key. If you didn’t see one or either of the words, don’t worry, just guess and press either key”.

Unmasked exposure condition

“The final task is almost identical to the first task, however the words are not covered by a mask. You will be able to see the words clearly when they are presented on the screen. Your task is the same as in part one. If you see one dot press the left shift key, if you see two dots, press the right shift key. Remember to focus on the dots rather than the words and respond as quickly as possible. If you make a mistake, don’t worry and just keep going. You will have several breaks throughout the task, so keep continue when you are ready and try and stay focussed on the task”.
# Appendix N. Experiment 4. Mean probe-detection latencies in milliseconds

<table>
<thead>
<tr>
<th>Task Array Group</th>
<th>High Threshold</th>
<th>Low Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (ms)</td>
<td>SD (ms)</td>
</tr>
<tr>
<td>Low Stress Masked Social Word Top- Probe Bottom</td>
<td>462 (51)</td>
<td>45 (5)</td>
</tr>
<tr>
<td>Low Stress Masked Social Word Top- Probe Top</td>
<td>457 (58)</td>
<td>44 (4)</td>
</tr>
<tr>
<td>Low Stress Masked Social Word Bottom Probe Bottom</td>
<td>461 (55)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Low Stress Masked Physical Word Top- Probe Top</td>
<td>456 (56)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Low Stress Masked Physical Word Top- Probe Bottom</td>
<td>446 (54)</td>
<td>45 (3)</td>
</tr>
<tr>
<td>Low Stress Masked Physical Word Bottom Probe Top</td>
<td>455 (49)</td>
<td>46 (3)</td>
</tr>
<tr>
<td>Low Stress Masked Positive Word Top- Probe Bottom</td>
<td>431 (43)</td>
<td>42 (3)</td>
</tr>
<tr>
<td>Low Stress Masked Positive Word Top- Probe Top</td>
<td>433 (37)</td>
<td>41 (3)</td>
</tr>
<tr>
<td>Low Stress Masked Positive Word Bottom Probe Bottom</td>
<td>430 (35)</td>
<td>42 (3)</td>
</tr>
<tr>
<td>Low Stress Masked Positive Word Bottom Probe Top</td>
<td>438 (30)</td>
<td>41 (3)</td>
</tr>
<tr>
<td>Low Stress Unmasked Social Word Top- Probe Top</td>
<td>476 (55)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Low Stress Unmasked Social Word Top- Probe Bottom</td>
<td>476 (55)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Low Stress Unmasked Social Word Bottom Probe Bottom</td>
<td>481 (45)</td>
<td>47 (4)</td>
</tr>
<tr>
<td>Low Stress Unmasked Physical Word Top- Probe Top</td>
<td>473 (54)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Low Stress Unmasked Physical Word Top- Probe Bottom</td>
<td>483 (54)</td>
<td>47 (4)</td>
</tr>
<tr>
<td>Low Stress Unmasked Physical Word Bottom Probe Top</td>
<td>479 (63)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Low Stress Unmasked Physical Word Bottom Probe Bottom</td>
<td>479 (63)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Low Stress Unmasked Positive Word Top- Probe Top</td>
<td>459 (61)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Low Stress Unmasked Positive Word Top- Probe Bottom</td>
<td>459 (61)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Low Stress Unmasked Positive Word Bottom Probe Top</td>
<td>458 (48)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Low Stress Unmasked Positive Word Bottom Probe Bottom</td>
<td>458 (48)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>High Stress Masked Social Word Top- Probe Top</td>
<td>457 (45)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>High Stress Masked Social Word Top- Probe Bottom</td>
<td>457 (45)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>High Stress Masked Social Word Bottom Probe Bottom</td>
<td>455 (45)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>High Stress Masked Physical Word Top- Probe Top</td>
<td>456 (45)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>High Stress Masked Physical Word Top- Probe Bottom</td>
<td>456 (45)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>High Stress Masked Physical Word Bottom Probe Top</td>
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## Appendix O. Experiment 5. Mean probe-detection latencies in milliseconds

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