# The Reciprocal Effects of Induced Mood and Interpretation Biases in High and Low Trait Anxious Participants Performing a Cognitive Task

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Abstract

*Introduction*

Mood congruent interpretation biases are common amongst high trait anxious individuals. Recent research (Hunter, Mackintosh & Eckstein, 2006; Vinnicombe, Mackintosh & Eckstein, 2006) showed that induced anxious mood lead to mood incongruent biases, which was interpreted as a mood repair process. The dual-process model of mood regulation (Forgas & Ciarrochi, 2002) suggests that processing is initially mood congruent, switching to mood incongruent to attenuate mood states. The effortful mood incongruent processing is hypothesised to break down in high trait anxious individuals. A bi-directional relationship between mood and interpretation biases has yet to be explored within low and high anxious individuals.

*Experiment 1*

Induced positive (n=38) and anxious (n=35) moods decayed over time for low (n=41) and high (n=32) anxious participants. Following the mood induction the ambiguous scenario method was used to measure interpretation biases. A positive response bias was observed following the positive mood induction, although this did not maintain the positive mood. For the negative mood induction, mood incongruent interpretation biases were observed which became increasingly positive over time. Low anxious participants also showed a more positive response bias.

*Experiment 2*

Induced positive (n=26) and anxious (n=24) moods decayed over time for both low (n=26) and high (n=24) trait anxious participants. Participants undertook

the same tasks as in experiment 1 under a cognitive load hypothesised to block effortful mood incongruent processing. A positive response bias was observed after a positive mood induction but no biases were observed following an anxious mood induction. There were no differences between high and low trait anxious participants.

*General Discussion*

Methodological issues limited the conclusions drawn. However, the results appeared to support the dual-process models account of mood regulation as mood incongruent processing was observed following an anxious mood induction, and this process appeared to be blocked by a cognitive load. Implications for future research were discussed.

# CHAPTER 1: INTRODUCTION

## 1.1 Overview of the Chapter and Study Aims

Anxiety is a common mental health problem affecting one in six adults in the United Kingdom (McIntosh et al., 2004). It has been established that mood congruent interpretation biases are more common in anxious adults (Mathews & MacLeod, 1994). Cognitive behavioural theories of anxiety disorders (Wells, 1999) predict that interpretation biases will play an important role in the predisposition to, precipitation and maintenance of anxiety, however the causal relationship between the two is still uncertain. Failures in mood regulation have been hypothesised to have a causal effect on the development of anxiety disorders (Bradley, 1990) and cognitive behavioural interventions include elements focused at manipulating interpretation biases (Wells, 1999). However, little research has been conducted with clinical populations to investigate how mood regulation strategies are maladaptive in anxiety disorders (Amstadter, 2007). Information processing theories have proposed mechanisms by which interpretation biases may function to cause and maintain non-clinical anxiety (Dalgliesh, 2003), and theories regarding the regulation of mood also contain mechanisms by which mood precipitates changes in cognitive processing biases which in turn may operate to repair mood (e.g., Forgas, 2000b). Recent research (Hunter et al., 2006; Vinnicombe et al., 2006) found that individuals low in trait anxiety showed mood incongruent interpretation biases when exposed to anxiety provoking films. It was hypothesised that the interpretation biases acted as part of a mood repair mechanism and the current study aims to replicate this work in order to further understand the potential mechanisms of action of interpretation biases in relation to anxiety, and also to extend it to compare how the mechanism may differ in high and low trait anxious individuals. Such an understanding would have importance in the development of interventions focused on individuals with clinical anxiety disorders.

Firstly a definition of anxiety and the differences between mood and emotion will be discussed in section 1.2. This will be followed by an explanation of the importance of investigating phenomena associated with anxiety in section 1.3. In section 1.4 three conflicting theories regarding the regulation of mood will be presented, along with a critical review of the evidence in support of each. After this the evidence for interpretation biases in anxious populations and the effects of interpretation biases on mood and vice versa will be presented in section 1.5. An evaluation of this research will follow, along with its clinical importance, aims and hypotheses in section 1.6.

## 1.2 What is Anxiety?

Anxiety has been defined as "a feeling of worry, nervousness, or unease, typically about an imminent event or something with an uncertain outcome" (Anxiety, 2009). State anxiety is a reaction to a current or imminent threat, whereas trait anxiety is an individual's predisposition to experiencing state anxiety (Spielberger, 1983). Cognitive theories of anxiety (Wells, 1997) have proposed four elements to anxiety, including worry, emotional arousal, physical arousal and behavioural change (e.g., checking behaviours in obsessive compulsive disorder).

Anxiety can be described as an emotion or a mood. Emotions tend to be related to a specific event, are focused on a specific object such as another person, tend to come on quickly and dissipate quickly, and are relatively intense (Parkinson, Totterdell, Briner & Reynolds, 1996). Moods tend to be more related to one's internal world, coming on gradually, persisting for several hours or days, with less intensity than emotions (Parkinson et al., 1996). Whilst there are differences between moods and emotions, it has been shown that they are also related, with emotional reactions often resulting in a congruent mood change following the emotion-causing event (Isen, 1984). The mood regulation models discussed later in this chapter can be applied to both, although some may have more relevance to moods (Power & Dalgliesh, 1997) and others to emotions (Bower, 1991). The terms mood and emotion may be used interchangeably in the current study, although the focus is predominantly on mood, as it is the ability to repair persistent and debilitating moods that is clinically significant due to their relationship to a person's internal world.

Research involving mood as a factor was undertaken for many years under the assumption that affect, including both moods and emotions (Blechman, 1990), was a bipolar construct, differing in valence at each end of the scale, for example happiness and unhappiness (Feldman Barrett & Russell, 1998). Other research has investigated the possibility that positive and negative moods (labelled positive and negative affect, PA and NA in this research) could be conceptualized as more independent, unipolar constructs (Watson, Clark & Tellegen, 1988). Proponents of the bipolar view argued that PA and NA appeared as independent factors, but could be shown to be dependent and related when measurement error was controlled (Green, Goldman, & Salovey, 1993). Tellegen, Watson and Clark (1994) argued that their results did not fully support a bipolar view as the correlations between NA and PA did not approach -1.00. Further evidence for the unipolar view came from the finding that trait PA and NA were related to extraversion and neuroticism respectively (Tellegen, 1985), and that PA was associated with sensitivity to reward, and NA to sensitivity to punishment (Gray, 1994). Research reviewed by Watson et al. (1988) indicated that there were resulting effects of sensitivity to reward and punishment on coping and frequency of pleasant events amongst others. Reich, Zautra and Davis (2003) reviewed physiological research that showed differences in brain hemisphere activation and neurotransmitter processes for PA and NA.

Both moods and emotions were found to differ in their degree of activation, as well as valence (Bush, 1973). Such research highlighted that any model of mood must consider activation level, as well as valence and two related models comprising both components were shown to have empirical support (Watson & Tellegen, 1985; Feldman Barrett & Russell, 1998). Tellegen, Watson and Clark (1999) also showed that ratings of happiness and unhappiness exist in a bipolar relationship alongside the two-dimensional relationships between PA, NA, pleasantness and engagement which suggests that the bipolar and unipolar views can be reconciled to a certain extent. Table 1.1 details some examples of affective terms organised according to whether they are high or low in PA, NA, pleasantness or engagement. NA and PA appear to be independent constructs, which require separate measurement.

Table 1.1: Categorisation of affective terms according to Watson & Tellegen (1985)

| | Positive affect | Negative Affect | Pleasantness | Engagement |
|---|---|---|---|---|
| High | Elated | Fearful | Content | Aroused |
| | Strong | Jittery | Pleased | Surprised |
| Low | Drowsy | At rest | Lonely | Quiet |
| | Dull | Placid | Sorry | Still |

## 1.3 Why Study Anxiety?

Increasing rates of mental health problems have led to the view that it is mental health, rather than unemployment that is the biggest social problem faced by Britain today (Layard, 2004). One in six individuals will suffer with a mental health problem at some point in their lives (Department of Health; DH, 2007) and the psychiatric morbidity survey (Office of National Statistics, 2001) showed that 15% of working age adults reported suffering from an anxiety disorder. Mental health problems including anxiety disorders take up one-third of GP's time (Jenkins, McCulloch, Friedli & Parker, 2002) and whilst the government's improving access to psychological therapies programme (DH, 2007) is proving to be successful (Ireland, 2009), it is also costly (Layard, 2006). Although interventions like cognitive behavioural therapy (CBT; Gould, Otto, Pollack & Yap, 1997, National Institute for Health and Clinical Excellence (NICE), 2007) have been proven to reduce anxiety levels, most do not return to levels of functioning seen in those never diagnosed with an anxiety disorder (Ballenger, 1999). Recent research showed that modification of cognitive processing biases had beneficial effects on anxiety levels for high trait anxious individuals, although further research is needed to determine the mechanism of action involved in order to develop the task as a clinical intervention (Salemink, van den Hout, & Kindt, 2009). Further research is needed in order to improve understanding of the aetiology of anxiety disorders, as this may lead to new, more cost-effective treatments

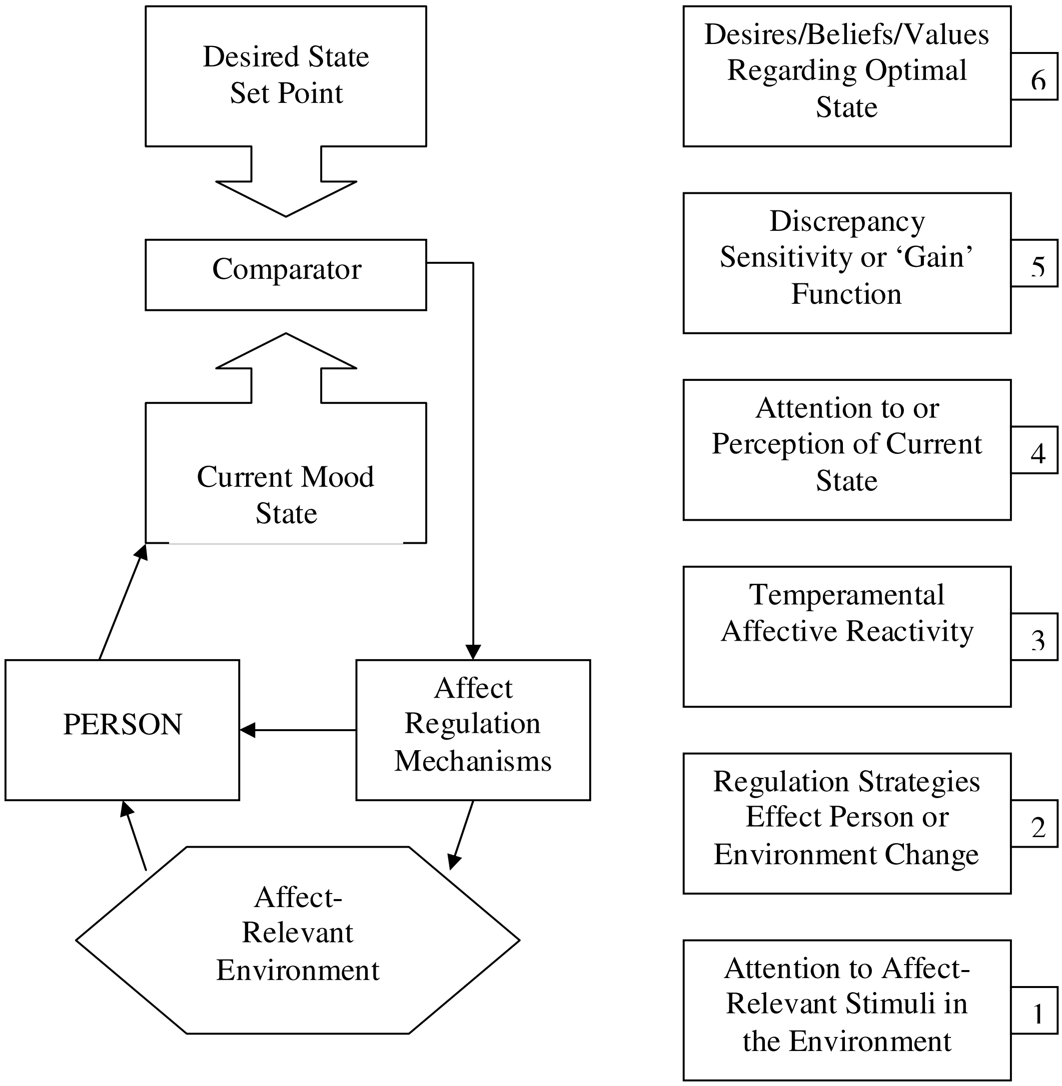
## 1.4 Theories Regarding the Regulation of Mood

In order to develop interventions focused at helping individuals regulate clinical anxiety, it is important to consider how the regulation of non-clinical levels of mood has been conceptualised. A literature search was carried out to identify articles of potential relevance to the functioning of cognitive biases in mood repair. A number of referencing databases (Academic Search Elite, Cochrane Library, Embase, Intute: Social Sciences, PscyINFO, Science Direct and Web of Knowledge) were searched with combinations of the words, 'mood', 'affect', 'emotion', 'anxiety', 'repair', 'management' and 'regulation'. Abstracts were reviewed to ascertain which met the inclusion criteria and additional papers were identified from reviewing reference lists. Studies concerning children under the age of 18 years were excluded, as were those concerning explicit, behavioural mood management. Articles printed in languages other than English and those not printed in peer-reviewed journals were excluded. Teape (2009) described three potentially useful models, which were identified in the literature search, and articles citing these models were reviewed, as was the special issue of the journal 'Psychological Inquiry' that the models were published in.

*1.4.1 The 'Hedonistic' Model*

Larsen (2000a) proposed a model of mood regulation suggesting that individuals compare their current mood state to a desired set-point, and then use mood regulation mechanisms directed either internally or externally to move closer to that set-point. The processes involved could be affected by six kinds of individual differences (Figure 1.1). Whilst these individual differences are described in detail, the proposed mood regulation mechanisms are not.

Figure 1.1: Control theory model of mood regulation (Larsen, 2000a)



1.4.1.1 *Critical Review of the Evidence for the 'Hedonistic' Model*

The basic assumption behind Larsen's (2000a) model was that individuals will strive to increase pleasure and to decrease pain, which seems likely given that the ratio of PA and NA experienced by individuals over several months correlates with subjective wellbeing (SWB), life satisfaction and happiness (Larsen & Diener, 1985). Larsen (2000b) also reviewed evidence showing that most people feel happy most of the time (Meyers & Diener, 1996), and cite happiness as their main goal in life (Diener, 2000). Participants induced into a happy mood non-consciously chose to watch positive film titles more frequently than those induced into a sad or neutral mood (Handley, Lassiter, Nickell, & Herchenroeder, 2004) which the authors suggested was due to participants automatically learnt maintenance of positive moods.

However participants induced into a sad mood experienced greater mood improvement than those induced into a happy or neutral mood in a study by Chang (2006), suggesting that decreasing pain is the overriding goal of mood regulation. Indeed, Wood, Heimpel and Michela (2003) found that individuals low in self-esteem, in comparison to those high in self-esteem were more likely to dampen positive moods. They concluded that the regulation of PA and NA is distinct and that individuals with low self-esteem may have a lower 'set-point' as the goal of mood regulation. A study in rate of affect change by Hemenover (2003) found that individuals high in neuroticism showed slow NA decay and fast PA decay, whilst extravert individuals showed slow PA decay and fast NA decay, following positive, negative and neutral mood inductions using films. Whilst these results, along with those of Wood et al. (2003) suggest different motives for mood regulation between groups of individuals, Hemenover recognized that this could be due to the use of inefficient mood regulation strategies by these groups.

Whilst Kuppens, Realo and Diener (2008) found that the frequency of reported positive emotions was related to a cognitive evaluation of satisfaction with life, cultural differences emerged that suggested that this was weaker in cultures where survival was a more pressing concern. This suggests that the pursuit of PA may not be the only goal of mood regulation as the avoidance of physical threat in the environment is an important concern in some cultures, and such avoidance does not usually result in PA (Maslow, 1943). As Larsen (2000a, 2000b) did not discriminate between the cognitive and the emotional aspects of happiness and life satisfaction in the studies he reviewed, an important distinction appears to have been missed.

Larsen (2000a; 2000b) does not recognise that happiness may just be a lucky by-product of the process of goal attainment, as Martin (2000) points out, just because something occurs more frequently does not mean that is was the intended outcome. This also assumes that achieving an optimal level of affect is always a goal in and of itself, and does not consider the possibility that goals such as avoiding a physical threat may be better served by maintaining negative moods, at least in the short term as they serve an informational purpose (Clore & Robinson, 2000; Isen, 2000). Cacioppo and Gardner (1999) reviewed a wide range of evidence supporting the idea that the behavioural expression of emotion may be unipolar in that individuals will either be inclined to approach or withdraw from a stimulus.

However, the evidence they reviewed suggested that the approach/withdrawal tendency is governed by information generated from two distinct positive and negative evaluative channels. The ‘positivity offset’ they described, in which there is a tendency for PA in the face of neutral or unfamiliar stimuli, supports the hedonistic model. However the ‘negativity bias’ they described, in which there is a stronger reaction to negative than positive information, does not support the hedonistic model as it demonstrates the utility of NA in ensuring safety.

The studies that Larsen (2000a) reviewed to support the hedonistic assumption generally attempted to explore explicit goals with regards to emotion. A study by Tamir, Chiu and Gross (2007) showed that participants viewed negative emotions such as worry as useful for the avoidance of threat. Participants who held this view implicitly also preferred to engage in tasks which increased worry and fear when they anticipated a threatening task. Participants in Tamir and Ford’s (2009) study also chose to increase their level of fear when they expected a goal related to avoidance. The hedonistic model cannot account for these data as it demonstrates that explicit declarations of goals for mood regulation do not always match implicit aims. Whilst Diener (2000) found that most people around the world rated happiness as their most important goal in life, it may be that individuals are not aware of what goals the emotion system works towards (Mayer, Salovey & Caruso, 2000) and/or the goals the system works towards were not included on the list used by Diener (2000). Interestingly, a minority of people in Diener’s (2000) study did not rate happiness as their most important goal in life, and the majority, whilst endorsing happiness as the most important goal, would presumably have admitted that other goals carry some importance (albeit less than happiness). Whilst happiness is clearly an important concern, such a simplistic view cannotaccount for the wide range of goal-driven situations where an individual might want to regulate their mood. Also, Diener's (2000) research may not support Larsen's (2000a; 2000b) position as it focused on long-term goals, which Freitas and Salovey (2000) pointed out are often met by ignoring current mood state.

Additionally, Larsen's (2000a) proposition that the hedonic goal of mood regulation is achieved by increasing pleasure and decreasing pain contains an implicit assumption that PA and NA are mutually exclusive constructs. However, Larsen, McGraw and Cacioppo (2001) demonstrated that it is possible to feel happy and sad at the same time by asking participants to rate a range of different emotion terms in typical situations, and comparing them to the same ratings made in untypical situations such as after graduating from University. Participants were more likely to have mixed feelings on untypical than on typical occasions, and the results could not be explained by what the authors termed acquiescence as similar patterns of responding were not seen for all emotion items. The overriding goal of mood regulation cannot therefore be hedonistic, as this ignores the possibility that NA can co-occur with PA.

Other research has shown that at least in the short-term, goals other than the attainment of PA may be important. In one study, individuals in self-reported negative moods chose to watch films with congruent affective valence (Strizhakova & Krcmar, 2007). Tice and Baumeister (1993) reviewed reports suggesting that anger is sometimes useful for example in attempts to influence officials in sports matches, in protestors or in certain occupations such as debt collection where anger may pressurize people to pay (Hothschild, 1983). Self-report data collected by Tice (1990) showed that individuals did occasionally attempt to create an angry state, but were more likely to try to prolong an angry state when they believed it might be useful. Whilst self-reported experiences may not be representative of what actually occurs in practice, these data suggest that hedonism cannot be the only goal of mood regulation. Other research has also demonstrated that speed of evaluations is increased when in a negative mood state for those high in trait neuroticism (Tamir & Robinson, 2004) and when in a neutral mood state for those low in trait extraversion (Tamir, Robinson, & Clore, 2002). These results suggest that alternatives to positive mood states can be beneficial for certain individuals during evaluative processing. Gender differences found in social interactions also showed that men might seek NA to exert influence over others, whereas women seek PA to maintain the relationship (Timmers, Fischer & Manstead, 1998). Watson (2000) reviewed evidence that shows that most individuals will engage in activities that do not fit with a short-term goal to increase PA, but do fit with a more long term goal to increase SWB. Such differences in the apparent motivations to achieve PA and NA do not support a purely hedonistic understanding of the regulation of mood.

Richards (2004) suggested that the differential effects of context on the mood congruency of interpretation biases in anxious and non-anxious individuals (Blanchette & Richards, 2003; Richards, Blanchette & Munjiza, 2007) showed that context is an important factor in mood regulation. Indeed in collectivist, eastern cultures, where the focus is on the group rather than the individual, individuals reported experiencing shorter and less intense periods of emotion than those in more individualistic, western cultures (Markus & Kitayama, 1991) which Eisenberg and Zhou (2000) suggested was due to individuals in eastern cultures learning to pay less attention to their emotions. Indeed, emotions and life satisfaction have been found to be less correlated in collectivist as compared to individualistic nations, where it could be hypothesised that individual experiences of emotion have little relation to the centrally important social organization (Suh, Diener, Oishi, & Triandis, 1998). It appears then that context may override hedonism in the process of mood regulation, since mood does not seem to be the most important determinant of life satisfaction across cultures.

Tice and Bratslavsky (2000) put forward a modular theory which describes emotion regulation as one of many forms of self-regulation. They reviewed evidence from eating, drinking, smoking and gambling which showed that individuals will sacrifice long term gains to achieve short term increases in PA. They also reviewed experimental evidence that showed that negative moods can interfere with achieving a long term goal, as individuals attempt to repair their mood, at the expense of their long term goal. Another problem with Larsen's (2000a) model seems therefore to be a focus on short-term over long-term goals (Freitas & Salovey, 2000).

Whilst Tice and Bratslavsky's (2000) theory seems sensible, and fits with the idea that hedonism will be the overriding concern "all other things being equal" (Larsen, 200b; p. 220), the situations when mood will become the overall focus are not defined, and neither are the particular mechanisms involved. Larsen (2000b) admitted that affect also provides information in a feedback loop for most tasks of self-regulation, but also needs to be regulated in and of itself. Whilst this could be seen to be hedonistic, it could equally be explained by the research reviewed by Tice and Bratslavsky (2000) that is, mood needs to be regulated before it interferes with long term goals. Individual differences in the methods and outcomes of mood regulation could therefore be seen as differences in the tendency to either seek desired goals, or to avoid undesired ones, and research reviewed by Hirt and McCrea (2000) supports this idea.

#### *1.4.1.2 Summary*

Methodological problems existed for many of the studies reviewed such as correlational designs attempting to imply causation, the ecological validity of reported preferences and experimental tasks and the lack of control conditions in certain studies. Nevertheless, it seems clear that hedonistically defined goals are sometimes important for some people, some of the time. However, such a simplistic view does not account for the changing effects of context on goals, be they emotional or otherwise, or indeed the time course over which such goals operate at least in experimental contexts. Additionally, certain individual differences seem to affect the goals of mood regulation such that NA can be desirable in certain circumstances.

### *1.4.2 The 'Social Constraints Model'*

Erber and Erber (2000) put forward a model of mood regulation which pays more attention to the importance of social and contextual factors than the hedonistic model. They suggested that hedonism may be the principal goal "all else being equal" (Erber & Erber, 2000, p. 143) but the process of repairing mood may cause the hedonistic principle to be overridden in the short-term at least. Similarly to Larsen (2000a; 2000b) the mechanisms involved were not specified, although they reviewed a number of studies which provide support for the model.

*1.4.2.1 Critical Review of the Evidence for the Social Constraints Model*

Several studies have shown that mood repair will occur for both positive and negative moods when individuals are engaged in challenging, but not in 'easy' tasks. For example, Erber and Tesser (1992) conducted a series of studies to investigate whether effort expended on a task can attenuate negative and positive moods through what they termed 'absorption' which proposed prevents a focus on mood congruent thoughts and therefore allows moods to decay. They found that induced positive and negative moods were attenuated through the completion of a marketing task, but only when participants believed that the amount of effort they put in was instrumental to their success. In a third study differences in induced positive and negative moods disappeared after completion of a difficult maths task, but not after completing an easy maths task or after doing nothing. They concluded that the results proved that absorption in difficult tasks attenuated mood, and that this could not be explained by simple mood decay given the results of their third study. Similar results were obtained by Erber and Therriault (1994) using easy or hard physical exercise tasks. If the hedonistic principle were correct, positive mood would not be mitigated after completing a difficult task and negative mood would not stay negative after completing easy tasks.

In order to extend the findings regarding task absorption, Erber and Erber (1994) induced sad and happy moods using memory recall, and then asked participants to recall a mood incongruent memory using low or high effort, or to use a list of adjectives to rate their mood in a control condition. They found that sad moods were attenuated to a greater extent in the high effort as opposed to the low effort condition. In a second study in a naturalistic setting, induced negative and positive moods produced mood incongruent memory recall only when task demands were perceived. The results of the first study suggest that increasing effort results in increasing efficacy of mood regulation, and the results of the second study provide further support for the effects of task demands on mood regulation as they occurred in a more naturalistic setting than those of previous research. A psycho physiological study by Silvestrini and Gendolla (2009) found that task effort for pleasant tasks was justified but not necessarily mobilised in comparison to task effort for unpleasant tasks. They concluded that individuals will be motivated to undertake pleasant tasks for hedonic purposes as long as other tasks do not require the resources. It appears as if both positive and negative moods will be regulated in certain contexts, suggesting that hedonistic concerns are not necessarily primary..

Kaufmann and Vosburg (1997) found that induced negative but not positive or neutral mood facilitated creative problem solving. In a series of studies involving self-report and choices in memory recall, Tamir (2005) also showed that individuals high in neuroticism were more likely than those low in neuroticism to choose to increase worry when they expected a task to be demanding, but not when they expected it to be easy. It also appeared as if such choices were beneficial to promoting performance on a cognitive task. This suggests that personality characteristics mediate the effects of context on the goal of mood regulation.

Erber and Erber (2000) expanded their ideas to those involving social contexts. They described something called the ‘coolness effect’, the tendency to maintain a neutral mood in the presence of others. They suggested that this is necessary in order to stay composed in an unpredictable situation. For example, Erber, Wegner and Therriault (1996) found that following negative and positive mood inductions, participants chose to complete mood congruent tasks when they thought that they would complete them alone, and mood incongruent tasks when they thought they would complete them with a stranger, regardless of the perceived mood of the stranger. Similar results were found by Commons and Erber (1997) for the completion of tasks with a romantic partner versus a stranger or with an accepting versus a critical other, and by Augustine and Hemenover (2008) for NA repair following a negative mood induction when in the presence of a supportive other. Interestingly, Augustine and Hemenover also found that the difference between introverts’ and extraverts’ ability to repair NA (with introverts having poorer abilities than extraverts when alone) disappeared in the presence of another. If hedonistic principles always drove mood repair such effects should not occur. Erber and Erber (2000) suggested that in social contexts, particularly with unknown or even potentially critical others, a more neutral mood state is desirable as extreme mood states may be inappropriate if others are in contrasting states.

Whilst Erber and Erber (2000) accepted that mood will remain unregulated until a reason to regulate it arises, they placed specific emphasis on social situations and difficult tasks without further expansion on other situations where mood regulation might be necessary. Given the fact that humans are social beings who spend a vast amount of time in social contact the fact that most individuals spend only 15% of their time in a neutral mood state (Larsen, Diener & Emmons, 1985) does not support Erber and Erber's (2000) position. This suggests that other motivations than social context must be important to the regulation of mood.

*1.4.2.2 Summary*

It seems clear that contextual factors play an important part in when, and indeed how, individuals manage their mood. However, by ignoring individual differences such as personality constructs (Mayer, 2000) and those described by Larsen (2000a), it is difficult to pinpoint when mood will become the focus of the self-control mechanisms described by Tice and Bratslavsky (2000) in the face of many self-control tasks, particularly as the model does not differentiate between short and long-term goals.

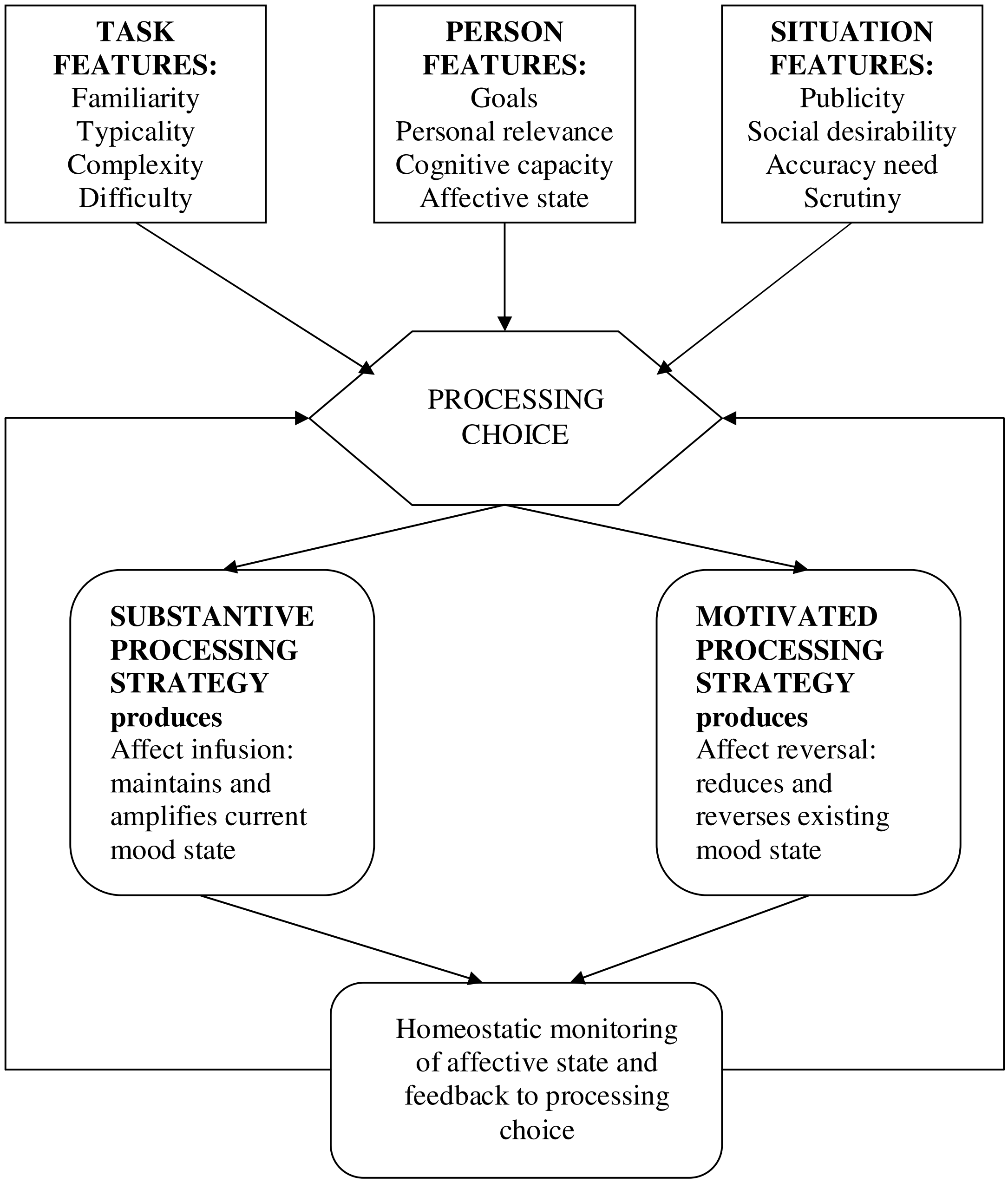
*1.4.3 Dual-Process Model of Mood Regulation*

Forgas and Ciarrochi (2002) described a 'dual-process model of mood regulation' based on Forgas' (1995) 'affect infusion model' in which spontaneous management of mood occurs through two types of information processing (Figure 1.2).

Substantive processing promotes what Forgas (2000a) described as 'affect infusion' as mood congruent effects occur in cognition, which serve to maintain and amplify the mood state. Motivated processing promotes what Forgas (2000a) described as 'affect control' through an effortful search for mood incongruent information, which serves to attenuate the mood state. Forgas and Ciarrochi (2002) suggested that substantive processing spontaneously occurs and motivated processing is only triggered in order to attenuate the mood state when a) a certain level of mood intensity (positive or negative; Erber & Erber, 2001) is reached or b) when personal, situational or task variables determine that the mood state needs to be attenuated.

For example mood may not be regulated if physical threat is detected in the environment which needs to be dealt with or if insufficient cognitive resources are available to switch to motivated processing. However mood may be regulated if a particularly happy mood occurs at a time when it is deemed to be inappropriate, for example at a funeral or if a particularly anxious mood occurs at a time when no physical threat in the environment is detected. Mood is seen to be constantly monitored in a homeostatic feedback loop such that for example if mood became too sad at the funeral resulting in excessive displays of emotion which were deemed to be disapproved of by others, mood could be regulated again. The thresholds within which mood is maintained are seen to differ between individuals by the model, and this could explain why anxious individuals experience more negative moods perhaps due to valuing of negative moods for potential threat detection. Difficulties in switching from substantive to motivated processing could also explain anxious individuals prolonged experiences of NA.

Figure 1.2: The dual process model of mood regulation (Forgas & Ciarrochi, 2002)




This model seems the most plausible when compared with the hedonistic and social constraints models, as it incorporates internal hedonistic influences and contextual influences on the spontaneous regulation of mood. Also it does not say that positive mood or neutral mood is the goal, rather that situational, task or person factors dictate the current goal, which may require a particular mood state. Indeed Arnold and Reynolds (2009) found an interaction between approach versus avoidance goals and regulation of negative affect, suggesting that it is not mood per se which is the goal, but that particular moods are useful depending on an individual's goal orientation. The model also suggests a way by which extreme mood states are attenuated given the fact that except in clinical mood disorders, they do not go on interminably (Forgas, 2000a) and describes this mechanism in greater detail than either the hedonistic or social constraints models.

*1.4.3.1 Contributions from Information Processing Theories*

Some theories have posited that emotions act as super-ordinate representations (Cosmides & Tooby, 2000), whereas other theories have seen cognition as primary, with emotion as a subordinate by-product of cognitive processing (e.g., Beck, 1967, 1976). The dual process model predicts a bi-directional relationship, and this possibility was also suggested by Mathews and MacLeod (2002) through their investigations of the causal nature of the relationship between cognitive biases and anxiety.

Oatley and Johnson –Laird (1987) proposed that goals are achieved through the execution of plans, and that emotions were used in helping to decide which goals to give priority with different processing modes for different emotions. The Schematic Propositional Analogical and Associative Representational Systems model (SPAARS; Power & Dalgliesh, 1997) predicted that processing of cognitions and emotions was far more complex, as they suggested that individual word meanings, beliefs and schematic goals were represented at different levels, with a simpler associative network of connections for previously repeated events. Mogg and Bradley (1998) suggested that the level of threat in a given situation was assessed, which affected whether current goals were set aside in favour of pursuing ‘safety goals’. They suggested that trait anxiety was defined by how biased the evaluation of threat for ambiguous information was. This is supported by research from cognitive neuroscience which has demonstrated both an automatic and a conscious pathway for the processing of threat-related information (LeDoux, 1996). Such models help to explain the dual-process model’s account of how and when mood will become the focus of current goals.

Several theories have described integrative processing or elaboration as a strategic, controlled process which will strengthen a representation and its connections as opposed to activation, which is more automatic (Graf & Mandler, 1984; Willams, Watts, MacLeod & Mathews; 1988, 1997). Given that integrative processing is controlled, it could be seen as analogous to motivated processing in the dual-process model except that Forgas (2000a) suggested that motivated processing will lead only to affect control, and not to affect infusion as these ideas would suggest. It seems possible that motivated processing could include an effortful search for mood incongruent *or* mood congruent information in order to attenuate or amplify current mood state depending on the current goal.

Mathews and Mackintosh (1998) suggested that the tendency to carry out integrative processing was determined by the allocation of greater cognitive resources by a ‘threat evaluation system’, determined by the level of perceived threat. They suggested that processing capacity for threatening information could be limited in those with high trait anxiety, but not in those with clinical anxiety disorders, through controlled effort, although this could be limited when mental load was already high. This view is in line with that of the dual-process model, which suggests that pursuing a safety goal could be overridden depending on task, situation or person factors when cognitive resources were available.

*1.4.3.2 Critical Review of the Evidence for the Dual-Process Model*

Forgas (2000a) cited a range of studies supporting the proposition that substantive processing leads to maintenance of the current mood state. For example positive mood leads to greater recall of positive memories (Bower, 1991), more positive attributions and judgements of others (Clore, Schwarz & Conway, 1994; Forgas, 1994; Forgas, 1995) and greater cooperation and confidence in certain behaviours (Forgas, 1998, 1999). Ideas from Bower's (1991) associative network theory suggest that substantive processing would also lead to maintenance of the mood state (Bower & Forgas, 2001) and further research has found that substantive processing leads to affect infusion (Forgas & Bower, 1987).

Statistical modelling using data from an adult panel demonstrated the homeostatic management of mood (Chow, Ram, Boker, Fujita & Clore, 2005; Hess, Kacen & Kim, 2006) and Mogg et al. (1994) found that mood congruent interpretation biases on a homophone task for anxious individuals disappeared over time, which they interpreted as a mood repair mechanism in operation. A study by McFarland, Buehler, von Rutti, Nguyen and Alvaro (2007) also suggested that when participants adopted a goal to repair their mood they were more likely to experience mood incongruent thoughts following a negative mood induction. Effects on mood were however not measured over time.

Several studies have found that mood incongruent effects occur in a number of domains such as memory recall and task preferences (Erber & Erber, 1994; Harris, Sharman, Barnier, & Moulds, 2010; Parrott & Sabini, 1990, Raghunathan & Corfman, 2004; Raghunathan & Trope, 2002; Rinck, Glowalla, & Schneider, 1992). Berkowitz, Jaffee, Jo and Troccoli (2000) showed that social judgments were mood congruent when attention was directed towards others, but mood incongruent when attention was directed towards themselves. It is possible that social constraints (Erber & Erber, 2000) impacted on the perceived appropriateness of participants' mood causing the apparent switch from substantive to motivated processing to occur although this is difficult to conclude with certainty as no final measure of mood was taken. Similar results were found by Forgas (1991) which had consequent effects on mood in the predicted direction suggesting that a switch in processing style does result in attenuation of mood states.

A study by Knobloch (2003) provided evidence linking both the social constraints and dual process models. Participants were induced into a positive or negative mood using a game or task expectation paradigm. Their choices of music to listen to over the following time interval suggested that whilst participants mostly chose music congruent with their mood state, when they expected a difficult task to continue, they chose incongruent music. As mood was not measured over time it is difficult to conclude that positive mood states were attenuated. A similar study with no task expectations found mood incongruent music choices with no effect on induced positive, negative and neutral mood (Knobloch & Zillman, 2002). This suggests that mood incongruent cognitive biases are important in the regulation of mood, which depends on the task at hand.

A study by Sedikides (1994) provided evidence for the occurrence of spontaneous mood management. Following an imagery mood induction of sad, happy or neutral mood, participants were asked to write self-descriptions which were initially mood congruent, but became more mood incongruent as time went on, particularly for the sad mood. Such effects were interpreted by Forgas (2000a) as evidence that participants spontaneously switched from substantive to motivated processing in order to repair their (sad) mood. However, as mood was not assessed following generation of self-descriptions it is difficult to conclude that attenuation of mood occurred.

Further evidence supporting the dual-process model comes from a series of studies by Forgas and Ciarrochi (2002) in which following a variety of positive, and negative mood induction techniques participants showed a consistent pattern of mood congruent, followed by mood incongruent responding in the generation of other person descriptions, in a word completion task and in the generation of self-referent statements. No change in the pattern of congruency of responding was found for neutral mood inductions. A pilot study suggested a ‘dry-well’ account for the switch to mood incongruent responding whereby individuals run out of mood congruent responses was not likely as participants were able to provide far more positive or negative person descriptions than those generated before the switch to mood incongruent responses in the main study. Similar results have also been found by Chen, Zhou and Bryant (2007) with participants induced into a negative mood choosing to listen to joyful music with increasing frequency over time when compared to participants induced into a neutral mood. Forgas and Ciarrochi admitted it was possible that mood simply decayed over time following the mood induction, and it was this that triggered the responding incongruent to the induced mood, but which was actually congruent with the mood as it decayed. However they suggested that mood decay alone could not account for their results given that such a dramatic change in responding was seen. Such a ‘chicken and egg’ account seems difficult to disprove given the wealth of evidence for mood congruent effects in cognition (e.g., Bower, 1991), the ongoing debate in the literature regarding the causal nature of the relationship between affect and certain cognitive processes (Mathews & MacLeod, 2002; Salemink, van den Hout & Kindt, 2007b) and the lack of mood measurement over time in the studies they report.

Further support for the model comes from Beevers (2005) who applied it to understanding cognitive vulnerability to depression, suggesting that individuals have a negative bias in the substantive processing of information about the self. It was proposed that motivated processing was not triggered to repair the mood for one of three reasons: 1) lack of cognitive resources, 2) because the individual’s expectations had not been violated or 3) because motivated processing was not sufficient to overcome the negative mood state. Teasdale (1988) used the term ‘cognitive interlock’ to explain the situation where negative mood results in mood congruent cognition through substantive processing, which results in further negative mood. It is this interaction between mood and cognition which Beevers hypothesised to result in a depletion of cognitive resources which then makes motivated processing more difficult, and several studies have shown that depressive cognition interferes with performance on cognitively challenging tasks (Ellis, Moore, Varner & Ottaway, 1997; Ellis, Ottaway, Varner, Becker & Moore, 1997). Furthermore, Beevers (2005) reviewed several studies suggesting that individuals may be vulnerable to depression due to being ‘stuck’ in substantive processing. Wenzlaff and Bates (1998) found that recovered, but previously depressed individuals completed sentences in a more negative way than those who had never been depressed, and Rude, Wenzlaff, Gibbs, Vane and Whitney (2002) found that these results significantly predicted which individuals would be more depressed four to six weeks later.

The studies by Erber and Tesser (1992) and Erber and Erber (1994) demonstrated the importance of task effort in the attenuation of mood states. When negative moods were induced using pictures, Van Dillen and Koole (2007) found that mood was attenuated by completion of cognitive tasks. These results suggest that motivated processing occurs when participants are engaged in tasks involving increased amounts of effort although this does not necessarily prove that effort is a necessary pre-requisite for motivated processing to occur.

Research has also suggested ways in which the process of mood regulation described by the dual-process model may break down. Mood incongruent biases have been found in memory recall which seemed to function to repair an induced negative mood (Joormann & Siemer, 2004; Josephson, Singer & Salovey, 1996). However, the effect in the Joorman and Siemer (2004) study was only apparent for non-dysphoric and not for dysphoric individuals, and only when participants were directed to ruminate on current mood state. This suggests that, at least for dysphoric individuals, the ability to use mood incongruent memory biases as part of a mood repair mechanism is impaired. As rumination facilitated the mood repair process this also suggested that processing effort was important.

A study by Ottati and Isbell (1996) found both mood congruent and mood-incongruent effects on interpretation of ambiguous information for naturally occurring (non-specified) negative mood, which were dependent on individual differences between participants. When asked to evaluate information about political candidates, individuals high in political expertise were more likely to make positive judgements about the candidates which were incongruent with their negative mood than those with low expertise. Ottati and Isbell (1996) suggested such results demonstrated interpretative processing biases acting as part of motivated processing in a mood repair mechanism when cognitive capacity was made available to focus on mood state due to high expertise, in line with the dual-process model.

Using texts describing job interviews, Hirsch and Mathews (1997) asked high anxious or low anxious individuals to make lexical or grammatical decisions about ambiguous probe words in relation to the text being read. Low anxious individuals made faster decisions for words with a benign interpretation, whereas high anxious individuals showed no preference for either. Using the same method as the current study, Eysenck, Mogg, May, Richards and Mathews (1991) presented clinically anxious patients, recovered patients, and non anxious controls with ambiguous sentences (e.g., “At the refugee camp, the week (weak) would soon be finished"). Later, participants were asked if they recognised sentences with benign or threatening interpretations of the sentences they had previously read (e.g., "At the camp the sick would soon be dead/At the camp, the weekend had nearly arrived"). The non anxious participants tended to rate the benign interpretations as being more similar, whereas anxious participants did not show a preference. Both sets of findings indicate that the attention of low anxious individuals was diverted to a more benign interpretation as part of a 'mood preservation' process in the non-anxious participants, which was compromised in the anxious participants in line with the dual-process model. These results suggest a way by which the use of motivated processing in mood regulation may be impaired in high anxious individuals, although the fact that effects on mood were not measured makes it difficult to conclude this with certainty.

*1.4.3.3 Summary*

The dual-process model seems best placed of the three models reviewed in to explain how individuals might regulate their mood under a variety of contextual conditions, with reference to both hedonistic and other more instrumental goals. It is also in line with information processing theories accounts of the interplay between mood and cognition. There is some evidence to suggest that when a threshold level of mood is reached, individuals switch from initially mood congruent to mood incongruent processing with the effect of attenuating both positive and negative moods when cognitive resources are available, and that this process is impaired in high trait anxious individuals. Given the abundant literature on cognitive processing biases in anxious mood it would seem likely that such biases might be involved in the regulation of anxious mood as the dual-process model would predict. A review of the literature regarding the relationship between cognitive processing biases and anxious mood follows in the next section.

## 1.5 Interpretive Processing Biases

A further literature search was carried out to identify articles of relevance to the relationship between interpretive biases and anxious mood. A number of referencing databases (Academic Search Elite, Cochrane Library, Embase, Intute: Social Sciences, PscyINFO, Science Direct and Web of Knowledge) were searched with combinations of the words, 'anxiety', 'anxious', 'cognitive', 'interpretation' and 'bias'. Abstracts were reviewed to ascertain which met the inclusion criteria and additional papers were identified from reviewing reference lists. Studies concerning children under the age of 18 years were excluded, as were those concerning attentional or other kinds of cognitive biases, those not concerned with anxiety and those concerning explicit, behavioural mood regulation. Articles printed in languages other than English and those not printed in peer-reviewed journals were excluded.

### *1.5.1 Anxious Populations*

Research in this area has focused on individuals in three main groups, those in transient emotional states of anxiety, those who have a high disposition to experience anxiety (high trait anxiety) and those diagnosed with anxiety disorders. The research can be further broken down into research into attentional processing biases, interpretive processing biases and memory biases.

Much research to date has demonstrated the existence of mood congruent attentional biases in both clinically and non-clinically anxious individuals (Williams, Watts, MacLeod & Mathews 1997). The existence of mood congruent memory biases is more controversial, and seems to depend largely on the existence of co-morbid depression (Mineka, Rafaeli, & Yovel, 2003). Several studies, using a variety of methods, have now shown that clinically anxious individuals, as well as high-trait anxious individuals are more likely to interpret ambiguous emotional information in a negative way (Ouimet, Gawronski, & Dozois, 2009; Richards, 2004). For example deciding between two possible interpretations of a homophone (a word with the same pronunciation but more than one meaning for example 'die' and 'dye') presented auditorily (Eysenck, MacLeod & Mathews, 1987; Mathews, Richards & Eysenck, 1989; Mogg et al., 1994). Richards and French (1992) found that for high anxious participants but not for low anxious participants, lexical decisions for real or nonsense words could be speeded up by presentation of an associated threatening homograph as a prime (a homograph is a word with more than one meaning although both are spelt the same). This effect was only found when the prime was presented for 750 milliseconds or longer and only when the prime was related to the target words. The conclusion drawn was that the anxious participants must have accessed the threatening interpretation of the homographs which facilitated their decisions regarding the targets.

Interpretation biases were also found for high-anxious individuals when reading ambiguous sentences which were followed by sentences that were consistent with either a benign or a threatening interpretation (MacLeod & Cohen, 1993). As reading times were slower when the second sentence had a benign interpretation, it was concluded that a threatening interpretation had already been made by the time the second sentence was presented. Similar studies supported this idea (Calvo, Eysenck & Castillo, 1997; Calvo, Eysenck & Estevez, 1994), finding not only that lexical decisions for homographs or interpretations of ambiguous sentences are made in favour of threatening interpretations, but that information presented later is understood more quickly when that information also has a threatening meaning.

Using a more elaborate method, Eysenck et al. (1991) found that non-anxious control participants were more likely to recognize benign interpretations of an ambiguous sentence that they had previously read, relative to anxious participants. Whilst it is possible that an implicit memory bias was responsible for the effects observed, little evidence has been found for the existence of implicit memory biases in anxiety (Mineka et al., 2003). Socially anxious individuals were shown to have factual recall but impose a bias on their interpretation of ambiguous information, especially after a time delay (Brendle & Wenzel, 2004) and predictive inferences in reading seem to be made on-line (Calvo & Castillo, 2001).

Much research in this area has focused specifically on individuals with social anxiety. When asked explicitly, participants with generalised social phobia (compared with anxious and non-anxious controls) appeared to have a negative interpretation bias for social information (Amir, Beard & Bower, 2005; Amin, Foa & Coles, 1998; Wenzel, Finstrom, Jordan, & Brendle, 2005), for the ambiguous behaviour of others (Kanai, Sasagawa, Chen, Shimada, & Sakano, 2010), for the identification of facial emotional expressions (Mohlman, Carmin, & Price, 2007) and for the prediction of negative self-evaluation, negative personal characteristics and negative long term consequences due to social anxiety (Wilson & Rapee, 2005). Interpretation bias for ambiguous social information appeared to disappear following treatment (Franklin, Huppert, Langner, Leiberg & Foa, 2005). Individuals high in social anxiety also demonstrated a negative interpretation bias and a lack of a positive interpretation bias for ambiguous social sentences in comparison to individuals low in social anxiety, both when they were required to independently generate their responses, and when they made a selection from two responses (Huppert, Pasupuleti, Foa & Mathews, 2007). A review by Hirsch and Clark (2004) also concluded that socially anxious individuals lack a positive interpretation bias, rather than possess a negative interpretation bias, which was supported in a study by Moser, Hajcak, Huppert, Foa and Simons (2008) using event-related brain potentials and in a correlational study by Huppert, Foa, Furr, Filip and Mathews (2003). Hirsch and Clark hypothesised that positive interpretation biases are used to repair mood in non-anxious individuals and that this process is blocked by negative self-imagery in those who are socially anxious.

Amir, Beard and Przeworski (2005) found that individuals with generalized social phobia (GSP) were unable to learn a non-threat meaning of a homograph in comparison to non-anxious controls (NACs). Beard and Amir (2009) found that when threatening or benign words primed ambiguous sentences, NACs were more likely to endorse a benign interpretation and less likely to endorse a threatening interpretation compared to socially anxious individuals, who showed no preference for either. Reaction time data suggested that threat interpretations were activated for socially anxious individuals, but not for NACs. The authors suggested that threat and benign interpretation biases should be treated as separate constructs when thinking about cognitive processing biases and the roles they play in causing and maintaining anxiety. The results of the Huppert et al. (2003) study supported this view as they found only a modest correlation between positive and negative interpretation biases in participants with varying degrees of social anxiety. These studies suggest that individuals with anxiety disorders are unable to disengage from threatening information which the NACs appeared to be able to do, perhaps as part of a mood repair mechanism.

Research reviewed by Richards (2004) supported the view that there is automatic vigilance for threatening information, which is later avoided, and there is some evidence that this is compromised in individuals with post-traumatic stress disorder (Amir, Foa & Coles, 2002). It may be that this strategic avoidance manifests itself as delayed disengagement from threatening information in those with high trait anxiety or clinical anxiety disorders (Fox, 2004). Mogg and Bradley (2004) suggested that such avoidance occurs when the stimulus is too aversive as a protective fear response, but that attention is sometimes maintained when the level of threat is lower as a safety-seeking anxiety response. It seems possible that individuals with clinical levels of anxiety perform this safety seeking response on information with much higher levels of perceived threat than non-clinically anxious individuals.

Research undertaken with individuals with generalized anxiety disorder (GAD) has similarly shown that they are more likely to interpret ambiguous information in a threatening way, compared with NACs (MacLeod & Rutherford, 2004). It is also commonly accepted that individuals with agoraphobia and panic disorder interpret bodily sensations in a negative way when compared with individuals with social anxiety and NACs (Rosmarin, Bourque, Antony, & McCabe, 2009; Stoler & McNally, 1991). Westling and Öst (1995) showed that interpretation biases resolved for individuals with panic disorder following cognitive behavioural treatment.

Individuals with GAD have been found to use antecedent information to interpret homographs used as primes in a threatening way, compared with low anxious individuals (Hazlett-Stevens & Borkovec, 2004). Interestingly, the same individuals were unable to use non-threat cues to assist their interpretation of non-threat homographs in comparison to low anxious individuals. Again this suggests that individuals with clinical levels of anxiety are unable to strategically avoid threatening information, although since the effect occurred both with threat and non-threat homographs, an explanation around being unable to disengage from threat seems unlikely. It is possible that the clinically anxious individuals were unable to switch from substantive to motivated processing (Forgas, 2000a, 2000b).

As the presence of cognitive processing biases in clinical and non-clinical anxiety seems well-established, research has since moved on to attempts to induce biases in order to ascertain causality in their relationship with anxiety.

### *1.5.2 The Influence of Cognition on Mood*

In a review of several studies, Mathews and MacLeod (2002) stated that it was possible to induce both positive and negative interpretation biases, with congruent changes in mood being reported only when individuals needed to actively generate meanings of ambiguous scenarios. They concluded that changes in state anxiety can be induced by inducing biased processing of emotionally ambiguous information. For example, Mathews and Mackintosh (2000) used the 'ambiguous scenario' method to induce either positive or negative interpretation biases in participants. Scenarios with either a negative or a positive ending as a word fragment were presented, with the scenarios ending negatively containing both physical and social threat. Participants' interpretation biases were then measured using similar scenarios with ambiguous endings, followed by recognition ratings for sentences which either had a positive or a negative interpretation of the scenario and which had either similar or dissimilar content. The results showed that participants in the positive condition showed a more positive bias through higher recognition of positive target items and participants in the negative condition showed a more negative bias through higher recognition of negative target items. Congruent changes in mood were also noted and the authors suggested that it was possible that the procedure used to induce an interpretation bias had direct effects on mood. Additional studies found that the biases endured over a long time delay after the mood had decayed suggesting that it was the bias that had caused the mood and not vice versa and that the bias occurred at the time of encoding the information rather than at the time of testing. When participants were not required to actively generate the ending of the scenario through completion of the word fragment, the effects of the training on interpretation biases and on anxiety disappeared.

Salemink, van den Hout and Kindt (2007a) replicated the study by Mathews and Mackintosh (2000) with the inclusion of a measure of participants' awareness of the valence of their training. They replicated the results found by Mathews and Mackintosh with regards to trained interpretation biases, but did not find congruent changes in mood or anxiety vulnerability (measured by mood response to a stressful anagram task) which they put down to differences in the sample between the two studies. They did however find that participants were explicitly aware of the valence of their training, and the effect of training on interpretation biases disappeared when this was entered as a covariate into their main analysis. They noted that this did not preclude the applicability of the results to naturalistic processes, especially as participants' awareness of the valence of their responses on the recognition test was not measured (Teape, 2009).

Given that the method to induce biases and the recognition test were essentially the same task, Salemink, van den Hout and Kindt (2007b) replicated their study but included two further measures of interpretation bias in order to test whether participants had learnt what they termed as a 'method-dependent strategy'. The first measure was implicit, the extrinsic affective Simon task (EAST; De Houwer, 2003) and the second allowed participants to report their own interpretations (rather than rating interpretations imposed by the experimenters), and was called the Ambiguous Social Situations Interpretation Questionnaire (ASSIQ; Stopa & Clark, 2000). Whilst Mathews and Mackintosh's (2000) results for interpretation biases using the recognition task were replicated for the positive training condition, no effects were seen for the negative training condition. No effects of training were found for either the EAST or the ASSIQ although reported power for the analysis for the EAST was low and the ASSIQ was designed for use in clinical populations and may not have been sensitive enough to detect changes in a non-clinical population. Congruent effects on state anxiety were reported for both training conditions, and for trait anxiety for the positive training condition. It therefore seemed possible that participants had learnt a method dependent strategy, and that no change in actual interpretation biases had occurred. It was also still possible that the procedure had influenced anxiety rather than interpretation biases per se.

Standage, Ashwin and Fox (2010) conducted two studies to test this hypothesis. In the first study participants underwent cognitive bias modification (CBM) by reading positively or negatively valenced statements, and their bias was assessed through a scrambled sentences test (SST; Wenzlaff, 1993). In the second study participants underwent a positive or a negative musical mood induction and had their biases assessed through the SST. Whilst interpretation biases congruent with the CBM condition were seen in the first study, with congruent changes in mood, no interpretation biases were observed for the second study, although changes in mood congruent to the induction condition were observed. As musical mood induction did not produce changes in interpretation biases when interpretation bias induction did, Standage et al. concluded that changes in interpretation bias could not be attributed solely to changes in mood since musical mood induction is not hypothesised to affect cognition. However, the visual analogue scales that they used to measure mood were bipolar with ‘anxious’ and ‘relaxed’ at each end of the anxiety scale and 'happy' and 'depressed' at each end of the depression scale. As PA and NA should be measured independently it is difficult to be sure that the mood results are valid. Nevertheless, when combined with the results of Mathews and Mackintosh (2000) it appears likely that interpretation bias affected mood, rather than the CBM procedure modifying mood which then modified interpretation bias. Given that the method used to assess biases in Standage et al. was different to the method used to induce the biases, it also seems unlikely that participants learnt a method dependent strategy and that the results revealed 'true' interpretation biases.

Further research in this area demonstrated that inducing both positive and negative interpretation biases in clinically anxious, high trait anxious and non-anxious individuals had congruent effects on social anxiety symptoms, thought intrusions, worry, self-imagery, state and trait anxiety, avoidance behaviour, emotional vulnerability, anxiety sensitivity and emotional reactivity (Beard & Amir, 2008; Beard, Brady, Klumpp, Elias & Amir, 2005; Hayes, Hirsch, Krebs & Mathews, 2010; Hirsch, 2009; Hirsch, Mathews & Clark, 2007; Holmes, Mathews, Dalgliesh, & Mackintosh, 2006; Lange et al., 2010; Mackintosh, Mathews, Yiend, Ridgeway & Cook, 2006; Mathews, Ridgeway, Cook & Yiend, 2007; Murphy, Hirsch, Mathews, Smith & Clark, 2007; Salemink, van den Hout & Kindt, 2009; Salemink, van den Hout & Kindt, 2010; Steinman & Teachman, 2010; Wilson, MacLeod, Mathews & Rutherford, 2006). A recent study by Beard and Amir (2010) found that negative interpretation of ambiguous social information mediated the relationship between social anxiety and state anxiety symptoms in response to a stressful speaking task in socially anxious participants. The results of this study provide further weight to the conclusion that the relationship between interpretation biases and anxiety is causal.

Yiend, Mackintosh and Mathews (2005) found that the effects of CBM endured over time periods of up to one day. More ambiguous results were however seen in a study by Standage, Ashwin & Fox (2009), which aimed to investigate alternatives to visual presentation of CBM material. Whilst negative interpretation biases were induced for both visual and auditory presentation, mood was seen to decrease for both the positive and the negative CBM conditions when the material was presented auditorily, which the authors suggested was due to the increased length of testing in that condition.

Two recent studies also shed light on the mechanism behind the CBM results, finding firstly that CBM did not produce effects for lexical decisions about valenced words which were not homographs or homophones (Grey & Mathews, 2009) and secondly that training involving active generation of word fragment meaning following presentation of ambiguous homographs resulted in greater effects on anxiety than did passive training (Hoppitt, Mathews, Yiend & Mackintosh, 2010a; Hoppitt, Mathews, Yiend & Mackintosh, 2010b). Both studies concluded that biased interpretations which affect mood only appear when two possible responses compete for resources, and not purely as a response bias to valenced targets.

There is a wealth of evidence to suggest therefore that interpretation biases can have a causal effect on mood.

### *1.5.3 The Influence of Mood on Cognition*

Calvo, Eysenck and Castillo (1997) found a negative mood congruent interpretation bias in high as opposed to low-test anxious individuals who had been exposed to a stressful examination procedure intended to invoke an anxious mood. They used the ambiguous scenarios method described earlier, with reading times for the disambiguating positive or negative sentences indicating the direction of the interpretation bias. Faster reading times were seen to indicate that meaning had already been accessed during reading of the scenarios. The bias appeared to be generated when the participants initially encoded the information, rather than when they were later asked to retrieve it. Also meanings did not appear to be accessed automatically when the disambiguating word in the sentence was read, but seemed to be accessed through integrative processing of the threat meaning.

Calvo and Castillo (1997) similarly found mood congruent interpretation biases for high anxious individuals following an anxious mood induction, but not for low anxious participants in either an anxious or neutral mood induction. The bias in the high anxious individuals was only present after time lags over 1,250 milliseconds; again suggesting that integrative, motivated processing of all meanings occurred, followed by selection of a negatively biased interpretation. It is possible that the low anxious participants initially demonstrated mood congruent biases which became mood incongruent over time as a result of a switch to motivated processing in order to repair mood. As biases were not measured as a function of time such effects would have been lost in the analysis.

A study by Chen and Craske (1998) with university undergraduate participants found that change in anxiety states over the time around a stressful exam positively predicted change in interpretation bias for ambiguous exam-related information. The authors recognised that such correlational evidence did not allow conclusions regarding the causality of the relationship between mood and interpretation bias to be drawn.

The results of these studies appear to confirm that mood does have an effect on interpretation biases. Mood incongruent interpretation biases were however not found, in contrast to predictions from the dual-process model. There could be a number of explanations for this. The mood congruent biases may have been activated through substantive processing early in the mood regulation process and later measurement would have revealed mood incongruent biases. As mood was assessed before and after the mood induction (which was also the interpretation bias test) it is difficult to ascertain whether mood changed due to the mood induction itself, or due to the effects of the interpretation biases themselves.

The role of context in the resolution of ambiguity was evidenced in a study by Blanchette and Richards (2003). Participants in both an anxious and a control mood induction condition demonstrated both mood congruent and mood incongruent interpretation biases in a homophone spelling task, which depended on matching contextual information. Anxiety was induced by telling participants that their performance on the interpretation bias test was being filmed and participants were presented with a contextual cue related to either the benign or negative interpretation of the homophone on a computer screen whilst listening to the homophone through headphones. The effect was stronger for participants induced into an anxious mood, and has been replicated in a more naturalistic setting with dental patients (Richards et al. 2007). Richards (2004) suggested such effects could be attributed to a mood repair mechanism in operation, suggesting that contextual cues are able to override cues from mood and shift the individual into motivated processing. The fact that the effect was stronger for the anxious participants may have been due to the fact that greater processing resources had been allocated to the threatening interpretations, allowing further motivated processing to repair the mood. It would be interesting to find out whether the same results are observed in clinically anxious individuals. If not, this suggests that clinically anxious individuals are not able to strategically avoid threatening information (Richards, 2004) or they are not able to implement mood repair mechanisms such as mood incongruent interpretation biases as part of motivated processing. Whilst the result is interesting, it does not provide evidence for the assertion that interpretation biases are influenced by mood. As Teape (2009) pointed out, the results could demonstrate an attentional bias for the threatening contextual cues, particularly as the presence of the video camera may have induced participants to try to do what they thought the experimenters wanted that is, pay attention to the contextual cues on screen.

It seems possible therefore that mood incongruent interpretation biases form part of a range of responses designed to negate the impact of potentially threatening events (Taylor, 1991). It seems likely that this occurs through the motivated and effortful process of diverting attention to benign interpretations. For anxious individuals, it seems that it is difficult to switch into this motivated processing mode.

Although providing contextual information that there is no imminent danger helps, this does not seem to be sufficient for clinically anxious individuals. It seems possible that mood incongruent interpretation biases also exist as response-focussed strategies, occurring after the anxiety state has been experienced and potential danger avoided, in order to return mood to a subjective set-point (Larsen, 2000a).

### *1.5.4 Summary*

It now seems clear that high trait anxious (e.g., Richards & French, 1992) and clinically anxious individuals (e.g., Amir, Beard & Bower, 2005) are more likely to interpret threatening information in a negative way, and it is possible that the tendency to experience state anxiety in these individuals is due to a difficulty switching to motivated processing from substantive processing, the latter of which would be seen to cause the observed interpretation biases by the dual-process model.

There is some evidence that inducing interpretation biases had congruent effects on mood (e.g., Hoppitt et al., 2010a), although the generalisability of the findings to more naturalistic processes is questionable due to participants' apparent awareness of the valence of their training (Salemink et al., 2007a). The large number of studies reporting similar results in this area and the study by Beard and Amir (2010) suggest that interpretation biases can have causal effects on mood. A range of studies also demonstrated that both induced (Calvo & Castillo, 1997) and naturalistic mood (Chen & Craske,1998) produced congruent effects on interpretation biases, and that these biases appeared to be generated during semantic elaboration, rather than being produced automatically. There is no evidence for mood incongruent interpretation biases acting to repair mood as the dual-process model predicts, although as biases were not measured at different time points in the studies reviewed it is possible that biases changed over time. None of the studies reviewed investigated the possibility of an interaction between mood and interpretation biases as the dual-process model predicts. Whilst the model can account for most of the findings reviewed such that mood congruent effects of cognition on mood could be seen as substantive processing and mood incongruent effects could be seen as motivated processing, the limited information available as to the time-point in the mood repair mechanism that such biases were observed makes any definitive conclusions impossible to draw. Future research would benefit from a direct focus on measurement of biases over time to delineate the potential switch from substantive to motivated processing, and to provide information about the time course for such a switch. It would also be interesting to compare the mechanism in individuals low and high on measures of trait anxiety to determine if this individual difference affects the performance of the proposed mood repair mechanism.

## 1.6 The Bi-Directional Relationship of Mood and Interpretation Biases

Two unpublished studies (Hunter, Mackintosh & Eckstein, 2006; Vinnicombe, Mackintosh & Eckstein, 2006) found evidence for a mood incongruent response bias in those low trait anxious individuals who had undergone a negative but not a positive mood induction. Mood was induced using film clips, with the ambiguous scenarios method used to assess interpretation biases and music perceived to be congruent to the mood induction condition was played during the reading of the scenarios in an attempt to get participants to maintain their mood. Mood was assessed before the mood induction, after the mood induction and after the recognition test. The authors suggested that the observed effects should be attributed to a mood repair mechanism in line with the dual-process model since the effect was not seen in the positive mood induction, and was only observed for social and not physical information as different regulatory processes occur for social and physical threat information (Otto & Hupka, 1999). The authors also suggested that mood repair could explain their results as mood was seen to change congruent to the mood induction, and then returned to baseline after the interpretation bias test for participants in both mood induction conditions.

The authors suggested that the results could equally be viewed as a contrast effect, for example, information in the interpretation bias test seemed more positive because the individual compared it to the negative content of the film used to induce mood, which was completely unrelated to their current mood state. However, this seemed unlikely due to the lack of mood incongruent effects in the positive mood induction condition. Furthermore, whilst the mood induction method itself was validated through pre- and post- measurement of mood, the effect of music played during the interpretation bias test (with the aim of maintaining the mood) was not measured and it is possible that it was at the very least distracting or at worst undermined the effects of the mood induction as music has been shown to have differential effects depending on previous experience (Carter, Wilson, Lawson, & Bulik, 1995). Mood was also only assessed on a single, unipolar scale meaning that changes in positive affect may have been masked by changes in negative affect and vice versa, as it has been shown that positive and negative affect are separate constructs requiring distinct measurement.

The current study aimed to replicate Hunter et al. (2006) and Vinnicombe et al. (2006) in order to correct some of the above methodological problems, to extend the results to individuals with high trait anxiety and also to include the variable of time in order to ascertain if a switch from substantive, mood congruent processing, to motivated, mood incongruent processing would be observed. Since previous research seemed to suggest that mood incongruent response biases functioned to repair anxious mood in low trait anxious individuals it seemed important to test this by experimentally manipulating mood and observing the effects on both interpretation bias and mood, as this has yet to be done. It also seems important to extend the research to individuals high in trait anxiety, as previous research suggests that such individuals may be compromised in their ability to repair mood using interpretation biases.

Clinically, the research is important as it will aid understanding of the way mood is regulated in non-clinical populations. Such an understanding will help to evaluate how regulation of mood may break down in those suffering from clinical anxiety disorders and in what circumstances. A review by Tice and Bratslavsky (2000) cited studies looking at failures in mood regulation, which found that those who expend lots of energy in trying to modulate negative affect often fail because it is necessary to work out all the ways to stop negative affect from being produced. They also said moods are difficult to control when your energy is depleted from engaging in other self-control tasks and this might explain why individuals suffering with clinical mood disorders may struggle to switch from substantive to motivated processing (Beevers, 2005).

Indeed interventions which use training of motivated processing in those with clinical levels of anxiety have shown some promising initial results (e.g., Beard & Amir, 2008) and the current research will help to direct future developments in this technique.

### *1.6.1 The Proposed Study*

The study was conducted by myself and a fellow trainee clinical psychologist, Lynda Teape. Lynda undertook what is reported as experiment 1 in the current research (Teape, 2009), whilst I undertook what is reported as experiment 2. Both experiments aimed to investigate the effects of positive and anxious mood induction on interpretation bias as a function of time in low and high trait anxious individuals. The experiments also aimed to investigate the effects of mood induction on mood at times 1, 2 and 3 (before and after the mood induction, and after the interpretation bias test). Additionally, all participants in experiment 2 undertook the interpretation bias measure alongside another cognitive task, hypothesised to block motivated processing since previous research has suggested that this requires cognitive processing capacity. The addition of a cognitive load will help to add more weight to the argument that effort is necessary for motivated processing to occur if it is found that motivated processing does not occur when cognitive processing capacity is limited. The positive mood induction was included as a control for the effects of context in order to test predictions from the social constraints model, as this would suggest no differences between a positive and negative mood induction undertaken in the same context. Indeed contrast effects as mentioned by Hunter et al. (2006) and Vinnicombe et al. (2006) would result in the same pattern of results. If predictions from the hedonistic model are correct, differences will be observed between the positive and negative mood inductions, as participants will be motivated to maintain a positive mood but to repair an anxious mood. However, if predictions from the dual-process model are correct, high anxious participants will not be able to repair an anxious mood as they will not be able to disengage from substantive, mood congruent processing.

*1.6.1.1 Experiment 1*

In experiment 1 it was predicted that for the anxious mood induction, high anxious participants would show mood congruent interpretation biases throughout the test as there is evidence that they will be unable to shift from substantive to motivated processing (Amir et al., 2002; Beard & Amir, 2009; Eysenck et al., 1991; Fox, 2004; Hirsch & Clark, 2004; Hirsch & Mathews, 1997) perhaps due to expectations not being violated as predicted by Beevers (2005). This will result in mood maintenance. In contrast it was predicted that low anxious participants would show a switch from mood congruent to mood incongruent biases with resulting return of mood to baseline. In the positive mood induction for experiment 1 it was predicted that both high and low anxious participants would show mood congruent interpretation biases resulting in mood maintenance.

*1.6.1.2 Experiment 2*

In the anxious mood induction in experiment 2 it was predicted that both high and low anxious participants would show mood congruent interpretation biases throughout the test due to an inability to switch from substantive to motivated processing due to insufficient cognitive resources as a result of the cognitive load

(Beevers, 2005; Erber & Erber, 1994; Erber & Tesser, 1992; Ottati & Isbell; 1996). It was predicted that an anxious mood would be maintained. In the positive mood induction it was predicted that both high and low anxious participants would show mood congruent interpretation biases throughout the test with a positive mood being maintained.

*1.6.1.3 Hypotheses*

Experiment 1a – Anxious mood induction, no cognitive load

1. High trait anxious participants
    a. Participants will show mood congruent interpretation biases throughout the test.
    b. Participants will show a more negative mood at times 2 and 3 than at time 1.
2. Low trait anxious participants
    a. Participants will show an initially mood congruent interpretation bias in the first half of the test, changing to a more positive, mood incongruent interpretation bias in the second half of the test.
    b. Participants will show a more negative mood at time 2 than at times 1 and 3.

Experiment 1b – Positive mood induction, no cognitive load

1. High trait anxious participants
    a. Participants will show a mood congruent interpretation bias throughout the test.

    b. Participants will show a more positive mood at times 2 and 3 than at time 1.

2. Low trait anxious participants

    a. Participants will show a mood congruent interpretation bias throughout the test.

    b. Participants will show a more positive mood at times 2 and 3 than at time 1.

Experiment 2a – Anxious mood induction with a cognitive load

1. High trait anxious participants

    a. Participants will show a mood congruent interpretation bias throughout the test.

    b. Participants will show a more negative mood at times 2 and 3 than at time 1.

2. Low trait anxious participants

    a. Participants will show a mood congruent interpretation bias throughout the test.

    b. Participants will show a more negative mood at times 2 and 3 than at time 1.

Experiment 2b – Positive mood induction with a cognitive load

1. High trait anxious participants

    a. Participants will show a mood congruent interpretation bias throughout the test.

   b. Participants will show a more positive mood at times 2 and 3 than at time 1.

2. Low trait anxious participants
   a. Participants will show a mood congruent interpretation bias throughout the test.
   b. Participants will show a more positive mood at times 2 and 3 than at time 1.

# CHAPTER 2: METHOD

## 2.1 Overview

The methods for experiments 1 and 2 were mostly the same. Details of the methods for experiments 1a and 1b are therefore given first in section 2.2; following which details of any changes to this for experiments 2a and 2b are detailed in section 2.3. Within section 2.2 a summary of the design is presented in section 2.2.1, following which details of participant recruitment is given in section 2.2.2. An overview of the measures used, along with a rationale for their use is given in section 2.2.3. There follows detailed consideration of the materials used for the mood induction and interpretation bias test in section 2.2.4, along with a rationale for their use. Ethical considerations are discussed in section 2.2.5, with a detailed account of the procedure described in section 2.2.6. Sections 2.3.1 and 2.3.2 detail changes to the measures and procedure respectively for experiment 2. The chapter is concluded with details of the plans for data analysis in section 2.4.

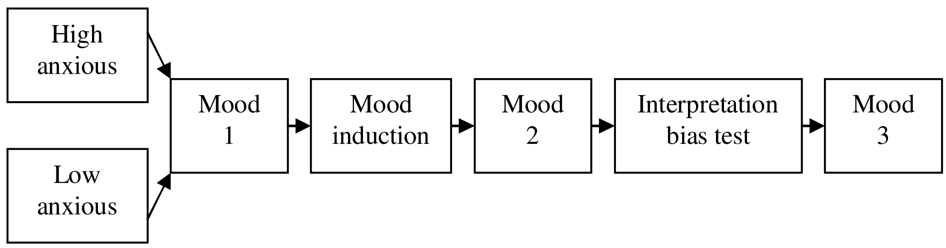
## 2.2 Experiment 1

Experiment 1 was run by Lynda Teape and was reported in full in Teape (2009).

### *2.2.1 Design*

To test predictions regarding mood following an anxious and a positive mood induction, an experimental 2x3 mixed design was used for each of experiments 1a (anxious mood induction) and 1b (positive mood induction). The dependent variable was mood score, the between subjects variable was anxiety condition (high or low) and the within subjects variable was time (1: before the mood induction, 2: after the mood induction and 3: after the interpretation bias test). To test predictions regarding interpretation biases, an experimental 2x2x2x2 mixed design was used. The dependent variable was sentence recognition rating, the between subjects variable was anxiety condition (high or low) and the within subjects variables were item type (target or foil), item valence (positive or negative) and test half (first half or second half). The design of the study is shown in figure 2.1.

Figure 2.1: Design of experiments 1a and 1b, anxious and positive mood inductions




Participants' mood was assessed at three time points, before the mood induction, immediately after the mood induction, and immediately after completing the interpretation bias test. Interpretation bias was assessed once, immediately after the mood induction. Mood was measured repeatedly to ensure that the mood induction had worked. Although it would have been ideal to repeatedly measure interpretation bias in addition to mood, measures with sufficient test re-test reliability to do this are still under development. Manipulating mood experimentally, and observing the effect on interpretation bias, along with the resulting effect on mood allows the role of interpretation biases in mood repair to be determined.

### *2.2.2 Participants*

Participants were students and staff at the University of East Anglia (UEA) recruited via campus advertisements, from a psychology research volunteer website and emails sent out to school mailing lists of students and staff (Appendix A). Emails included a copy of the study information sheet (Appendix B). The information sheet clearly stated that the study might induce negative emotions that participants could find distressing and that they were free to withdraw at any point without any adverse impact on their studies at the University. The information sheet also contained contact details if further information was required, if a complaint needed to be made, or if the participant suffered distress as a result of participation in the study.

#### *2.2.2.1 Inclusion Criteria*

Participants over the age of 18 years were included in the study. As the questionnaires and interpretation bias measures required fluent English and reading ability, participants were excluded if they were not a native English speaker, or if they had not lived in an English speaking country since the age of 10. This latter criterion was imposed as a response bias was noted in non-native English participants who claimed to be fluent in English in a separate but related study (personal communication, B. Mackintosh, October 2008). Participants with trait anxiety scores in the high or low anxious range were also included, and this will be further defined in section 2.2.3.2.1.

*2.2.2.2 Exclusion Criteria*

It was intended that those who showed signs of repressive coping characterised by low levels of reported trait anxiety and high levels of defensiveness would be excluded as such individuals often experienced higher levels of anxiety than they reported (Weinberger, Schwartz & Davidson, 1979). This has the effect of reducing any effects observed between anxiety conditions, as participants are not validly allocated to high or low anxious conditions. Participants were excluded if they had taken part in a similar study in the past. Participants who identified themselves as having suffered from a mental illness within the last five years were excluded to avoid the risk of invoking distress by inducing anxious mood and to ensure that the sample was representative of a non-clinical population. Similarly, any participants who demonstrated clinical levels of anxiety or depression on the screening measures (discussed in section 2.2.3.2) were also excluded as a condition of the study's ethical approval. Participants who identified themselves as having a learning difficulty were also excluded to ensure participants could undertake the reading elements of the task. Participants excluded due to mental illness, trait anxiety or repression scores were told that participants with specific demographic characteristics were being sought in order to match samples to avoid causing unnecessary distress. A non-clinical population was chosen to be able to compare directly with Hunter et al. (2006) and Vinnicombe et al. (2006) and to understand the possible mood repair mechanisms operating in healthy volunteers.

*2.2.2.3 Sample Size*

As the current research base is small, estimating the likely number of participants required to ensure detection of an effect was difficult. If the effect size for the interaction between sentence valance and mood induction found to be significant by Hunter et al. (2006) and Vinnicombe et al. (2006) is used, then 20 participants in each anxiety condition, for each experiment, would be needed to achieve this effect at the 0.05 level of significance with 80% power. Therefore it was aimed to recruit 40 participants to experiment 1a and 40 to experiment 1b. The full power calculation is detailed in Appendix C.

*2.2.3Measures*

*2.2.3.1 Demographics*

A demographic questionnaire (Appendix D) was used to collect information about all participants who responded to recruitment advertisements at the screening stage, before attendance at the study session.

*2.2.3.2 Screening*

*2.2.3.2.1 Anxiety.*

As only participants who were high or low in trait anxiety scores were to be included a brief screening tool was needed to identify participants who might have trait anxiety scores that fell in that range. Participants were screened using a shortened version of the trait scale of the Spielberger State-Trait Anxiety Inventory (STAI; Spielberger, 1983) called the Mackintosh and Mathews Anxiety Questionnaires (MANX; Mackintosh & Mathews, 2006; Appendix E). The MANX is a 10 item self report instrument assessing trait anxiety, defined as an individual's predisposition to anxiety when faced with possible danger ("Anxiety", 1999). It gives a total score out of 30, with higher scores indicating higher anxiety levels. It is not formally standardised, but its reliability and validity were sufficient as a brief screen since the STAI was used to formally allocate participants to groups. The MANX has been used successfully as a brief screen in similar studies and has a high correlation of .90 with the STAI and has good internal consistency with Cronbach's alpha .93, (B. Mackintosh, personal communication, February 1, 2008). Scores on the MANX can be converted to predicted scores on the STAI using the formula (MANX x 2.3) + 8.8 = STAI (Mackintosh & Mathews, 2006). It was used to identify participants likely to have scores on the trait scale of the STAI below 38 and above 48 (13 and 17 respectively on the MANX), which were the boundaries for the lower and upper third of participants tested by Lambie and Baker (2003) in a student population.

*2.2.3.2.2 Repression.*

As only participants who were truly high or low in trait anxiety score were to be included a brief screening tool was needed to identify participants who might report low trait anxiety as they are subjectively unaware of experiencing anxiety, but in fact objectively experience similar symptoms and behaviours as those who report high trait anxiety (Lambie & Baker, 2003). As repression is characterised by high levels of defensiveness along with low levels of reported trait anxiety a shortened version of the Marlowe-Crowne Social Desirability Scale (S-MCSDS; Reynolds, 1982, Appendix F) was used to identify defensive responding. The S-MCSDS

(Reynolds, 1982) was developed from the full MCSDS (Crowne & Marlowe, 1960) which has been widely used in research to identify socially desirable and defensive responding. The S-MCSDS is a 13 item self-report measure, giving a total score out of 13 with higher scores indicating more socially desirable responding. It has acceptable Kuder-Richardson reliability of .76 and correlates highly (.93) with the MCSDS (Reynolds, 1982). As previous research (Lambie & Baker, 2003) found that university students with scores in the lower third on the trait scale of the STAI and in the upper third for the MCSDS show a repressive coping style, individuals returning screening questionnaires with MANX scores below 7 and S-MCSDS scores above 6 were not invited to participate.

*2.2.3.3 Trait Anxiety*

In order to confirm predictions from the MANX and to finally allocate participants to the high or low trait anxious conditions participants completed a measure of trait anxiety prior to the mood induction. The trait scale of the STAI is a 20 item self-report questionnaire with a minimum score of 20 and a maximum score of 80. It has been standardised on several groups, including university students. It has been extensively used in similar research studies and has acceptable test-retest reliability ranging between .73 and .86 and good internal consistency of .90 (Spielberger, 1983). In terms of validity, the trait scale of the STAI discriminated well between individuals with and without anxiety disorders and showed high correlations (.73 - .85) with other measures of trait anxiety (Spielberger, 1983).

*2.2.3.4 Depression*

In order to identify participants with clinical levels of depression all participants completed a measure of depression before the mood induction procedure. The Beck Depression Inventory - II (BDI-II; Beck, Steer & Brown, 1996) is a 21 item self-report questionnaire assessing severity of depressive symptoms. It gives a total score out of 63, with higher scores indicating more severe symptoms. It has good test-retest reliability and internal consistency of .93. In terms of validity it discriminated well between patients with and without mood disorders and showed high correlations (.71 - .93) with other measures of depression (Beck et al., 1996). Kaiser's measure of sampling adequacy (Dziuban & Shirkey, 1974) was ..95 for the intercorrelations of the sampling matrix for psychiatric outpatients which is considered to show that the BDI-II has very good factorial validity.

*2.2.3.5 Current Mood*

Eight visual analogue scales (VAS, Appendix G) were used to assess the effectiveness of the mood induction, and any subsequent changes in mood over the course of the testing session, as this was the measure used by Hunter et al. (2006) and Vinnicombe et al. (2006). The VAS was developed from the brief mood introspection scale (BMIS; Mayer & Gaschke, 1988), which was developed from Watson and Tellegen's (1985) model of affective states, with two items each representing high and low PA and high and low NA. As Hunter et al. (2006) and Vinnicombe et al. (2006) averaged ratings on all eight scales to provide a single rating of mood, it is possible that changes in PA could have been obscured by changes in NA as the two are seen to be independent constructs (see chapter 1). This was not therefore repeated in this study, with scores on high and low NA being entered into the analysis for experiment 1a, and scores on high and low PA being entered into the analysis for experiment 1b.

Participants were asked to place a mark on a horizontal line, anchored by the statements ‘very much less’ and ‘very much more’. The eight VAS were presented in a random order for each assessment of mood. A score in millimetres is given for the distance of the participant’s mark from the ‘very much less’ end of the line for each mood. A VAS for anxiety was found to have good criterion validity of .30 when compared with the state scale of the STAI (Hornblow & Kidson, 1976). As participants who had greater knowledge of anxiety were more likely to use the VAS as a continuous scale they suggested that providing information about the nature of the construct could improve its validity. This was achieved by the use of the STAI prior to the VAS in the present study, mirroring the procedure of Hornblow and Kidson (1976). Hornblow and Kidson also found a test-retest reliability coefficient for their VAS “very close to the median test-retest reliability coefficient of .32 reported . . . for the STAI (State) anxiety scale.” (p.340, Hornblow & Kidson, 1976). Similar visual analogue scales have also been shown to be both reliable and valid when assessing related phenomena (Gift, 1989), and an electronic version showed exceptional concurrent validity of .98 with the VAS (van Duinen, Rickelt & Griez, 2008). It was used because, unlike most standardised measures of mood, it is extremely simple and quick to complete, which should reduce the likelihood of induced moods decaying over time.

### *2.2.4 Materials*

#### *2.2.4.1 Mood Induction*

It was necessary to choose a method that validly induced an anxious and a positive mood, and also to keep the method as close as possible to that used by Hunter et al. (2006) and Vinnicombe et al. (2006) in order to be able to compare the results. As discussed in chapter 1, the reliability and validity of the mood induction procedure was not known, and it is possible that the use of music had a confounding effect on those of the films, due to differential effects of different music for different people.

Inducing moods using films was found to be more successful than other methods such as social vignettes or photos (Gerrards-Hesse, Spies & Hesse, 1994; Westermann, Spies, Stahl & Hesse, 1996). Clips from the films ‘Halloween’ and ‘The Silence of the Lambs’ for the anxious mood induction in experiment 1a and ‘When Harry Met Sally’ and ‘An Officer and a Gentleman’ for the positive mood induction in experiment 1b were therefore used. These clips were shown to elicit the moods of fear (for ‘Halloween’ and ‘The Silence of the Lambs’), amusement, pleasure and happiness (for ‘When Harry Met Sally’ and ‘An Officer and a Gentleman’) consistently more often than any other emotion (Hewig et al., 2005). As the clips were relatively short (up to three minutes in length) both clips for each mood induction were shown in order to maximise the degree of the mood induced. Please see tables 2.1 and 2.2 for details of the clips used and editing guidelines for the anxious and positive mood inductions respectively.

Table 2.1: Film clips for the anxious mood induction.

| Film | Silence of the Lambs |
|---|---|
| | Editing instructions from Gross and Levenson (1995) |
| Clip description | Clarice is on the hunt for a serial killer and goes to interview James. She follows him into the basement and is faced with a gruesome sight. |
| Editing guidelines | Start: Camera shot of woodland, with a green caravan in the left of the scene. Camera pans across to left over rail tracks to a house with a grey car parked outside. End: Clarice enters the basement, metal wire is hanging down and appears to touch her nose. Re-start: A hand holding gun moves rapidly across the screen with yellow wallpaper in the background. End: After the gruesome sight in the bath, the lights go out and she gasps. |
| Clip length | 2'15'' |
| Target emotion | Fear |
| **Film** | **Halloween** |
| | Editing instructions from Philippot (1993) |
| Clip description | Laurie arrives to babysit but finds no one home. She explores the house a finds a corpse, whilst pursued by the killer. |
| Editing guidelines | Start: Laurie is in the house in the dark where she has arrived to babysit but no one is home. End: Having seen the corpse in the wardrobe, she moves away and the murderer raises the knife behind her, end just before he lowers the knife. |
| Clip length | 0'58'' |
| Target emotion | Fear |

Specific clip times have not been provided as these tend to differ depending on the recorded format.

Table 2.2: Film clips for the positive mood induction.

| | |
|---|---|
| Film | When Harry Met Sally |
| | Editing instructions from Philippot (1993) |
| Clip description | Sally (Meg Ryan) is faking an orgasm at the table of a restaurant. |
| Editing guidelines | Start: Camera pans across restaurant to Sally and Harry sat at a table discussing Harry's previous relationships.<br>End: Woman at next table places her order "I'll have what she's having". |
| Clip length | 2'45'' |
| Target emotion | Amusement |
| Film | An Officer and a Gentleman |
| | Editing instructions from Tomarken, Davidson, and Henriques (1990). |
| Clip description | Paula is working in a factory. Zack comes in, kisses her and carries her out of the factory. |
| Editing guidelines | Start: Final scene of film set in the factory. Camera shot of machine and Zak (officer) is seen to appear from behind the machine entering the factory. End: Zak carries Paula out of the factory. End before credits appear. |
| Clip length | 2'08'' |
| Target emotion | Amusement |

Specific clip times have not been provided as these tend to differ depending on the recorded format.

As reviewed by Teape (2009), whilst there is evidence that music is effective when inducing moods (Bruner, 1990), which piece of music is effective differs between individuals, and is also dependent on context and current mood state (Crozier, 1997). Music was therefore not used as an addition to the films due to its potential diluting effects on the induced mood.

The four selected film clips were piloted on a small sample of six individuals by Teape (2009) which demonstrated that there were significant differences in the valence and affect induced by the four clips. The differences were found to be in the expected direction for each clip and demonstrate that the clips induced the moods intended.

*2.2.4.2 Measure of Interpretation Bias.*

In order to be able to validly compare the results of this study with those of Hunter et al. (2006) and Vinnicombe et al. (2006) the ambiguous scenarios method was used to assess participants' interpretation biases following the mood induction. This method is also preferable over for example, the homograph method, as it enables both social and physical threat to be investigated, which is especially important as the content of the films for the anxious mood induction is more related to physical threat information, whereas content for the positive mood induction is more related to social information. The ambiguous scenario method also allows true interpretation biases to be differentiated from positive or negative response biases, due to the inclusion of target and foil items in the recognition test. The recognition test part of the measure was validated by Salemink and Van Den Hout (2010) where it was shown to discriminate between individuals low and high in neuroticism, regardless of induced mood.

In the ambiguous scenario method, participants are presented with 20 vignettes of ambiguous scenarios, 10 with a social theme and 10 a physical theme. They were presented line by line on a computer screen, with the final word incomplete which participants must complete in order to make sense of the content. This is followed by a simple yes/no question to ensure participants actively process the content of the vignette. For example, one vignette was as follows:

**The wedding reception**

Your friend asks you to give a speech at her wedding reception. You prepare some remarks and when the time comes, get to your feet. As you speak, you notice some people in the audience start to L—gh.

Press the down arrow key when you have identified the incomplete word.

Then find and press the letter key corresponding to the first missing letter of the incomplete word.

“Did you get up to speak”     Y/N?

This was followed by a recognition test, consisting of a series of four statements corresponding to each vignette presented one by one on a computer screen. Whilst the content of the statements did not exactly match the content of the vignettes, two were targets, with similar content to the vignettes, and two were foils, with content not closely related to the vignette. Of these, two were a positive and two a negative possible interpretation of the vignette. Participants were required to rate on a four point scale ranging from 'very different meaning' to 'very similar meaning' how closely each of the sentences resembled the vignette. The statements related to the example above were:

**The wedding reception**

A) As you speak, people in the audience laugh appreciatively (positive target)

B) As you speak, people in the audience find your efforts laughable (negative target)

C) As you speak, some people in the audience start to yawn (negative foil)

D) As you speak, people in the audience applaud your comments (positive foil)

This method of assessing interpretation bias was originally reported by Mathews and Mackintosh (2000) where significant differences between positive and negative interpretations were consistently found between groups who had been trained to interpret in a positive or a negative way respectively. An interpretation bias was evidenced in this study by an interaction of sentence type (target or foil) and sentence valence (positive or negative). This measure has advantages over other measures of interpretation bias such as the homophone method, as it enables a distinction to be made between positive or negative *response* biases, and true interpretation biases. Using this method a response bias would be evident from a main effect of sentence valence, without the interaction with sentence type. It seems clear that the measure has face validity, and Eysenck et al. (1991) found that it discriminated between individuals with generalised anxiety disorder (GAD), individuals who had recovered from GAD and matched control participants when using a shortened version of the same method. Details of all vignettes and their associated sentences, which were adapted from Mathews and Mackintosh can be found in Appendix H.

### *2.2.5 Ethical Considerations*

Potential participants were sent an information sheet (Appendix B) regarding the study, and those participants who signed up for the study session were given a further opportunity to read this, as well as an opportunity to ask questions about the study. Participants who attended the study session signed a consent form (Appendix I) if they agreed to participate following reading the information sheet and asking questions of the experimenter. It was therefore ensured that participants understood that the study might induce negative emotions that they might find distressing and that they were free to withdraw at any point without any adverse impact on their studies at the University. The information sheet contained contact details if further information was required, if a complaint needed to be made, or if the participant had suffered distress as a result of participation in the study. As a trainee clinical psychologist, the experimenter was trained and experienced in helping individuals cope with difficult emotions, and also had access to supervision from a qualified clinical psychologist so was able to provide support to participants who did find the negative film clips distressing.

Those scoring in the clinically anxious and/or depressed ranges on the trait scale of the STAI or the BDI-II, taken to be three standard deviations above the mean score in the respective normative sample, were diverted to the positive mood induction (with their data excluded from analysis) and were given advice regarding where to access help. It was intended that the participant would be asked to return to a later testing session if participants in their session were all in the negative mood induction condition in order not to dilute the effects of the mood induction. However in practice when this occurred, there were no other participants present in that session, so the participant was shown the positive film clip immediately.

As the procedure involved intentionally invoking negative emotions it was possible that some participants would become significantly distressed, although the procedures have been well tolerated in the past. All participants were asked before leaving the testing session to rate their current mood and any participants that did not feel that their emotional state was manageable had their needs assessed by the experimenter and appropriate action taken for example, talking through their thoughts and feelings. All participants in the anxious mood induction condition were given the opportunity to watch the positive film clips at the end of the testing session.

All personally identifiable information collected about participants was kept strictly confidential. Participants were allocated a participant number which was used to identify data pertaining to them. The information matching this code to participants' identifiable details was held in an encrypted computer file, separate from other data. Whilst the study was undertaken data were stored in a safe in the researcher's home. After the study has been completed data will be stored in a locked archive room at the University of East Anglia.

Participants were paid £5 in exchange for the time they had given up in taking part and were given an information sheet regarding advice and support for mental health problems available at the University and in the surrounding area (Appendix J). It was necessary to deceive participants as to the specific hypotheses being investigated so as not to bias responses. Whilst they were told they would read vignettes, they were not told about the recognition task. However it was not expected that any aspect of the deception would be distressing for participants, particularly as research in the field often involves this kind of deception following which no participant distress has been reported. Participants were fully debriefed at the end of the study session and information given about where to access further sources of help if appropriate.

Participants excluded at the screening stage due to a history of mental illness, reported learning difficulty, or scores on the MANX in the mid-anxious range were told that the study was aiming to recruit participants with specific characteristics and therefore not every participant who applied was being invited to the study session. Participants excluded at the screening stage or at the study session due to trait anxiety or depression scores were informed of this, and directed to possible sources of help and support. Participants excluded due to repression scores were not informed of this. Repression is seen as a form of defence against anxiety (Teape, 2009) of which individuals are mostly not aware (Derakshan & Eysenck, 1999) and to inform individuals of a repressive coping style could be damaging as it may expose them to emotions which may be intolerable for them.

Ethical approval for the study was granted by the University of East Anglia, Faculty of Health Ethics Committee on 1st August 2008, with approved amendments made on 22nd October 2008 (Appendices K and L).

### *2.2.6 Procedure*

A flow diagram of the procedure is shown in Appendix M. Upon receiving ethical approval for the study from the University's ethics committee, consent to recruit students as participants from UEA heads of schools was sought. When this consent was obtained, emails were sent to all students in the school inviting them to participate in a psychology experiment, including copies of the participant information sheet, demographic questionnaire, MANX and S-MCSDS. Interested students returned the questionnaires by e-mail. Advertisements were also placed around campus on school notice-boards and flyers were given to participants attending the study session to pass on to interested friends. Students and staff who responded to these adverts were emailed a copy of the information sheet and both questionnaires.

Participants who scored in the high or low anxious range on the MANX and who met the inclusion criteria were sent a link to an online scheduler to book a suitable time slot to attend for a testing session (Appendix N).

Participants who did not meet the inclusion criteria were thanked for their interest in the study and were provided with details of a website where they could view details of further psychology experiments running at the University that they might wish to sign up for (Appendix O).

*2.2.6.1 Participant Allocation to Experiment*

Experiments 1 and 2 were planned to run as a collaborative project as part of the Doctoral Programme in Clinical Psychology at the University of East Anglia. Experiment 1 was to be run and reported by Lynda Teape, and experiment 2 by the author. Participants were to be allocated to a testing session as soon as they expressed an interest, in order to avoid participant attrition. As a result it was not possible to fully randomise participants to experiments, as this would have required waiting for all participants' details to be available. It was therefore decided to alternately allocate experimental sessions accommodating up to five participants each as experiment 1a, 1b, 2a or 2b. It was hoped this would prevent dilution of mood effects as participants in each session would either be watching the positive or the anxious films. Eligible participants then signed up to a convenient testing session, without any knowledge as to which experiment they would take part in. It was further planned that each experimenter would run sessions for both experiments 1 and 2, in order to avoid experimenter bias.

Initial allocation of participants to experiments occurred in the way described. However due to a change in the author's personal circumstances, only a small number of participants were recruited in the way described, with data collection and analysis for experiment 1 being completed significantly before that for experiment 2.

*2.2.6.2 Testing Conditions*

Participants were tested in the same room in a computer laboratory on the university campus. The laboratory contained 20 computers, segregated by privacy screens.

*2.2.6.3 Apparatus*

Each participant sat at a workstation with a desktop computer, keyboard and mouse. Participants wore headphones firstly so that they could hear the soundtrack in the film clips, but secondly to block out background noise in the room for example, when the experimenter spoke to other participants to give them instructions.

E-prime (Schneider, Eschmann, & Zuccolotto, 2002) was used to present the STAI, VAS and interpretation bias test. E-prime also recorded participants' responses for the data analysis. Participants completed a paper copy of the BDI-II. The film clips were edited using Wondershare Video Converter Suite (Wondershare Software Company Ltd, 2008) and were presented on the computer using Windows Media Player (Microsoft, 2004).

*2.2.6.4 Procedure*

During the testing session participants first signed the consent form and then completed the trait scale of the STAI on the computer after reading the following instructions:

> A number of statements, which people have used to describe themselves, will be displayed on the screen.

Please read each statement and then tick the appropriate box to the right of the statement to indicate how you GENERALLY feel.

There are no right or wrong answers but you will be unable to go back to the previous question if you make a mistake.

Do not spend too much time on any one statement, but give the answer that best describes how you usually feel.

Please use the mouse to tick the boxes. Call us in when the screen says 'thank-you'.

Press any key to go on.

Each item for the STAI was displayed sequentially on the screen, with the next statement only appearing once a response had been selected for the last statement. Once complete, the participants score was displayed embedded in a digit string for the experimenter to note down after which the experimenter instructed them to complete a paper version of the BDI-II, and to inform the experimenter when they had completed it. During this time the experimenter checked the participants STAI score was not above the clinical cut-off.

Participants then made their first rating on the VAS, after reading the following instructions which were presented on the computer:

In this task you are asked to indicate how you are feeling at the moment, compared with how you generally feel.

Indicate your rating by clicking on the scale bar.

A practice trial will be shown to illustrate how to do the rating.

Each time, please read the labels on the scale very carefully before you start.

Press any key to go on.

Participants completed a practice trial using the item ‘tired’ before proceeding to the test items. Each item was displayed one at a time, with the next item being displayed once a response had been made. During this time, the experimenter scored the participants responses on the BDI-II to ensure that they did not fall in the clinical range. If it (or the score on the STAI) was in the clinical range the participant was diverted to the positive mood induction if necessary.

On completing the VAS, participants watched the appropriate film clips after reading the following instructions, presented on white A4 paper:

We would now like you to watch two short film clips.

Please put on the headphones provided so that you can hear the audio track.

There are two film clips, each of which is 2-3 minutes long. The clips are taken from commercially available and well known films.

Please watch the films closely and pay attention to what feelings the film evokes in you, as you will be asked about this afterwards.

The films may contain material that some people might find distressing.

If at any point you decide that you don’t want to continue, you can stop the film at anytime by pressing the ESCAPE button in the top left hand corner of the keyboard, or you can ask one of the researchers to stop it for you.

A second rating on the VAS followed the film clips. Participants then completed the interpretation bias measure after reading the following instructions presented on the computer:

> You are about to read 20 short stories, each story will be displayed line by line.
> Please press the ARROW DOWN key to start the story and to read each line.
> The last word of each story will appear in an incomplete form.
> Your task is to work out what the word is.
> AS SOON AS YOU HAVE IDENTIFIED THE WORD, PRESS THE ARROW DOWN KEY.
> Then find and press the LETTER KEY corresponding to the FIRST missing letter of the word.
> You will then be asked a simple question about the text and given feedback about your response.
> The first two stories are for practice.
> Press the ‘arrow down’ key to go on.

After the instructions the story was presented one line at a time, after which the word fragment was presented on a new page. After entering the first missing letter of the word fragment the completed word was presented for one second. The comprehension question was then displayed on a new page, and participants were instructed to press the left arrow key to answer no and the right arrow key to answer yes after which a new screen informed them if they were correct or incorrect. The task began with two practice items, before the 20 test items were presented in a random order by E-Prime. The same process was repeated for all 20 vignettes after which the recognition test began after participants had read the following instructions:

> Thank you. That is the end of the first part of the task.
>
> Press the "arrow down" key to start the second part.
>
> [new page]
>
> Remember back to the stories you read before.
>
> Now you will be shown the title and a brief description as a reminder for each story along with 4 different endings.
>
> Please rate the endings in the following way:
>
> Press one of the number keys 1, 2, 3, 4 to indicate how similar the ending is to how you remember it.
>
> 1=very different in meaning
>
> 2=fairly different in meaning
>
> 3=fairly similar in meaning
>
> 4=very similar in meaning
>
> Read each ending carefully.
>
> Respond as quickly as possible.
>
> You will begin with two practice items.
>
> Please press the 'arrow down' key to start.

Participants completed two practice trials of four sentences each, related to the two practice vignettes read earlier before moving on to the test items. The four sentences comprised a negative target, a positive target, a positive foil and a negative foil. The four sentences corresponding to each vignette were presented in blocks, although the order was randomised for each participant within each block. The order of presentation of each block was also randomised for every participant. In total 80 statements for the recognition test were presented, with the title of the vignette they related to displayed at the top of the screen. Finally participants completed a third rating on the VAS.

At the end of this time participants were given their £5 payment along with an information sheet about where to find help regarding mental health problems at UEA and in Norwich. They were then asked for any comments, and the researcher checked that their mood had returned to a tolerable state. Those participants who scored in the clinical range on the STAI and/or BDI were given information about where to access help for mental health problems at UEA. Participants in the anxious mood induction condition were given the opportunity to watch the positive mood induction film clips.

## 2.3 Experiment 2

Apart from the changes detailed below, experiments 2a and 2b were identical to experiments 1a and 1b as detailed above.

### *2.3.1 Materials*

#### *2.3.1.1 Cognitive Load*

In order to limit participants' cognitive resources during the time that interpretation biases are hypothesised to be generated a cognitive load was applied whilst participants were reading the vignettes. Participants were asked to remember a four digit number string whilst reading the vignettes. The number string to be remembered was randomly generated, and differed from trial to trial. It was presented before the first line of the vignette, and participants were asked to enter the number string immediately after answering the yes/no question regarding the content of the vignette. This method was previously effectively used in similar research where it was found not to interfere with participants undertaking of similar cognitive tasks (Wood, Mathews & Dalgliesh, 2001). Participants who were asked to remember one digit string in Standage et al. (2010) still demonstrated mood congruent interpretation biases, suggesting that it did not prevent substantive processing from occurring. Participants were asked to remember four digits, as this was the capacity of short-term memory in most adults (Cowan, 2001). Participants were not given feedback on their performance on this task as it is the effortful part of the process, rather than the outcome that is important since it is this that will create the cognitive load. Also, it was important not to distract participants' attention too much from the interpretation bias measure itself. Wood et al. (2001) found that participants failed to remember the digit string correctly on 13% of trials, and data regarding participants' performance on the number string recall were logged, and it was planned to compare the number of digit strings recalled correctly to those recalled incorrectly in order to ensure that significant differences were found which would indicate that participants attended to the task.

The vignettes with the addition of the cognitive load were piloted on an opportunistic sample of four participants. This showed that all participants were able to attempt to remember the digit strings with no adverse effect on their ability to process the content of the vignettes. Details can be found in appendix P.

### *2.3.2 Procedure*

#### *2.3.2.1 Recruitment*

Participant recruitment initially progressed as described in section 2.2.6, with consent being sought from heads of schools before sending emails out to staff and students on the school mailing lists. However, following the author's break from recruitment a change of University protocol meant that all requests to approach students to participate in research had to go through the Dean of Students Office. Due to the Dean receiving a large number of similar requests it was decided to send one email out to first and second year undergraduate students only.

In addition to recruitment methods described in section 2.2.6.1, recruitment to experiment 2 was also achieved through advertisements placed on the University's online portal and on various student and staff interest websites.

#### *2.3.2.2 Testing Conditions*

Following the author's break from recruitment, testing initially continued under the conditions described in section 2.2.6.2. Due to a change in room bookings it was no longer possible to continue to use the computer laboratory, and testing was moved to a purpose designed psychology research laboratory in a separate building on the University campus. This consisted of five sound proofed research pods, which each contained a desktop computer, keyboard and mouse. It was possible for the participant to communicate when sections of the procedure had finished through a small window.

*2.3.2.3 Procedure*

This was the same as for experiment 1 except following the second rating on the VAS the instructions for the test for interpretation biases were slightly altered:

> You are about to read 20 short stories.
>
> Before seeing each description you will see a four digit number which you should try to remember.
>
> Following the number each story will be displayed line by line.
>
> Please press the ARROW DOWN key to start the story and to read each line.
>
> The last word of each story will appear in an incomplete form.
>
> Your task is to work out what the word is.
>
> AS SOON AS YOU HAVE IDENTIFIED THE WORD, PRESS THE 'ARROW DOWN' KEY.
>
> Then find and press the LETTER KEY corresponding to the FIRST missing letter of the word.
>
> You will then be asked a simple question about the text and given feedback about your response.
>
> The first two stories are for practice.
>
> Press the 'arrow down' key to go on.

Following the presentation of the instructions for the first part of the interpretation bias test a new page was displayed which said:

Remember the following number:
5847.

The digit string was displayed for 3 seconds following which a new page appeared and the vignette was then presented line by line as previously described. Following the feedback for the comprehension question a new screen was presented which said:

Please enter the number you were remembering.

This screen remained until the participant made a response consisting of four key presses after which the next vignette was presented on a new screen. No feedback was given regarding participants performance on the digit string task in order to keep their attention focussed on the content of the vignettes.

## 2.4 Plan For Analysis

It would have been possible to add mood induction condition and cognitive load as variables into the analyses, and analyse all of the data for experiments 1 and 2 together. Given the differences in the way participants were recruited and tested described above, it did not seem appropriate to analyse the data for experiments 1 and 2 together as this would have introduced experimenter bias, and bias due to time of year into the results. Differences in participant numbers in each of the experiments would have reduced degrees of freedom for some of the analyses which would have had the effect of reducing the power of the analyses to detect effects where they existed. As reviewed in chapter 1, PA and NA can be viewed as independent constructs and therefore it seemed more appropriate to undertake analyses regarding their effects separately. It was therefore planned to carry out separate analyses for each of experiments 1a, 1b, 2a and 2b.

For each experiment the data were checked for differences between groups firstly using a chi-square test for gender. Following this demographic data were checked for normality by looking at skew, kurtosis and tests for normality. Parametric t tests or non-parametric Mann Whitney U tests were then used as appropriate to test for differences between the groups on age, STAI, BDI-II, MANX and S-MCSDS scores.

It was planned to test the mood data and the interpretation bias data for normality by examining skew, kurtosis and by performing tests for normality. It was planned to transform the data in order to meet normality assumptions for parametric tests.

To test hypotheses regarding the effect of trait anxiety on mood, 2x3 mixed model ANOVAs were planned for each experiment. The dependent variable was to be VAS score, the between subjects variable anxiety condition (high or low) and the within subjects variable time (1=before the mood induction, 2=after the mood induction, 3=after the interpretation bias test). To test hypotheses regarding the effect of trait anxiety on interpretation biases, 2x2x2x2 mixed model ANOVAs were planned for each experiment. The dependent variable was to be recognition ratings for the sentences in the recognition task, and the between subjects variable anxiety condition (high or low). The within subjects variables were to be sentence type (target or foil), sentence valence (positive or negative) and test half (first or second half of test).

# CHAPTER 3: EXPERIMENTS 1A AND 1B

## 3.1 Results

Results for experiments 1a and 1b have been summarised for the purposes of this report. They were reported in full by Teape (2009).

### *3.1.1 Overview*

Section 3.1.2 describes recruitment to experiment 1 and gives demographic information regarding the sample. Section 3.1.3 and section 3.1.4 respectively summarise the results of experiment 1a and 1b, the anxious and positive mood inductions. Summaries of two mixed model ANOVAs for the effects of the mood induction on high and low NA (high and low PA for experiment 1b) are presented in sections 3.1.3.3 and 3.1.3.4 (3.1.4.3 and 3.1.4.4 for experiment 1b). A summary of the results of a mixed model ANOVA for the interpretation bias data is presented in section 3.1.3.6 (3.1.4.6 for experiment 1b).

### *3.1.2 Demographics and Recruitment*

253 participants returned the screening questionnaires, 131 of which met the inclusion criteria. Of these 18 were diverted to experiment 2, and 35 did not attend for the experiment. Therefore 78 participants took part in experiment 1, and were quasi-randomly allocated to either experiment 1a or 1b. Due to difficulties recruiting enough high anxious participants and the MANX not serving as a suitable predictor of STAI scores, participants were allocated to high or low anxious groups based on a median split of the 253 received MANX scores. Five participants were then excluded from further analysis for a number of reasons including software failure or BDI or STAI scores in the severe range (see section 2.2.2.2). Table 3.1

summarises the number of participants in each experiment and each anxiety condition.

Table 3.1: Number of participants in experiments 1a and 1b, divided by anxiety condition.

| | High anxious | Low anxious |
|---|---|---|
| Experiment 1a (anxious mood induction) | 15 | 20 |
| Experiment 1b (positive mood induction) | 17 | 21 |

### *3.1.3 Experiment 1a – Anxious Mood Induction*

#### *3.1.3.1 Participant Demographic Information*

Thirty five participants took part in experiment 1a. No differences were found between the high and low anxious groups in terms of gender or scores on the S-MCSDS. Significant differences were observed for age and for scores on the MANX, STAI and BDI-II. Such differences might be expected given differences in trait anxiety, as depression and anxiety scores were found to correlate to a high degree (Clark, Steer & Beck, 1994) and social desirability was found to decrease in those with high trait anxiety (Lambie & Baker, 2003). Differences in age could be due to changes to the recruitment procedure which involved including staff, in order to recruit more high anxious participants. These variables were therefore not entered into the main mood data analysis as covariates as to do so would have resulted in loss of power.

*3.1.3.2 Selection of Mood Items*

Literature reviewed in chapter 1 suggested that an anxious mood induction should produce increases on items high in NA (worried and tense) and decreases on items low in NA (calm and content). Correlations revealed that mood items of calm and content were correlated with each other, so they were averaged to form the new variable low NA. Correlations between worried and tense items were not as robust, so high NA was represented by the mood item tense alone.

*3.1.3.3 Main Analysis of High NA Data*

Data normality assumptions were addressed through the removal of outliers following which the data also met the assumption of homogeneity of variance. To test the hypotheses that low anxious participants would show a more negative mood at time 2 than at times 1 and 3 (as evidenced by an increase in high NA at time 2 when compared with times 1 and 3), and that high anxious participants would show a more negative mood at times 2 and 3 than at time 1, a 2x3 mixed model ANOVA was performed. The dependent variable was high NA, the between subjects variable was anxiety group (high or low) and the within subjects variables was time (1, 2 or 3). Descriptive statistics for the high NA data and the results of the mixed model ANOVA can be found in appendix Q.

There was a main effect of time, $F(2, 66) = 13.499$, $p < .01$, and planned comparisons showed that high NA significantly increased from time 1 to time 2 as predicted [$t(34) = 4.99$, $p < .01$], but were shown to significantly decrease from time 2 to time 3 for all participants [$t(34) = 3.65$, $p < .01$]. The predicted interaction between time and anxiety group was not significant [$F(2, 66) = 0.164$, $p = .849$]

although observed power was found to be 0.99, suggesting that lack of power could not explain this result.

*3.1.3.4 Main Analysis of Low NA Data*

Data normality assumptions were addressed through the removal of outliers following which the data also met the assumption of homogeneity of variance. To test the hypotheses that low anxious participants would show a more negative mood at time 2 than at times 1 and 3 (as evidenced by a decrease in low NA at time 2 when compared with times 1 and 3), and that high anxious participants would show a more negative mood at times 2 and 3 than at time 1, a 2x3 mixed model ANOVA was performed. The dependent variable was low NA, the between subjects variable was anxiety group (high or low) and the within subjects variables was time (1, 2 or 3). Descriptive statistics for the low NA data and the results of the mixed model ANOVA can be found in appendix R.

There was a main effect of time, [$F(2, 66)=27.214$, $p < .01$], and planned comparisons showed that low NA significantly decreased from time 1 to time 2 [$t(34) = 6.68$, $p < .01$], but was shown to significantly increase from time 2 to time 3 [$t(34) = 5.21$, $p < .01$]. The predicted interaction between time and anxiety group was not significant [$F(2, 66) = 0.764$, $p = .470$] although observed power was found to be 1.0 suggesting that lack of power could not explain the result.

*3.1.3.5 Summary of Analysis of Mood Data*

Both low and high anxious participants showed an increase in high NA and a decrease in low NA following an anxious mood induction and a decrease in high NA and an increase in low NA following the interpretation bias test, suggesting that NA returned to baseline levels.

*3.1.3.6 Analyses of Interpretation Bias Data*

Data normality and homogeneity of variance assumptions were met. It was hypothesised that high anxious participants would show a negative (mood congruent) interpretation bias in both halves of the test but that low anxious participants would show a negative bias which became more positive in the second half of the test. A 2x2x2x2 mixed model ANOVA was performed to test these hypotheses with recognition rating as the dependent variable, anxiety condition (high or low) as the between subjects variable and test half (first or second), item valence (positive or negative) and item type (target or foil) as the within subjects variables. The hypothesised effects would be demonstrated by an interaction between anxiety group, test half, item valence and item type. Descriptive statistics for the recognition data and the results of the mixed model ANOVA can be found in appendix S.

There was a main effect of item type [$F(1, 33) = 467.54$, $p < .01$], with targets being recognised more frequently than foils. There was a main effect of anxiety group [$F(1, 33) = 4.810$, $p < .05$], with low anxious participants reporting higher recognition ratings in general than high anxious participants. There was a significant interaction between anxiety group, test half and item type [$F(1, 33) = 7.13$, $p < .05$] and post hoc t tests using a Bonferroni correction with alpha=0.025 revealed that low anxious participants recognised more target items in the second than the first half of the test, with no such difference apparent for high anxious participants. There was a significant interaction between test half, item valence and item type and two further 2x2 repeated measures ANOVAs were undertaken to explore this, the results of which can be found in appendix S.

The first, for target items with item valence and test half as the within subjects factors showed a significant interaction between item valence and test half [$F(1, 34) = 5.47$, $p < .05$[. Post hoc t tests using a Bonferroni correction with alpha=0.025 revealed a significant increase in recognition of positive target items from the first to the second half of the test, but no similar decrease for negative target items. The second repeated measures ANOVA, for foil items with item valence and test half as the within subjects factors showed no main effects or interactions.

The predicted interaction between anxiety group, test half, item valence and item type was not significant [$F(1, 33) = 0.08$, $p = .784$] although observed power was found to be 0.97 suggesting that lack of power could not explain the result.

*3.1.3.7 Summary of Interpretation Bias Data Analysis*

As predicted, all participants showed higher recognition of target over foil items. Low anxious participants also showed higher recognition in general than high anxious participants and recognised more target items in the second than the first half of the test. There was an increase in the recognition of positive target items from the first to the second half of the test for all participants. For low anxious participants the hypothesised negative (mood congruent) interpretation bias in the first half of the test, which would become a positive (mood incongruent) interpretation bias in the second half of the test was not found. For high anxious participants the hypothesised negative (mood congruent) interpretation bias in both halves of the test was also not found. Power for the analyses pertaining to these hypotheses was not found to be low. This suggests that all participants initially showed no interpretation biases, which became mood incongruent in the second half of the test.

#### *3.1.3.8 Summary of Results of Experiment 1a*

Both low and high anxious participants showed a more anxious mood following an anxious mood induction and a less anxious mood following the interpretation bias test. During the interpretation bias test no interpretation biases were initially observed, but a mood incongruent positive interpretation bias was observed during the second half of the test for all participants. Contrary to the hypotheses, no differences were observed between low and high anxious participants with regards to interpretation biases.

### *3.1.4 Experiment 1b – Positive Mood Induction*

#### *3.1.4.1 Participant Demographics*

Thirty eight participants took part in experiment 1b. No differences were found between the high and low anxious groups in terms of gender or age. Significant differences were observed for scores on the MANX, S-MCSDS, STAI and BDI-II. Such differences might be expected given differences in trait anxiety, as depression and anxiety scores were found to correlate to a high degree (Clark et al.,1994) and social desirability was found to decrease in those with high trait anxiety (Lambie & Baker, 2003). These variables were therefore not entered into the main mood data analysis as covariates as to do so would have resulted in loss of power.

*3.1.4.2 Selection of Mood Items*

Literature reviewed in chapter 1 suggested that a positive mood induction should produce increases on items high in PA (happy and carefree) and decreases on items low in PA (low and sad). Correlations revealed that mood items of happy and carefree were correlated with each other, as were the mood items of low and sad, so they were averaged to form the new variables of high and low PA respectively.

*3.1.4.3 Main Analysis of High PA Data*

Data normality assumptions were addressed through the removal of outliers following which the data also met the assumption of homogeneity of variance. To test the hypotheses that all participants would show a more positive mood at times 2 and 3 than at time 1 (as evidenced by an increase in high PA at times 2 and 3 when compared with time 1), a 2x3 mixed model ANOVA was performed. The dependent variable was high PA, the between subjects variable was anxiety group (high or low) and the within subjects variables was time (1, 2 or 3). Descriptive statistics for the high PA data and the results of the mixed model ANOVA can be found in appendix T.

There was a main effect of time [$F(1, 72) = 25.109$, $p < .01$], and planned comparisons showed that high PA significantly increased from time 1 to time 2 as predicted [$t(37) = 5.88$, $p < .01$], but no significant differences were observed between time 1 and time 3 [$t(37) = 1.29$, $p = .102$].

*3.1.4.4 Main Analysis of Low PA Data*

Data normality assumptions were addressed through the removal of outliers. Data did not meet the assumption of homogeneity of variance and a more conservative alpha level of 0.025 was therefore used (Tabachnick & Fidell, 2007). To test the hypotheses that all participants would show a more positive mood at times 2 and 3 than at time 1 (as evidenced by a decrease in low PA at times 2 and 3 when compared with time 1), a 2x3 mixed model ANOVA was performed. The dependent variable was low PA, the between subjects variable was anxiety group (high or low) and the within subjects variables was time (1, 2 or 3). Descriptive statistics for the low PA data and the results of the mixed model ANOVA can be found in appendix U.

There was a main effect of time [$F(2, 72) = 26.320$, $p < .01$], and planned comparisons showed that, as predicted, low PA significantly decreased from time 1 to time 2 [$t(37) = 5.54$, $p < .01$], but no differences were found between times 1 and 3 [$t(37) = 0.615$, $p = .271$].

*3.1.4.5 Summary of Analysis of Mood Data*

Both low and high anxious participants showed an increase in high PA and a decrease in low PA following a positive mood induction and a decrease in high PA and an increase in low PA following the interpretation bias test, suggesting that PA returned to baseline levels.

*3.1.4.6 Analyses of Interpretation Bias Data*

Data normality assumptions were addressed through the removal of outliers following which the data also met the assumption of homogeneity of variance. It was hypothesised that all participants would show a positive (mood congruent) interpretation bias in both halves of the test. A 2x2x2x2 mixed model ANOVA was performed to test this hypotheses with recognition rating as the dependent variable, anxiety condition (high or low) as the between subjects variable and test half (first or second), item valence (positive or negative) and item type (target or foil) as the within subjects variables. The hypothesised effect would be demonstrated by an interaction between item valence and item type. Descriptive statistics for the recognition data and the results of the mixed model ANOVA can be found in appendix V.

There was a main effect of item type [$F(1, 36) = 327.51$, $p < .01$], with targets being recognised more frequently than foils. There was a main effect of item valence [$F(1, 36) = 4.90$, $p < .05$], with positive items being more frequently recognised than negative items.

There was a significant interaction between item valence and anxiety group [$F(1, 36) = 7.46$, $p < .05$]. Post hoc t tests using a Bonferroni correction with alpha=0.025 revealed that low anxious participants recognised more positive items than negative items [$t(20) = 3.3$, $p < .025$], with no such difference apparent for high anxious participants. There was a significant interaction between test half and item valence [$F(1, 36) = 5.39$, $p < .05$]. Post hoc t tests using a Bonferroni correction with alpha=0.025 revealed that the recognition of positive items increased from the first to the second half of the test [$t(37) = 2.9$, $p < .01$] with no difference in recognition of negative items between either half of the test [$t(37) = 0.57$, $p = .570$].

The predicted interaction between item valence and item type was not significant [$F(1, 36) = 2.58$, $p = .117$] although observed power was found to be 1.0 suggesting that lack of power could not explain the result.

*3.1.4.7 Summary of Interpretation Bias Data Analysis*

As predicted, all participants showed higher recognition of target over foil items and also of positive over negative items, and this became more positive over time. This positive response bias only appeared for the low anxious participants. The hypothesised interaction between item valence and item type was not found and power for the analysis was not found to be low. This suggests that participants did not display interpretation biases.

*3.1.4.8 Summary of Results of Experiment 1b*

All participants showed a more positive mood following a positive mood induction and a less positive mood following the interpretation bias test. During the interpretation bias test a positive response bias became increasingly positive over time. The positive response bias was observed only for the low anxious participants. Whilst the mood data would suggest a mood repair process in operation, no interpretation biases were found in either direction.

# CHAPTER 4: EXPERIMENTS 1A AND 1B

## 4.1 Discussion

A discussion of the results of experiments 1a and 1b can also be found in Teape (2009).

### *4.1.1 Overview*

A discussion of the findings for experiments 1a (section 4.1.2) and 1b (section 4.1.3) is presented with reference to hypothesised results (sections 4.1.2.1 and 4.1.3.1 for experiments 1a and 1b respectively) and observed results (sections 4.1.2.2 and 4.1.3.2 respectively). Discussion of the results in light of reviewed literature and relevant theory is discussed in sections 4.1.2.3 and 4.1.3.3 for experiments 1a and 1b respectively.

### *4.1.2 Experiment 1a*

#### *4.1.2.1 Hypotheses*

For experiment 1a it was predicted that both low and high anxious participants would show a more anxious mood following an anxious mood induction. Using ideas from the dual-process model of mood regulation, it was predicted that for low anxious participants, mood congruent interpretation biases would initially be evident, through substantive processing. It was further predicted that mood incongruent biases would emerge through a process of motivated processing in order to repair the anxious mood. It was predicted that this would result in a return of mood levels to baseline for the low anxious participants following the interpretation bias test. It was predicted that high anxious participants would show mood congruent interpretation biases throughout as a result of substantive processing, which would result in an anxious mood being maintained.

*4.1.2.2 Results*

As predicted, both low and high anxious participants showed a more anxious mood following an anxious mood induction. Whilst it was predicted that there would be differences between low and high anxious participants in observed interpretation biases during the first and second halves of the test following the anxious mood induction, no such differences were observed. Instead, no interpretation biases were initially observed, but a mood incongruent positive interpretation bias was observed during the second half of the test for all participants. Consequently, a less anxious mood was observed for all participants following the interpretation bias test, suggesting that they were all able to switch from substantive to motivated processing in order to repair an anxious mood.

*4.1.2.3 Discussion*

The results of experiment 1a appear to support the dual-process model of mood regulation (Forgas,200a), as an anxious mood appeared to be repaired for both low and high anxious participants by mood incongruent, positive interpretation biases. There is some support that mood and interpretation biases have a bi-directional relationship with anxious mood leading to mood incongruent interpretation biases, leading to a less anxious mood.

It is however possible that the reduction in anxious mood following the long and repetitive interpretation bias test was due to mood decay, especially as differences were not observed between low and high anxious participants, as mood decay would be expected to apply regardless of the level of trait anxiety. This also seems likely as mood congruent interpretation biases were not observed in the first half of the test, which would have provided more robust support to an explanation regarding mood repair, rather than an explanation around mood decay. It is therefore possible that a process of mood decay caused a reduction in the anxious mood, which resulted in a more positive interpretation bias in the second half of the test through substantive processing.

The predicted difference between low and high trait anxious individuals in the interpretation biases observed was not found which may be due to a number of factors. Firstly, it is possible that high anxious participants still possessed enough cognitive resources to switch to effortful, motivated processing as the low anxious participants possibly did, as the induced mood was not extreme enough to load cognition to the required extent. The addition of a cognitive load to the procedure in experiment 2 should help to test this hypothesis. Secondly, it is possible that the induced mood was not extreme enough and therefore congruent interpretation biases were not generated through substantive processing. As a result cognitive resources would not have been impaired to the extent required by multiple generations of mood congruent associations, as predicted by Bower's (1991) network activation theory in order to prevent motivated processing from occurring. This would seem likely as mood congruent interpretation biases were not observed for either the low or the high anxious participants in either half of the test.

The fact that high anxious participants showed lower recognition ratings in general than low anxious participants could be explained by an increased cognitive load for the high anxious participants caused by increasing substantive processing in comparison to the low anxious participants, which makes the task of recognising target items more difficult for the high anxious participants (Erber & Erber, 2000). As low anxious participants reported recognising more target items in the second than the first half of the test it is possible that this also evidences a switch from substantive to motivated processing. This is because the cognitive load caused by substantive processing may make the recognition of target items more difficult, which becomes easier as motivated processing takes over and mood congruent associations lessen. The addition of a cognitive load to the procedure in experiment 2 is therefore further indicated.

The results observed in experiment 1a could also be explained by the social constraints model of mood regulation, as participants may have been motivated to repair their mood due to the slightly anxiety provoking nature of the situation which involved strangers, in line with the work by Erber et al. (1996). If the social constraints model is correct, then positive mood should also be regulated in the same way.

Further discussion of the results in terms of theoretical and clinical implications, and with regard to methodological limitations, can be found in chapter 7.

*4.1.2.4 Conclusions*

Experiment 1a has provided some limited support for a dual-process model of mood regulation, although the results of experiment 1b will help to test the hypothesis that mood was managed in this experiment due to contextual demands of the situation.  A number of hypotheses have been highlighted to account for the lack of differences observed between high and low anxious participants.  The addition of a cognitive load to the procedure in experiment 2 should allow these hypotheses to be tested.

### *4.1.3 Experiment 1b*

#### *4.1.3.1 Hypotheses*

For experiment 1b it was predicted that both low and high anxious participants would show a more positive mood following a positive mood induction. Using ideas from the dual-process model of mood regulation, it was predicted that both low and high anxious participants would show mood congruent interpretation biases throughout as a result of substantive processing.  It was predicted that this would result in maintenance of the positive mood.

#### *4.1.3.2 Results*

As predicted, all participants showed a more positive mood following a positive mood induction.  Whilst it was predicted that all participants would show mood congruent interpretation biases throughout the interpretation bias test, instead a positive *response bias* was observed which became increasingly positive over time.  The positive response bias was observed only for the low anxious participants. As discussed in chapter 2, response biases evidence a propensity to respond to the sentences in the recognition test in a generally positive or negative way, regardless of the similarity to the vignette content.  As such, they are not seen to demonstrate true interpretation biases where a propensity to respond in a valenced way would be mediated by an interaction with item type.  Whilst the mood data would suggest a mood repair process in operation as a less positive mood was observed for all participants following the interpretation bias test, no interpretation biases per se were found in either direction.

*4.1.3.3 Discussion*

It is difficult to say which model of mood regulation the results of experiment 1b appear to support, as although an induced positive mood returned to baseline, this occurred following a measured *positive* response bias which became more positive over time (for the low anxious participants only). It seems possible that the decline in positive mood following the interpretation bias test was due to decay, as the test is long and somewhat repetitive, and that any effects of mood regulation on mood were lost during this procedure which often took up to 40 minutes to complete.

The dual-process (Forgas, 2000a) and social constraints models (Erber and Erber, 2000) might suggest that participants did not attempt to regulate their mood as the context was not sufficiently challenging or anxiety provoking (at least for the low anxious participants). As a result there was no switch from substantive to motivated processing and no evidence of interpretation biases. The addition of a cognitive load to the procedure in experiment 2 is therefore indicated in order to determine if contextual changes motivate mood repair strategies for low (and perhaps also high) anxious participants (Blanchette & Richards, 2003).

The fact that mood congruent interpretation biases were not observed could be explained by the relatively long time interval between the mood induction and the interpretation bias test, combined with the relatively mild mood induced. This would mean that any biases may have decayed by the time the test was performed. The observed positive response bias could be tentatively viewed as an emerging mood congruent bias which functioned to maintain positive mood, but which did not reach significance due to the same reasons.

Given that a response bias was not observed for the high anxious participants, it would seem unlikely that a pure hedonistic model (Larsen, 2000a) could explain the overall pattern of results obtained. This is because this model would say that all individuals would be motivated to achieve a positive mood and also because a positive mood was not obtained at the end of the interpretation bias test. It is possible that the high anxious participants were not able to access as many positive associations (Bower, 1991) as the low anxious participants during the switch from substantive to motivated processing to maintain a positive mood. The addition of a cognitive load to the procedure in experiment 2 is therefore indicated to determine if the difference between high and low anxious participants in this regard disappears under conditions of reduced cognitive resources.

Further discussion of the results in terms of theoretical and clinical implications, and with regard to methodological limitations, can be found in chapter 7.

*4.1.3.4 Conclusions*

The results of experiment 1b could support either the dual-process model or the social constraints model of mood regulation, with the lack of mood maintenance being explained through a process of mood decay. The addition of a cognitive load in experiment 2 is indicated.

# CHAPTER 5: EXPERIMENTS 2A AND 2B

## 5.1 Results

It should be noted that similar analyses to those run by Teape (2009) were performed in order to be able to validly compare the results obtained.

### *5.1.1 Overview*

Section 5.1.2 describes recruitment to experiment 2 and gives demographic information regarding the sample. Section 5.1.3. and section 5.1.4 respectively summarise the results of experiment 2a and 2b, the anxious and positive mood inductions. Summaries of two mixed model ANOVAs for the effects of the mood induction on high and low NA (high and low PA for experiment 2b) are presented in sections 5.1.3.3 and 5.1.3.4 (5.1.4.3 and 5.1.4.4 for experiment 2b). A summary of the results of a mixed model ANOVA for the interpretation bias data is presented in section 5.1.3.6 (5.1.4.6 for experiment 2b).

### *5.1.2 Demographic Information and Recruitment for Experiments 2a and 2b*

Three hundred and thirty two participants returned the screening questionnaires (table 5.1), of which 207 (62.3%) were female and 125 (37.7%) were male. Of those who returned the screening questionnaires, 129 (38.9%) met the inclusion criteria for the study.

Of the 203 participants who did not meet inclusion criteria, 130 (64.0%) were excluded due to scores on the MANX in the mid-anxious range , 47 (23.2%) were excluded due to lack of fluent English, 26 (12.8%) were excluded due to previous participation in similar research studies, 12 (5.9%) were excluded due to missing data, 10 (4.9%) were excluded due to a history of mental health problems, 10 (4.9%) were excluded due to learning difficulties involving reading or writing abilities and 3 (1.5%) were excluded (and directed to possible sources of help) due to displaying clinical anxiety levels on the MANX. Participants excluded due to more than one reason have been included in all categories that applied to them for the above analysis.

Table 5.1: Demographic information regarding all participants who returned the screening questionnaires

| | | Age | | MANX | | S-MCSDS | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD |
| Total | 332 | 24.1 | 7.65 | 14.5 | 4.11 | 6.7 | 2.77 |

MANX – Mackintosh and Mathews Anxiety Scale
S-MCSDS – Short form of the Marlowe-Crowne Social Desirability Scale

Of the 129 eligible participants, 11 were quasi-randomly diverted to experiment 2 and 66 did not respond to the invitation to participate in the study session, or did not attend the study session itself. This left 52 participants who took part in the study session, 3 of whom were given information about where to access help for mental health problems as they showed high levels of anxiety on the STAI and/or depression on the BDI-II. One participant's data had to be excluded from the analysis due to technical problems during the second half of the testing session.

The 52 participants who took part in the study session were initially allocated to the high or low trait anxious group using a predicted STAI score derived from the formula STAI = (MANX x 2.3) + 8.8 (Mathews & Mackintosh, 2006). As described in chapter 2, the limits used by Lambie and Baker (2003) for identifying high and low trait anxious individuals were used in order to do this such that participants with a MANX score of 17 or above (STAI score of 48 or above) were allocated to the high trait anxious condition and participants with a MANX score of 13 or below (STAI score of 38 or below) were allocated to the low trait anxious condition. Participants were then quasi-randomly allocated to either the positive (experiment 2a) or anxious (experiment 2b) mood induction conditions as described in chapter 2.

As participant recruitment continued, it became apparent that more high than low trait anxious participants were being recruited. Once participants began to attend the testing session it could also be seen that the MANX did not adequately predict trait anxiety scores at the testing session, perhaps due to changes in state anxiety caused by the change in context between completing the MANX and completing the STAI. Whilst Mackintosh and Mathews (2006) reported a correlation of .87 between the MANX and the STAI, Teape (2009) reported a lower correlation of .78, and data from experiment 2 showed a correlation of .79. As a result several participants allocated to either the high or low trait anxious conditions had scores in the mid trait anxious range on the STAI. Table 5.2 shows numbers of participants in each condition based on the Lambie and Baker (2003) cut-offs.

Table 5.2: Number of participants in each of the low and high trait anxious conditions, partitioned by mood induction condition using the Lambie and Baker (2003) cut-offs.

| Mood induction condition | High trait anxious | Mid anxious | Low trait anxious |
|---|---|---|---|
| Positive | 11 | 5 | 12 |
| Negative | 7 | 6 | 11 |
| Total | 18 | 11 | 23 |

In order to maximise the number of participants data included in the analysis, given the aforementioned difficulties in recruiting sufficient numbers of participants, those participants in the mid anxious range were re-allocated to either the high or low trait anxious condition based on a median split of the 322 MANX scores recorded on the screening questionnaires. This meant that all participants with an STAI score of 43 or below (15 or below on the MANX) were allocated to the low anxious condition, and all participants with a score of 44 or above (16 or above on the MANX) were allocated to the high anxious condition. Data for two participants were excluded from further analysis due to a software failure for one participant and due to a score on the BDI-II in the clinical range for another. This participant (and indeed several others who displayed particularly high STAI or BDI-II scores) was offered the opportunity to watch the positive film clips and directed to appropriate sources of support. Table 5.3 shows the number of participants in each of the new high and low trait anxious conditions.

Table 5.3: Number of participants in each of the low and high trait anxious conditions, partitioned by mood induction condition using median cut-offs of STAI scores.

| Mood induction condition | High trait anxious | Low trait anxious |
|---|---|---|
| Positive | 13 | 13 |
| Negative | 11 | 13 |
| Total | 24 | 26 |

### *5.1.3 Experiment 2a – Anxious Mood Induction*

#### *5.1.3.1Participant Demographics*

Demographic information and screening questionnaire data for participants included in the data analysis for experiment 2a are shown in table 5.4 below.

A Chi-square test showed that the high and low anxious conditions did not differ by gender [$\chi^2(1) = 1.399$, $p = .237$]. Since the data for age was not normally distributed, and showed significant skew and kurtosis, the Mann Whitney U Test was used to compare the high and low anxious conditions on this variable (table 5.5). The conditions were found to differ significantly on age.

The data for MANX, STAI, S-MCSDS and BDI-II scores were found to be normally distributed so independent samples t tests were used to compare the high and low anxious groups on these variables. The data for STAI, S-MCSDS and BDI-II scores met the homogeneity of variance assumptions. The data for the MANX scores did not meet the homogeneity of variance assumption so a lower alpha level of 0.025 was applied (Tabachnick & Fidell, 2007). The results of these tests are presented in table 5.6 below. The conditions were found to differ significantly on MANX, STAI, S-MCSDS and BDI-II scores.

Table 5.4: Demographic and screening questionnaire information for all participants' data included in the analysis for experiment 2a.

| | Total | | High anxious | | Low anxious | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Total | 24 | 100 | 11 | 100 | 13 | 100 |
| Female | 18 | 75 | 7 | 64 | 11 | 85 |
| Male | 6 | 25 | 4 | 26 | 2 | 15 |
| | Mean | SD | Mean | SD | Mean | SD |
| Age | 23.0 | 6.47 | 23.0 | 8.22 | 22.9 | 4.88 |
| MANX | 14.1 | 3.84 | 16.9 | 3.08 | 11.8 | 2.68 |
| STAI | 41.2 | 9.31 | 49.9 | 4.28 | 33.8 | 4.78 |
| S-MCSDS | 6.8 | 3.36 | 5.2 | 3.37 | 8.2 | 2.79 |
| BDI-II | 8.4 | 6.03 | 12.5 | 5.72 | 4.9 | 3.77 |

MANX – Mackintosh and Mathews Anxiety Scale
STAI – Spielberger Trait Anxiety Scale
S-MCSDS – Short form of the Marlowe-Crowne Social Desirability Scale
BDI-II – Beck Depression Inventory – Second Edition

Table 5.5: Mann Whitney U Test for differences in age between the high and low anxious conditions in experiment 2a.

| | U | z-score | Exact sig. (2-tailed) |
|---|---|---|---|
| Age | 37.5 | 1.989 | .047* |

* significant difference at p < .05

Table 5.6: T Tests for differences in MANX, STAI, S-MCSDS and BDI-II scores between the high and low anxious conditions in experiment 2a.

| | t | df | Sig. (2-tailed) |
|---|---|---|---|
| MANX | 4.371 | 22 | .001** |
| STAI | 8.607 | 22 | .001** |
| S-MCSDS | 2.363 | 22 | .027* |
| BDI-II | 3.865 | 22 | .001** |

MANX – Mackintosh and Mathews Anxiety Scale
STAI – Spielberger Trait Anxiety Scale
S-MCSDS – Short form of the Marlowe-Crowne Social Desirability Scale
BDI-II – Beck Depression Inventory – Second Edition
* significant difference at p < .05
** significant difference at p < .01

As expected, the conditions differed according to their trait anxiety score as assessed by both the MANX and the STAI. Significant differences between the conditions in terms of BDI-II and S-MCSDS scores might be expected given differences in trait anxiety, as depression and anxiety scores were found to correlate to a high degree (Clark, et al., 1994) and social desirability was found to decrease in those with high trait anxiety (Lambie & Baker, 2003). Whilst it was somewhat surprising to see that the groups differed according to age, the result was only marginally significant (p = .047). MANX, STAI, BDI-II, S-MCSDS scores and age were not entered as covariates in the analysis of the mood and interpretation bias data as to do so would involve loss of degrees of freedom (Coolican, 2004) with resulting loss of power which was already low due to smaller numbers of participants recruited than had been aimed for. Additionally, entering these data as covariates into the analysis would have provided little additional information regarding the variables of interest in the study (mood and interpretation bias) but would have reduced the chance of finding significant effects where they existed.

*5.1.3.2 Mood Data*

*5.1.3.2.1 Selection of mood items.*

Eight visual analogue scales were used for participants to rate their mood at time points one, two and three. Literature reviewed in chapter 1 suggested that an anxious mood induction should produce increases on items high in NA (worried and tense) and decreases on items low in NA (calm and content).

*5.1.3.2.2 Data accuracy.*

The data were checked for missing values and inaccurate data input and one case of missing data was found in the raw high and low NA items. Each missing value for this case was replaced with its series mean (Appendix W; Tabachnick & Fidell, 2007).

*5.1.3.2.3 Correlations between mood items.*

In order to be sure that these items could be combined to provide two measures of high and low NA, a correlation analysis was carried out. The data were not normally distributed and showed significant skew and kurtosis (Appendix W) but it was not possible to transform the data due to the extent and direction of skew and kurtosis at different time points, on different items. A non-parametric test was therefore used to examine the correlations between the four items at times 1, 2 and 3, the results of which are presented in table 5.7.

Table 5.7: Spearman's correlations between items low and high in NA at time points 1, 2 and 3 in experiment 2a.

| Time | Item | Worried | Tense | Calm | Content |
|---|---|---|---|---|---|
| 1 | Worried | 1 | 0.476** | -0.333 | -0.318 |
| | Tense | 0.476** | 1 | -0.522** | -0.375* |
| | Calm | -0.333 | -0.522** | 1 | 0.542** |
| | Content | -0.318 | -0.375* | 0.542** | 1 |
| 2 | Worried | 1 | 0.719** | -0.701** | -0.834** |
| | Tense | 0.719** | 1 | -0.751** | -0.772** |
| | Calm | -0.701** | -0.751** | 1 | 0.726** |
| | Content | -0.834** | -0.772** | 0.726** | 1 |
| 3 | Worried | 1 | 0.278 | -0.536** | -0.427** |
| | Tense | 0.278 | 1 | -0.544** | -0.442* |
| | Calm | -0.536** | -0.544** | 1 | 0.459* |
| | Content | -0.427** | -0.442* | 0.459* | 1 |

*Significant correlation at $p < .05$ (one-tailed)
**Significant correlation at $p < .01$ (one-tailed)

Items low in NA (calm and content) were found to be significantly correlated at all three times. Items high in NA (worried and tense) were significantly correlated at times 1 and 2, but not at time3. Similar to the results of experiment 1a (reported in Teape, 2009) it was apparent to see that data for the worried item did not show as strong a pattern of change, as the data for the tense item (table 5.8). It was therefore decided to use only data for the tense item to reflect high NA. A new variable of low NA was therefore calculated by averaging scores on calm and content at all three time points. Analyses of the low and high NA variables is summarised below.

Table 5.8: Descriptive statistics for the worried and tense items at times 1, 2 and 3 in experiment 2a.

| Anxiety group | Item | Time | N | Mean | SD |
|---|---|---|---|---|---|
| Low anxious | Worried | 1 | 13 | 0.49 | 0.16 |
| | | 2 | 13 | 0.60 | 0.10 |
| | | 3 | 13 | 0.47 | 0.11 |
| | Tense | 1 | 13 | 0.44 | 0.18 |
| | | 2 | 13 | 0.65 | 0.18 |
| | | 3 | 13 | 0.58 | 0.10 |
| High anxious | Worried | 1 | 11 | 0.54 | 0.14 |
| | | 2 | 11 | 0.55 | 0.08 |
| | | 3 | 10 | 0.49 | 0.12 |
| | Tense | 1 | 11 | 0.57 | 0.11 |
| | | 2 | 11 | 0.65 | 0.21 |
| | | 3 | 10 | 0.50 | 0.14 |

*5.1.3.3 Analysis of High NA Data*

*5.1.3.3.1 Assumptions of normality and homogeneity of variance.*

Data normality assumptions were addressed through the removal of outliers following which the data also met the assumption of homogeneity of variance (Appendix X).

*5.1.3.3.2 Mixed model ANOVA with high NA data.*

To test the hypotheses that both the high and low anxious participants would show a more negative mood at times 2 and 3 than at time 1 (as evidenced by an increase in high NA at times 2 and 3 when compared with time 1), a 2x3 mixed model ANOVA was performed. The dependent variable was high NA, the between subjects variable was anxiety group (high or low) and the within subjects variable was time (1, 2 or 3). Descriptive statistics for the dependent variable at all three time points for both anxiety groups are shown below in table 5.9.

Table 5.9: Descriptive statistics for high NA scores at times 1, 2 and 3 for the high and low anxious groups in experiment 2a.

| Group | Time | Mean | SD | N |
|---|---|---|---|---|
| High anxious | 1 | 0.57 | 0.11 | 11 |
| | 2 | 0.69 | 0.12 | 11 |
| | 3 | 0.51 | 0.14 | 11 |
| Low anxious | 1 | 0.48 | 0.09 | 13 |
| | 2 | 0.65 | 0.18 | 13 |
| | 3 | 0.58 | 0.10 | 13 |

Mauchly's test of sphericity was not significant (W(2) = 0.965, p = .684), so sphericity was assumed. The results of the mixed model ANOVA are reported in table 5.10.

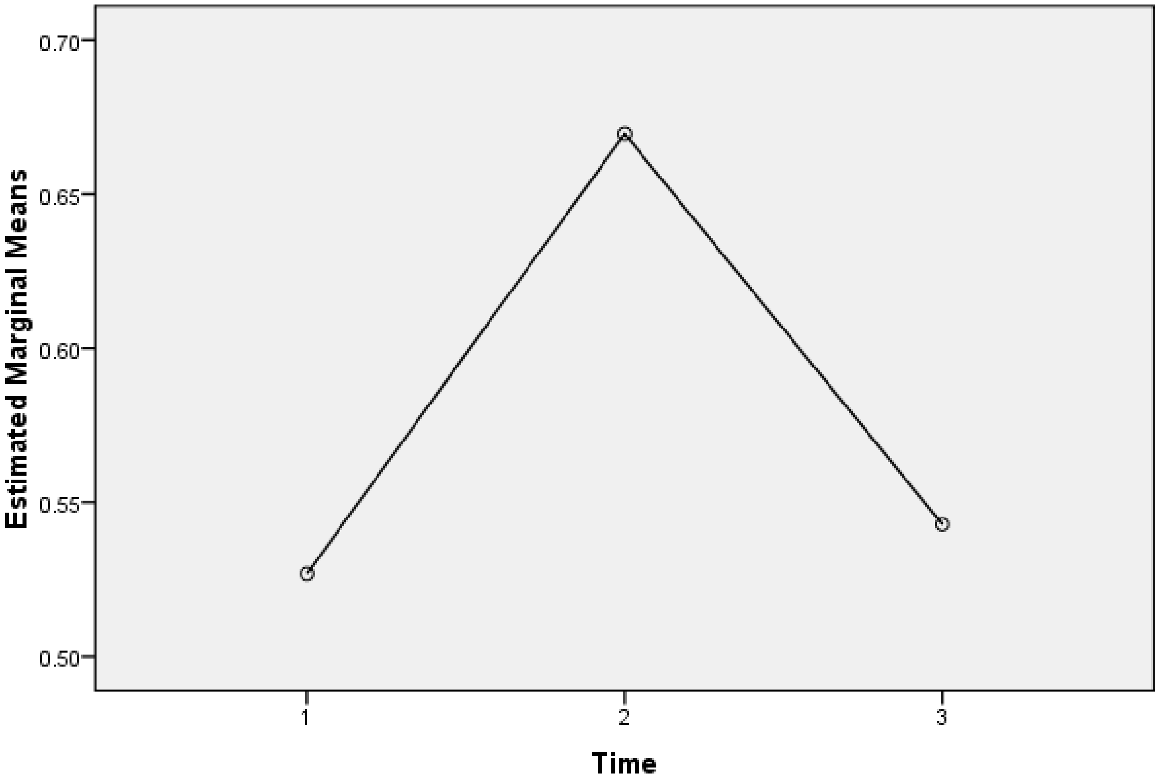
Table 5.10: Mixed model ANOVA for high NA data in experiment 2a

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| Within-subjects effects | | | | | | |
| Time | 0.291 | 2 | 0.146 | 12.329 | .000** | 0.359 |
| Time x Anxiety | 0.078 | 2 | 0.039 | 3.303 | .046* | 0.131 |
| Error(Time) | 0.520 | 44 | 0.012 | | | |
| Between-subjects effects as above | | | | | | |
| Anxiety | 0.005 | 1 | 0.005 | 0.210 | .651 | 0.009 |
| Error | 0.537 | 22 | 0.024 | | | |

*significant at $p < .05$
**significant at $p < .01$

There was a main effect of time as predicted, and a significant interaction between anxiety group and time, which was not predicted. A priori planned t tests were used to break down the main effect of time. As predicted, participants showed significantly higher high NA scores at time 2 (mean=0.67) than at time 1 (mean = 0.52), [$t(23) = 4.289$, $p < .001$]. However, high NA scores were not shown to be higher at time 3 than at time 1 as predicted, as no significant differences were found between high NA scores at time 3 (mean = 0.55) and time 1 (mean = 0.52), [$t(23) = 0.663$, $p = .514$]. The main effect of time is illustrated in figure 5.1.

Figure 5.1: Plot of average high NA scores at times 1, 2 and 3 in experiment 2a




The significant interaction between anxiety group and time is demonstrated in Figure 5.2 below.

By looking at figure 5.2 and the means for the low and high anxious conditions at times 1, 2 and 3 (table 5.9) it can be seen that they show different patterns. Whilst the mean high NA score seems to return to baseline (and below) at time 3 for the high anxious group, it does not do so for the low anxious group, appearing to stay higher than the mean high NA score at time 1. The interaction between anxiety condition and time was analysed using two one-way repeated measures ANOVAs looking at the effects of time on high NA scores for the low and then the high anxious participants. For both, the dependent variable was high NA and the independent variable was time (1, 2 or 3). Mauchly's test of sphericity was not significant for either the low anxious participants [W(2) = 0.890, p = .527] or for the high anxious participants [W(2) = 0.998, p = .993] , so sphericity was assumed. The results of the one-way ANOVA for the low anxious participants are reported in table 5.11.

Figure 5.2: Plots of average high NA scores at times 1, 2 and 3 for both the low and high anxious groups in experiment 2a.

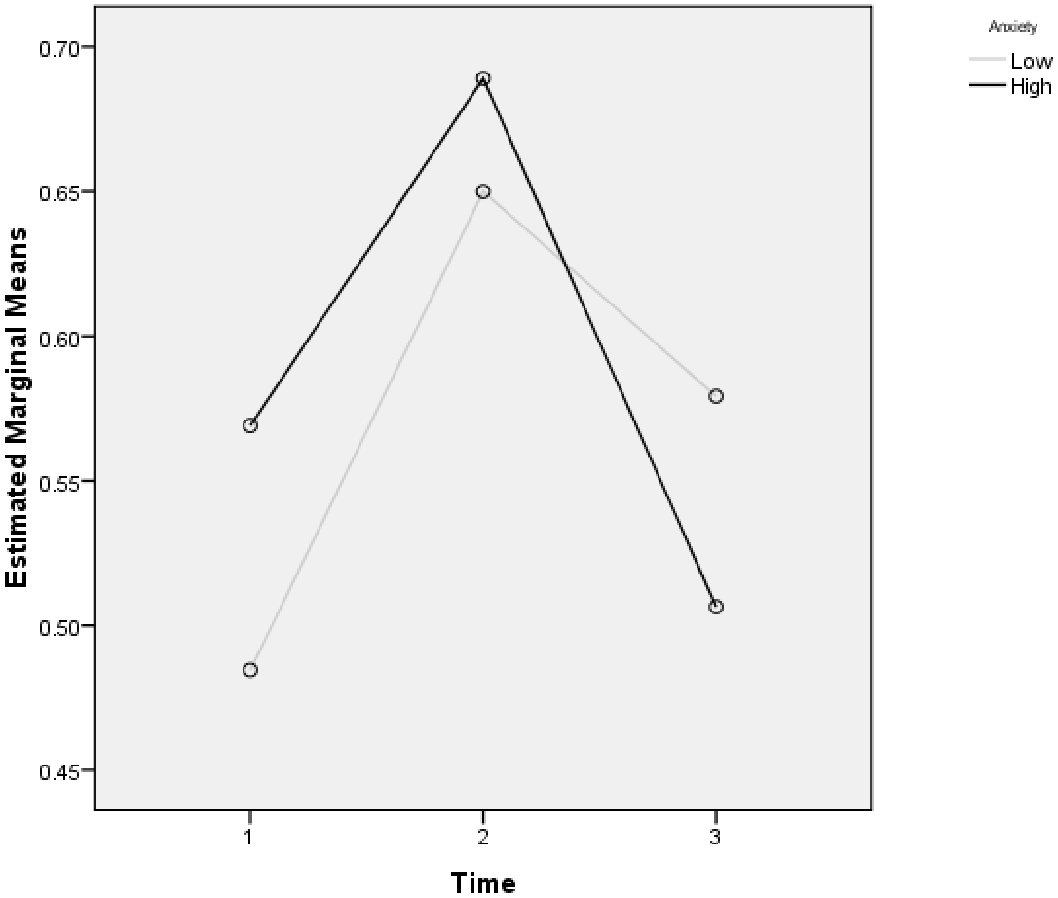


Table 5.11: Summary of one-way repeated measures ANOVA for the effects of time on high NA score for the low anxious participants in experiment 2a.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| Time | 0.179 | 2 | 0.09 | 7.906 | .002** | 0.397 |
| Error(Time) | 0.272 | 24 | 0.011 | | | |

**significant at p < .01

There was a significant main effect of time for the low anxious participants. Post-hoc comparisons using a Bonferroni correction for multiple tests showed a significant increase in high NA scores between time 1 (mean=0.48) and time 2 (mean=0.65) and between time 1 (mean = 0.48) and time 3 (mean = 0.58). No significant differences were found for high NA scores between time 2 (mean = 0.65) and time 3 (mean = 0.58). The analyses are summarized in table 5.12.

Table 5.12: Post-hoc comparisons between high NA scores at times 1, 2 and 3 for the low anxious participants in experiment 2a.

| Comparison | Mean differences | SE | Sig.[a] |
|---|---|---|---|
| Time 1 – time 2 | -0.165* | 0.048 | .005 |
| Time 1 – time 3 | -0.095* | 0.039 | .033 |
| Time 2 – time 3 | .071 | 0.037 | .080 |

*significant at p < .05
[a] Bonferroni adjustment for multiple comparisons

The results of the one-way ANOVA for the high anxious participants are reported in table 5.13.

Table 5.13: Summary of one-way repeated measures ANOVA for the effects of time on high NA scores for the high anxious participants in experiment 2a.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| Time | 0.189 | 2 | 0.095 | 7.637 | .003** | 0.433 |
| Error(Time) | 0.248 | 20 | 0.012 | | | |

**significant at $p < .01$

There was a significant main effect of time for the high anxious participants. Post-hoc comparisons using a Bonferroni correction for multiple tests showed a significant increase in high NA scores between time 1 (mean = 0.57) and time 2 (mean = 0.69) and a significant decrease between time 2 (mean = 0.69) and time 3 (mean = 0.51). No significant differences were found for high NA scores between time 1 (mean = 0.57) and time 3 (mean = 0.51). The analyses are summarized in table 5.14.

Table 5.14: Post-hoc comparisons between high NA scores at times 1, 2 and 3 for the high anxious participants in experiment 2a.

| Comparison | Mean differences | SE | Sig.[a] |
|---|---|---|---|
| Time 1 – time 2 | -0.120* | 0.048 | .032 |
| Time 1 – time 3 | 0.063 | 0.048 | .219 |
| Time 2 – time 3 | 0.183* | 0.047 | .003 |

*significant at $p < .05$
[a] Bonferroni adjustment for multiple comparisons

*5.1.3.4 Analysis of Low NA Data*

*5.1.3.3.1 Assumptions of normality and homogeneity of variance.*

The low NA data was checked for normality using the Shapiro-Wilk test as the number of participants was less than 2000 (Field, 2005). No evidence of non-normality, skew or kurtosis was found. The data also met the homogeneity of variance assumption. The analyses are summarised in Appendix Y.

*5.1.3.3.2 Mixed model ANOVA with low NA data.*

To test the hypotheses that both the high and low anxious participants would show a more anxious mood at times 2 and 3 than at time 1 (as evidenced by a decrease in low NA at times 2 and 3 when compared with time 1), a 2x3 mixed model ANOVA was performed. The dependent variable was low NA, the between subjects variable was anxiety group (high or low) and the within subjects variables was time (1, 2 or 3). Descriptive statistics for the dependent variable at all three time points for both anxiety groups are shown below in table 5.15.

Mauchly's test of sphericity was not significant ($W(2) = 0.860$, $p = .204$), so sphericity was assumed. The results of the mixed model ANOVA are reported in table 5.16.

Table 5.15: Descriptive statistics for low NA scores at times 1, 2 and 3 for the high and low anxious groups in experiment 2a.

| Group | Time | Mean | SD | N |
|---|---|---|---|---|
| High anxious | 1 | 0.49 | 0.08 | 11 |
| | 2 | 0.39 | 0.10 | 11 |
| | 3 | 0.51 | 0.09 | 11 |
| Low anxious | 1 | 0.58 | 0.13 | 13 |
| | 2 | 0.40 | 0.11 | 13 |
| | 3 | 0.47 | 0.07 | 13 |

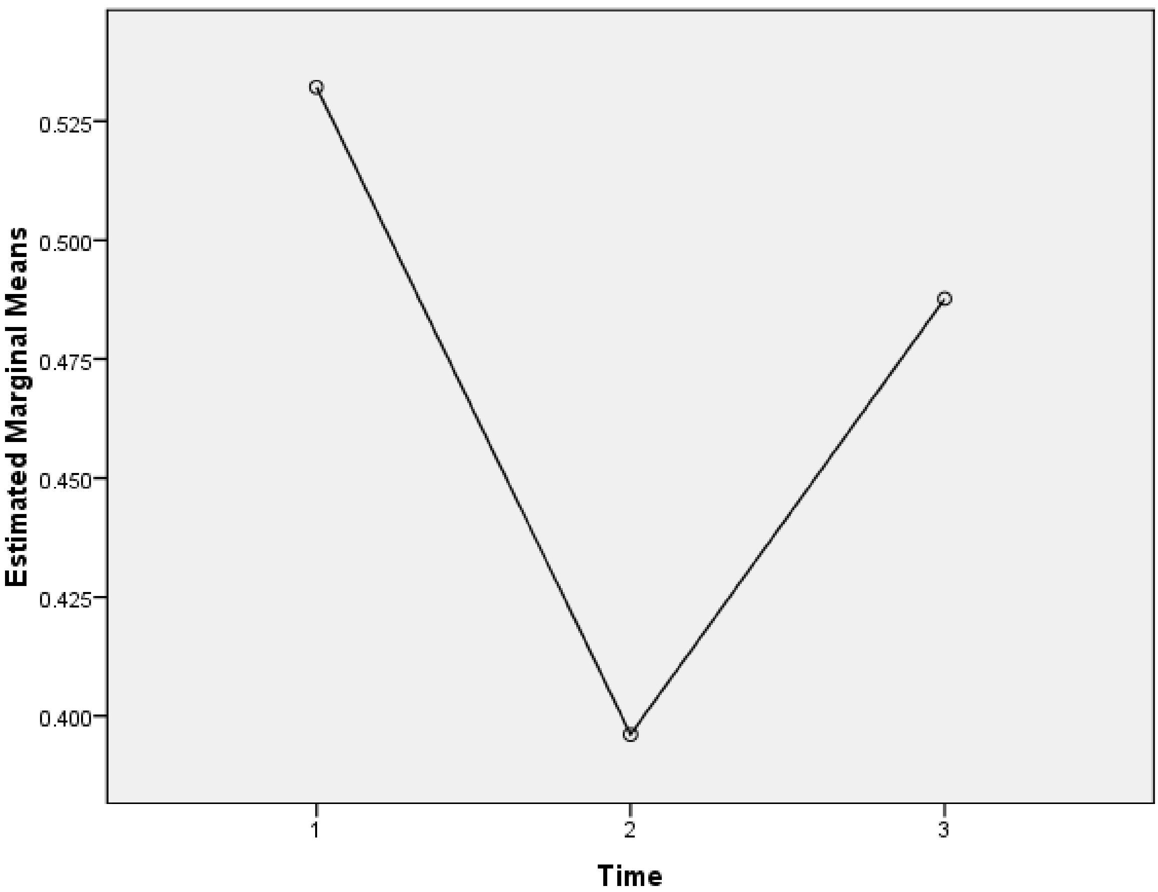
Table 5.16: Mixed model ANOVA for low NA scores in experiment 2a.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| Within-subjects effects | | | | | | |
| Time | 0.229 | 2 | 0.115 | 10.435 | .000** | 0.322 |
| Time x Anxiety | 0.051 | 2 | 0.026 | 2.343 | .108 | 0.096 |
| Error(Time) | 0.484 | 44 | 0.011 | | | |
| Between-subjects effects | | | | | | |
| Anxiety | 0.007 | 1 | 0.007 | 0.661 | .425 | 0.029 |
| Error | 0.223 | 22 | 0.010 | | | |

**significant at $p < .01$

There was a main effect of time, with no significant interaction between anxiety group and time as predicted. A priori planned t tests were used to break down the main effect of time. As predicted, participants showed significantly lower low NA scores at time 2 (mean=0.40) than at time 1 (0.54), [$t(23) = 3.929$, $p < .01$]. However, low NA scores were not shown to be lower at time 3 than at time 1 as predicted, as no significant differences were found between low NA scores at time 1 (mean = 0.0.54) and time 3 (mean = 0.49), [$t(23) = 1.602$, $p = .123$]. The main effect of time is illustrated in figure 5.3.

Figure 5.3: Average low NA scores at times 1, 2 and 3 in experiment 2a.



*5.1.3.5 Summary of Analysis of Mood Data*

High and low anxious participants showed an increase in high NA and a decrease in low NA following an anxious mood induction. Significant differences in high NA were found for the low anxious participants between times 1 and 3, suggesting that NA remained elevated following the interpretation bias test. No significant differences in high NA for the high anxious participants, and in low NA for both the high and low anxious participants were found between times 1 and 3, suggesting that NA returned to baseline levels following the interpretation bias test.

*5.1.3.6 Analyses of Interpretation Bias Data*

*5.1.3.6.1 Data accuracy.*

The data were checked for accuracy as described by Tabachnick and Fidell (2007). No inaccurate data or missing cases were identified.

*5.1.3.6.2 Cognitive load accuracy.*

It was important to check that participants actually attempted to remember the digit string whilst reading the vignettes, in order to be certain that a cognitive load was being applied to participants. Data regarding how many times participants recalled a digit string inaccurately was therefore compared for participants in the low and high anxious groups.

*5.1.3.6.2.1 Normality assumptions.*

Data normality assumptions were met (Appendix Z).

*5.1.3.6.2.2 Independent samples t test.*

An independent samples t test revealed that there were no significant differences between the mean number of inaccurately recalled digit strings between the low (mean = 6.23) and the high anxious groups (mean = 5.73), [$t(22) = 0.249$, $p = .806$]. Remembering of digit strings was therefore assumed to provide an adequate cognitive load for both the low and the high anxious groups during the interpretation bias test.

*5.1.3.6.3 Assumptions of normality and homogeneity of variance for recognition data.*

Data normality assumptions were addressed through the removal of outliers following which the data also met the assumption of homogeneity of variance. A summary of these analyses can be found in appendix AA.

*5.1.3.6.4 Mixed model ANOVA with recognition interpretation bias data.*

It was hypothesised that both low and high anxious participants would show a negative (mood congruent) interpretation bias in both halves of the test. A 2x2x2x2 mixed model ANOVA was performed to test these hypotheses with recognition rating as the dependent variable, anxiety condition (high or low) as the between subjects variable and test half (first or second), item valence (positive or negative) and item type (target or foil) as the within subjects variables. The hypothesised effect would be demonstrated by an interaction between item valence and item type for both the low and the high anxious participants. Descriptive statistics for the recognition data for both the high and low anxious participants can be found in table 5.17. The results of the mixed model ANOVA are reported in table 5.18.

Table 5.17: Descriptive statistics for recognition data for all participants in experiment 2a.

| Anxiety | Item | Test half | Mean | SD | N |
|---|---|---|---|---|---|
| High anxious | Positive target | 1 | 2.61 | 0.288 | 11 |
| | | 2 | 2.63 | 0.343 | 11 |
| | Positive foil | 1 | 1.66 | 0.287 | 11 |
| | | 2 | 1.68 | 0.343 | 11 |
| | Negative target | 1 | 2.62 | 0.627 | 11 |
| | | 2 | 2.65 | 0.515 | 11 |
| | Negative foil | 1 | 1.54 | 0.307 | 11 |
| | | 2 | 1.61 | 0.226 | 11 |
| Low anxious | Positive target | 1 | 2.60 | 0.416 | 13 |
| | | 2 | 2.74 | 0.617 | 13 |
| | Positive foil | 1 | 1.55 | 0.328 | 13 |
| | | 2 | 1.54 | 0.524 | 13 |
| | Negative target | 1 | 2.63 | 0.522 | 13 |
| | | 2 | 2.28 | 0.650 | 13 |
| | Negative foil | 1 | 1.44 | 0.250 | 13 |
| | | 2 | 1.45 | 0.414 | 13 |

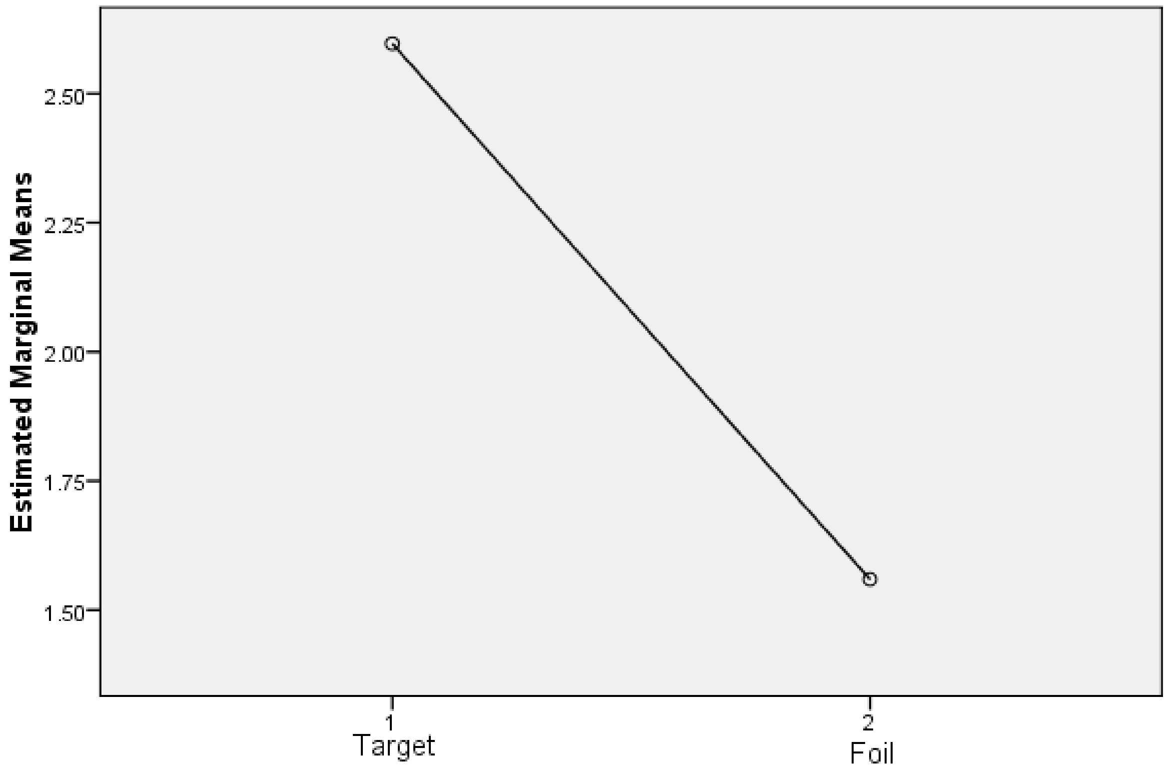
Table 5.18: Mixed model ANOVA for recognition data in experiment 2a.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| **Within-subjects effects** | | | | | | |
| Test half | 0.003 | 1 | 0.003 | 0.028 | .869 | 0.001 |
| Test half x anxiety group | 0.094 | 1 | 0.094 | 1.034 | .320 | 0.045 |
| Error (test half) | 1.990 | 22 | .090 | | | |
| Item valence | 0.466 | 1 | 0.466 | 2.046 | .167 | 0.085 |
| Item valence x anxiety group | 0.156 | 1 | 0.156 | 0.687 | .416 | 0.030 |
| Error (item valence) | 5.010 | 22 | 0.228 | | | |
| Item type | 51.263 | 1 | 51.263 | 161.578 | .000** | 0.880 |
| Item type x anxiety group | 0.048 | 1 | 0.048 | 0.152 | .700 | 0.007 |
| Error (item type) | 6.980 | 22 | 0.317 | | | |
| Test half x item valence | 0.113 | 1 | 0.113 | 1.464 | .239 | 0.062 |
| Test half x item valence x anxiety group | 0.209 | 1 | 0.209 | 2.704 | .114 | 0.109 |
| Error (test half x item valence) | 1.702 | 22 | 0.077 | | | |
| Test half x item type | 0.043 | 1 | 0.043 | 0.383 | .542 | 0.017 |
| Test half x item type x anxiety group | 0.022 | 1 | 0.022 | 0.198 | .661 | 0.009 |
| Error (test half x item type) | 2.461 | 22 | 0.112 | | | |
| Item valence x item type | 0.000 | 1 | 0.000 | 0.001 | .978 | 0.000 |
| Item valence x item type x anxiety group | 0.156 | 1 | 0.156 | 2.014 | .170 | 0.084 |
| Error (item valence x item type) | 1.708 | 22 | 0.078 | | | |
| Test half x item valence x item type | 0.234 | 1 | 0.234 | 2.962 | .099 | 0.119 |
| Test half x item valence x item type x anxiety group | 0.173 | 1 | 0.173 | 2.194 | .153 | 0.091 |
| Error (test half x item valence x item type) | 1.739 | 22 | 0.079 | | | |
| **Between-subjects effects** | | | | | | |
| Anxiety | 0.428 | 1 | 0.428 | 0.733 | .401 | 0.032 |
| Error | 12.845 | 22 | 0.584 | | | |

**significant at $p < .01$

There was a main effect of item type, with target items (mean = 2.60) being recognised more often than foil items (mean = 1.56) by all participants. The effect is demonstrated in figure 5.4.

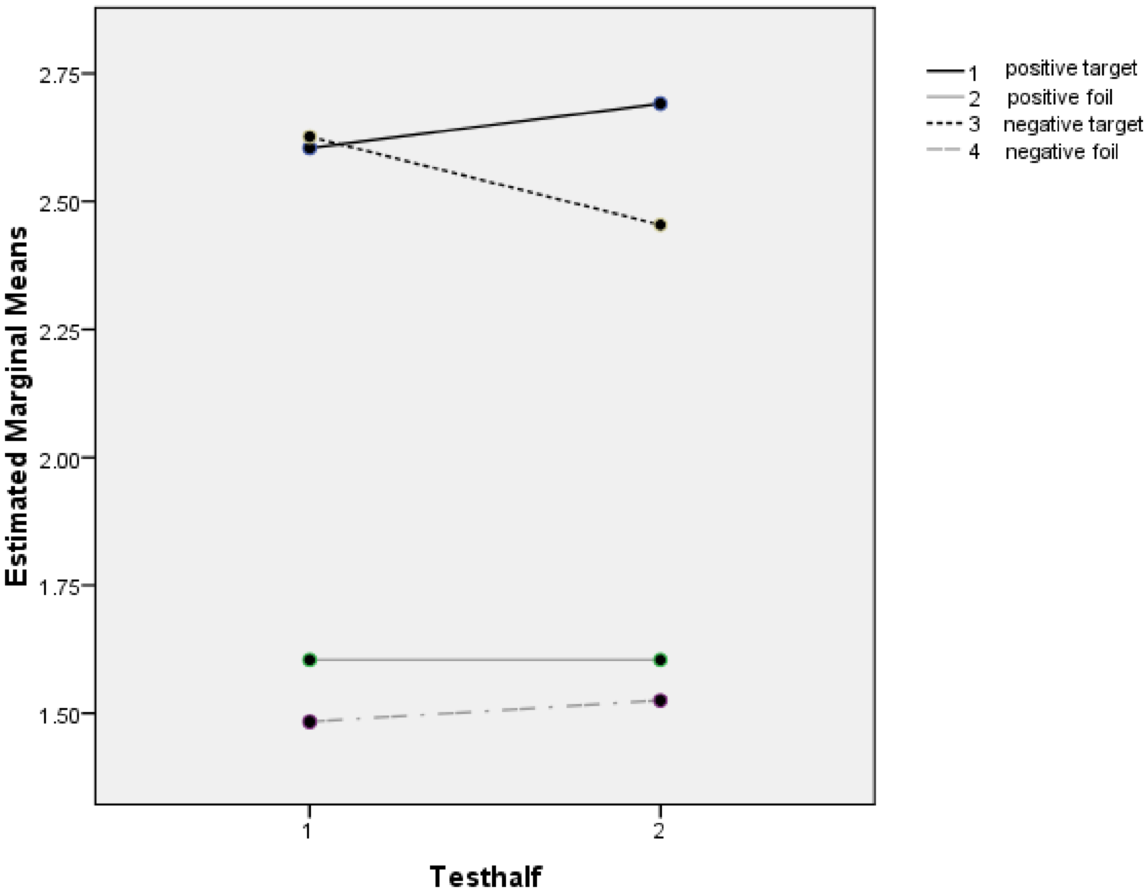
Figure 5.4: Average recognition ratings for target and foil items for all participants in experiment 2a




The predicted interaction between item valence and item type was not found [$F(1,22) = 0.001$, $p = .978$]. A post-hoc power calculation was performed which showed that the analysis achieved power of only .05 using partial eta-squared as an estimate of effect size.

One interaction that did approach significance was that between test half, item valence and item type [$F(1,22) = 2.962$, $p = .099$]. Post-hoc power for this analysis was also low (.12). By examining a plot of the interaction (figure 5.5) it appears as if recognition of positive target items increased from the first to the second half of the test, and that recognition of negative target items decreased from the first to the second half of the test for all participants.

Figure 5.5: Average recognition data for all participants in the first and second half of the test for positive and negative items and for target and foil items in experiment 2a.



*5.1.3.6.5 Summary of interpretation bias data analysis.*

As predicted, all participants showed higher recognition of target over foil items. For all participants the hypothesised negative (mood congruent) interpretation bias in both halves of the test was not found. Power for the analysis was found to be low and it is not possible to reject the null hypothesis that interpretation biases would not be evident.

*5.1.3.7 Summary of Results of Experiment 2a*

Following an anxious mood induction, both high and low anxious participants demonstrated a more anxious mood shown by an increase in high NA and a decrease in low NA. Following a test for interpretation biases, high anxious participants' mood returned to baseline, as shown by a decrease in high NA and an increase in low NA. Low anxious participants' mood appeared to return to baseline when low NA scores were examined, but did not appear to do so for high NA scores. No evidence of interpretation biases was found, with all participants showing higher recognition of target over foil items. Limited evidence was found for increasing recognition of positive targets and decreasing recognition of negative targets from the first to the second half of the test.

*5.1.4 Experiment 2b – Positive Mood Induction*

*5.1.4.1Participant Demographics*

Demographic information and screening questionnaire data for participants included in the data analysis for experiment 2b are shown in table 5.19 below.

Table 5.19: Demographic and screening questionnaire information for all participants data included in the analysis for experiment 2b.

| | Total | | High anxious | | Low anxious | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Total | 26 | 100 | 13 | 50 | 13 | 50 |
| Female | 17 | 65 | 9 | 53 | 8 | 47 |
| Male | 9 | 35 | 4 | 44 | 5 | 56 |
| | Mean | SD | Mean | SD | Mean | SD |
| Age | 24.7 | 6.93 | 24.0 | 7.10 | 25.3 | 6.97 |
| MANX | 14.3 | 5.11 | 18.5 | 2.82 | 10.2 | 3.11 |
| STAI | 41.4 | 11.56 | 51.5 | 5.04 | 31.2 | 5.43 |
| S-MCSDS | 6.6 | 2.74 | 4.8 | 2.19 | 8.6 | 1.78 |
| BDI-II | 7.4 | 6.05 | 11.1 | 6.12 | 3.8 | 3.17 |

MANX – Mackintosh and Mathews Anxiety Scale
STAI – Spielberger Trait Anxiety Scale
S-MCSDS – Short form of the Marlowe-Crowne Social Desirability Scale
BDI-II – Beck Depression Inventory – Second Edition

A Chi-square test showed that the high and low anxious conditions did not differ by gender [$\chi^2(1) = 0.170$, $p = .680$]. Since the data for age and BDI-II scores was not normally distributed, being significantly skewed, the Mann Whitney U Test was used to compare the high and low anxious conditions on these variables. The results of these tests are presented in table 5.20 below. The conditions were found to differ significantly on BDI-II score but not on age.

Table 5.20: Mann Whitney U Tests for differences in age and BDI-II scores between the high and low anxious conditions in experiment 2b.

| | U | z-score | Exact sig. (2-tailed) |
|---|---|---|---|
| Age | 61.5 | 1.18 | .243 |
| BDI-II score | 20.0 | 3.32 | .000* |

BDI-II – Beck Depression Inventory – Second Edition
* significant difference at p < .05

The data for MANX, STAI and S-MCSDS scores was all found to be normally distributed so independent samples t tests were used to compare the high and low anxious groups on these variables. The data also met the homogeneity of variance assumption. The results of these tests are presented in table 5.21 below. The conditions were found to differ significantly on MANX, STAI and S-MCSDS scores.

Table 5.21: T Tests for differences in MANX, STAI and S-MCSDS scores between the high and low anxious conditions in experiment 2b.

| | t | df | Sig. (2-tailed) |
|---|---|---|---|
| MANX | 7.07 | 24 | .000** |
| STAI | 9.88 | 24 | .000** |
| S-MCSDS | 4.65 | 23 | .000** |

MANX – Mackintosh and Mathews Anxiety Scale
STAI – Spielberger Trait Anxiety Scale
S-MCSDS – Short form of the Marlowe-Crowne Social Desirability Scale
** significant difference at p < .01

As expected, the conditions differed according to their trait anxiety score as assessed by both the MANX and the STAI. Significant differences between the conditions in terms of BDI-II and S-MCSDS scores might be expected given differences in trait anxiety, as depression and anxiety scores were found to correlate to a high degree (Clark et al.,1994) and social desirability was found to decrease in those with high trait anxiety (Lambie & Baker, 2003). MANX, STAI, BDI-II and S-MCSDS scores were not entered as covariates in the analysis of the mood and interpretation bias data as to do so would involve loss of degrees of freedom (Coolican, 2004) with resulting loss of power which was already low due to smaller numbers of participants recruited than had been aimed for. Additionally, entering these data as covariates into the analysis would have provided little additional information regarding the variables of interest in the study (mood and interpretation bias) but would have reduced the chance of finding significant effects where they existed.

*5.1.4.2 Mood Data*

*5.1.4.2.1 Selection of mood items.*

Eight visual analogue scales were used for participants to rate their mood at time points one, two and three. Literature reviewed in chapter 1 suggested that a positive mood induction should produce increases on items high in PA (happy and carefree) and decreases on items low in PA (low and sad).

*5.1.4.2.2 Correlations between mood items.*

In order to be sure that these items could be combined to provide two measures of high and low PA, a correlation analysis was carried out. The data were not normally distributed and showed significant skew and kurtosis (Appendix AB) but it was not possible to transform the data due to the extent and direction of skew and kurtosis at different time points, on different items. A non-parametric test was therefore used to examine the correlations between the four items at times 1, 2 and 3, the results of which are presented in table 5.22.

Table 5.22: Spearman's correlations between items low and high in PA at time points 1, 2 and 3 in experiment 2b

| Time | Item | Carefree | Happy | Low | Sad |
|---|---|---|---|---|---|
| 1 | Carefree | 1 | 0.568** | -0.291 | -0.435* |
| | Happy | 0.568** | 1 | -0.75** | -0.703** |
| | Low | -0.291 | -0.75** | 1 | 0.762** |
| | Sad | -0.435* | -0.703** | 0.762** | 1 |
| 2 | Carefree | 1 | 0.514** | 0.076 | -0.446* |
| | Happy | 0.514** | 1 | -0.815** | -0.917** |
| | Low | 0.076 | -0.815** | 1 | 0.798** |
| | Sad | -0.446* | -0.917** | 0.798** | 1 |
| 3 | Carefree | 1 | 0.741** | -0.562** | -0.502** |
| | Happy | 0.741** | 1 | -0.611** | -0.627** |
| | Low | -0.562** | -0.611** | 1 | 0.632** |
| | Sad | -0.502** | -0.627** | 0.632** | 1 |

*Significant correlation at $p < .05$
**Significant correlation at $p < .01$

Items high in PA were found to be significantly correlated at all three times, as were items low in PA. Two new variables high and low PA were therefore calculated by averaging scores on carefree and happy, and low and sad respectively at all three time points. Analyses of the low and high PA variables is summarised below.

*5.1.4.3 Analysis of High PA Data*

5.*1.4.3.1 Data accuracy.*

The data were checked for missing values and inaccurate data input but no cases were found (Tabachnick & Fidell, 2007).

5.*1.4.3.2 Assumptions of normality and homogeneity of variance.*

Data normality assumptions were addressed through the removal of outliers and the data did not meet the homogeneity of variance assumption so a more conservative alpha level of .025 was used (Tabachnick & Fidell, 2007). The analyses are summarised in Appendix AC.

5.*1.4.3.3 Mixed model ANOVA with high PA data.*

To test the hypotheses that both the high and low anxious participants would show a more positive mood at times 2 and 3 than at time 1 (as evidenced by an increase in high PA at times 2 and 3 when compared with time 1), a 2x3 mixed model ANOVA was performed. The dependent variable was high PA, the between subjects variable was anxiety group (high or low) and the within subjects variables was time (1, 2 or 3). Descriptive statistics for the dependent variable at all three time points for both anxiety groups are shown below in table 5.23.

Mauchly's test of sphericity was not significant [$W(2) = 0.997$, $p = .963$], so sphericity was assumed. The results of the mixed model ANOVA are reported in table 5.24.

Table 5.23: Descriptive statistics for high PA scores at times 1, 2 and 3 for the high and low anxious groups in experiment 2b.

| Group | Time | Mean | SD | N |
|---|---|---|---|---|
| High anxious | 1 | 0.45 | 0.11 | 13 |
| | 2 | 0.58 | 0.09 | 13 |
| | 3 | 0.44 | 0.11 | 13 |
| Low anxious | 1 | 0.55 | 0.18 | 13 |
| | 2 | 0.65 | 0.16 | 13 |
| | 3 | 0.50 | 0.12 | 13 |

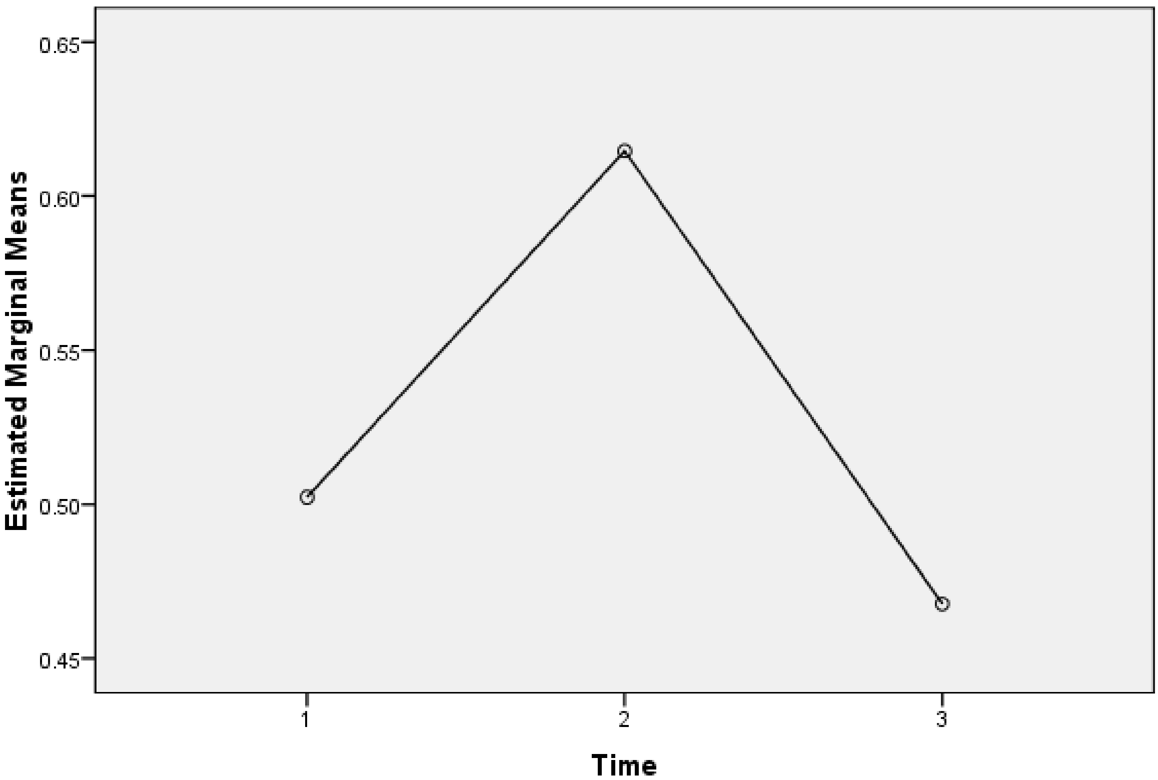
Table 5.24: Mixed model ANOVA for high PA scores in experiment 2b.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| Within-subjects effects | | | | | | |
| Time | 0.307 | 2 | 0.153 | 15.147 | .000* | 0.387 |
| Time x Anxiety | 0.005 | 2 | 0.002 | 0.223 | .801 | 0.009 |
| Error(Time) | 0.486 | 48 | 0.010 | | | |
| Between-subjects effects | | | | | | |
| Anxiety | 0.111 | 1 | 0.111 | 3.331 | .080 | 0.965 |
| Error | 0.798 | 24 | 0.033 | | | |

*significant at $p < .025$

There was a main effect of time, with no significant interaction between anxiety group and time as predicted. Parametric a priori planned t tests were used to break down the main effect of time. As predicted, participants showed significantly higher high PA scores at time 2 (mean = 0.61) than at time 1 (0.50), [$t(25) = 4.051$, $p < .025$]. However, high PA scores were not shown to be lower at time 3 than at time 1 as predicted, as no significant differences were found between high PA scores at time 1 (mean = 0.50) and time 3 (mean = 0.47), [$t(25) = 1.292$, $p = .208$]. The main effect of time is illustrated in figure 5.6.

Figure 5.6: Average high PA scores at times 1, 2 and 3 in experiment 2b.



*5.1.4.4 Analysis of Low PA Data*

*5.1.4.4.1 Data accuracy.*

The data were checked for missing values and inaccurate data input but no cases were found (Tabachnick & Fidell, 2007).

*5.1.4.4.2 Assumptions of normality and homogeneity of variance.*

Data normality assumptions were addressed through the removal of outliers following which the data also met the assumption of homogeneity of variance. The analyses are summarised in Appendix AD.

*5.1.4.4.3 Mixed model ANOVA with low PA data.*

To test the hypotheses that both the high and low anxious participants would show a more positive mood at times 2 and 3 than at time 1 (as evidenced by a decrease in low PA at times 2 and 3 when compared with time 1), a 2x3 mixed model ANOVA was performed. The dependent variable was low PA, the between subjects variable was anxiety group (high or low) and the within subjects variables was time (1, 2 or 3). Descriptive statistics for the dependent variable at all three time points for both anxiety groups are shown below in table 5.25.

Mauchly's test of sphericity was not significant [$W(2) = 0.815$, $p = .096$], so sphericity was assumed. The results of the mixed model ANOVA are reported in table 5.26.

Table 5.25: Descriptive statistics for low PA scores at times 1, 2 and 3 for the high and low anxious groups in experiment 2b.

| Group | Time | Mean | SD | N |
|---|---|---|---|---|
| High anxious | 1 | 0.49 | 0.16 | 13 |
| | 2 | 0.38 | 0.19 | 13 |
| | 3 | 0.49 | 0.09 | 13 |
| Low anxious | 1 | 0.47 | 0.12 | 13 |
| | 2 | 0.37 | 0.18 | 13 |
| | 3 | 0.46 | 0.13 | 13 |

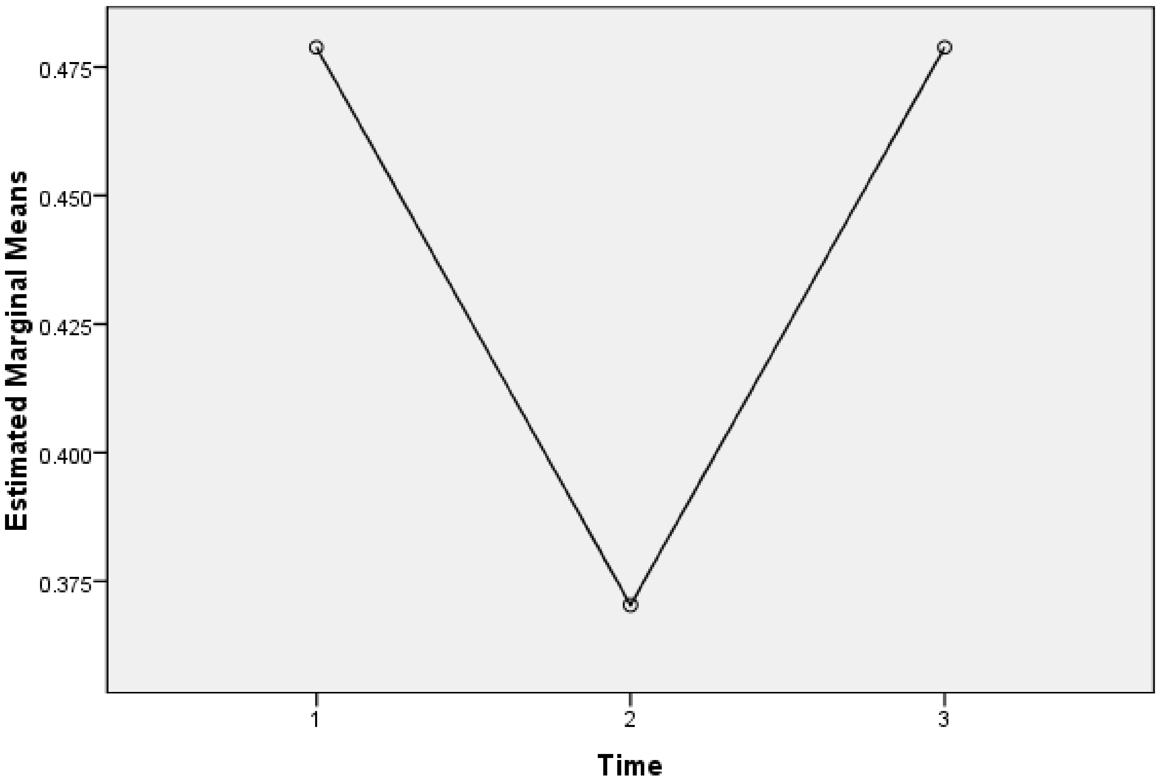
Table 5.26: Mixed model ANOVA for low PA scores in experiment 2b.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| **Within-subjects effects** | | | | | | |
| Time | 0.204 | 2 | 0.102 | 8.871 | .000* | 0.278 |
| Time x Anxiety | 0.001 | 2 | 0.001 | 0.062 | .940 | 0.003 |
| Error(Time) | 0.528 | 48 | 0.011 | | | |
| **Between-subjects effects** | | | | | | |
| Anxiety | 0.007 | 1 | 0.007 | 0.155 | .697 | 0.006 |
| Error | 1.055 | 24 | 0.044 | | | |

*significant at $p < .01$

There was a main effect of time, with no significant interaction between anxiety group and time as predicted. Parametric a priori planned t tests were used to break down the main effect of time. As predicted, participants showed significantly lower low PA scores at time 2 (mean = 0.37) than at time 1 (mean = 0.48), [$t(25) = 3.309$, $p < .01$]. However, low PA scores were not shown to be lower at time 3 than at time 1 as predicted, as no significant differences were found between low PA scores at time 1 (mean = 0.48) and time 3 (mean = 0.48), [$t(25) = 0.000$, $p = 1.000$]. The main effect of time is illustrated in figure 5.7.

Figure 5.7: Average low PA scores at times 1, 2 and 3 in experiment 2b



*5.1.4.5 Summary of Analysis of Mood Data*

High and low anxious participants showed an increase in high PA and a decrease in low PA following a positive mood induction. No significant differences in high or low PA were found for either the high or low anxious participants between times 1 and 3, suggesting that PA returned to baseline levels following the interpretation bias test.

*5.1.4.6 Analyses of Interpretation Bias Data*

*5.1.4.6.1 Data accuracy.*

The data were checked for accuracy as described by Tabachnick and Fidell (2007). No inaccurate data or missing cases were identified.

*5.1.4.6.2 Cognitive load accuracy.*

It was important to check that participants actually attempted to remember the digit string whilst reading the vignettes, in order to be certain that a cognitive load was being applied to participants. Data regarding how many times participants recalled a digit string accurately and inaccurately was therefore compared for participants in the low and high anxious groups.

*5.1.4.6.2.1 Normality assumptions.*

The data was checked for using the Shapiro-Wilk test as the number of participants was less than 2000 (Field, 2005). No evidence of non-normality, skew or kurtosis was found. The analyses are summarised in Appendix AE.

*5.1.4.6.2.2 Independent and paired samples t tests.*

An independent samples t test revealed that there was a significant difference between the mean number of inaccurately recalled digit strings between the low (mean = 4.69) and the high anxious groups (mean = 7.69), [$t(24) = 2.326$, $p < .05$]. Whilst this suggests that the cognitive load was more effective for the low than the high anxious group, a paired samples t test revealed that in general participants recalled significantly more digit strings accurately (mean=13.8) than inaccurately (mean=6.2), $t(23) = 5.444$, $p < .01$. Remembering of digit strings was therefore assumed to provide an adequate cognitive load during the interpretation bias test.

*5.1.4.6.3Normality assumptions for the recognition data.*

Data normality assumptions were addressed through the removal of outliers following which the data also met the assumption of homogeneity of variance. A summary of these analyses can be found in appendix AF.

*5.1.4.6.4 Mixed model ANOVA with recognition interpretation bias data.*

It was hypothesised that all participants would show a positive (mood congruent) interpretation bias in both halves of the test. A 2x2x2x2 mixed model ANOVA was performed to test this hypothesis with recognition rating as the dependent variable, anxiety condition (high or low) as the between subjects variable and test half (first or second), item valence (positive or negative) and item type (target or foil) as the within subjects variables. The hypothesised effects would be demonstrated by an interaction between item valence and item type. Descriptive statistics for the recognition data for both the high and low anxious participants can be found in table 5.27. The results of the mixed model ANOVA are reported in table 5.28.

Table 5.27: Descriptive statistics for recognition data for all participants in experiment 2b.

| Anxiety | Item | Test half | Mean | SD | N |
|---|---|---|---|---|---|
| High anxious | Positive target | 1 | 2.76 | 0.423 | 13 |
| | | 2 | 2.80 | 0.469 | 13 |
| | Positive foil | 1 | 0.72 | 0.460 | 13 |
| | | 2 | 1.60 | 0.428 | 13 |
| | Negative target | 1 | 2.60 | 0.497 | 13 |
| | | 2 | 2.70 | 0.549 | 13 |
| | Negative foil | 1 | 1.51 | 0.395 | 13 |
| | | 2 | 1.65 | 0.422 | 13 |
| Low anxious | Positive target | 1 | 2.74 | 0.403 | 13 |
| | | 2 | 2.83 | 0.368 | 13 |
| | Positive foil | 1 | 1.48 | 0.196 | 13 |
| | | 2 | 1.62 | 0.387 | 13 |
| | Negative target | 1 | 2.46 | 0.487 | 13 |
| | | 2 | 2.50 | 0.705 | 13 |
| | Negative foil | 1 | 1.39 | 0.253 | 13 |
| | | 2 | 1.48 | 0.366 | 13 |

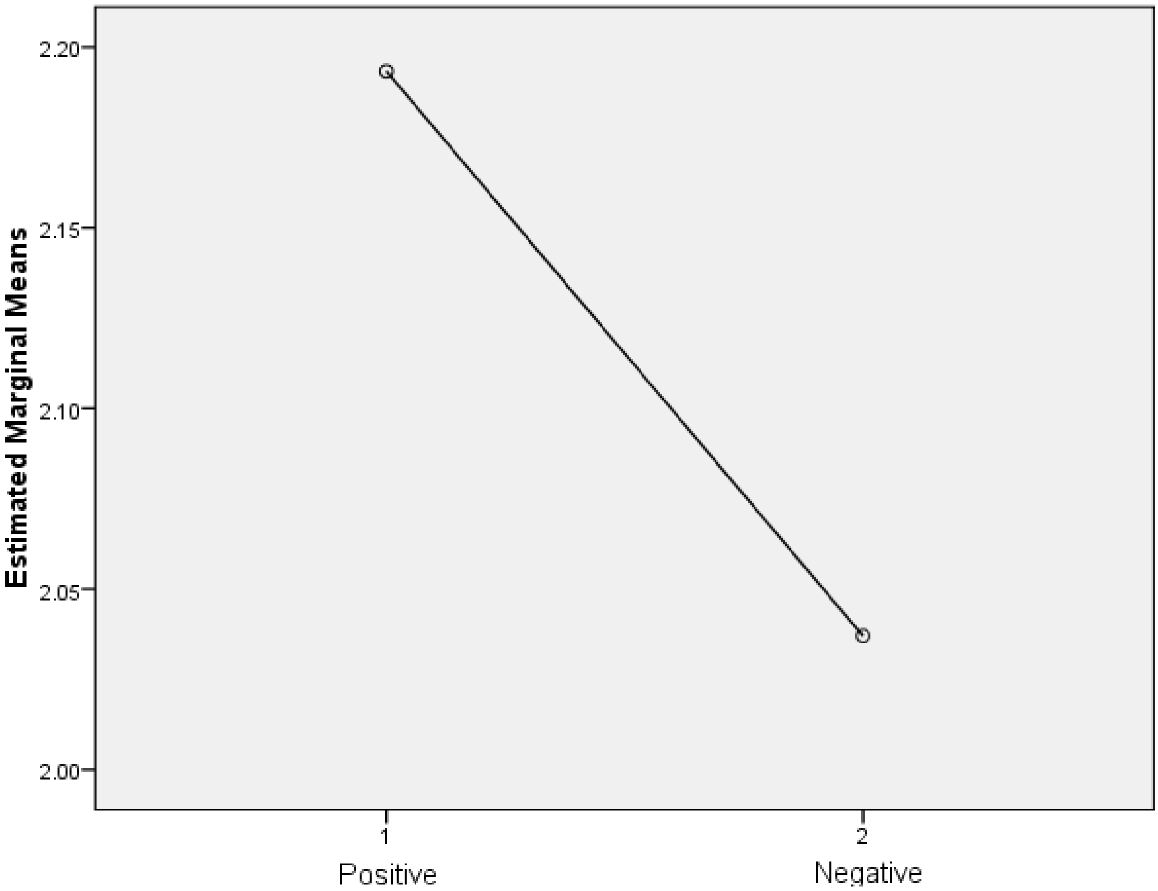
Table 5.28: Mixed model ANOVA for recognition data in experiment 2b.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| **Within-subjects effects** | | | | | | |
| Test half | 0.213 | 1 | 0.213 | 1.686 | .206 | 0.066 |
| Test half x anxiety group | 0.031 | 1 | 0.031 | 0.248 | .623 | 0.010 |
| Error (test half) | 3.026 | 24 | 0.126 | | | |
| Item valence | 1.270 | 1 | 1.270 | 4.689 | .041* | 0.163 |
| Item valence x anxiety group | 0.138 | 1 | 0.138 | 0.508 | .483 | 0.021 |
| Error (item valence) | 6.498 | 24 | 0.271 | | | |
| Item type | 64.971 | 1 | 64.971 | 519.322 | .000** | 0.956 |
| Item type x anxiety group | 0.031 | 1 | 0.031 | 0.250 | .622 | 0.010 |
| Error (item type) | 3.003 | 24 | 0.125 | | | |
| Test half x item valence | 0.039 | 1 | 0.039 | 0.694 | .413 | 0.028 |
| Test half x item valence x anxiety group | 0.153 | 1 | 0.153 | 2.728 | .112 | 0.102 |
| Error (test half x item valence) | 1.350 | 24 | 0.056 | | | |
| Test half x item type | 0.001 | 1 | 0.001 | 0.007 | .934 | 0.000 |
| Test half x item type x anxiety group | 0.036 | 1 | 0.036 | 0.432 | .517 | 0.018 |
| Error (test half x item type) | 2.021 | 24 | 0.084 | | | |
| Item valence x item type | 0.194 | 1 | 0.194 | 1.397 | .249 | 0.055 |
| Item valence x item type x anxiety group | 0.064 | 1 | 0.064 | 0.462 | .503 | 0.019 |
| Error (item valence x item type) | 3.330 | 24 | 0.139 | | | |
| Test half x item valence x item type | 0.034 | 1 | 0.034 | 0.517 | .479 | 0.021 |
| Test half x item valence x item type x anxiety group | 0.034 | 1 | 0.034 | 0.517 | .479 | 0.021 |
| Error (test half x item valence x item type) | 1.568 | 24 | 0.065 | | | |
| **Between-subjects effects** | | | | | | |
| Anxiety | 0.598 | 1 | 0.598 | 0.878 | .358 | 0.035 |
| Error | 16.342 | 24 | 0.681 | | | |

*significant at p < .05
**significant at p < .01

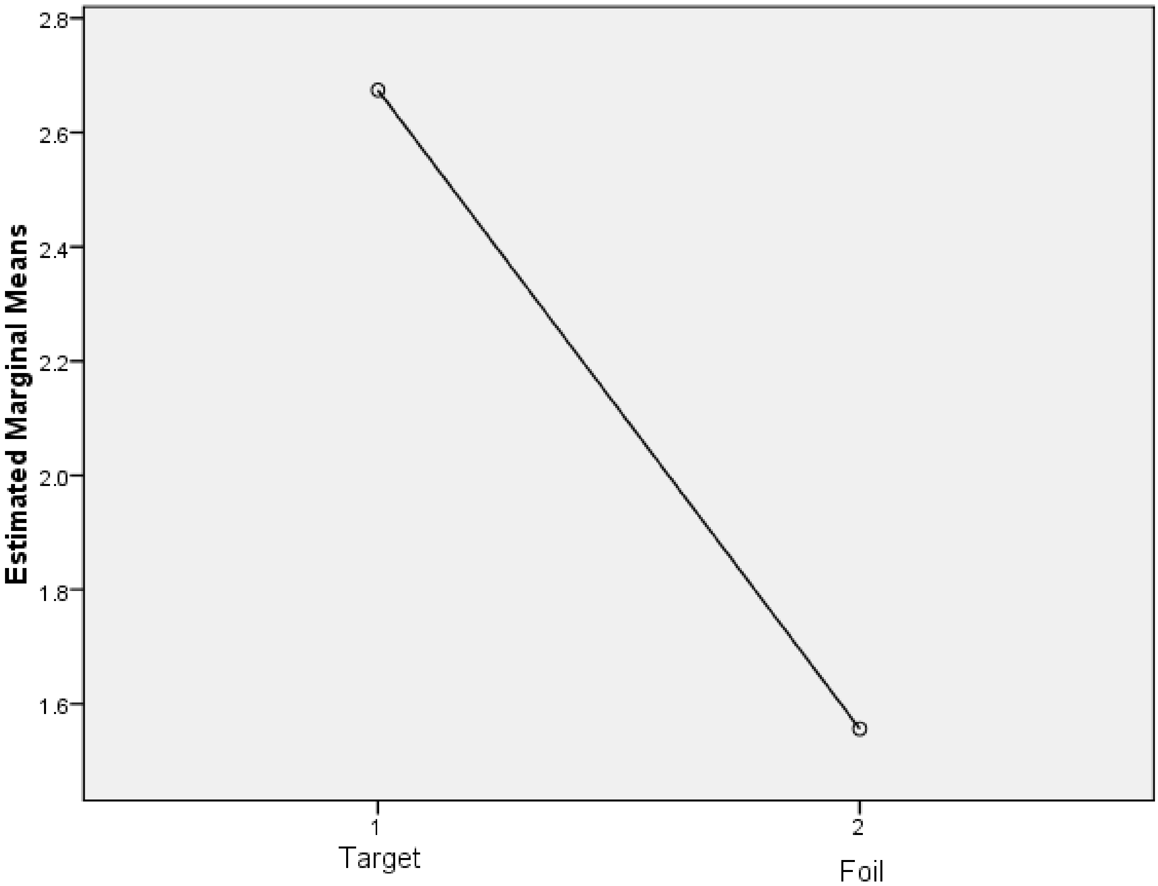
There was a main effect of item valence, with positive items (mean = 2.19) being recognised more often than negative items (mean = 2.04) by all participants. The effect is demonstrated in figure 5.8.

Figure 5.8: Average recognition ratings for positive and negative items for all participants in experiment 2b.




There was a main effect of item type, with target items (mean = 2.67) being recognised more often than foil items (mean = 1.56). The effect is demonstrated in figure 5.9.

Figure 5.9: Average recognition ratings for target and foil items for all participants in experiment 2b.




The predicted interaction between item valence and item type was not found, [F(1,24) = 1.397, p = .249] and observed power for the interaction was low (.21).

*5.1.4.6.5 Summary of interpretation bias data analysis.*

As predicted, all participants showed higher recognition of target over foil items and they also showed higher recognition of positive over negative items (a positive response bias). The hypothesised positive (mood congruent) interpretation bias in both halves of the test for all participants was not found although observed power was found to be low. It was not possible to reject the null hypothesis that interpretation biases would not be evident.

*5.1.4.7 Summary of Results of Experiment 2b*

Following a positive mood induction, both high and low anxious participants demonstrated a more positive mood shown by an increase in high PA and a decrease in low PA. Following a test for interpretation biases, both low and high anxious participants' mood returned to baseline, as shown by a decrease in high PA and an increase in low PA. No evidence of interpretation biases as such was found, with all participants showing higher recognition of target over foil items and higher recognition of positive over negative items.

# CHAPTER 6: EXPERIMENTS 2A AND 2B

## 6.1 Discussion

### *6.1.1 Overview*

A discussion of the findings for experiments 2a (section 6.1.2) and 2b (section 6.1.3) is presented with reference to hypothesised results (sections 6.1.2.1 and 6.1.3.1 for experiments 2a and 2b respectively) and observed results (sections 6.1.2.2 and 6.1.3.2 respectively). Discussion of the results in light of reviewed literature and relevant theory is discussed in sections 6.1.2.3 and 6.1.3.3 for experiments 2a and 2b respectively.

### *6.1.2 Experiment 2a*

#### *6.1.2.1 Hypotheses*

For experiment 2a it was predicted that both low and high anxious participants would show a more anxious mood following an anxious mood induction. Using ideas from the dual-process model of mood regulation, it was predicted that for both low and high anxious participants, negative, mood congruent interpretation biases would be evident throughout the interpretation bias test as a result of substantive processing. It was not predicted that mood incongruent interpretation biases would emerge as it was hypothesised that the cognitive load would not allow effortful motivated processing to occur. It was predicted that the mood congruent interpretation biases would result in maintenance of an anxious mood for both low and high anxious participants following the interpretation bias test.

*6.1.2.2 Results*

As predicted, both low and high anxious participants showed a more anxious mood following an anxious mood induction. Interpretation biases were not observed for low or high anxious participants, instead all participants showed higher recognition of target over foil items. Except for low anxious participants' high NA scores, mood was observed to return to baseline for all participants following the interpretation bias test.

*6.1.2.3 Discussion*

It is difficult to say which of the models the results of experiment 2a support. It seems likely that the decline in anxious mood was due to mood decay, due to the length and nature of the interpretation bias test (as discussed in chapter 4). Whilst low anxious participants' high NA scores did not appear to return to baseline following the interpretation bias test in experiment 2a, the relevant result did approach significance, and this is most likely due to low power rather than mood maintenance per se. Erber and Tesser's (1992) 'absorption' hypothesis predicted the attenuation of positive and negative moods in experiment 2 through prevention of focus on mood congruent thoughts. This however seems unlikely as similar results were seen for experiments 1a and 1b where a cognitive load was not present. Given the failure to find evidence of interpretation biases of any kind it seems unlikely that an explanation for the mood results around mood repair is plausible.

The failure to find any kind of interpretation bias suggests that interpretation biases are not involved in mood repair as the dual-process model predicts. There are a number of possible explanations for this finding.

Firstly, as commented on in chapter five, observed power for the analysis that would demonstrate interpretation biases (an interaction between item valence and item type) was low, suggesting that the sample size was too small to detect any effects that may have been present. It is therefore impossible to accept or reject the null hypothesis that no interpretation biases would be present. However there is an important point to be made about this conclusion. Observed power is calculated based on the observed effect size, not on effect size estimated from previous research (O'Keefe, 2007). The effect sizes for the two interactions observed in experiment 1a (anxiety group, test half and item type; test half, item valence and item type) were large (partial eta-squared=0.94). Vinnicombe et al. (2006) also reported a large effect size (partial eta-squared=0.89) for a two-way interaction (item valence and mood induction). Whilst power was undoubtedly low, the failure to find even a small effect that approached significance was surprising (the effect size found was =0.000).

Secondly, it is possible that the participants who took part in experiment 2a were not anxious enough for any kind of interpretation bias to be evident as their average trait STAI score was actually over 2 standard deviations lower than the clinical cut-off. This seems unlikely as the mean trait STAI score for the participants who took part in experiment 1a was actually lower, and interpretation biases were still evident in that experiment. We also know it is possible to induce mood congruent interpretation biases in control participants and in those showing high levels of trait anxiety (Mathews & MacLeod, 2002) and it is therefore difficult to understand why mood congruent biases at least would not be present. As mood congruent biases were not observed in experiment 1 either, it is possible that any bias had decayed during the relatively long period between the mood induction procedure and the interpretation bias test. This would seem more likely given the relatively mild nature of the induced mood, which would lead to respectively mild induced biases.

Thirdly, it is possible that the cognitive load was so extreme that it prevented participants engaging in the interpretation bias test at all that is, their responses were no better than chance would predict. This seems unlikely given that a large effect was seen for item type, which demonstrates that all participants recognised target items significantly more often than foils. It therefore seems obvious that participants were engaged in the task as they were able to recognise sentences that were related to the content of the vignettes compared with those that weren't.

Lastly, the hedonistic model does not contain terms enabling predictions to be made under conditions of cognitive load as the mechanisms are not specified in detail. Both the social constraints and dual-process models would predict that mood repair mechanisms will breakdown under cognitive load as the processes are effortful. Neither mood congruent nor mood incongruent biases were observed. Perhaps the cognitive load was extreme enough to cause the process of motivated processing to breakdown for both the low and the high anxious participants, and also to cause substantive processing to breakdown. Breaking down mood congruent biases is an important focus of psychological therapies for anxiety disorders (Wells, 1997) and this finding might prove useful for future research into cognitive bias modification in anxiety disorders. If neither mood congruent nor mood incongruent biases were present induced mood would be expected to decay as there would be no bias to regulate it. An explanation for both the mood and the interpretation bias results involving the blocking of mood repair mechanisms by the cognitive load therefore seems likely.

Further discussion of the results in terms of theoretical and clinical implications, and with regard to methodological limitations, can be found in chapter 7.

#### *6.1.2.4 Conclusions*

Experiment 2a has produced some unexpected results which seem possible to accommodate within the dual-process framework. It seems that the cognitive load may have stopped mood incongruent interpretation biases acting in a mood repair mechanism for both low and high anxious participants. Whilst methodological issues may play a role in the interpretation of the results, it may be possible to utilise them in future research into the benefits of cognitive bias modification with clinically anxious individuals.

### *6.1.3 Experiment 2b*

#### *6.1.3.1 Hypotheses*

For experiment 2b it was predicted that both low and high anxious participants would show a more positive mood following a positive mood induction. Using ideas from the dual-process model of mood regulation, it was predicted that both low and high anxious participants would show mood congruent interpretation biases throughout as a result of substantive processing. It was predicted that this would result in maintenance of the positive mood.

*6.1.3.2 Results*

As predicted, all participants showed a more positive mood following a positive mood induction. Whilst it was predicted that all participants would show evidence of mood congruent, positive interpretation biases, no evidence of interpretation biases as such was found. All participants showed higher recognition of target over foil items and higher recognition of positive over negative items (a positive response bias). Following the test for interpretation biases, both low and high anxious participants' mood returned to baseline.

*6.1.3.3 Discussion*

Similar to experiment 1b, it is difficult to say which model of mood regulation the results of experiment 2b support, as although an induced positive mood returned to baseline, this occurred following a measured *positive* response bias. It seems possible that the decline in positive mood following the interpretation bias test was due to decay, as the test is long and repetitive, and that any effects of mood regulation on mood were lost during this procedure which took up to 40 minutes to complete.

Whilst mood decay is likely to be the explanation for the lack of observed mood maintenance, the hedonistic model is unable to account for this, due to the unspecified nature of the mechanisms involved. The social constraints model might suggest that participants did not attempt to regulate their mood as the context was not sufficiently challenging or anxiety provoking. However, changing the context from experiment 1, by adding a cognitive load and making the task more challenging, did not achieve significantly different results suggesting that context alone cannot explain the results obtained. This indicates that the social constraints model is not best placed to make predictions about when and how individuals go about regulating their mood.

It is difficult to evaluate the dual-process model in light of the results of this experiment alone. The failure to find mood congruent interpretation biases, which might have supported the model could be explained by the relatively long time delay between the mood induction and the interpretation bias test, and the mild nature of the mood induced. The finding of a positive response bias would support such an explanation, since it suggests the presence of a decaying bias. Similar to experiment 2a, it seems unlikely that the cognitive load made it impossible for participants to attend to or access the task, given the higher recognition of target over foil items.

Further discussion of the results in terms of theoretical and clinical implications, and with regard to methodological limitations, can be found in chapter 7.

*6.1.3.4 Conclusions*

The results of experiment 2b could be seen to support the dual-process model of mood regulation, with the lack of mood maintenance being explained through a process of mood decay. By combining conclusions regarding experiments 1a and 1b with those for experiments 2a and 2b it should be possible to make more definite conclusions regarding the utility of the dual-process model.

# CHAPTER 7: GENERAL DISCUSSION

## 7.1 Overview

A summary of the methodological limitations of the study is provided in section 7.1.1. This is followed by a summary of the hypotheses (section 7.1.2) and results (section 7.1.3) for both experiments 1 and 2. Implications of the results for a hedonistic model of mood regulation are discussed in section 7.1.4, for the social constraints model in section 7.1.5 and for the dual-process model in section 7.1.6. Further implications for the results in terms of the effects of trait anxiety on interpretation biases (section 7.1.7) and in terms of a bi-directional relationship between mood and interpretation biases (section 7.1.8) are also discussed. Ideas for future research and discussion of the clinical implications of the current research are set forward in section 7.1.9. Conclusions are made in section 7.1.10.

### *7.1.1 Methodological Limitations*

#### *7.1.1.1 Design*

Analyses for experiments 1a, 1b, 2a and 2b with regards to both the mood data and the interpretation bias data were conducted separately. Data from all four experiments could have been pooled in order to perform one analysis for each of the mood and interpretation bias data, by adding two new variables of mood induction condition (positive or anxious) and cognitive load (load or no load). Hypotheses regarding differences between the positive and negative mood inductions and regarding the effects of a cognitive load could then have been tested. The decision to conduct separate analyses for the positive and negative mood inductions was made due to theoretical and empirical support for the independent nature of PA and

NA, as reviewed in chapter 1. It was felt that any effects of mood inductions on PA and NA should therefore be assessed independently.

Whilst it was planned that the experiments conducted with load and those conducted without be run as part of the same study, this did not occur in practice as outlined in chapter 2. As a result most participants who took part in experiment 2 were recruited at a different time to those recruited for experiment 1. There were also differences in testing conditions and recruitment methods, as well as differences in the experimenters. It seemed sensible to conduct separate analyses in order to be explicit regarding these sources of systematic bias. Separate analyses were carried out in order to maximize the chance of finding effects of interest to the research hypotheses as differences in participant numbers in experiments 1 and 2 would have reduced power.

*7.1.1.2 Participants*

Due to changes to University regulations discussed in chapter 2 and technical problems with the apparatus it was not possible to recruit as many participants as planned to experiment 2. This reduced the power of the analyses for the mood and interpretation bias data (Coolican, 2004). However, as discussed in chapter 6, the failure to find even a small effect that approached significance was surprising, given the large effects found in experiment 1 and by Hunter et al. (2006) and Vinnicombe et al. (2006). Nevertheless it is difficult to conclude that the analyses had sufficient power to detect any effects that might have existed.

*7.1.1.3 Measures*

*7.1.1.3.1 MANX.*

As discussed in chapters 3 and 5, there were unexpected difficulties with the MANX as an adequate and reliable predictor of STAI score. Whilst it was expected that participants who attended for testing sessions would fall either within the high or low anxious ranges, many did not, and this contributed to the small difference in STAI score between the low and high anxious groups. These effects are surprising given the good correlation between MANX and STAI scores reported by Mackintosh and Mathews (2006), and the acceptable correlations found in experiments 1 and 2. The difficulties in using the MANX to reliably predict STAI scores is probably due to low test-retest reliability, which has yet to be assessed. Trait anxiety is defined as a relatively stable variable, and the STAI has acceptable test-retest reliability (Spielberger, 1983).

As the MANX was used only to predict STAI scores, and therefore did not directly affect the main results. As such the real effect of the difficulties with the MANX was to reduce the difference between the low and high anxious groups. This problem is discussed in more detail in section 7.1.7.

*7.1.1.3.2 VAS.*

The measure of current mood used in experiments 1 and 2 is unstandardised, with undefined reliability and validity. It is therefore possible that the results achieved were not due to changes in PA and NA as concluded in chapters 4 and 6. However, correlations were found amongst items theoretically predicted to be related to each other which suggests some degree of internal consistency, and the measure was able to detect predicted changes in mood over time. The use of eight items also helps to control for general positive or negative response biases, which can occur in research looking for more specific interpretation biases (Salemink, et al., 2007a), as response biases would be more likely to occur with a measure with fewer items.

Analyses were carried out only for the NA data in experiments 1a and 2a, and for only the PA data in experiments 1b and 2b. However all participants in both experiments completed all eight items of the VAS at all three time points. Future research might consider assessing only those items which pertain to the predicted variable of interest for example, PA items for a positive mood induction. This is especially important as the measure was chosen for its brevity, which is compromised when participants complete items which are never used in a subsequent analysis. It is not thought that this affected the results to a great extent, as each item took most participants less than 10 seconds to complete.

*7.1.1.3.3 Interpretation bias test.*

The reported method of assessing interpretation biases has been used several times in similar research studies due to its ability to discriminate between social and physical threat and to truly discriminate between response biases and interpretative biases (e.g., Salemink et al.,2007a). However, as Teape (2009) pointed out, it is possible due to the length and depth of the procedure that participants were aware that their interpretation biases were being assessed, and therefore altered their responses accordingly (Salemink et al., 2007b). This would therefore not represent a measurement of true interpretation biases, but a measurement of participants' response bias given their assessment of experimenter expectations. As Teape (2009) pointed out, whilst this was not explicitly measured in either experiment 1 or 2, such an explanation seems unlikely. Participants in both experiments were routinely asked what they thought the aims of the experiment were, and very few were able to correctly identify them. Only two participants commented on doing what Salemink et al. (2007b) hypothesized was occurring that is, consciously changing their responses from negative to positive. It therefore seems likely that the results can be applied to understanding the function of more naturalistic biases, as they do not seem to be due solely to conscious efforts to modify responding. However, future research should measure participants' awareness of the process more formally in order to be certain that this is the case.

*7.1.1.4 Materials*

*7.1.1.4.1 Mood induction procedure.*

The film clips effectively induced both a positive and an anxious mood, although it appears as if the extensiveness and durability of these moods was low given that they appeared to decay following the interpretation bias test in both experiments. Inducing moods in experimental conditions is always challenging, especially given that more extreme methods would most likely not be ethical, and induced moods are therefore by their nature less extreme. The decision not to use music to enhance the mood induction procedure seems warranted, given research that suggested that the effects of musical mood induction varied between individuals (Crozier, 1997), and that music induced only low intensity emotions (Konecni, 2008). Music may therefore have decreased the overall effects of the films on mood, rather than enhanced them. Nevertheless, future research may need to focus on perhaps using only one film clip, in order to prevent possible dilution of effects from one film to the next, to determine the optimal mood induction procedure. Additionally, future research could consider including only data for participants who reached pre-specified criteria for mood induction, in order to ensure that differences between mood induction conditions are achieved.

*7.1.1.4.2 Cognitive load.*

The results of experiment 2 suggest that the cognitive resources of both low and high anxious participants were more extremely impaired than expected, as no evidence of interpretation biases of any kind was found. This is supported by the fact that nearly all participants who took part in experiment 2 commented on how difficult it was to remember the numbers at the same time as completing the interpretation bias measure. Despite this, the results of experiment 2 where higher recognition of target over foil items was seen, suggest the method did not stop participants engaging in the task itself. Further research is needed to determine whether an easier task would result in the observation of the predicted mood congruent interpretation biases for example a simultaneous Stroop task presented visually (Stroop, 1935). Having said that the brevity and simplicity of the task meant that it did not add excessive time to the procedure.

*7.1.1.5 Procedure*

*7.1.1.5.1 Recruitment.*

Whilst recruitment to experiments 1 and 2 was planned to run concurrently, in practice there were differences both in when participants were recruited and also in the methods used, as discussed in chapter 2. There is therefore a small possibility that participants who took part in experiments 1 and 2 effectively came from different populations. This seems unlikely given that the main method to contact potential participants was the same that is, via email, the only difference was that one email was sent by the Dean of Students for experiment 2, whereas several emails were sent by individual school offices for experiment 1. Whilst other differences in contact methods existed for example, experiment 2 used student interest websites to advertise on, the number of participants who actually contacted the researcher via this method was relatively small. Additionally participants who were recruited to experiment 2 were recruited almost exactly one year later, such that there were no differences in for example, time of year.

Nevertheless, it is important to bear these differences in mind when drawing conclusions regarding the results, and a strength of the study's design is that analyses for experiments 1 and 2 were carried out separately in order to avoid allowing confounding variable such as recruitment method to affect the results.

*7.1.1.5.2 Participant allocation to experiment.*

Participants were not randomly allocated to experiments due to time constraints. It was also important to allocate eligible participants to experiments as and when they expressed an interest in participating, in order to avoid participant attrition. As a result there is a possibility that some systematic bias could have been introduced. As Teape (2009) pointed out, block randomisation (Tabachnick & Fidell, 2007) may have been possible, although this would not have allowed participants to choose a convenient time. Further developments to this system may make more elaborate randomization procedures possible which would help to reduce the possibility of systematic bias whilst continuing to avoid high participant attrition.

*7.1.1.5.3 Testing conditions.*

Differences in testing conditions between experiments 1 and 2 could also have introduced some systematic bias into the results, as some of the participants tested in experiment 2 did so under different conditions to those tested in experiment 1. Approximately two thirds of participants were actually tested under the same conditions as experiment 1, and the differences were minor in relation to the overall procedure for example, tested in individual research pods rather than in an open plan computer lab. Such differences affected both experiments 2a and 2b, and it would therefore be hoped that systematic bias had not been introduced. The decision to conduct separate analyses for experiments 1 and 2 is therefore further supported.

*7.1.1.5.4 Procedure.*

The finding of a mood incongruent, positive interpretation bias during the second half of the test in experiment 1a suggests that motivated processing was used to repair the induced anxious mood, as the dual-process model would predict. However, it is difficult to conclude this with certainty given that it appears that induced moods decayed following the mood induction in all four experiments. It is therefore possible that interpretation biases in the second half of experiments 1a were actually produced through substantive processing as they were actually *congruent* with participants' mood as it decayed (Mathews & Mackintosh, 2000). Given the positive response bias seen in experiment 1b this seems unlikely, as such an explanation would predict that a negative bias would have been seen. It seems more likely that the biases observed in experiments 1a and 1b were produced through motivated processing to repair and maintain induced moods, but that the effects on mood in experiment 1b were lost due to decay as the bias produced was only a response bias, not an interpretation bias and was therefore not strong enough to maintain the mood.

Nevertheless, the addition of a fourth measure of mood on the VAS in between reading the vignettes and completing the recognition test would allow this hypothesis to be tested in future research.

The application of the cognitive load during the time when participants read the vignettes was a strength of the procedure, as both the results of experiments 2a and 2b, and participant comments suggested that the cognitive effort involved made it difficult for them to engage in motivated processing.

*7.1.1.6 Summary of Methodological Limitations*

Methodological limitations were identified which involved difficulties recruiting sufficient participants to experiment 2, difficulties with the MANX as an adequately reliable predictor of STAI score, overuse of all items on the VAS, the mild nature of the induced moods, the lack of randomization to experiments and the lack of mood measurement during the interpretation bias test. These limitations have mostly been controlled for by conducting separate analyses for each experiment, or did not have direct effects on the results obtained. Where they did have direct effects on the results, conclusions have been drawn tentatively. Several strengths of the methodology were also identified including the decision to conduct separate analyses for each experiment, the ability of the VAS and the interpretation bias test to control for response bias and the brevity, apparent effectiveness and timing of the cognitive load task in the procedure.

### *7.1.2 Hypotheses*

The dual-process model would predict that induced anxious mood would result in mood congruent interpretation biases, which would become mood incongruent over time as a result of motivated processing to repair induced anxious moods. It was predicted that this process would not be observed for high anxious participants due to limited cognitive resources caused by increased load on cognition of the anxious mood. It was therefore predicted that neither high nor low anxious participants would be able to engage in motivated processing under a cognitive load, and that mood regulation would subsequently not occur. It was predicted that all participants would engage in substantive processing to maintain induced positive moods, and that this process would not be affected by the application of a cognitive load.

### *7.1.3 Results*

In experiments 1a and 1b an anxious and a positive mood were induced which appeared to decay over time. Whilst a positive response bias for the low anxious participants, which became increasingly positive over time was observed in experiment 1b, a positive interpretation bias was observed in experiment 1a, which also became increasingly positive over time. No differences were observed between low and high anxious participants in experiment 1a. The results obtained were interpreted as evidence of mood incongruent interpretation biases acting to repair an induced anxious mood through motivated processing.

Similar to experiments 1a and 1b, an anxious and a positive mood were induced which appeared to decay over time in experiments 2a and 2b. A positive response bias was also seen in experiment 2b, but no evidence of response or interpretation biases was observed in experiment 2a. No differences were observed between low and high anxious participants. The results obtained were interpreted as evidence of a cognitive load blocking the use of mood incongruent interpretation biases in mood repair through motivated processing.

### *7.1.4 Hedonistic Model of Mood Regulation*

Similar to the results of Erber et al. (1996) and Commons and Erber (1997), and in contrast to the results of Handley et al. (2004), a positive mood was not maintained in either experiments 1b or 2b. This does not support the hedonistic model's prediction that participants would be motivated to attempt to maintain a positive mood. Whilst this could be due to the cognitive load blocking attempts at mood maintenance in experiment 2b, this could not explain why mood was not maintained in experiment 1b. The positive response bias seen in both experiments 1b and 2b might be evidence that participants attempted to maintain a positive mood, especially as this bias became increasingly positive over time for the low anxious participants in experiment 1b. It is therefore likely that the high anxious participants in experiment 1b, and those under a cognitive load in experiment 2b were not able to switch from automatic substantive processing to effortful motivated processing involving stronger mood congruent biases as the low anxious participants in experiment 1b did. This replicates results achieved by Joorman and Siemer (2004) with dysphoric individuals.

### *7.1.5 Social Constraints Model of Mood Regulation*

The social constraints model suggested that participants tested in the same context should be motivated to maintain or regulate their mood to the same extent (Commons & Erber, 1997; Erber et al., 1996). By comparing the results of experiments 1a and 1b, and the results of experiments 2a and 2b, it can be seen that differences in observed cognitive biases exist between experiments 1a and 1b and between experiments 2a and 2b. That is a positive interpretation bias emerged over time in experiment 1a, and a positive response bias became more positive over time for the low anxious participants in experiment 1b. No evidence of response or interpretation biases was found in experiment 2a and a positive response bias was observed for all participants in experiment 2b. The differing conditions between experiments 1 and 2 seem to be responsible for the differing pattern of results, as differences in task expectations were in the study by Knobloch (2003) and as differences in attention were in the study by Berkowitz et al. (2000). This suggests that a factor other than context must explain the differences observed. It appears as if, at least for these experimental conditions, hedonistic concerns were motivating participants to attempt to maintain a positive mood, but to regulate an anxious mood.

### *7.1.6 Dual Process Model of Mood Regulation*

Following an anxious mood induction it appears as if participants attempted to regulate their mood through the use of mood incongruent interpretation biases during motivated processing, similar to the results found by Chen et al. (2007) and Sedikides (1994). When this process was repeated under a cognitive load, no such biases were evident suggesting that the load on cognitive resources prevented participants from engaging in effortful motivated processing and this resulted in mood decay, as no biases were present to maintain or regulate induced mood. This provides further evidence that task effort is important for mood repair (Erber & Erber, 1994), and is similar to the results obtained by Ottati and Isbell (1996), Hirsch and Mathews (1997) and Eysenck et al. (1991) where it was hypothesised that lack of cognitive resources prevented some participants from engaging in motivated processing. Having said that, no evidence of both substantive and motivated processing was found (Forgas & Ciarrochi, 2002; Sedikides, 1994), perhaps due to insufficient strength of the mood induction.

Following a positive mood induction it appears as if under conditions of no cognitive load, some participants attempted to maintain their mood through the use of a positive response bias as this became increasingly positive over time. This result is similar to that of Sedikides (1994) but in contrast to that of Forgas and Ciarrochi (2002) suggesting that unspecified contextual differences between studies may impact on the regulation of mood as found by Knobloch (2003). The same result was not found for participants completing the procedure under a cognitive load. This suggests that whilst positive response biases were activated through initial substantive processing, these biases were not maintained or enhanced through motivated processing due to limited cognitive resources. It appears as if mood congruent substantive processing alone may not be sufficient to maintain positive moods, at least in an anxiety provoking experimental context. Motivated processing involving mood congruent biases may therefore be needed. Such results could help to inform the dual-process model of mood regulation in that motivated processing could be seen to involve an effortful search for both mood congruent and incongruent information, depending on the current (mood) goal. Further support is also provided for the notion that motivated processing is effortful (Dillen & Koole, 2007; Erber & Erber, 1994; Erber & Tesser, 1992), given that it did not appear to be observed under conditions of cognitive load.

Unfortunately the mood results do not support these conclusions, most likely due to mild induced moods decaying during a long and repetitive interpretation bias test. Whilst it was mentioned in chapter four that the positive interpretation biases observed in experiment 1a may therefore in fact be congruent to the mood as it decays, the fact that a congruent positive response bias was seen in experiments 1b and 2b and the fact that the biases observed by Mathews and Mackintosh (2000) endured over long time periods would make this conclusion seem unlikely. Clearly future research should measure mood during the interpretation bias test itself, as well as piloting different mood induction methods in order to assess more clearly the effects on mood of biases hypothesised to be involved in mood repair. The methodological limitations highlighted earlier also make the conclusions regarding interpretation biases tentative, and future research should attempt to replicate this data having addressed the concerns identified.

### *7.1.7 Effects of Trait Anxiety on Interpretation Biases*

Following an anxious mood induction, there were no differences in observed biases between the low and high anxious participants in experiment 1a in contrast to the results of Calvo and Castillo (1997), Calvo et al. (1997) and Eysenck et al. (1991). However, high anxious participants showed lower recognition in general and low anxious participants showed increasing recognition of target items from the first to the second half of the test. This suggests that the ability of the high anxious participants to engage in the task itself was lower than the low anxious participants, and that the low anxious participants showed a change in their processing style from the first to the second half of the test which the high anxious participants did not. Such differences might be due to decreased cognitive resources for the high anxious participants and an increased ability for the low anxious participants to switch from substantive to motivated processing. Indeed NACs in Beard and Amir's (2009) study appeared to have accessed threatening interpretations which they later suppressed which could also be viewed as a switch from substantive to motivated processing.

Such conclusions are supported by the lack of observed interpretation biases under a cognitive load for either low or high anxious participants following an anxious mood induction in experiment 2a, which also occurred in Salemink et al.s (2007b) study. As Teape (2009) pointed out, such conditions may be more indicative of everyday life, where in the context of increasing demands for cognitive resources, mood regulation does not become the focus out of the many self-control tasks a regulatory system has to deal with (Tice & Bratslavsky, 2000).

For the positive mood induction in experiment 1b only the low anxious participants appeared to attempt to maintain their mood through the use of a positive response bias. This was not found for high anxious participants suggesting that insufficient cognitive resources were available for motivated processing to be instigated or that the high anxious participants were not motivated to maintain a positive mood as found by Hemenover (2003). As stated in section 7.1.6, it appears as if mood congruent substantive processing alone may be insufficient to maintain positive moods.

It is likely that predicted differences between low and high anxious participants in observed interpretation biases were not found due to the small differences in trait anxiety scores between the groups, as discussed in section 7.1.1.3.1. Future research should attempt to maximise the possibility of finding predicted differences by using different methods to recruit participants high in trait anxiety for example by using a clinical sample compared with a control sample recruited from a student population.

*7.1.8 The Bi-Directional Relationship of Mood and Interpretive Processing Biases*

Due to what appears to be decay of the induced moods over time, it is not possible to draw conclusions regarding the causal effect of interpretive processing biases on mood. However, it is possible to comment on the causal effect of induced mood on interpretation biases.

It appears as if, in line with the results of Hunter et al. (2006) and Vinnicombe et al. (2006), an anxious mood induction caused participants to engage in motivated processing using mood incongruent, positive interpretation biases. It also appears as if this effortful motivated processing may have been blocked by the application of a cognitive load. A positive mood induction resulted in what appeared to be mood congruent response biases, regardless of whether a cognitive load was applied.

Given that there is a wealth of research that has demonstrated that interpretation biases have causal effects on mood (Mathews & MacLeod, 2002), it appears as if the relationship may in fact be bi-directional, with mood influencing interpretation biases, which in turn influence mood. In the context of a dual-process model of mood regulation, it appears as if at least under these experimental conditions, hedonistic concerns motivate the attainment or regulation of positive moods.

### *7.1.9 Future Research and Clinical Implications*

The methodological limitations discussed in section 7.1.1 should be addressed in any future research which attempts to replicate the results achieved here, particularly with regard to ensuring adequate numbers of participants are recruited in order to test the research hypotheses with sufficient power to detect any effects that might exist. In addition to this it would be important to add another measure of mood in between reading the vignettes and completing the recognition task during the interpretation bias test, in order to delineate the causal effects of interpretation biases on mood and vice versa. As discussed in chapter 1, Standage et al. (2010) found that active processing of vignette content was not required to demonstrate interpretation biases, and future research may therefore be able to shorten and simplify the interpretation bias measure.

It would be particularly interesting to extend the research to clinical samples, perhaps compared with a non-clinical control sample in order to test predictions regarding differences between individuals high and low in trait anxiety. Such research would enable conclusions regarding differences to be drawn with more certainty, as there would likely be significantly greater differences in trait anxiety between the groups.

If differences between the groups were found in the extent to which interpretation biases were used to repair anxious moods, and/or to maintain positive moods, further research could use varying levels and modifications to the cognitive load task to determine what level of cognitive resources are needed in order for motivated processing to occur. The simplicity and brevity of the cognitive load used in this study helped to minimise effects on the length of the procedure and may have helped participants to remain focused on the interpretation bias test. However, it may be that other tasks such as tracking tasks (Levens, Muhtadie & Gotlib, 2009) or a modified visual Stroop task are easier to vary in terms of the cognitive resources they use.

The results of this study are helpful to an understanding of how mood regulation and maintenance might be achieved by low trait anxious individuals. It is also possible that other forms of cognitive processing biases such as attentional and memory biases are involved in a dual-process model of mood regulation, and future research could also investigate this possibility.

The results also give an insight into how and when the process of mood regulation might break down for individuals high in trait anxiety, and future research should ensure that participants in a high trait anxious condition are truly representative of a ‘high trait anxious’ label, perhaps by using participants drawn from a clinical sample. This would enable conclusions to be drawn regarding the severity of trait anxiety at which mood regulation through the use of interpretative processing biases becomes problematic.

Following on from this it would be important to understand whether insufficient cognitive resources are the only factor responsible for a breakdown in motivated processing in mood repair and maintenance. It may be that other parts of the mechanism proposed by Beevers (2005) in his application of the dual-process model to vulnerability to depression may break down such as expectations not being violated. In applying his ideas to an understanding of anxiety, individuals high in trait anxiety may have positive beliefs about the usefulness of worry and anxiety (Wells, 1997) and may not therefore have learnt to switch from substantive to motivated processing.

The results obtained in this study have important implications for the development of cognitive bias modification (CBM) paradigms used to engender positive, mood incongruent interpretation biases in individuals suffering from a wide range of mood disorders (e.g., Beard & Amir, 2008). The results provide support for the idea that mood regulation can be achieved through the use of interpretation biases. However, they also suggest that in order to be successful individuals need to have available to them sufficient cognitive resources to engage in effortful motivated processing. Future CBM research should therefore attempt to ensure that tasks are as simple as possible in order to ensure that participants have sufficient cognitive resources in order to be able to learn how to engage in motivated processing. Whilst context was not seen to influence achieved results in this study, previous research found that participants attempted to achieve a more neutral mood when undertaking difficult tasks and in the presence of strangers (Erber & Tesser, 1992; Erber et al. 1996). It would therefore be important to ensure that participants have sufficient practice at CBM tasks and to ensure that participants know the individuals who undertake the tasks with them, or perhaps even to conduct them online from the comfort of participants homes, to ensure that they are successful.

The results of experiment 2b also suggest that substantive as well as motivated processing was blocked under conditions involving a cognitive load. Given that increased substantive processing is what was predicted to both cause and maintain symptoms of anxiety in anxious populations (Hazlett-Stevens & Borkovec, 2004; MacLeod & Rutherford, 2004) then this finding could be used in the development of interventions for individuals suffering from anxiety disorders. Perhaps CBM training tasks as described above could be modified to include very difficult cognitive load tasks in order to break down substantive processing in order to determine whether this can generalise to everyday life for individuals suffering with high levels of anxiety?

### *7.1.10 Conclusions*

The results of this study have provided some insights into the use of interpretation biases in mood regulation as predicted by the dual-process model of mood regulation. Neither the hedonistic nor the social constraints model is able to account for the results obtained, as a more complex model is needed to help understand when hedonistic concerns will become the focus of self-control. Methodological issues limit the strength of the conclusions drawn, particularly with respect to how such biases operate under conditions of cognitive load. Nevertheless, it appears as if mood regulation is achieved through a switch from substantive mood congruent processing, to motivated processing which may be mood congruent or incongruent. Such a switch from substantive to motivated processing appears to require cognitive processing capacity, which may be limited in individuals high in trait anxiety. Further research should attempt to correct the methodological limitations identified and investigate further the differences in the process between high and low trait anxious individuals. The results have wide reaching theoretical and clinical implications, particularly with regard to helping individuals high in trait anxiety learn to manage mood through the use of cognitive processing biases.

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APPENDIX A

Initial E-mail to Students Inviting Participation in this Study

Dear Fellow Student,

**An Invitation to Participate in Psychological Research**

We are trainee Clinical Psychologists undertaking doctoral studies at the Institute of Health, UEA. We are contacting you to invite you to participate in a research study that we are undertaking for our thesis.

This is an exciting project looking at the effect of emotions on the way people think and behave. It is hoped that the results of this study will help inform future treatments and interventions for people with emotional disorders.

The study will take only an hour of your time, at your convenience and will take place on the UEA campus. We hope that taking part in the study will be an interesting experience and an opportunity for you to find out more about psychological research. As compensation for your time, we would also like to offer all participants a **£5 HMV Voucher and an informative booklet about coping with the stress of being a student.**

If you are interested in taking part or would just like to find out more, then please e-mail us at xxxxxx**.** Once we receive your e-mail, we will send you further details of the study to help you decide if you would like to take part. With the information will be some short questionnaires for you to complete and return to us if you do decide to take part.

Best wishes

| | |
|---|---|
| **Lynda Teape** | **Lorna Shelfer** |
| **Trainee Clinical Psychologist** | **Trainee Clinical Psychologist** |

Supervised by

Dr Bundy Mackintosh, Senior Lecturer in Abnormal Psychology

Dr Helen Buxton, Clinical Psychologist and Senior Clinical Tutor

APPENDIX B

Participant Information Sheet

Please reply to

Lynda Teape and Lorna Shelfer

Doctoral Programme in Clinical Psychology

Elizabeth Fry Building

University of East Anglia

Norwich NR4 7TJ

**04th March 2008** E-mail: l.teape@uea.ac.uk or l.shelfer@uea.ac.uk

## Participant Information Sheet

### *Cognition and Emotion Research Project*

### *Title of Project: The Effects on Comprehension of Viewing Emotional Films*

In order to improve understanding of the way our emotions work, new research projects regularly take place with the eventual aim of developing improved treatments and services for those individuals that suffer from emotional disorders or other mental health problems. I would therefore like to invite you to take part in a current research project. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. Talk to others about the study if you wish. If you are agreeable we will go over the details when we meet to make sure you understand what is involved and you will be asked to sign a form to give your consent to taking part. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

*What is the purpose of the study?*

Psychologists have realised for some time that when people experience emotions there are changes in the way they think and behave and these changes can perpetuate those emotions. We are interested in your experience of emotions and how that affects the way you think and behave.

*Why have I been chosen?*

You have been chosen because you are an undergraduate student at the University of East Anglia.

*Do I have to take part?*

No. It is up to you whether or not to take part. If you do, you will be given the opportunity to discuss the project further when we meet when you will be asked to sign a consent form if you are willing to go ahead. You will remain free to withdraw at any time and without giving a reason. A decision not to take part, or to later withdraw, will in no way affect your studies at the University and no-one except the research team will be aware of any aspects of your participation.

*What will happen to me if I take part?*

The first thing that will happen is that you will be asked to complete a number of questionnaires asking you about your thoughts, feelings and behaviour. This will help us decide whether this study is suitable for you and to ensure we select equivalent individuals for the different parts of the study. Then some people will be asked to attend a session, lasting approximately an hour, when you will complete a number of further questionnaires, watch a short video clip, and answer some questions about what you saw on the video. Not everyone who completes the questionnaires will be asked to attend this session. For instance, you would not be suitable for the study if you are not fluent in written and spoken English or have any significant reading problems. Also, as this is a study of usual emotional responses in volunteers we will not ask people to participate if they have a history of depression, anxiety or other mental illness in the past 5 years. Finally, people who have completed a similar psychology study in the past may not be suitable as this could affect the reliability of the results of the study, we will need to ask about any previous studies in which you have participated. The study is not aimed at investigating the quality of your memory of the video clip; we are more interested in your perception of it.

*What do I have to do?*

All you will have to do is complete the initial questionnaires and come to a session at a time agreed between you and the researcher to complete the further questionnaires, watch the video clip and answer the questions about it, and complete a brief comprehension task. These activities are not at all difficult.

*Will I be paid?*

Individuals who attend the testing session will be paid £5 and will also be given a booklet on how to improve mental wellbeing as a thank you for taking part.

*What are the possible benefits of taking part?*

We hope that this will be an interesting and informative experience of psychological research for you. Although there are no direct benefits for participants it will help our understanding of emotions, which will be helpful in developing further psychological treatments.

*Are there any disadvantages of taking part?*

The video clips contain scenes taken from popular movies, some pleasant and some less pleasant which could invoke negative emotions and there is a possibility that some may find these distressing. If this is the case you can ask the researcher to stop at any time and withdraw yourself from the study. However, as the clips have all been taken from movies available to the public on general release, and have been used in previous research where they have caused no problems to other participants this is highly unlikely. Most find that the negative emotions invoked dissipate after a short period of time. The only other disadvantage is the possible inconvenience of coming to the session. Some people have also said that the activities can seem a bit dull! However, others have also said they have found them quite interesting to do and find out about, so this might not be too much of a problem for you.

*Will my taking part in the study be kept confidential?*

Yes. All information which is collected about you during the course of the research will be kept strictly confidential to the research team. You will be allocated an anonymous code number which will be used to identify your personal contribution. The information that matches this code to your name will be held in a special encrypted computer file, separate from the other information about the study. Once we have completed collecting information about you for the study we will ensure that only the anonymous code remains so that the results remain completely confidential. Storage and use of information in this study will be fully compliant with the Data Protection Act.

*What will happen to the results of the research study?*

We hope to publish the results in journals reporting research in psychology. You will not be identified in any way in the reports of the research. We will be happy to send you a summary of our findings.

*Who is organising and funding the research?*

The research has been organised by Lynda Teape and Lorna Shelfer as part of their research on the Doctoral Programme in Clinical Psychology. They are supervised by Dr Bundy Mackintosh, an academic research psychologist and Dr Helen Buxton, a clinical psychologist. None of the research team is being paid additionally to their normal salaries. Please contact Lynda Teape or Lorna Shelfer on the email addresses above if you would like any further information.

*Who has reviewed the study?*

The study has been reviewed by the University of East Anglia Research Ethics Committee and given a favourable ethical opinion for conduct at the University.

*If there is a problem:*

If you have a concern about any aspect of the study you should contact Lynda Teape or Lorna Shelfer, Trainee Clinical Psychologists on the contact details above, who will do their best to answer your concerns, or direct you to further sources of help and advice. If you remain unhappy and wish to make a more formal complaint, then you should contact Dr Helen Buxton, Clinical Tutor for the Doctoral Programme in Clinical Psychology on 01603 593 310 who will help you to take the complaint forward.

Although we are not able to make any clinical diagnoses or offer treatment, and this is not the aim of this study, it may become apparent that you are currently experiencing distress. If this is the case, we will provide you with some information and suggest where to seek help.

**This Information Sheet and the Consent Form that follows are for you to keep.**

With many thanks for considering taking part and taking time to read this sheet.

## APPENDIX C

### Power Calculation

Hunter et al. (2006) reported an effect size of 0.89 for a two-way interaction between item valence and mood induction.

$$\eta^2 = \frac{F_{effect}\,df_{effect}}{F_{effect}\,df_{effect} + df_{error}}$$

$$\eta^2 = \frac{5.79 \times 1}{5.79 \times 1 + 35}$$

$$\eta^2 = 0.03$$

Where $\eta^2$ = effect size

$$\phi' = \sqrt{\frac{\eta^2}{1-\eta^2}}$$

$$\phi' = \sqrt{\frac{0.03}{1-0.03}}$$

$$\phi' = 0.176$$

$$\phi = \phi' \sqrt{n}$$

Where $\phi$ =power set to 0.80

$$n = \left(\frac{\phi}{\phi'}\right)^2$$

$$n = 20$$

Therefore 20 participants would be needed in each of the high and low anxious conditions.

APPENDIX D

Demographic Questionnaire

| | | |
|---|---|---|
| Please answer ALL questions in ALL three sections: | | |
| | | |
| | Section one: | |
| 1. | Full Name | |
| 2. | Date of Birth (01/01/1980) | |
| 3. | Gender | |
| 4. | School or Faculty | |
| 5. | Year of Study | |
| 6. | Is English your first language? Or have you spoken English in an English speaking country since the age of 10 years? | |
| 7. | Are you aware that you have any learning or language difficulties (e.g. dyslexia, dysphasia, memory impairments)? | |
| 8. | Do you currently have or have you experienced in | |

| | | |
|---|---|---|
| | the last five years, any form of mental illness whether treated or untreated? | |
| 9. | Have you participated in a psychological study at UEA before? | |
| 10. | If you have answered YES to question 9, please give as much detail as you can about the study, including who ran the experiment, when it was, and what the study was about. | |

APPENDIX E

Short Form MANX

Instructions:

Below are a number of words that describe different feelings or emotions.

Please read each item and then tick the box to the right of the word which best indicates how you **GENERALLY** feel**.** Please do not dwell long on each answer as we are interested in the first response that comes to mind. Just give the answer that best describes your feelings generally. There are no right or wrong answers.

| | | Almost never | Occasionally | Sometimes | Often | Almost always |
|---|---|---|---|---|---|---|
| 1 | interested | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2 | satisfied | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3 | inadequate | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4 | sleepy | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5 | calm | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6 | worried | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7 | energetic | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8 | useful | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9 | optimistic | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10 | a failure | ☐ | ☐ | ☐ | ☐ | ☐ |

APPENDIX F

*S-MCSDS*

|_|_|_|_|_|_|_| ARFNO |_|_|_| SUBNO RBC0140 FORM 02 OCC |_|_|_|_|_|_| DY/MO/YR

**Name:** ________________________________

## SDS

**Listed below are a number of statements concerning personal attitudes. Read each item and circle whether the statement is true or false as it pertains to you personally.**

**T / F** It is sometimes hard for me to go on with my work if I am not encouraged.

**T / F** I sometimes feel resentful when I don't get my way.

**T / F** On a few occasions, I have given up doing something because I thought too little of my ability.

**T / F** There have been times when I felt like rebelling against people in authority even though I knew they were right.

**T / F** No matter who I'm talking to, I'm always a good listener.

**T / F** There have been occasions when I took advantage of someone.

**T / F** I'm always willing to admit it when I make a mistake.

**T / F** I sometimes try to get even, rather than forgive or forget.

**T / F** I am always courteous, even to people who are disagreeable.

**T / F** I have never been irked when people expressed ideas very different from my own.

**T / F** There have been times when I was quite jealous of the good fortune of others.

**T / F** I am sometimes irritated by people who ask favours of me.

**T / F** I have never deliberately said something that hurt someone's feelings.

APPENDIX G

Visual Analogue Scales

*1. Practice Item*

Compared with how you feel generally, how *tired* are you feeling right now?

←less tired than usual more tired than usual→

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| very much less | much less | less | a little bit less | the same | a little bit more | more | much more | very much more |

Please use the mouse to move to a point on the scale and click to record your choice.

--------new page--------

Thank you, this was the practice example.

Please press any key to go on.

--------new page--------

*2. Test Item*

Compared with how you feel generally, how *low/depressed* are you feeling right now?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| very much | much less | less | a little bit | the same | a little bit | more | much | very much |
| less | | | less | | more | | more | more |

Please use the mouse to move to a point on the scale and click to record your choice.

--------new page--------

*3. Test Item*

Compared with how you feel generally, how *sad* are you feeling right now?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| very much | much less | less | a little bit | the same | a little bit | more | much | very much |
| less | | | less | | more | | more | more |

Please use the mouse to move to a point on the scale and click to record your choice.

--------new page--------

*4. Test Item*

Compared with how you feel generally, how *tense* are you feeling right now?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| very much | much less | less | a little bit | the same | a little bit | more | much | very much |
| less | | | less | | more | | more | more |

Please use the mouse to move to a point on the scale and click to record your choice.

--------new page--------

*5. Test Item*

Compared with how you feel generally, how *worried* are you feeling right now?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| very much less | much less | less | a little bit less | the same | a little bit more | more | much more | very much more |

Please use the mouse to move to a point on the scale and click to record your choice.

--------new page--------

*6. Test Item*

Compared with how you feel generally, how *carefree* are you feeling right now?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| very much less | much less | less | a little bit less | the same | a little bit more | more | much more | very much more |

Please use the mouse to move to a point on the scale and click to record your choice.

--------new page--------

*7. Test Item*

Compared with how you feel generally, how *content* are you feeling right now?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| very much | much less | less | a little bit | the same | a little bit | more | much | very much |
| less | | | less | | more | | more | more |

Please use the mouse to move to a point on the scale and click to record your choice.

--------new page--------

*8. Test Item*

Compared with how you feel generally, how *calm* are you feeling right now?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| very much | much less | less | a little bit | the same | a little bit | more | much | very much |
| less | | | less | | more | | more | more |

Please use the mouse to move to a point on the scale and click to record your choice.

--------new page--------

*9. Test Item*

Compared with how you feel generally, how *happy* are you feeling right now?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| very much less | much less | less | a little bit less | the same | a little bit more | more | much more | very much more |

Please use the mouse to move to a point on the scale and click to record your choice.

--------new page--------

Thank you.

# APPENDIX H

## Vignettes and Recognition Sentences Used in the Ambiguous Scenario Method to Assess Interpretation Biases

*Practice Item 1*

| | |
|---|---|
| Title | Walking in the park |
| Line1 | You are walking through the park early on a Sunday morning. |
| Line2 | The sun is shining and as you look around you see children playing |
| Line3 | on the grass.  You begin to tire, so you decide to rest for |
| Line4 | a few minutes while sitting on a |
| Word fragment | b - n c - |
| Completed word | bench |
| Comprehension question | Did you see children in the park? |
| Positive Target | You were walking through the park and sat down to rest |
| Negative Target | You had a picnic in the park one afternoon |
| Positive Foil | You rode your bike through the park on your way home |
| Negative Foil | You were walking through the park when a thunderstorm started |

*Practice Item 2*

| | |
|---|---|
| Title | Getting off the bus |
| Line1 | You are on the bus going to work |
| Line2 | when you see your stop approaching. |
| Line3 | You press the bell and |
| Line4 | get ready to stand up when the bus |
| Word fragment | s t o - p s |

| | |
|---|---|
| Completed word | stops |
| Comprehension question | Were you going to work on the bus? |
| Positive Target | As you stand, the bus comes to a slow halt |
| Negative Target | As you stand, the bus screeches to a halt |
| Positive Foil | As you stand, the bus drives straight past your stop |
| Negative Foil | As you stand, the bus accelerates past your stop |

*Social Threat Item 1*

| | |
|---|---|
| Title | The wedding reception |
| Line1 | Your friend asks you to give a speech at her wedding reception. |
| Line2 | You prepare some remarks and when the time comes, |
| Line3 | get to your feet. As you speak, you notice |
| Line4 | some people in the audience start to |
| Word fragment | l - - g h |
| Completed word | l a u g h |
| Comprehension question | Did you stand up to speak? |
| Positive Target | As you speak, people in the audience laugh appreciatively |
| Negative Target | As you speak, people in the audience find your efforts laughable |
| Positive Foil | As you speak, people in the audience applaud your comments |
| Negative Foil | As you speak, some people in the audience start to yawn in boredom |

*Social Threat Item 2*

| | |
|---|---|
| Title | The local club |
| Line1 | You are invited for a night out at a local club, although you don't |

| | |
|---|---|
| | know |
| Line2 | any of the members very well. As you approach the door |
| Line3 | you can hear loud music and noisy conversation, |
| Line4 | but as you enter the room it is quiet for a |
| Word fragment | m - m - n t |
| Completed word | m o m e n t |
| Comprehension question | Do you know most of the club members? |
| Positive Target | As you enter the room the music stops for a moment. |
| Negative Target | As you enter the room everyone stops and stares at you. |
| Positive Foil | As you enter the room someone greets you warmly. |
| Negative Foil | As you enter the room someone asks you why you are there. |

*Social Threat Item 3*

| | |
|---|---|
| Title | The bus ride |
| Line1 | You get on a bus and find an empty seat next to one |
| Line2 | that has a rip in it. At the next stop several people get on |
| Line3 | that you vaguely recognise, but they sit together |
| Line4 | and the seat next to you remains |
| Word fragment | v - c a - t |
| Completed word | v a c a n t |
| Comprehension question | Were the people who got on strangers to you? |
| Positive Target | The seat next to you remains empty because it looks damaged. |
| Negative Target | The seat next to you is empty because no one wants to sit with you. |
| Positive Foil | The person in the seat next to you talks to you in a friendly way. |

| | |
|---|---|
| Negative Foil | The person in the seat next to you makes a rip in the fabric. |

*Social Threat Item 4*

| | |
|---|---|
| Title | The job interview |
| Line1 | You applied for a job in a company you'd really like to work in. |
| Line2 | You are invited to an interview, where you answer |
| Line3 | the questions as well as you can. Reflecting later, |
| Line4 | you think that the quality of your answers decided the |
| Word fragment | o u - c o m - |
| Completed word | o u t c o m e |
| Comprehension | |
| question | Did you think about your answers later? |
| Positive Target | You think that your astute answers led to you being offered the job. |
| Negative Target | You think that your poor answers lost you the job. |
| Positive Foil | You think it was a good thing you did not take the job. |
| Negative Foil | You think your poor reference must have made a bad impression. |

*Social Threat Item 5*

| | |
|---|---|
| Title | Meeting a friend |
| | In the street, you bump into an old friend you haven't seen for a |
| Line1 | long time. |
| Line2 | She is too busy to stop, so you arrange to meet later in a bar. |
| Line3 | You arrive a little late but the bar is empty |
| Line4 | and a few minutes later she is still not |
| Word fragment | t h - - e |
| Completed word | t h e r e |
| Comprehension | Was anyone else in the bar? |

| | |
|---|---|
| question | |
| Positive Target | You arrange to meet a friend in a bar but your friend is late. |
| Negative Target | You arrange to meet in a bar but your friend stands you up. |
| Positive Foil | You are busy but your friend insists on meeting you in a bar. |
| Negative Foil | Your friend tells you that she does not want to meet you. |

*Social Threat Item 6*

| | |
|---|---|
| Title | Your birthday |
| Line1 | It is your birthday and you wake up looking forward to your day. |
| Line2 | You wonder how many friends will send you a birthday card. |
| Line3 | However, you have to go to work as usual, |
| Line4 | and by the time you leave, no cards have |
| Word fragment | a r r - v - d |
| Completed word | a r r i v e d |
| Comprehension question | Did you have to go to work on your birthday? |
| Positive Target | You have to leave for work before the postman brings your mail. |
| Negative Target | You leave for work realising that no one has sent you a card. |
| Positive Foil | You leave for work feeling pleased with the cards you have received. |
| Negative Foil | You leave for work knowing that it is going to be a stressful day. |

*Social Threat Item 7*

| | |
|---|---|
| Title | Your first painting |
| Line1 | You've taken up painting as a hobby, and have just finished |
| Line2 | your first picture. You hang it on the wall |
| Line3 | when a group of friends visit. Later you overhear your friends |

| | |
|---|---|
| Line4 | making remarks that make clear their opinion of your |
| Word fragment | a b - l - t y |
| Completed word | a b i l i t y |
| Comprehension question | Did you leave the painting on an easel? |
| Positive Target | You overhear some friends saying how much they liked your painting. |
| Negative Target | You overhear some friends making critical remarks about your picture. |
| Positive Foil | You overhear some complimentary remarks about your good taste. |
| Negative Foil | You overhear some friends making fun of something you just said. |

*Social Threat Item 8*

| | |
|---|---|
| Title | The private view |
| Line1 | Your neighbour invites you to a private exhibition of his art. |
| Line2 | You arrive to find many other guests whom you do not know. |
| Line3 | You try talking to some of them, and can see |
| Line4 | how interested they are in your |
| Word fragment | c - - v e r - - t i - n |
| Completed word | c o n v e r s a t i o n |
| Comprehension question | Was the private view at a relative's house? |
| Positive Target | You talk to some guests and can tell that they find you interesting. |
| Negative Target | You talk to some guests but they think what you say is boring. |
| Positive Foil | You meet many guests whom you know and enjoy talking to them. |
| Negative Foil | You don't know anyone there and everyone ignores you completely. |

*Social Threat Item 9*

| | |
|---|---|
| Title | The first aid refresher |
| Line1 | You participate on a first aid refresher course at work. |
| Line2 | The instructor asks a question and no one in the group volunteers an answer, so he looks directly at you. You offer a |
| Line3 | reply, |
| Line4 | thinking about how your answer must be sounding to the |
| Word fragment | o t h - - s |
| Completed word | o t h e r s |
| Comprehension question | Was the refresher course organized by a local charity? |
| Positive Target | You answer the question, thinking that the others may be quite impressed. |
| Negative Target | You answer the question, thinking how ignorant you may seem. |
| Positive Foil | You answer the question, pleased that you have such an interesting teacher. |
| Negative Foil | You answer the question, realising you are irritated by this teaching style. |

*Social Threat Item 10*

| | |
|---|---|
| Title | The joke |
| Line1 | You are with a group of new friends, on your way to an open air concert. |
| Line2 | You decide to tell a joke you heard recently. Everyone looks at you |
| Line3 | as you start telling the joke, and you see |
| Line4 | their expressions change when you get to the punch |
| Word fragment | l - n e |

| | |
|---|---|
| Completed word | l i n e |
| Comprehension question | Did you hear the joke you told quite recently? |
| Positive Target | When you get to the end you see everyone starting to laugh. |
| Negative Target | When you get to the punch line everyone looks confused. |
| Positive Foil | When you get to the end you receive several compliments. |
| Negative Foil | When you start telling your joke someone interrupts you. |

*Physical Threat Item 1*

| | |
|---|---|
| Title | Visiting the doctor |
| Line1 | You have been feeling dizzy occasionally, and decide to get a check-up. |
| Line2 | You make an appointment right away. |
| Line3 | Your doctor takes your blood pressure and listens to your chest, |
| Line4 | and then tells you to relax while giving you his |
| Word fragment | o p - n - o n |
| Completed word | o p i n i o n |
| Comprehension question | Did you delay before going to the doctor? |
| Positive Target | The doctor tells you all is normal and you are in good health. |
| Negative Target | The doctor tells you he has bad news about your health. |
| Positive Foil | The doctor tells you that you have free dental care on your health plan. |
| Negative Foil | The doctor tells you that you will have to pay extra on your health plan. |

*Physical Threat Item 2*

| | |
|---|---|
| Title | Late return home |
| Line1 | Your partner is working late this evening but now it is well past the time |
| Line2 | you were expecting them home. You are thinking about a crash you saw on |
| Line3 | the route your partner drives, when the phone rings. You pick it up and |
| Line4 | find out what had |
| Word fragment | h a - - e n - d |
| Completed word | h a p p e n e d |
| Comprehension question | Did you expect your partner to be late? |
| Positive Target | The phone rings and it is your partner telling you they are nearly home. |
| Negative Target | The phone rings and you are informed your partner is hurt in the accident. |
| Positive Foil | The phone rings and a friend invites you and your partner round for a meal. |
| Negative Foil | The phone rings and a friend tells you about gossip being spread about you. |

*Physical Threat Item 3*

| | |
|---|---|
| Title | Your eye operation |
| Line1 | You're finding that your sight is worse than it was and despite the risks |
| Line2 | you decide to try an experimental laser surgery you've read about. |

| | |
|---|---|
| | Afterwards as the bandages are taken off your eyes, you realise |
| Line3 | your life |
| Line4 | will be affected radically by the |
| Word fragment | r - s u - t |
| Completed word | r e s u l t |
| Comprehension question | Did you read about the laser surgery? |
| Positive Target | You realise that this operation has made your vision perfect |
| Negative Target | You realise that the operation has made your vision much worse |
| Positive Foil | You realise that you are surrounded by gifts from your friends |
| Negative Foil | You realise the operation cost far more than you can afford |

*Physical Threat Item 4*

| | |
|---|---|
| Title | The evening stroll |
| Line1 | You are taking a stroll on a quiet street near where you live. |
| Line2 | As you round the corner you see someone coming towards you on the same side of the road. As you meet, he stares straight at |
| Line3 | you |
| Line4 | and moves closer while raising his |
| Word fragment | h - - d |
| Completed word | h a n d |
| Comprehension question | Was the person on the opposite side of the street? |
| Positive Target | As you meet he waves in recognition and gives you a friendly greeting |
| Negative Target | As you meet he moves closer and raises his fist menacingly |
| Positive Foil | As you meet he tells you how much he and his wife love your |

| | |
|---|---|
| | house |
| Negative Foil | As you meet he mutters obscenities and staggers away drunkenly |

*Physical Threat Item 5*

| | |
|---|---|
| Title | A flight abroad |
| Line1 | You are on your way on holiday abroad. You have been in the air |
| Line2 | for an hour when you hear a change in the sound of the engine |
| Line3 | next to you. The fasten seat-belt sign flashes, |
| Line4 | and you hear the captain begin to make an |
| Word fragment | a n n - - n c - - e n t |
| Completed word | a n n o u n c e m e n t |
| Comprehension question | Did the engine sound different than before? |
| Positive Target | The seat belt light comes on and the captain says there will be turbulence |
| Negative Target | The seat belt light comes on and the captain tells you one engine is failing |
| Positive Foil | The seat belt light comes on and the cabin crew say lunch will be served now |
| Negative Foil | The seat belt light comes on, the cabin crew say you are diverted due to fog |

*Physical Threat Item 6*

| | |
|---|---|
| Title | At home one night |
| Line1 | You are at home alone late one night. You have just |
| Line2 | finished reading and turn out the light to go to sleep. |
| Line3 | While lying in the dark you hear a soft rustling sound |

| | |
|---|---|
| Line4 | coming from just outside your |
| Word fragment | w - - d - w |
| Completed word | w i n d o w |
| Comprehension question | Were you listening to the radio before turning out the light? |
| Positive Target | Lying in bed you hear the sound of a small animal outside your window |
| Negative Target | Lying in bed you hear the sound of someone trying to get in at your window |
| Positive Foil | Lying in bed you hear the sound of birds singing outside your window |
| Negative Foil | Lying in bed you hear a car accident in the street outside your window |

*Physical Threat Item 7*

| | |
|---|---|
| Title | The screening clinic |
| Line1 | You have been offered a routine cancer screening appointment |
| Line2 | at your local health centre. You have an X-ray and some samples |
| Line3 | are taken for tests. While waiting you see the doctor point out something |
| Line4 | on the X-ray plate to the |
| Word fragment | n - r s e |
| Completed word | n u r s e |
| Comprehension question | Were you being screened for cancer? |
| Positive Target | You notice the Doctor pointing out to the nurse that your X-ray is normal. |

| | |
|---|---|
| Negative Target | You notice the Doctor pointing out a tumour on your X-ray to the nurse. |
| Positive Foil | You notice the Doctor pointing out your impressive fitness score. |
| Negative Foil | You notice the Doctor pointing out that you are very unfit. |

*Physical Threat Item 8*

| | |
|---|---|
| Title | Walking home |
| Line1 | You have been visiting some friends in the centre of town, when you |
| Line2 | realise it is getting late. They offer you a lift but you set off on foot. |
| Line3 | Walking through a street that you don't know at all well, you can hear |
| Line4 | someone running up from |
| Word fragment | b e - - n d |
| Completed word | b e h i n d |
| Comprehension question | Did your friends offer you a lift? |
| Positive Target | In the unfamiliar street your friend runs up from behind to walk with you |
| Negative Target | In the unfamiliar street a mugger runs up from behind and threatens you |
| Positive Foil | In the unfamiliar street you think about how much you enjoyed your visit |
| Negative Foil | In the unfamiliar street you think about how bored you were that evening |

*Physical Threat Item 9*

| | |
|---|---|
| Title | The exercise regime |
| Line1 | You decide that you must start to exercise more. |
| Line2 | For the next week you take a little more exercise each day. |
| Line3 | After several weeks, you are running further and decide to see |
| Line4 | how far you can push yourself, when you notice your breathing is |
| Word fragment | l a - o u r - - |
| Completed word | l a b o u r e d |
| Comprehension question | Have you been exercising for several weeks? |
| Positive Target | Running further than usual you have to breath harder and deeper |
| Negative Target | Pushing yourself too hard you cannot get enough air and feel dizzy |
| Positive Foil | Pushing yourself more than usual you feel your running is much easier |
| Negative Foil | You push yourself so hard you strain a muscle and hurt yourself |

*Physical Threat Item 10*

| | |
|---|---|
| Title | The car park |
| Line1 | It is late at night and you are in a multi-storey car park |
| Line2 | trying to find your car. You have been looking for about ten minutes |
| Line3 | and still cannot find it. You hear a noise behind you |
| Line4 | and see a shadow of |
| Word fragment | s o - e t h - - g |
| Completed word | s o m e t h i n g |
| Comprehension question | Did you find your car right away? |

| | |
|---|---|
| Positive Target | You see a security person approaching to help you. |
| Negative Target | You see someone coming towards you looking threatening. |
| Positive Foil | You see some money on the floor and pick it up. |
| Negative Foil | You see that you have forgotten your ticket and will have to pay a fine. |

APPENDIX I

Participant Consent Form

# CONSENT FORM

Participant identification number for this trial:

Title of Project: ***Clinical Psychology Research Project***

Chief Investigator: Lorna Shelfer

**Please initial box:**

1. I confirm that I have read and understand the information sheet dated DATE for the above study and have had the opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my studies at the University of East Anglia or my legal rights being affected. ☐
3. I agree to take part in the above study.

| ____________________ | ____________ | ______________ |
|---|---|---|
| **Name of participant** | Date | Signature |
| ____________________ | ____________ | ______________ |
| **Researcher** | Date | Signature |

APPENDIX J

Mental Health Information Sheet

**Information for Students**

Being a student can be a very exciting time, but it can also bring with it a number of different stresses. You may be away from home, all your friends and family for the first time, in a new city and trying to make new friends. You may be experiencing financial difficulties or struggling with the academic pressures of the course. Many people at some point in their lives have found that they would benefit some support or advice to help them through a difficult period.

There are a number of places that you can access support and advice at these times. Many of the organisations we have listed below have a range of services available, including on-line information, telephone help lines and face-to-face counselling.

**If your are concerned...**
If you are concerned about your own emotional well-being or mental health, or that of someone close to you, please do talk to your GP who will be able to help.

**Norwich Mind**
www.norwichmind.org.uk
Norwich Mind is a highly regarded provider of mental health services in the City of Norwich and in the Central area of Norfolk. The services are easy to access and many can be delivered to people in a place of their choosing.
If you need assistance and you reside in Norfolk, you can contact their Advice Service, Mind Body & Soul, on 01603 432457 or by email at mbs@norwichmind.org.uk

If you are caring for someone with a mental health problem you can contact their Carer Support Service on 01603 432457.

**rethink**
www.rethink.org
rethink is an organisation that provides information and a range of services to individuals nationwide. Their website provides information for people experiencing mental health problems, their carers and those working and volunteering in mental health services. They also provide information and links to services available in your area.

Contact details:

Rethink general enquiries
Telephone: 0845 456 0455 or email:info@rethink.org

National advice service
Telephone: 0207 840 3188 (open 10am to 3pm Monday, Wednesday & Friday; 10am to 1pm Tuesday & Thursday) or e-mail: advice@rethink.org

**University of East Anglia Counselling Services**
http://www1.uea.ac.uk/cm/home/services/students/ucs
The University Counselling Service is part of Student Services and their aim is to enable students to achieve their academic and personal goals by providing confidential counselling and support for any difficulties encountered while at UEA.
In addition to providing one-to-one counselling, the Counselling Service also offers group work and workshops to both students and staff. They work closely with other support services to provide an integrated service.
The Counselling Service website contains information, including links to online cognitive behavioural courses and guides to managing commonly experienced difficulties such as stress and perfectionism.

**Samaritans**
www.samaritans.org.uk
The Samaritans provides confidential non-judgemental emotional support, 24 hours a day for people who are experiencing feelings of distress or despair, including those which could lead to suicide.
They offer their service by telephone, email, letter and face to face in most of their branches.
08457 90 90 90
jo@samaritans.org
19 St. Stephen's Square, Norwich, Norfolk
NR1 3SS
United Kingdom
Phone: (08457) 90 90 90

**Mental Health Care**
www.mentalhealthcare.org.uk
A useful web-based resource containing mental health information for friends, family and carers. It contains information about mental health and mental illness, research findings from the Institute of Psychiatry and South London and Maudsley NHS Foundation Trust and personal stories written by carers. There are also links to other organisations and local services in your area.

**Bridge**
BRIDGES is a drop-in centre for people with mental health issues. The Centre is open to anyone over 16 years old without referral. The Centre offers companionship and mutual support, a choice of activities and gives members a full say in how the centre operates with the opportunity to be involved in the everyday running of the centre.
52 Magdalen Road
Norwich
NR3 4AQ
01603 403411
bridges@rethink.org

APPENDIX K

Initial Ethical Approval

**Institute of Health**
**Finance and Research Offices**

UEA NORWICH

Miss Lorna Shelfer
Doctorate in Clinical Psychology
Room 2.01
Elizabeth Fry Building
UEA
Norwich
NR4 7TJ

**University of East Anglia**
Norwich NR4 7TJ England

*Finance Telephone*
01603 593028
Research Telephone
01603 591720
*Fax*
01603 591132

1st August 2008

Dear Lorna,

**The effects of induced anxiety on interpretation biases in high and low anxious participants – 2008030**

The resubmission of your above proposal has now been considered by the Chair of the FOH Ethics Committee. We can now confirm that your proposal has now been approved.

Please could you ensure that any amendments to either the protocol or documents submitted are notified to us in advance and also that any adverse events which occur during your project are reported to the committee. Please could you also arrange to send us a report once your project is complete.

The committee would like to wish you good luck with your project.

Yours sincerely

DGraver

Debbie Graver
Notetaker
Faculty of Health Ethics Committee
Tel: 01603 591023
Email: Deborah.Graver@uea.ac.uk

APPENDIX L

Ethical Approval For Amendments

**Institute of Health**
**Finance and Research Offices**

UEA NORWICH

**University of East Anglia**
Norwich NR4 7TJ England

*Finance Telephone*
01603 593028
Research Telephone
01603 591720
*Fax*
01603 591132

Miss Lorna Shelfer
Doctorate in Clinical Psychology
Room 2.01
Elizabeth Fry Building
UEA
Norwich
NR4 7TJ

22nd October 2008

Dear Lorna,

**The effects of induced anxiety on interpretation biases in high and low anxious participants – 2008030**

The amendments to your above proposal has now been considered by the Chair of the FOH Ethics Committee. We can now confirm that your proposal has now been approved.

Please could you ensure that any amendments to either the protocol or documents submitted are notified to us in advance and also that any adverse events which occur during your project are reported to the committee. Please could you also arrange to send us a report once your project is complete.

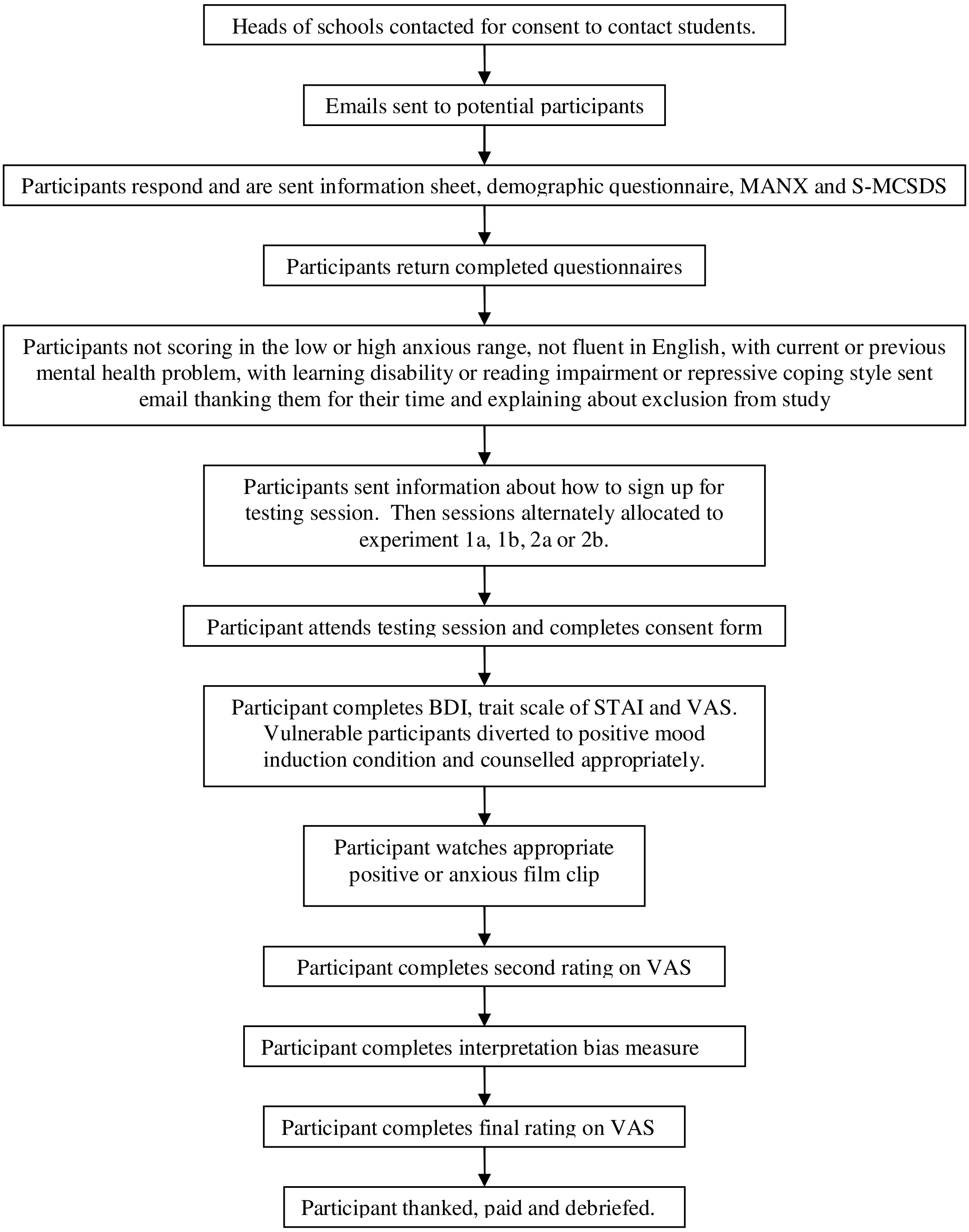
The committee would like to wish you good luck with your project.

Yours sincerely

Debbie Graver
Notetaker
Faculty of Health Ethics Committee
Tel: 01603 591023
Email: Deborah.Graver@uea.ac.uk

APPENDIX M

Flow Diagram For Procedure



APPENDIX N

E-mail to Potential Participants Meeting the Inclusion Criteria

Hi [###],

Thank you for your interest, and for completing the screening questionnaires.

I'm pleased to tell you that you are eligible to participate in the study.

All you need to do now is go to the following website: http://uea-uk.sona-systems.com/ and sign up for an account (if you don't already have one) by clicking the link on the left hand side of the page.

When you have your login and password, login to the website and click on the tab that says 'studies' at the top of the page. Click on the link that says 'timeslots available' for our study (look for the study title "the effects on comprehension of viewing emotional films").

At the bottom of the page click 'view timeslots for this study'. Choose a timeslot that is convenient for you. You will need a code to be able to sign up for a time slot.

Please enter the code **kas4892y**

Then click 'sign up'.

If you cannot find a suitable time, please contact me to arrange a more convenient time.

Any problems, please let me know.

Best wishes

Lorna Shelfer

## APPENDIX O

### E-mail to Potential Participants Not Meeting the Inclusion Criteria

Dear [###]

Thank you for your interest in the above study and for taking the time to complete the initial questionnaires.

Unfortunately, we will not be inviting you to attend for the testing session as we now have enough participants with a similar profile to yourself for this section of the study.

However, the cognition and emotion research group are running a number of studies at present, which you may be eligible for. If you would be interested in participating in other studies then please go to www.uea.ac.uk/med-swp-research where you can find out more.

We would like to store the information from your screening questionnaires, along with your contact details in order that we may invite you to participate in further studies being conducted by the cognition and emotion group over the next year.

Please do let us know if you would prefer not to be invited for future studies.

Best wishes

Lorna Shelfer

Trainee Clinical Psychologist

## APPENDIX P

### Pilot of Cognitive Load Procedure

An opportunistic sample of four participants took part in a pilot of part 1 of the interpretation bias test with the addition of the cognitive load. Data regarding the number of times the digit string was correctly and incorrectly recalled, along with data regarding the number of times the comprehension question was answered correctly or incorrectly can be found in table P1 below.

Table P1: Digit string recall data and comprehension question data for cognitive load pilot.

| | Digit string recall | | Comprehension question | |
|---|---|---|---|---|
| Participant | Correct | Incorrect | Correct | Incorrect |
| 1 | 4 | 16 | 19 | 1 |
| 2 | 20 | 0 | 19 | 1 |
| 3 | 15 | 5 | 20 | 0 |
| 4 | 18 | 2 | 20 | 0 |

Whilst it can be seen that three out of four participants recalled at least 75% of the digit strings correctly, one recalled less than 25% correctly. However, on closer inspection of the data for this participant it can be seen that most digit strings contain at least two correct digits out of four, and that some of these contain four correct digits, transposed to make the response incorrect. It therefore seems apparent that even this participant made a good *attempt* to remember the digit strings. It also seems clear that all participants were able to attend to both remembering the digit strings and processing the content of the vignettes, as all achieved near perfect scores on the comprehension questions.

APPENDIX Q

Analyses of High NA Data for Experiment 1a

Table Q1: Descriptive statistics for high NA data for the high and low anxious participants at times 1, 2 and 3 in experiment 1a.

| Group | Time | Mean | SD | N |
|---|---|---|---|---|
| High anxious | 1 | 0.46 | 0.157 | 15 |
| | 2 | 0.64 | 0.107 | 15 |
| | 3 | 0.51 | 0.157 | 15 |
| Low anxious | 1 | 0.50 | 0.128 | 20 |
| | 2 | 0.64 | 0.187 | 20 |
| | 3 | 0.51 | 0.121 | 20 |

Table Q2: Mixed model ANOVA for high NA data in experiment 1a.

| Within-subjects effects | | | | | | |
|---|---|---|---|---|---|---|
| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
| Time | 0.519 | 2 | 0.260 | 13.499 | .000** | 0.96 |
| Time x Anxiety | 0.006 | 2 | 0.003 | 0.164 | .849 | 0.38 |
| Error(Time) | 1.269 | 66 | 0.019 | | | |
| Between-subjects effects | | | | | | |
| Anxiety | 0.005 | 1 | 0.005 | 0.344 | .561 | 0.17 |
| Error | 0.480 | 33 | 0.015 | | | |

*significant at $p < .05$

**significant at $p < .01$

APPENDIX R

Analyses of Low NA Data for Experiment 1a

Table R1: Descriptive statistics for low NA data for the high and low anxious participants at times 1, 2 and 3 in experiment 1a.

| Group | Time | Mean | SD | N |
|---|---|---|---|---|
| High anxious | 1 | 0.56 | 0.137 | 15 |
| | 2 | 0.40 | 0.067 | 15 |
| | 3 | 0.49 | 0.117 | 15 |
| Low anxious | 1 | 0.52 | 0.084 | 20 |
| | 2 | 0.38 | 0.094 | 20 |
| | 3 | 0.51 | 0.082 | 20 |

Table R2: Mixed model ANOVA for low NA data in experiment 1a.

| Within-subjects effects | | | | | | |
|---|---|---|---|---|---|---|
| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
| Time | 0.409 | 2 | 0.204 | 27.214 | .000** | 0.98 |
| Time x Anxiety | 0.011 | 2 | 0.006 | 0.764 | .470 | 0.66 |
| Error(Time) | 0.496 | 66 | 0.008 | | | |
| Between-subjects effects | | | | | | |
| Anxiety | 0.005 | 1 | 0.005 | 0.383 | .540 | 0.53 |
| Error | 0.455 | 33 | 0.014 | | | |

*significant at $p < .05$

**significant at $p < .01$

APPENDIX S

Analyses of Interpretation Bias Data for Experiment 1a

Table S1: Descriptive statistics for recognition interpretation bias data for all participants in experiment 1a.

| Anxiety | Item | Test half | Mean | SD | N |
|---|---|---|---|---|---|
| High anxious | Positive target | 1 | 2.44 | 0.466 | 15 |
| | | 2 | 2.56 | 0.510 | 15 |
| | Positive foil | 1 | 1.44 | 0.280 | 15 |
| | | 2 | 1.53 | 0.367 | 15 |
| | Negative target | 1 | 2.61 | 0.443 | 15 |
| | | 2 | 2.67 | 0.478 | 15 |
| | Negative foil | 1 | 1.39 | 0.308 | 15 |
| | | 2 | 1.47 | 0.381 | 15 |
| Low anxious | Positive target | 1 | 2.60 | 0.201 | 20 |
| | | 2 | 2.85 | 0.429 | 20 |
| | Positive foil | 1 | 1.70 | 0.320 | 20 |
| | | 2 | 1.63 | 0.342 | 20 |
| | Negative target | 1 | 2.65 | 0.523 | 20 |
| | | 2 | 2.69 | 0.609 | 20 |
| | Negative foil | 1 | 1.54 | 0.375 | 20 |
| | | 2 | 1.64 | 0.383 | 20 |

Table S2: Mixed model ANOVA for recognition data for experiment 1a.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| **Within-subjects effects** | | | | | | |
| Test half | 0.08 | 1 | 0.08 | 0.71 | .405 | 0.64 |
| Test half x anxiety group | 0.16 | 1 | 0.16 | 1.36 | .251 | 0.76 |
| Error (test half) | 3.81 | 33 | 0.12 | | | |
| Item valence | 0.24 | 1 | 0.24 | 0.77 | .387 | 0.66 |
| Item valence x anxiety group | 0.00 | 1 | 0.00 | 0.00 | .966 | 0.00 |
| Error (item valence) | 10.44 | 33 | 0.32 | | | |
| Item type | 73.99 | 1 | 73.99 | 467.54 | .00** | 1.00 |
| Item type x anxiety group | 0.06 | 1 | 0.06 | 0.36 | .554 | 0.51 |
| Error (item type) | 5.22 | 33 | 0.16 | | | |
| Test half x item valence | 0.28 | 1 | 0.28 | 2.59 | .117 | 0.85 |
| Test half x item valence x anxiety group | 0.20 | 1 | 0.20 | 1.84 | .184 | 0.80 |
| Error (test half x item valence) | 3.50 | 33 | 0.11 | | | |
| Test half x item type | 0.02 | 1 | 0.02 | 0.27 | .604 | 0.46 |
| Test half x item type x anxiety group | 0.45 | 1 | 0.45 | 7.13 | .012* | 0.94 |
| Error (test half x item type) | 2.01 | 33 | 0.06 | | | |
| Item valence x item type | 0.00 | 1 | 0.00 | 0.00 | .961 | 0.00 |
| Item valence x item type x anxiety group | 0.00 | 1 | 0.01 | 0.06 | .809 | 0.24 |
| Error (item valence x item type) | 2.64 | 33 | 0.08 | | | |
| Test half x item valence x item type | 0.73 | 1 | 0.73 | 7.44 | .010* | 0.94 |
| Test half x item valence x item type x anxiety group | 0.01 | 1 | 0.01 | 0.08 | .784 | 0.27 |
| Error (test half x item valence x item type) | 3.22 | 33 | 0.10 | | | |
| **Between-subjects effects** | | | | | | |
| Anxiety | 2.652 | 1 | 2.652 | 4.810 | .035* | 0.91 |
| Error | 18.20 | 33 | 0.55 | | | |

*significant at p < .05

**significant at p < .01

TableS3: 2x2 repeated measures ANOVA for target items with item valence and test half as the within subjects factors for experiment 1a.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| Item valence | 0.11 | 1 | 0.11 | 0.40 | .533 | 0.53 |
| Error (item valence) | 9.81 | 34 | 0.29 | | | |
| Test half | 0.05 | 1 | 0.05 | 0.48 | .492 | 0.57 |
| Error (test half) | 3.40 | 34 | 0.10 | | | |
| Valence x test half | 0.86 | 1 | 0.86 | 5.47 | .025* | 0.92 |
| Error (Valence x test half) | 5.38 | 34 | 0.16 | | | |

*significant at p < .05

TableS4: 2x2 repeated measures ANOVA for foil items with item valence and test half as the within subjects factors for experiment 1a.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| Item valence | 0.14 | 1 | 0.14 | 1.44 | .239 | 0.77 |
| Error (item valence) | 3.27 | 34 | 0.10 | | | |
| Test half | 0.07 | 1 | 0.07 | 0.81 | .376 | 0.67 |
| Error (test half) | 3.09 | 34 | 0.09 | | | |
| Valence x test half | 0.07 | 1 | 0.07 | 1.61 | .213 | 0.79 |
| Error (Valence x test half) | 1.55 | 34 | 0.05 | | | |

APPENDIX T

Analyses of High PA Data for Experiment 1b

Table T1: Descriptive statistics for high PA data for the high and low anxious participants at times 1, 2 and 3 for experiment 1b.

| Group | Time | Mean | SD | N |
|---|---|---|---|---|
| High anxious | 1 | 0.48 | 0.134 | 17 |
| | 2 | 0.61 | 0.139 | 17 |
| | 3 | 0.46 | 0.077 | 17 |
| Low anxious | 1 | 0.53 | 0.134 | 21 |
| | 2 | 0.63 | 0.131 | 21 |
| | 3 | 0.49 | 0.051 | 21 |

Table T2: Mixed model ANOVA for high PA data for experiment 1b.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| Within-subjects effects | | | | | | |
| Time | 0.453 | 1 | 0.226 | 25.109 | .000** | 0.98 |
| Time x Anxiety | 0.005 | 2 | 0.003 | 0.305 | .738 | 0.48 |
| Error(Time) | 0.649 | 72 | 0.009 | | | |
| Between-subjects effects | | | | | | |
| Anxiety | 0.031 | 1 | 0.031 | 1.394 | .246 | 0.76 |
| Error | 0.798 | 36 | 0.022 | | | |

*significant at $p < .05$

**significant at $p < .01$

APPENDIX U

Analyses of Low PA Data for Experiment 1b

Table U1: Descriptive statistics for low PA data for the high and low anxious participants at times 1, 2 and 3 for experiment 1b.

| Group | Time | Mean | SD | N |
|---|---|---|---|---|
| High anxious | 1 | 0.54 | 0.154 | 17 |
| | 2 | 0.37 | 0.118 | 17 |
| | 3 | 0.51 | 0.075 | 17 |
| Low anxious | 1 | 0.45 | 0.110 | 21 |
| | 2 | 0.36 | 0.124 | 21 |
| | 3 | 0.49 | 0.033 | 21 |

Table U2: Mixed model ANOVA for low PA data for experiment 1b.

| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
|---|---|---|---|---|---|---|
| Within-subjects effects | | | | | | |
| Time | 0.417 | 2 | 0.209 | 26.320 | .000** | 0.98 |
| Time x Anxiety | 0.033 | 2 | 0.016 | 2.079 | .133 | 0.82 |
| Error(Time) | 0.571 | 72 | 0.008 | | | |
| Between-subjects effects | | | | | | |
| Anxiety | 0.044 | 1 | 0.044 | 2.299 | .138 | 0.83 |
| Error | 0.696 | 36 | 0.019 | | | |

*significant at p < .05

**significant at p < .01

APPENDIX V

Analyses of Interpretation Bias Data for Experiment 1b

Table V1: Descriptive statistics for recognition interpretation bias data for all participants in experiment 1b. Item type distinction not included as no item type interactions observed.

| Anxiety | Item valence | Test half | Mean | SD | N |
|---|---|---|---|---|---|
| High anxious | Positive | 1 | 2.02 | 0.337 | 17 |
| | | 2 | 2.04 | 0.386 | 17 |
| | Negative | 1 | 2.10 | 0.348 | 17 |
| | | 2 | 2.12 | 0.373 | 17 |
| Low anxious | Positive | 1 | 2.61 | 0.424 | 21 |
| | | 2 | 2.42 | 0.436 | 21 |
| | Negative | 1 | 2.08 | 0.394 | 21 |
| | | 2 | 2.02 | 0.370 | 21 |

Table V2: Mixed model ANOVA for recognition data in experiment 1b.

| Within-subjects effects | | | | | | |
|---|---|---|---|---|---|---|
| Effect | Sum of squares | df | Mean square | F | Sig. | Effect size |
| Test half | 0.18 | 1 | 0.18 | 2.49 | .123 | 0.84 |
| Test half x anxiety group | 0.03 | 1 | 0.03 | 0.37 | .55 | 0.52 |
| Error (test half) | 0.03 | 1 | 0.03 | | | |
| Item valence | 1.52 | 1 | 1.52 | 4.90 | .033* | 0.911 |
| Item valence x anxiety group | 2.31 | 1 | 2.31 | 7.46 | .010* | 0.94 |
| Error (item valence) | 11.16 | 36 | 0.31 | | | |
| Item type | 79.59 | 1 | 79.59 | 327.51 | .000** | 1.0 |
| Item type x anxiety group | 0.16 | 1 | 0.16 | 0.67 | .419 | 0.63 |
| Error (item type) | 8.75 | 36 | 0.24 | | | |
| Test half x item valence | 0.38 | 1 | 0.38 | 5.39 | .026* | 0.92 |
| Test half x item valence x anxiety group | 0.02 | 1 | 0.02 | 0.29 | .594 | 0.47 |
| Error (test half x item valence) | 2.52 | 36 | 0.07 | | | |
| Test half x item type | 0.01 | 1 | 0.01 | 0.06 | .802 | 0.24 |
| Test half x item type x anxiety group | 0.05 | 1 | 0.05 | 0.57 | .456 | 0.60 |
| Error (test half x item type) | 3.25 | 36 | 0.09 | | | |
| Item valence x item type | 0.16 | 1 | 0.16 | 2.58 | .117 | 0.85 |
| Item valence x item type x anxiety group | 0.00 | 1 | 0.00 | 0.00 | .951 | 0.00 |
| Error (item valence x item type) | 2.24 | 36 | 0.06 | | | |
| Test half x item valence x item type | 0.01 | 1 | 0.01 | 0.26 | .614 | 0.45 |
| Test half x item valence x item type x anxiety group | 0.00 | 1 | 0.00 | 0.04 | .836 | 0.20 |
| Error (test half x item valence x item type) | 1.92 | 36 | 0.05 | | | |
| Between-subjects effects | | | | | | |
| Anxiety | 0.97 | 1 | 0.97 | 1.3 | .264 | 0.75 |
| Error | 26.95 | 36 | 0.75 | | | |

*significant at p < .05

**significant at p < .01

APPENDIX W

Correlations Between Items High and Low in NA from Visual Analogue Scale at Times 1, 2 and 3 for Experiment 2a

Table W1: Analyses of normality of items high and low in NA at times 1, 2 and 3 in experiment 2a.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Item | Time | Statistic | df | Sig. |
| Worried | 1 | 0.941 | 49 | .016* |
| | 2 | 0.882 | 49 | .000* |
| | 3 | 0.911 | 49 | .001* |
| Tense | 1 | 0.902 | 49 | .001* |
| | 2 | 0.956 | 49 | .065 |
| | 3 | 0.958 | 49 | .077 |
| Calm | 1 | 0.929 | 49 | .006* |
| | 2 | 0.977 | 49 | .460 |
| | 3 | 0.905 | 49 | .001* |
| Content | 1 | 0.911 | 49 | .001* |
| | 2 | 0.928 | 49 | .005* |
| | 3 | 0.926 | 49 | .004* |

*significant at $p < .01$

Table W2: Analyses of skew and kurtosis for items high and low in NA at times 1, 2 and 3 in experiment 2a.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Item | Time | Mean | SD | Statistic | SE | Statistic | SE |
| Worried | 1 | 0.51 | 0.18 | -0.391 | 0.340 | 1.114 | 0.668 |
| | 2 | 0.48 | 0.23 | 0.790* | 0.340 | 4.400* | 0.668 |
| | 3 | 0.48 | 0.14 | -0.991* | 0.340 | 2.310* | 0.668 |
| Tense | 1 | 0.50 | 0.18 | -1.022* | 0.340 | 1.191 | 0.668 |
| | 2 | 0.52 | 0.22 | 0.082 | 0.340 | -0.679 | 0.668 |
| | 3 | 0.53 | 0.16 | -0.543 | 0.340 | 1.707* | 0.668 |
| Calm | 1 | 0.50 | 0.17 | 0.601 | 0.340 | 0.769 | 0.668 |
| | 2 | 0.44 | 0.20 | 0.404 | 0.340 | 0.158 | 0.668 |
| | 3 | 0.47 | 0.14 | 0.721* | 0.340 | 3.404* | 0.668 |
| Content | 1 | 0.55 | 0.17 | 0.627 | 0.340 | 1.229 | 0.668 |
| | 2 | 0.51 | 0.17 | 0.578 | 0.340 | 1.463* | 0.668 |
| | 3 | 0.50 | 0.12 | -0.014 | 0.340 | 2.209* | 0.668 |

*Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

APPENDIX X

Normality Checks for the High NA Data at Times 1, 2 and 3 for Experiment 2a

The high NA data was checked for normality using the Shapiro-Wilk test as the number of participants was less than 2000 (Field, 2005). This showed that for the high anxious participants, the high NA data were not normally distributed at time 2 and for the low anxious participants that data was not normally distributed at time 1 (table X1). For the high anxious participants, significant skew and kurtosis was also found for the high NA data at time 2. For the low anxious participants, significant skew was also found at time 1 (table X2; Wald criterion of skew or kurtosis statistic more than twice the standard error).

Table X1: Analyses of normality of high NA at times 1, 2 and 3 for experiment 2a.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Group | Time | Statistic | df | Sig. |
| High anxious | 1 | 0.916 | 11 | .291 |
| | 2 | 0.844 | 11 | .036* |
| | 3 | 0.920 | 11 | .323 |
| Low anxious | 1 | 0.805 | 13 | .008** |
| | 2 | 0.914 | 13 | .207 |
| | 3 | 0.970 | 13 | .894 |

*significant at $p < .05$

**significant at $p < .01$

Table X2: Analyses of skew and kurtosis for high NA at times 1, 2 and 3 for experiment 2a.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Group | Time | Mean | SD | Statistic | SE | Statistic | SE |
| High | 1 | 0.57 | 0.11 | 0.237 | 0.661 | -0.139 | 1.279 |
| anxious | 2 | 0.65 | 0.21 | -1.645* | 0.661 | 3.947* | 1.279 |
| | 3 | 0.51 | 0.14 | -0.512 | 0.661 | -0.810 | 1.279 |
| Low | 1 | 0.44 | 0.18 | -1.486* | 0.616 | 1.860 | 1.191 |
| anxious | 2 | 0.65 | 0.18 | 0.106 | 0.616 | -1.387 | 1.191 |
| | 3 | 0.58 | 0.10 | 0.039 | 0.616 | -0.403 | 1.191 |

*Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

As the data were differentially skewed for the two anxiety groups it was not possible to transform it without biasing the data . Therefore two of three identified outliers were changed to the mean plus or minus two standard deviations (Field, 2005). The third outlier was not changed as to do so would have decreased the raw score further. The new scores are shown in table X3.

Table X3: Identified outliers and their transformation in high NA data at times 1, 2 and 3 for experiment 2a.

| Group | Time | Outlier case no. | Raw score | Mean | SD | Transformed score |
|---|---|---|---|---|---|---|
| High anxious | 2 | 44 | 0.12 | 0.65 | 0.21 | 0.23 |
| Low | 1 | 33 | 0.13 | 0.44 | 0.18 | 0.13 |
| anxious | 1 | 49 | 0.01 | 0.44 | 0.18 | 0.08 |

The normality tests were re-run but the high NA data at time 1 for the low anxious participants was still shown to be non-normal with significant skew. As recommended by Tabachnick and Fidell (2007) this process was carried out a further two times (tables X4 and X5) but the data still showed significant non-normality, skew and kurtosis (tables X6 and X7).

Table X4: Identified outliers and their second transformation in high NA data at times 1, 2 and 3 for experiment 2a.

| Group | Time | Outlier case no. | Raw score | Mean | SD | Transformed score |
|---|---|---|---|---|---|---|
| High anxious | 2 | 44 | 0.23 | 0.66 | 0.18 | 0.30 |
| Low | 1 | 33 | 0.13 | 0.44 | 0.17 | 0.13 |
| anxious | 1 | 49 | 0.08 | 0.44 | 0.17 | 0.09 |

Table X5: Identified outliers and their third transformation in high NA data at times 1, 2 and 3 for experiment 2a.

| Group | Time | Outlier case no. | Raw score | Mean | SD | Transformed score |
|---|---|---|---|---|---|---|
| High anxious | 2 | 44 | 0.30 | 0.67 | 0.17 | 0.32 |
| Low | 1 | 33 | 0.13 | 0.44 | 0.17 | 0.13 |
| anxious | 1 | 49 | 0.09 | 0.44 | 0.17 | 0.09 |

Table X6: Analyses of normality of high NA at times 1, 2 and 3 following removal of outliers for experiment 2a.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Group | Time | Statistic | df | Sig. |
| High anxious | 1 | 0.916 | 11 | .291 |
| | 2 | 0.898 | 11 | .177 |
| | 3 | 0.920 | 11 | .323 |
| Low anxious | 1 | 0.816 | 13 | .011* |
| | 2 | 0.914 | 13 | .207 |
| | 3 | 0.970 | 13 | .894 |

*significant at p < .05

Table X7: Analyses of skew and kurtosis for high NA at times 1, 2 and 3 following removal of outliers for experiment 2a.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Group | Time | Mean | SD | Statistic | SE | Statistic | SE |
| High anxious | 1 | 0.57 | 0.11 | 0.237 | 0.661 | -0.139 | 1.279 |
| | 2 | 0.66 | 0.18 | -1.180 | 0.661 | 2.339 | 1.279 |
| | 3 | 0.51 | 0.14 | -0.512 | 0.661 | -0.810 | 1.279 |
| Low anxious | 1 | 0.44 | 0.17 | -1.284* | 0.616 | 1.118 | 1.191 |
| | 2 | 0.65 | 0.18 | 0.106 | 0.616 | -1.387 | 1.191 |
| | 3 | 0.58 | 0.10 | 0.039 | 0.616 | -0.403 | 1.191 |

*Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

As this was probably due to the difficulty replacing one of the identified outliers with the mean plus or minus two standard deviations a different method (replacing the outliers with the next nearest value) was used (table X8). The normality tests were re-run and although the normality test was still significant for the low anxious participants at time 1, no significant skew or kurtosis was found (tables X9 and X10). As skew is considered to be the most important statistic when assessing normality it was considered appropriate to use a parametric test.

Table X8: Identified outliers and their fourth transformation using the series mean method in high NA data at times 1, 2 and 3 for experiment 2a.

| Group | Time | Outlier case no. | Raw score | Nearest score |
|---|---|---|---|---|
| High anxious | 2 | 44 | 0.12 | 0.54 |
| Low anxious | 1 | 33 | 0.13 | 0.37 |
| | 1 | 49 | 0.01 | 0.37 |

Table X9: Analyses of normality of high NA at times 1, 2 and 3 following removal of outliers using series mean method for experiment 2a.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Group | Time | Statistic | df | Sig. |
| High anxious | 1 | 0.916 | 11 | .291 |
| | 2 | 0.909 | 11 | .240 |
| | 3 | 0.920 | 11 | .323 |
| Low anxious | 1 | 0.855 | 13 | .033* |
| | 2 | 0.914 | 13 | .207 |
| | 3 | 0.970 | 13 | .894 |

*significant at $p < .05$

Table X10: Analyses of skew and kurtosis for high NA at times 1, 2 and 3 following removal of outliers using series mean method for experiment 2a.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Group | Time | Mean | SD | Statistic | SE | Statistic | SE |
| High anxious | 1 | 0.57 | 0.11 | 0.237 | 0.661 | -0.139 | 1.279 |
| | 2 | 0.69 | 0.12 | 0.404 | 0.661 | -1.281 | 1.279 |
| | 3 | 0.51 | 0.14 | -0.512 | 0.661 | -0.810 | 1.279 |
| Low anxious | 1 | 0.48 | 0.09 | 0.175 | 0.616 | -0.606 | 1.191 |
| | 2 | 0.65 | 0.18 | 0.106 | 0.616 | -1.387 | 1.191 |
| | 3 | 0.58 | 0.10 | 0.039 | 0.616 | -0.403 | 1.191 |

*Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

The high NA met the criterion of homogeneity of variance assumption as assessed by the Levene statistic (Table X11).

Table X11: Levene statistic to assess homogeneity of variance in the high NA data in experiment 2a.

| Time | Levene statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| 1 | 0.874 | 1 | 22 | .360 |
| 2 | 1.960 | 1 | 22 | .175 |
| 3 | 2.003 | 1 | 22 | .171 |

APPENDIX Y

Normality Checks for the Low NA Data at Times 1, 2 and 3 for Experiment 2a

Table Y1: Analyses of normality of low NA at times 1, 2 and 3 in experiment 2a.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Group | Time | Statistic | df | Sig. |
| High anxious | 1 | 0.956 | 11 | .724 |
| | 2 | 0.960 | 11 | .775 |
| | 3 | 0.935 | 11 | .463 |
| Low anxious | 1 | 0.868 | 13 | .050 |
| | 2 | 0.975 | 13 | .942 |
| | 3 | 0.938 | 13 | .437 |

Table Y2: Analyses of skew and kurtosis for low NA at times 1, 2 and 3 in experiment 2a.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Group | Time | Mean | SD | Statistic | SE | Statistic | SE |
| High | 1 | 0.49 | 0.08 | 0.094 | .661 | 1.545 | 1.279 |
| anxious | 2 | 0.39 | 0.10 | .051 | 0.661 | -0.895 | 1.279 |
| | 3 | 0.51 | 0.09 | 0.845 | 0.661 | 0.400 | 1.279 |
| Low | 1 | 0.58 | 0.13 | 1.178 | 0.616 | 0.936 | 1.191 |
| anxious | 2 | 0.40 | 0.11 | 0.306 | 0.616 | 0.532 | 1.191 |
| | 3 | 0.47 | 0.07 | -0.746 | 0.616 | 0.435 | 1.191 |

Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

The low NA data met the criterion of homogeneity of variance at times 1, 2 and 3 as assessed by the Levene statistic (Table Y3).

Table Y3: Levene statistic to assess homogeneity of variance in the low NA data in experiment 2a.

| Time | Levene statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| 1 | 1.525 | 1 | 22 | .230 |
| 2 | 0.002 | 1 | 22 | .964 |
| 3 | 0.357 | 1 | 22 | .556 |

APPENDIX Z

Normality Checks on the Cognitive Load Accuracy Data for Experiment 2a

The data was checked for normality using the Shapiro-Wilk test as the number of participants was less than 2000 (Field, 2005). No evidence of non-normality, skew or kurtosis was found.

Table Z1: Normality checks on the cognitive load accuracy data for experiment 2a.

| | Shapiro-Wilk | | |
|---|---|---|---|
| Inaccurate digit string recall | Statistic | df | Sig. |
| Low anxious group | 0.897 | 13 | .120 |
| High anxious group | 0.920 | 11 | .317 |

TableZ2: Analysis of skew and kurtosis for the cognitive load accuracy data for experiment 2a.

| | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|
| Inaccurate digit string recall | Mean | SD | Statistic | SE | Statistic | SE |
| Low anxious group | 6.23 | 5.53 | 1.101 | 0.616 | 0.842 | 1.191 |
| High anxious group | 5.73 | 4.13 | 0.248 | 0.661 | -1.023 | 1.279 |

Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

# APPENDIX AA

## Normality Checks on the Interpretation Bias Recognition Data for Experiment 2a

The data was checked for normality using the Shapiro-Wilk test as the number of participants was less than 2000 (Field, 2005). High anxious participants' recognition data for negative foil items in the first half of the test was found to be non-normal (table AA1).

Screening for skew and kurtosis also highlighted that for the low anxious participants, recognition data for negative targets in the first half of the test, and for positive targets in the second half of the test, showed significant skew and kurtosis (table AA2).

Table AA1: Analyses of normality of recognition interpretation bias data at times 1, 2 and 3 for experiment 2a.

| | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|
| Group | Test half | Item | Statistic | df | Sig. |
| High anxious | 1 | Positive target | 0.909 | 11 | .237 |
| | | Positive foil | 0.954 | 11 | .690 |
| | 2 | Positive target | 0.938 | 11 | .499 |
| | | Positive foil | 0.876 | 11 | .092 |
| | 1 | Negative target | 0.942 | 11 | .545 |
| | | Negative foil | 0.819 | 11 | .017* |
| | 2 | Negative target | 0.961 | 11 | .787 |
| | | Negative foil | 0.905 | 11 | .215 |
| Low anxious | 1 | Positive target | 0.969 | 13 | .881 |
| | | Positive foil | 0.885 | 13 | .082 |
| | 2 | Positive target | 0.883 | 13 | .079 |
| | | Positive foil | 0.883 | 13 | 0.078 |
| | 1 | Negative target | 0.896 | 13 | 0.118 |
| | | Negative foil | 0.928 | 13 | 0.319 |
| | 2 | Negative target | 0.906 | 13 | 0.162 |
| | | Negative foil | 0.912 | 13 | 0.197 |

*significant at $p < .05$

Table AA2: Analyses of skew and kurtosis for recognition interpretation bias data at times 1, 2 and 3 in experiment 2a.

| Group | Test half | Item | Mean | SD | Skew Statistic | Skew SE | Kurtosis Statistic | Kurtosis SE |
|---|---|---|---|---|---|---|---|---|
| High anxious | 1 | Positive target | 2.61 | 0.288 | -0.019 | 0.661 | -1.680 | 1.279 |
| | | Positive foil | 1.66 | 0.287 | 0.013 | 0.661 | -1.137 | 1.279 |
| | 2 | Positive target | 2.63 | 0.350 | -0.536 | 0.661 | 0.722 | 1.279 |
| | | Positive foil | 1.68 | 0.343 | 0.370 | 0.661 | -1.380 | 1.279 |
| | 1 | Negative target | 2.62 | 0.627 | 0.468 | 0.661 | -0.773 | 1.279 |
| | | Negative foil | 1.54 | 0.307 | -0.823 | 0.661 | -1.030 | 1.279 |
| | 2 | Negative target | 2.65 | 0.515 | -0.536 | 0.661 | 0.534 | 1.279 |
| | | Negative foil | 1.61 | 0.226 | -0.393 | 0.661 | -1.013 | 1.279 |
| Low anxious | 1 | Positive target | 2.60 | 0.416 | -0.409 | 0.616 | -0.164 | 1.191 |
| | | Positive foil | 1.55 | 0.328 | -0.033 | 0.616 | -1.782 | 1.191 |
| | 2 | Positive target | 2.72 | 0.687 | -1.382* | 0.616 | 2.200 | 1.191 |
| | | Positive foil | 1.54 | 0.524 | 0.660 | 0.616 | -0.696 | 1.191 |
| | 1 | Negative target | 2.61 | 0.589 | -1.364* | 0.616 | 2.780* | 1.191 |
| | | Negative foil | 1.44 | 0.250 | 0.841 | 0.616 | 0.541 | 1.191 |
| | 2 | Negative target | 2.28 | 0.650 | -0.774 | 0.616 | -0.468 | 1.191 |
| | | Negative foil | 1.45 | 0.414 | 0.740 | 0.616 | -0.312 | 1.191 |

*Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

It was not possible to transform the data as it was differentially skewed between the low and high anxious groups.  Three outliers were therefore identified and transformed to the mean plus or minus two standard deviations as recommended by Tabachnick and Fidell (2007), see table AA3.

Table AA3:  Identified outliers and their transformation in recognition interpretation bias data at times 1, 2 and 3 in experiment 2a.

| Group | Test half | Item | Outlier case no. | Raw score | Mean | SD | Transformed score |
|---|---|---|---|---|---|---|---|
| High anxious | 2 | Positive target | 15 | 1.90 | 2.63 | 0.350 | 1.93 |
| Low anxious | 1 | Negative target | 43 | 1.10 | 2.61 | 0.589 | 1.43 |
| | 2 | Positive target | 43 | 1.00 | 2.72 | 0.687 | 1.35 |

The normality tests were re-run and no evidence of non-normality, skew or kurtosis was found (tables AA4 and AA5).

Table AA4: Analyses of normality of recognition interpretation bias data at times 1, 2 and 3 following removal of outliers in experiment 2a.

| | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|
| Group | Test half | Item | Statistic | df | Sig. |
| High anxious | 1 | Positive target | 0.909 | 11 | .237 |
| | | Positive foil | 0.954 | 11 | .690 |
| | 2 | Positive target | 0.942 | 11 | .543 |
| | | Positive foil | 0.876 | 11 | .092 |
| | 1 | Negative target | 0.942 | 11 | .545 |
| | | Negative foil | 0.819 | 11 | .017* |
| | 2 | Negative target | 0.961 | 11 | .787 |
| | | Negative foil | 0.905 | 11 | .215 |
| Low anxious | 1 | Positive target | 0.969 | 13 | .881 |
| | | Positive foil | 0.885 | 13 | .082 |
| | 2 | Positive target | 0.918 | 13 | .234 |
| | | Positive foil | 0.883 | 13 | .078 |
| | 1 | Negative target | 0.942 | 13 | .477 |
| | | Negative foil | 0.928 | 13 | .319 |
| | 2 | Negative target | 0.906 | 13 | .162 |
| | | Negative foil | 0.912 | 13 | .197 |

*significant at p < .05

Table AA5: Analyses of skew and kurtosis for recognition interpretation bias data at times 1, 2 and 3 following removal of outliers in experiment 2a.

| Group | Test half | Item | Mean | SD | Skew Statistic | Skew SE | Kurtosis Statistic | Kurtosis SE |
|---|---|---|---|---|---|---|---|---|
| High anxious | 1 | Positive target | 2.61 | 0.288 | -0.019 | 0.661 | -1.680 | 1.279 |
| | | Positive foil | 1.66 | 0.287 | 0.013 | 0.661 | -1.137 | 1.279 |
| | 2 | Positive target | 2.63 | 0.343 | -0.456 | 0.661 | 0.532 | 1.279 |
| | | Positive foil | 1.68 | 0.343 | 0.370 | 0.661 | -1.380 | 1.279 |
| | 1 | Negative target | 2.62 | 0.627 | 0.468 | 0.661 | -0.773 | 1.279 |
| | | Negative foil | 1.54 | 0.307 | -0.823 | 0.661 | -1.030 | 1.279 |
| | 2 | Negative target | 2.65 | 0.515 | -0.536 | 0.661 | 0.534 | 1.279 |
| | | Negative foil | 1.61 | 0.226 | -0.393 | 0.661 | -1.013 | 1.279 |
| Low anxious | 1 | Positive target | 2.60 | 0.416 | -0.409 | 0.616 | -0.164 | 1.191 |
| | | Positive foil | 1.55 | 0.328 | -0.033 | 0.616 | -1.782 | 1.191 |
| | 2 | Positive target | 2.74 | 0.617 | -1.010 | 0.616 | 0.763 | 1.191 |
| | | Positive foil | 1.54 | 0.524 | 0.660 | 0.616 | -0.696 | 1.191 |
| | 1 | Negative target | 2.63 | 0.522 | -0.893 | 0.616 | 1.159 | 1.191 |
| | | Negative foil | 1.44 | 0.250 | 0.841 | 0.616 | 0.541 | 1.191 |
| | 2 | Negative target | 2.28 | 0.650 | -0.774 | 0.616 | -0.468 | 1.191 |
| | | Negative foil | 1.45 | 0.414 | 0.740 | 0.616 | -0.312 | 1.191 |

Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

The recognition interpretation bias data met the criterion of homogeneity of variance assessed by the Levene statistic (table AA6).

Table AA6: Levene statistic to assess homogeneity of variance in the recognition interpretation bias data in experiment 2a.

| Item | Test half | Levene statistic | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| Positive | 1 | 0.874 | 1 | 22 | .360 |
| target | 2 | 3.671 | 1 | 22 | .068 |
| Positive | 1 | 0.786 | 1 | 22 | .385 |
| foil | 2 | 2.926 | 1 | 22 | .101 |
| Negative | 1 | 0.815 | 1 | 22 | .376 |
| target | 2 | 1.105 | 1 | 22 | .305 |
| Negative | 1 | 1.213 | 1 | 22 | .283 |
| foil | 2 | 3.845 | 1 | 22 | .063 |

APPENDIX AB

Correlations Between Items High and Low in PA from Visual Analogue Scale at Times 1, 2 and 3 for Experiment 2b

Table AB1: Analyses of normality of items high and low in PA at times 1, 2 and 3 in experiment 2b.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Item | Time | Statistic | df | Sig. |
| Carefree | 1 | .941 | 26 | .146 |
| | 2 | .975 | 26 | .749 |
| | 3 | .917 | 26 | .037* |
| Happy | 1 | .897 | 26 | .014* |
| | 2 | .978 | 26 | .837 |
| | 3 | .838 | 26 | .001* |
| Low | 1 | .946 | 26 | .191 |
| | 2 | .951 | 26 | .247 |
| | 3 | .896 | 26 | .013* |
| Sad | 1 | .861 | 26 | .002* |
| | 2 | .951 | 26 | .242 |
| | 3 | .769 | 26 | .000* |

*significant at p < .05

Table AB2: Analyses of skew and kurtosis for items high and low in PA at times 1, 2 and 3 in experiment 2b.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Item | Time | Mean | SD | Statistic | SE | Statistic | SE |
| Carefree | 1 | 0.45 | 0.22 | -0.0.42 | 0.456 | 0.138 | 0.887 |
| | 2 | 0.55 | 0.17 | -0.507 | 0.456 | 0.449 | 0.887 |
| | 3 | 0.43 | 0.13 | -0.638 | 0.456 | -0.391 | 0.887 |
| Happy | 1 | 0.53 | 0.18 | 0.482 | 0.456 | 1.734* | 0.887 |
| | 2 | 0.65 | 0.19 | -0.063 | 0.456 | -0.049 | 0.887 |
| | 3 | 0.51 | 0.14 | 1.547* | 0.456 | 4.714* | 0.887 |
| Low | 1 | 0.44 | 0.19 | -0.105 | 0.456 | 0.419 | 0.887 |
| | 2 | 0.39 | 0.18 | -0.338 | 0.456 | -0.203 | 0.887 |
| | 3 | 0.48 | 0.15 | -1.168* | 0.456 | 3.378* | 0.887 |
| Sad | 1 | 0.48 | 0.17 | -0.995 | 0.456 | 1.234 | 0.887 |
| | 2 | 0.35 | 0.21 | -0.061 | 0.456 | -1.018 | 0.887 |
| | 3 | 0.47 | 0.13 | -1.715* | 0.456 | 6.164* | 0.887 |

*Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

APPENDIX AC

Normality Checks for the High PA Data at Times 1, 2 and 3 for Experiment 2b

The high PA data was checked for normality using the Shapiro-Wilk test as the number of participants was less than 2000 (Field, 2005). This showed that for the high anxious participants, the high PA data were not normally distributed at time 1 (table AC1).

Table AC1: Analyses of normality of high PA at times 1, 2 and 3 for experiment 2b.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Group | Time | Statistic | df | Sig. |
| High anxious | 1 | 0.848 | 13 | .027* |
| | 2 | 0.917 | 13 | .231 |
| | 3 | 0.947 | 13 | .553 |
| Low anxious | 1 | 0.920 | 13 | .248 |
| | 2 | 0.974 | 13 | .940 |
| | 3 | 0.959 | 13 | .746 |

*significant at $p < .05$

For the high anxious participants, significant skew was also found for the high PA data at time 1 (Wald criterion of skew or kurtosis statistic more than twice the standard error), table AC2.

Table AC2: Analyses of skew and kurtosis for high PA at times 1, 2 and 3 for experiment 2b.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Group | Time | Mean | SD | Statistic | SE | Statistic | SE |
| High anxious | 1 | 0.43 | 0.15 | -1.433* | 0.616 | 1.996 | 1.191 |
| | 2 | 0.56 | 0.13 | -1.201 | 0.616 | 2.331 | 1.191 |
| | 3 | 0.44 | 0.11 | -0.172 | 0.616 | -0.299 | 1.191 |
| Low anxious | 1 | 0.55 | 0.18 | 0.381 | 0.616 | -0.540 | 1.191 |
| | 2 | 0.65 | 0.16 | -0.032 | 0.616 | -0.638 | 1.191 |
| | 3 | 0.50 | 0.12 | 0.521 | 0.616 | -0.101 | 1.191 |

*Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

As the data were differentially skewed for the two anxiety groups it was not possible to transform it without biasing the data. Therefore two outliers were identified and changed to the mean plus or minus two standard deviations (table AC3; Field, 2005) and the normality tests re-run, following which no evidence of non-normality, skew or kurtosis was found (tables AC4 and AC5).

Table AC3: Identified outliers and their transformation in high PA data at times 1, 2 and 3 in experiment 2b.

| Group | Time | Outlier case no. | Raw score | Mean | SD | Transformed score |
|---|---|---|---|---|---|---|
| High | 1 | 48 | 0.07 | 0.43 | 0.15 | 0.33 |
| anxious | 2 | 35 | 0.24 | 0.56 | 0.13 | 0.50 |

Table AC4: Analyses of normality of high PA at times 1, 2 and 3 following removal of outliers in experiment 2b.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Group | Time | Statistic | df | Sig. |
| High anxious | 1 | 0.929 | 13 | .333 |
| | 2 | 0.949 | 13 | .588 |
| | 3 | 0.947 | 13 | .553 |
| Low anxious | 1 | 0.920 | 13 | .248 |
| | 2 | 0.974 | 13 | .940 |
| | 3 | 0.959 | 13 | .746 |

Table AC5: Analyses of skew and kurtosis for high PA at times 1, 2 and 3 following removal of outliers in experiment 2b.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Group | Time | Mean | SD | Statistic | SE | Statistic | SE |
| High anxious | 1 | 0.46 | 0.11 | -0.931 | 0.616 | 1.566 | 1.191 |
| | 2 | 0.58 | 0.09 | 0.232 | 0.616 | -1.005 | 1.191 |
| | 3 | 0.44 | 0.11 | -0.172 | 0.616 | -0.299 | 1.191 |
| Low anxious | 1 | 0.55 | 0.18 | 0.381 | 0.616 | -0.540 | 1.191 |
| | 2 | 0.65 | 0.16 | -0.032 | 0.616 | -0.638 | 1.191 |
| | 3 | 0.50 | 0.12 | 0.521 | 0.616 | -0.101 | 1.191 |

The high PA data did not meet the criterion of homogeneity of variance at time 2 as assessed by the Levene statistic (table AC6) and as a result a more conservative alpha level of 0.025 was used (Tabachnick & Fidell, 2007).

Table AC6: Levene statistic to assess homogeneity of variance in the high PA data in experiment 2b.

| Time | Levene statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| 1 | 3.108 | 1 | 24 | .091 |
| 2 | 4.857 | 1 | 24 | .037* |
| 3 | 0.005 | 1 | 24 | .946 |

*significant at $p < .05$

APPENDIX AD

Normality Checks for the Low PA Data at Times 1, 2 and 3 for Experiment 2b

The low PA data was checked for normality using the Shapiro-Wilk test as the number of participants was less than 2000 (Field, 2005). This showed that for the low anxious participants, the low PA data were not normally distributed at times 1 and 3 (table AD1).

Table AD1: Analyses of normality of low PA at times 1, 2 and 3 in experiment 2b.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Group | Time | Statistic | df | Sig. |
| High anxious | 1 | 0.942 | 13 | .488 |
| | 2 | 0.972 | 13 | .918 |
| | 3 | 0.912 | 13 | .193 |
| Low anxious | 1 | 0.842 | 13 | .023* |
| | 2 | 0.962 | 13 | .781 |
| | 3 | 0.799 | 13 | .007* |

*significant at $p < .05$

For both the low and the high anxious participants, significant skew and kurtosis was also found for the low PA data at time 3 (table AD2; Wald criterion of skew or kurtosis statistic more than twice the standard error).

Table AD2: Analyses of skew and kurtosis for low PA at times 1, 2 and 3 in experiment 2b.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Group | Time | Mean | SD | Statistic | SE | Statistic | SE |
| High anxious | 1 | 0.49 | 0.16 | 0.270 | 0.616 | -.0266 | 1.191 |
| | 2 | 0.38 | 0.19 | 0.147 | 0.616 | -0.322 | 1.191 |
| | 3 | 0.50 | 0.10 | 1.046 | 0.616 | 2.715* | 1.191 |
| Low anxious | 1 | 0.43 | 0.18 | -1.062 | 0.616 | 0.475 | 1.191 |
| | 2 | 0.37 | 0.18 | -0.482 | 0.616 | -0.535 | 1.191 |
| | 3 | 0.46 | 0.16 | -2.021* | 0.616 | 5.122* | 1.191 |

*Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

As the data were differentially skewed for the two anxiety groups it was not possible to transform it without biasing the data. Therefore four of five identified outliers were identified and changed to the mean plus or minus two standard deviations (Field, 2005), with the fifth not being changed as to do so would have decreased the raw score further (tables AD3 and AD4).

Table AD3: Identified outliers and their transformation in low PA data at times 1, 2 and 3 in experiment 2b.

| Group | Time | Outlier case no. | Raw score | Mean | SD | Transformed score |
|---|---|---|---|---|---|---|
| Low | 1 | 24 | 0.07 | 0.43 | 0.05 | 0.33 |
| anxious | 3 | 24 | 0.01 | 0.46 | 0.16 | 0.14 |
| | 3 | 32 | 0.31 | 0.46 | 0.16 | 0.31 |
| | 3 | 32 | 0.31 | 0.46 | 0.16 | 0.14 |
| High anxious | 3 | 35 | 0.75 | 0.50 | 0.10 | 0.70 |

Table AD4: Identified outliers and their second transformation in low PA data at times 1, 2 and 3 in experiment 2b.

| Group | Time | Outlier case no. | Raw score | Mean | SD | Transformed score |
|---|---|---|---|---|---|---|
| Low | 3 | 24 | 0.14 | 0.47 | 0.13 | 0.21 |
| anxious | 3 | 32 | 0.31 | 0.47 | 0.13 | 0.21 |
| High anxious | 3 | 35 | 0.70 | 0.50 | 0.09 | 0.68 |

The normality tests were re-run and no evidence of non-normality, skew or kurtosis was found (tables AD5 and AD6).

Table AD5: Analyses of normality of low PA at times 1, 2 and 3 following second removal of outliers in experiment 2b.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Group | Time | Statistic | df | Sig. |
| High anxious | 1 | 0.942 | 13 | .488 |
| | 2 | 0.972 | 13 | .918 |
| | 3 | 0.964 | 13 | .807 |
| Low anxious | 1 | 0.901 | 13 | .138 |
| | 2 | 0.962 | 13 | .781 |
| | 3 | 0.862 | 13 | .040* |

*significant at $p < .05$

Table AD6: Analyses of skew and kurtosis for high PA at times 1, 2 and 3 following second removal of outliers in experiment 2b.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Group | Time | Mean | SD | Statistic | SE | Statistic | SE |
| High anxious | 1 | 0.49 | 0.16 | 0.270 | 0.616 | -0.266 | 1.191 |
| | 2 | 0.38 | 0.19 | 0.147 | 0.616 | -0.322 | 1.191 |
| | 3 | 0.49 | 0.09 | 0.318 | 0.616 | 0.836 | 1.191 |
| Low anxious | 1 | 0.47 | 0.12 | -0.097 | 0.616 | -0.222 | 1.191 |
| | 2 | 0.37 | 0.18 | -0.482 | 0.616 | -0.535 | 1.191 |
| | 3 | 0.46 | 0.13 | -1.109 | 0.616 | 0.732 | 1.191 |

The low PA data did meet the criterion of homogeneity of variance at times 1, 2 and 3 as assessed by the Levene statistic (table AD7).

Table AD7: Levene statistic to assess homogeneity of variance in the low PA data in experiment 2b.

| Time | Levene statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| 1 | 0.740 | 1 | 24 | .398 |
| 2 | 0.029 | 1 | 24 | .865 |
| 3 | 1.280 | 1 | 24 | .269 |

APPENDIX AE

Normality Checks for the Cognitive Load Accuracy Data for Experiment 2b

Table AE1: Normality checks on the cognitive load accuracy data for experiment 2b.

| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Digit string recall | Anxiety group | Statistic | df | Sig. |
| Accurate | Low | 0.913 | 13 | .202 |
| | High | 0.971 | 13 | .907 |
| Inaccurate | Low | 0.913 | 13 | .202 |
| | High | 0.971 | 13 | .907 |

TableAE2: Analysis of skew and kurtosis for the cognitive load accuracy data for experiment 2b.

| | | | | Skew | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| Digit string recall | Anxiety group | Mean | SD | Statistic | SE | Statistic | SE |
| Accurate | Low | 15.31 | 2.98 | -0.820 | 0.616 | -0.090 | 1.191 |
| | High | 12.31 | 3.57 | 0.027 | 0.616 | -0.811 | 1.191 |
| Inaccurate | Low | 4.69 | 2.98 | 0.820 | 0.616 | -0.090 | 1.191 |
| | High | 7.69 | 3.57 | -0.027 | 0.616 | -0.811 | 1.191 |

Skew or kurtosis in the data is indicated by statistics more than twice the standard error

## APPENDIX AF

### Normality Checks on the Interpretation Bias Recognition Data for Experiment 2b

The data was checked for normality using the Shapiro-Wilk test as the number of participants was less than 2000 (Field, 2005). High anxious participants' recognition data for negative foil items in the first half of the test was found to be non-normal as was low anxious participant's recognition data for positive target items in the second half of the test (table AF1).

Screening for skew and kurtosis also highlighted significant skew for the high anxious participants' recognition data for negative foils in the first half of the test (table AF2).

TableAF1: Analyses of normality of recognition interpretation bias data in experiment 2b.

| | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|
| Group | Test half | Item | Statistic | df | Sig. |
| High anxious | 1 | Positive target | 0.870 | 13 | .052 |
| | | Positive foil | 0.926 | 13 | .306 |
| | 2 | Positive target | 0.941 | 13 | .468 |
| | | Positive foil | 0.906 | 13 | .163 |
| | 1 | Negative target | 0.985 | 13 | .996 |
| | | Negative foil | 0.846 | 13 | .025* |
| | 2 | Negative target | 0.956 | 13 | .695 |
| | | Negative foil | 0.910 | 13 | .183 |
| Low anxious | 1 | Positive target | 0.964 | 13 | .814 |
| | | Positive foil | 0.904 | 13 | .154 |
| | 2 | Positive target | 0.849 | 13 | .027* |
| | | Positive foil | 0.932 | 13 | .357 |
| | 1 | Negative target | 0.955 | 13 | .680 |
| | | Negative foil | 0.927 | 13 | .311 |
| | 2 | Negative target | 0.918 | 13 | .236 |
| | | Negative foil | 0.945 | 13 | .530 |

*significant at p < .05

Table AF2: Analyses of skew and kurtosis for recognition interpretation bias data for experiment 2b.

| Group | Test half | Item | Mean | SD | Skew Statistic | Skew SE | Kurtosis Statistic | Kurtosis SE |
|---|---|---|---|---|---|---|---|---|
| High anxious | 1 | Positive target | 2.76 | 0.423 | 1.228 | 0.616 | 1.699 | 1.191 |
| | | Positive foil | 1.72 | 0.460 | 0.818 | 0.616 | 1.592 | 1.191 |
| | 2 | Positive target | 2.80 | 0.469 | -0.498 | 0.616 | -0.184 | 1.191 |
| | | Positive foil | 1.60 | 0.428 | 1.084 | 0.616 | 0.997 | 1.191 |
| | 1 | Negative target | 2.60 | 0.497 | -0.145 | 0.616 | -0.108 | 1.191 |
| | | Negative foil | 1.54 | 0.463 | 1.557* | 0.616 | 2.524* | 1.191 |
| | 2 | Negative target | 2.70 | 0.549 | -0.246 | 0.616 | -1.100 | 1.191 |
| | | Negative foil | 1.65 | 0.422 | 0.903 | 0.616 | 0.374 | 1.191 |
| Low anxious | 1 | Positive target | 2.74 | 0.403 | -0.188 | 0.616 | -0.734 | 1.191 |
| | | Positive foil | 1.48 | 0.196 | 1.003 | 0.616 | 0.808 | 1.191 |
| | 2 | Positive target | 2.83 | 0.368 | -1.022 | 0.616 | -0.050 | 1.191 |
| | | Positive foil | 1.62 | 0.387 | 0.382 | 0.616 | -1.003 | 1.191 |
| | 1 | Negative target | 2.46 | 0.487 | 0.327 | 0.616 | -0.919 | 1.191 |
| | | Negative foil | 1.39 | 0.253 | 0.575 | 0.616 | -0.480 | 1.191 |
| | 2 | Negative target | 2.50 | 0.705 | -0.694 | 0.616 | -0.621 | 1.191 |
| | | Negative foil | 1.48 | 0.366 | 0.593 | 0.616 | -0.527 | 1.191 |

*Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

It was not possible to transform the data as it was differentially skewed between the low and high anxious groups. One of five identified outliers was therefore transformed to the mean plus or minus two standard deviations as recommended by Tabachnick and Fidell (2007), table AF3.

Table AF3: Identified outliers and their transformation in recognition interpretation bias data in experiment 2b.

| Group | Test half | Item | Outlier case no. | Raw score | Mean | SD | Transformed score |
|---|---|---|---|---|---|---|---|
| High anxious | 1 | Negative foil | 6 | 1.00 | 1.54 | 0.463 | 1.00 |
| | | | 10 | 1.10 | 1.54 | 0.463 | 1.10 |
| | | | 29 | 2.70 | 1.54 | 0.463 | 2.47 |
| | | | 35 | 1.30 | 1.54 | 0.463 | 1.30 |
| | | | 47 | 2.20 | 1.54 | 0.463 | 2.20 |

Table AF4: Identified outliers and their second transformation in recognition interpretation bias data in experiment 2b.

| Group | Test half | Item | Outlier case no. | Raw score | Mean | SD | Transformed score |
|---|---|---|---|---|---|---|---|
| High anxious | 1 | Negative foil | 6 | 1.00 | 1.52 | 0.417 | 1.00 |
| | | | 10 | 1.10 | 1.52 | 0.417 | 1.10 |
| | | | 29 | 2.47 | 1.52 | 0.417 | 2.35 |
| | | | 35 | 1.30 | 1.52 | 0.417 | 1.30 |
| | | | 47 | 2.20 | 1.52 | 0.417 | 2.20 |

As this process did not correct the non-normality the process was repeated until no evidence of skew or kurtosis (the best method for assessing normality) was found (tables AF4, AF5 and AF6).

Table AF5: Analyses of normality of recognition interpretation bias data following removal of outliers in experiment 2b.

| | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|
| Group | Test half | Item | Statistic | df | Sig. |
| High anxious | 1 | Positive target | 0.870 | 13 | .052 |
| | | Positive foil | 0.926 | 13 | .306 |
| | 2 | Positive target | 0.941 | 13 | .468 |
| | | Positive foil | 0.906 | 13 | .163 |
| | 1 | Negative target | 0.985 | 13 | .996 |
| | | Negative foil | 0.885 | 13 | .084 |
| | 2 | Negative target | 0.956 | 13 | .695 |
| | | Negative foil | 0.910 | 13 | .183 |
| Low anxious | 1 | Positive target | 0.964 | 13 | .814 |
| | | Positive foil | 0.904 | 13 | .154 |
| | 2 | Positive target | 0.849 | 13 | .027* |
| | | Positive foil | 0.932 | 13 | .357 |
| | 1 | Negative target | 0.955 | 13 | .680 |
| | | Negative foil | 0.927 | 13 | .311 |
| | 2 | Negative target | 0.918 | 13 | .236 |
| | | Negative foil | 0.945 | 13 | .530 |

*significant at $p < .05$

Table AF6: Analyses of skew and kurtosis for recognition interpretation bias data at times following removal of outliers in experiment 2b.

| Group | Test half | Item | Mean | SD | Skew Statistic | Skew SE | Kurtosis Statistic | Kurtosis SE |
|---|---|---|---|---|---|---|---|---|
| High anxious | 1 | Positive target | 2.76 | 0.423 | 1.228 | 0.616 | 1.699 | 1.191 |
| | | Positive foil | 1.72 | 0.460 | 0.818 | 0.616 | 1.592 | 1.191 |
| | 2 | Positive target | 2.80 | 0.469 | -0.498 | 0.616 | -0.184 | 1.191 |
| | | Positive foil | 1.60 | 0.428 | 1.084 | 0.616 | 0.997 | 1.191 |
| | 1 | Negative target | 2.60 | 0.497 | -0.145 | 0.616 | -0.108 | 1.191 |
| | | Negative foil | 1.51 | 0.395 | 1.098 | 0.616 | 0.763 | 1.191 |
| | 2 | Negative target | 2.70 | 0.549 | -0.246 | 0.616 | -1.100 | 1.191 |
| | | Negative foil | 1.65 | 0.422 | 0.903 | 0.616 | 0.374 | 1.191 |
| Low anxious | 1 | Positive target | 2.74 | 0.403 | -0.188 | 0.616 | -0.734 | 1.191 |
| | | Positive foil | 1.48 | 0.196 | 1.003 | 0.616 | 0.808 | 1.191 |
| | 2 | Positive target | 2.83 | 0.368 | -1.022 | 0.616 | -0.050 | 1.191 |
| | | Positive foil | 1.62 | 0.387 | 0.382 | 0.616 | -1.003 | 1.191 |
| | 1 | Negative target | 2.46 | 0.487 | 0.327 | 0.616 | -0.919 | 1.191 |
| | | Negative foil | 1.39 | 0.253 | 0.575 | 0.616 | -0.480 | 1.191 |
| | 2 | Negative target | 2.50 | 0.705 | -0.694 | 0.616 | -0.621 | 1.191 |
| | | Negative foil | 1.48 | 0.366 | 0.593 | 0.616 | -0.527 | 1.191 |

Skew or kurtosis in the data is indicated by statistics more than twice the standard error.

The recognition interpretation bias data met the criterion of homogeneity of variance assessed by the Levene statistic (table AF7).

Table AF7: Levene statistic to assess homogeneity of variance in the recognition interpretation bias data in experiment 2b.

| Item | Test half | Levene statistic | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| Positive | 1 | 0.011 | 1 | 24 | .916 |
| target | 2 | 0.173 | 1 | 24 | .682 |
| Positive | 1 | 2.824 | 1 | 24 | .106 |
| foil | 2 | 0.037 | 1 | 24 | .849 |
| Negative | 1 | 0.017 | 1 | 24 | .896 |
| target | 2 | 0.471 | 1 | 24 | .499 |
| Negative | 1 | 1.187 | 1 | 24 | .287 |
| foil | 2 | 0.057 | 1 | 24 | .814 |