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Cognitive Biases in Social Anxiety

by

Matthew James Garner

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ABSTRACT

FACULTY OF MEDICINE, HEALTH AND LIFE SCIENCES

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COGNITIVE BIASES IN SOCIAL ANXIETY

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Recent cognitive models propose a variety of information processing biases considered to play a key role in the etiology and maintenance of social phobia (e.g. Clark & Wells, 1995; Rapee & Heimberg, 1997). The present thesis examined high and low socially anxious individuals' biases in attention, appraisal, interpretation and judgment, when processing external social cues (facial expressions).

Experiments 1 and 2 monitored eye-movements to pictures of faces and objects in high socially anxious and low socially anxious individuals. Under no-stress conditions (Experiment 1), high socially anxious individuals initially directed their gaze towards neutral faces, relative to objects, more often than low anxious individuals. However, under social-evaluative stress (Experiment 2), high socially anxious individuals showed reduced biases in initial orienting and maintenance of gaze on faces (cf. objects), compared with the low anxious participants. High socially anxious individuals were also relatively quicker to look at emotional faces than neutral faces, but looked at emotional faces for less time, compared with low socially anxious individuals.

In a third experiment (Experiment 3, task 1), participants' general tendency initially to orient towards and maintain attention for longer on a variety of social cues (angry, happy and neutral faces) relative to non-social cues (objects) was unaffected by social anxiety group. However, reduced maintenance of attention on face cues in general, relative to non-social cues was demonstrated in high compared to low socially anxious individuals in Experiment 4. Results from a modified visual probe task (Experiment 5 task 1) provided no evidence of selective attention in either social anxiety group.

In Experiments 3 and 4, explicit (valence and arousal ratings) and implicit (EAST, startle magnitude, skin conductance) measures of stimulus appraisal for social relative to non-social cues were unaffected by social anxiety group (Exp. 3, 4). However, high socially anxious individuals negatively rated and produced greater startle amplitudes in response to all face/object cues compared to low anxious individuals in Experiment 4.

Using a modified illusory correlation paradigm (Experiment 5, task 2), low socially anxious individuals demonstrated a relatively persistent tendency to over-associate positive social cues with pleasant outcomes. High socially anxious lacked this positive bias, and instead were biased in selectively recalling negative social cues. Finally, in a novel emotion classification paradigm (Experiment 5, task 3), high socially anxious individuals tended to interpret ambiguous (computer manipulated) emotional facial expressions in a negative fashion.

Results provide evidence of biases in various aspects of processing in social anxiety: reduced attention to external social cues; enhanced detection and recall of negative social cues; and negative inferential processes. These findings provide some support for recent cognitive models that emphasise the role of these biases in maintaining the concerns of individuals with social phobia.

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DECLARATION OF AUTHORSHIP

I, Matthew James Garner

declare that the thesis entitled: Cognitive Biases in Social Anxiety

and the work presented in it are my own. I confirm that:

- this work was done wholly or mainly while in candidature for a research degree at this University;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- where I have consulted the published work of others, this is always clearly attributed;
- where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
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Date:.....

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Chapter 1
Theoretical Models of Social Anxiety

Overview

The present chapter provides a detailed review of the different theoretical accounts of social anxiety disorder developed over recent years. The chapter begins with a brief discussion of the relationship between normal fear and pathological anxiety. Nosological descriptions of the various forms of anxiety disorder are presented, before discussing the various psychological and pharmacological interventions currently used to treat social anxiety disorder. Finally, current models outlining the various factors considered to underlie and maintain social anxiety are reviewed. Throughout the chapter, particular emphasis is given to cognitive models of social anxiety, however, relevant concepts from more general cognitive, behavioural and biological models of fear and anxiety, are also presented.

Normal Fear and Pathological Anxiety

Many individuals experience occasional feelings of apprehension, nervousness, fear and anxiety. For most, this natural and moderate response within an uncomfortable situation is both brief and infrequent. For example, when speaking in public, moderate elevations in apprehension and anxiety reflecting a desire to do well, might be associated with a variety of physical responses such as increases in perspiration, breathing and heart rate. Indeed, such moderate increases in arousal have the benefit of encouraging attention to remain focussed on task demands, thereby increasing the likelihood that performance is to a desired standard (Yerkes & Dodson, 1908). However, unfortunately for some individuals, this and other forms of social interaction are perceived to be sources of extreme threat and danger. For these individuals, overwhelming cognitions involving perceptions of threat combine with debilitating elevations in autonomic and somatic activity leading to further increases in anxiety and associated dysfunctional behaviours (Clark & Wells, 1995). Individuals who frequently and persistently endure these extreme levels of anxiety invariably suffer marked impairment in their quality of life and as a result often seek medical treatment.

The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994) currently recognises fourteen distinct anxiety disorders. Although subtle differences regarding the physiological aspects of the different anxiety disorders exist, the various forms of anxiety predominantly differ in terms of the cognitive content and environmental context surrounding the fear. For example, in *specific phobia*, anxiety occurs during exposure to a feared stimulus, such as a spider or snake. In contrast, *agoraphobia* is characterised by anxiety in environments from which escape is either

difficult or humiliating. *Panic disorder* features the sudden onset of intense apprehension and feeling of impending doom (e.g. death) while *generalized anxiety disorder* is characterised by persistent anxiety and worry. Finally, in *social phobia*, the anxiety is provoked by exposure to certain types of social or performance situation. The next section considers in more detail, the nosology of social phobia before briefly outlining current approaches to the treatment of social phobia.

Social Anxiety: Nature and Diagnosis

Social phobia (also known as social anxiety disorder) was formally recognised as a distinct mental disorder when it was incorporated into the DSM III (American Psychiatric Association, 1980) as an independent form of anxiety. Social phobia is currently defined in the DSM-IV as a "marked and persistent fear of one or more social or performance situations in which the person is exposed to unfamiliar people or to possible scrutiny by others" (American Psychiatric Association, 1994, p. 416). Consistent with diagnostic revisions in the DSM-III-R (American Psychiatric Association, 1987), the DSM-IV differentiates between two subtypes of social phobia: *non-generalized* (sometimes referred to as specific) and *generalized*. Generalized social phobia is characterised as a fear of most forms of social contact, whereas non-generalized social phobia is characterised by a narrower range of social fears, (e.g. eating in public, speaking in public).

A further diagnosis in the DSM-IV that relates to social fears is *avoidant personality disorder*, which is characterised by a "pervasive pattern of social inhibition, feelings of inadequacy and hyper-sensitivity to negative evaluation" (American Psychiatric Association, 1994, p. 664). Research suggests that generalized social phobia does not differ qualitatively from avoidant personality disorder (Holt, Heimberg, & Hope, 1992; Herbet, Hope, & Bellack, 1992; Turner, Beidel, & Townsley, 1992) but instead differs in severity, with avoidant personality disorder being a more severe expression of the disorder (Widiger, 1992). Thus, the distinct classifications of pathological social fear are commonly considered on a continuum, with non-generalized social anxiety disorder situated at one end, and avoidant personality disorder at the more extreme end, with patients likely to differ only in the degree to which their fears of negative evaluation and social avoidance are pervasive (Widiger, 1992).

Epidemiological studies suggest that social phobia is the third most prevalent psychiatric disorder following major depression and alcohol dependence. Adult lifetime prevalence for clinical social phobia is 13.3% (Kessler et al., 1994) and occurs more frequently in females (15.5 %) than males (11.1 %; Weinstock, 1999; though lower prevalence rates have been reported i.e. 4.9 % for males and 9.5 % for females; Wittchen, Stein, & Kessler, 1999). Indeed, as many as 20% of the general population are considered to

report irrational social fears, though many of these do not meet full diagnostic criteria (e.g. Furmark, et al., 1999; Pollard & Henderson, 1988). Social phobia is highly comorbid with other psychiatric disorders (Kessler et al., 1994; Schneier, Johnson, Hornig, Liebowitz, & Weissman, 1992), particularly anxiety (e.g. generalized anxiety disorder) and mood disorders (e.g. depression; Brown & Barlow, 1992). The average age of onset of social phobia is considered to be mid-adolescence (American Psychiatric Association, 1994; Schneier, Johnson, Hornig, Liebowitz, & Weissman, 1992) and coincides with the normal vulnerability to social embarrassment seen in adolescence. However, diagnosis of social phobia has been reported in children as young as eight years of age (Albano & DeBartolo, 1997, cited in Ollendick & Hirshfield-Becker, 2002). Following onset, the disorder follows a chronic course resulting in substantial and persistent impairment in academic, vocational and social functioning (e.g. Reich, Goldenberg, Vasile, Goisman, & Keller, 1994) and severe reductions in quality of life (Safren, Heimberg, Brown, & Holle, 1997; review by Kessler, 2003).

The identification and grouping of symptoms into distinct anxiety disorders outlined above, has largely emerged from the clinical need to explicitly define mental illness and thereby enable reliable diagnosis, (American Psychiatric Association, 1994). Throughout its many versions, the Diagnostic and Statistical Manual (DSM-I, 1952, through to the current DSM-IV, 1994) categorizes and defines sets of explicit diagnostic criteria using a multiaxial and descriptive approach whilst remaining neutral with respect to theories of etiology and maintenance (American Psychiatric Association, 1994). As such, the treatment of psychiatric illness (particularly from a medical perspective) has tended to focus on reducing the severity of symptoms associated with disorders, often at the expense of attempting to clarify the mechanisms that cause and maintain the disorder. A critical summary of the interventions currently used in the treatment of social phobia follows.

Treatment Approaches for Social Phobia

A variety of pharmacological and psychological treatment interventions have been demonstrated to reduce symptom severity in social phobia, however, pharmacological interventions remain the preferred first line of treatment following initial diagnosis (Blanco, Antia, & Liebowitz, 2002). Over recent years, numerous drug interventions have become licensed for the treatment of social anxiety disorder in the UK having shown efficacy in the acute treatment of social anxiety disorder. These include: Irreversible non-selective monoamine oxidase inhibitors (MAOIs; e.g. phenelzine); reversible inhibitors of monoamine oxidase A (RIMAs; e.g. moclobemide); selective serotonin reuptake inhibitors (SSRIs; e.g. paroxetine) and benzodiazepines (e.g. chlordiazepoxide). These compounds address specific neurotransmitter imbalances identified in social phobia as well as other anxiety disorders

(e.g. dopaminergic imbalances; Schneier et al., 2000). In addition, Beta-blockers are often used to treat both non-generalized and generalized forms of social anxiety on an 'as and when basis' as they are known to reduce some of the autonomic symptoms associated with anxiety (e.g. tachycardia, sweating, tremor). The significant clinical benefits of using pharmological interventions in the acute treatment of social phobia has been demonstrated in numerous clinical trials, (e.g. Stein et al., 1998; see reviews by Blanco et al., 2002; Blanco, Raza, Schneier, & Liebowitz, 2003; Davidson, 2003), however, there are limitations when using drug based treatments.

Worryingly, a large proportion of patients fail to respond to drug interventions, (35% to 65%, data from Davidson, 2003) and of those who do respond residual symptomology often remains. In addition, many patients fail to complete their treatment programme due to the undesirable side-effects associated with many compounds (e.g. sleep disturbances, hypertension associated with MAOIs; sedation, light-headedness associated with RIMAs; sexual dysfunction and nausea associated with SSRIs, Blanco et al., 2002). Furthermore, after treatment is discontinued, patients often either relapse, or show marked loss (50%; data from Versiani et al., 1992) in treatment gains. Thus, whilst the criteria for remission remain unclear, it is widely acknowledged that most patients receiving drug treatment for social phobia fail to achieve true recovery or remission (Davidson, 2003). As a result, individuals suffering with social phobia tend to require additional treatment, often in the form of psychological interventions.

Psychological treatments for social phobia tend to include social skills training and exposure-based treatments, with cognitive-behaviour therapy (CBT) currently the most popular psychological intervention (see review by van Dyck, 1996). Social skills training encourages patients to improve their deficits in social communication skills through varieties, and combinations, of modelling, behavioural rehearsal, corrective feedback and social reinforcement. Exposure-based treatments encourage the patient to remain engaged in increasingly threatening social situations so that natural conditioning processes (e.g. habituation and extinction) may ultimately desensitise fear responses. While both interventions have in the past produced reductions in anxiety and avoidant behaviours, the degree of change regarding patients' irrational beliefs (Emmelkamp et al., 1985) and fear of negative evaluation (Mattick, Peters, & Clarke, 1989) remain limited (Wells & Clark, 1997). In contrast, cognitive-behavioural techniques aim to directly modify patients' negative beliefs about their performance and evaluation in social situations (Wells & Clark, 1997).

Cognitive behavioural therapy (CBT) is a treatment approach based on the notion that the way an individual thinks about an event determines in part how they respond to that event, both in terms of affect and behaviour, (Beck, 1991). There are many different variants of CBT, however, their common aim is to identify and correct patients' dysfunctional beliefs

and maladaptive information processing strategies through a process of cognitive restructuring. This is often achieved by encouraging patients to treat their beliefs as hypotheses which are then tested throughout a series of behavioural exposure experiments. It is the use of exposure as a way of enabling the patient to collect information that will help them revise their judgements about the risk of social situations that distinguishes CBT from the more traditional exposure techniques derived from learning theory (Seligman, 1971). CBT has demonstrated to be efficacious when compared to no treatment and placebo psychological treatments (e.g. Heimberg et al., 1990; Heimberg, Salzman, Holt, & Blendell, 1993; reviews by Heimberg, 2002; Deacon & Abramowitz, 2004), however, little data exists regarding the differing, or combined, efficacy of pharmacological and cognitive-behavioural interventions.

Comparison of pharmacological and CBT interventions in controlled trials is ongoing, however, initial results suggest that both forms of treatment are equally effective at 12 weeks (Heimberg et al., 1998). Pharmacological treatments seem to be more effective at 6 weeks compared to CBT, while CBT appears to provide more enduring reductions in symptomology (i.e. lower relapse rates following the treatment phase, Liebowitz et al., 1999). However, although CBT might be considered to provide more sustained reductions in symptom severity, it has been reported that as many as 50% of individuals receiving CBT for social phobia, fail to make clinically significant improvements (Clark, 1997).

To summarize, a variety of pharmacological and psychological treatment interventions are currently used for the treatment of social anxiety disorder. While pharmacological interventions remain a popular initial treatment for clinicians, the undesirable side effects and high risk of relapse following treatment limit their utility. In contrast, prolonged efficacy appears more likely to be observed following psychological interventions, particularly cognitive-behavioural therapies. While combination treatments may ultimately be shown to be the most effective method of treating social phobia, existing psychological and pharmacological interventions can only continue to be improved, through increasing the understanding of the psychological and biological mechanisms thought to cause, and particularly maintain social phobia.

Theoretical Models of Social Fears and Social Phobia

Before reviewing the various theoretical models of social phobia, it is perhaps pertinent to note that the approaches discussed, are not considered mutually exclusive. Rather, they should be regarded as providing different levels of explanation as well as differing in the extent to which they address issues of causality and maintenance. For example, while evolutionary models justify the continued existence of social fears, they do little to explain why certain individuals are more fearful than others. In contrast,

conditioning models predominantly consider the factors thought to be involved in the development of social fears, while cognitive models instead tend to place more emphasis on the dysfunctional cognitive processes and maladaptive behaviours that characterise and maintain social phobia.

Theories of emotion (e.g. fear) conventionally sit within an adaptive and functional framework. Thus, emotions, such as fear, are considered to result from varying activation in appetitive and defensive motivational systems which have evolved to mediate a wide range of behaviours that promote survival (e.g. Hebb, 1949; Konorski, 1967; Dickinson & Dearing, 1979; Oatley & Johnson-Laird, 1987). Within this dichotomy, fear is defined as a highly aversive, emotional state that facilitates the detection and avoidance of danger (Tooby & Cosmides, 1990; Öhman, 1996). When faced with danger, threat or an aversive situation, this adaptive fear response is characterised by a series of fear-related behaviours including hypervigilance, phasic immobility (freezing), autonomic changes and increased reflexive responses (startle) to sensory stimuli (Rosen & Schulkin, 1998). It is the inappropriate exaggeration of this normal fear response that is considered to characterise pathological anxiety (Barlow, 1988; Barlow, Chorpita, & Turovsky, 1996; Gray & McNaughton, 1996; Rosen & Schulkin, 1998).

An important perspective relevant to ethological models of fear and anxiety disorders is that of biological preparedness (Seligman, 1971) and the related proposal of fear-relevance (Öhman, 1986; Öhman, Dimberg, & Öst, 1985). Preparedness theory was initially introduced in an attempt to account for the non-random distribution of fears and phobias seen clinically. The central idea is that all species have an evolutionarily based predisposition to acquire fears and phobias to objects (e.g. spiders) and situations (e.g. social groups) that may have been sources of threat to their evolutionary ancestors. As a result, individuals who easily acquire fears to these so-called 'fear-relevant' objects and situations (Öhman et al., 1985) are likely to have a selective advantage and improved evolutionary fitness (Darwin, 1872).

Consistent with the ethological models and preparedness theories, the key features of social phobia, such as extreme social wariness, submissive behaviour and social avoidance can be considered to reflect disturbances in the social functions evolved to survive within a 'fear-relevant' social group (e.g. Öhman, 1986; Mineka & Zinbarg, 1995; Gilbert & Trower, 2001). Evidence from many primate groups, support the view that social fears and submissive behaviours play key roles in enhancing the social cohesiveness of the group and reducing the likelihood of interpersonal danger (e.g. Burnstein, 1980).

Within social groups, threat commonly results from conspecific attack when established dominance hierarchies are violated. As a result, individuals at lower levels of the social hierarchy are motivated to identify potential threat when in the presence of a dominant conspecific, and respond using a variety of submissive behaviours. In social situations, facial expressions are an important environmental cue regarding the rank, appraisal and potential threat of a conspecific (Ekman, 1992) and are therefore considered to be of particular motivational relevance to socially fearful individuals (Dimberg & Öhman, 1983; Öhman & Dimberg, 1978). Thus, within this ethological framework, socially phobic individuals' dysfunctional social fear and behavioural submission, is considered to result from their extreme levels of low self esteem (and tendency to view others as more superior) but strong desire to remain accepted by the group.

While evolutionary approaches to social phobia identify the adaptive functionality of social fears, they fail to identify the functionality (or more appropriately the dysfunctionality) of pathological fears. As such, ethological models do little to clarify the means by which social fears *become* and *remain* dysfunctional in some individuals but not others. In contrast, conditioning theories of social phobia extend ethological models, and account for individual differences in 'biologically prepared' social fears by considering the processes by which certain individuals learn, via experience, to fear certain social situations more than other individuals. Within this learning framework, social phobia develops in a similar way to specific phobias, i.e. as a consequence of one or more traumatic conditioning experiences (Barlow, 1988; Öst & Hugdahl, 1981). As such, the different social situations in which phobic individuals experience anxiety, merely reflect the different social situations in which aversive conditioning has previously occurred (e.g. eating in public, or instead speaking in public, Mineka & Zinbarg, 1995). Furthermore, consistent with preparedness theory, once conditioned, fear associated with social situations and fear-relevant stimuli (e.g. threat faces) proves to be particularly resistant to extinction, even though subsequent experience of the social situation invariably occurs in the absence of unconditional negative reinforcers. (e.g. Öhman & Dimberg, 1978; Dimberg & Öhman, 1983; but see Bond & Siddle, 1996; Davey, 1992 for alternative explanation).

Conditioning models propose various forms of learning through which the aversive conditioning of social situations can occur. With direct traumatic conditioning, the phobic fear results from an individual's highly aversive personal experience within a previously neutral social situation. In contrast, observational (vicarious) conditioning suggests that an individual simply witnessing another (e.g. parent) behave fearfully in a social situation is sufficient to produce fear-conditioning to the same situation.

Several studies have assessed whether these forms of fear-conditioning are more common in individuals suffering with social phobia. For example, Öst and Hugdahl (1981) reported that a greater percentage of individuals with non-generalized social phobia recalled a traumatic conditioning experience compared to individuals with generalized social phobia and non-phobic controls. In addition, a compelling series of vicarious conditioning primate studies have demonstrated 'modelling' of context and cue specific fears through observational learning (e.g. Mineka, 1987; Mineka & Cook, 1988; see review in Öhman & Mineka, 2001).

The conditioning models of social phobia outlined above, are part of a wider group of behavioural theories of anxiety disorders (e.g. Mowrer, 1960) that consider pathological fear to be acquired though classical conditioning and maintained through operant conditioning in the form of avoidance behaviour (i.e. reinforcement). As discussed earlier, exposure interventions, consistent with the behavioural approach, seek to treat phobias though systematically exposing phobic individuals to their feared social situation such that fear responses habituate.

However, some authors have identified a variety of limitations with conditioning theories of phobias (Rachman, 1976; Rachman, 1977; Rachman, 1980). Rachman (1977) highlights several limitations with a conditioning theory of fear-acquisition, many of which have been subsequently acknowledged by preparedness theory and empirical demonstrations of vicarious conditioning. However, a limitation that remains, regards the observation that while many individuals who have been repeatedly exposed to uncontrollable and intense trauma (e.g. air raids) develop acute anxiety-related symptoms, this initial reaction appears to dissipate spontaneously and is therefore rarely presented as a pathological phobia. A further limitation, perhaps more relevant to social phobia regards the mechanisms by which phobic fear is maintained. Conditioning models propose that fear is maintained because active avoidance of feared situations reduces the likelihood that fear-responses habituate and extinguish in the absence of unconditioned reinforcement. Thus, most anxiety disorders are characterised by a tendency to avoid feared objects and environments, often with considerable success. However, individuals with social phobia are commonly unable to completely avoid social situations, instead frequently enduring interactions with intense distress. Thus, solely from a conditioning perspective, it remains unclear exactly how social phobia is maintained. In a series of influential cognitive models, David Clark and colleagues have sought to elucidate a variety of information processing biases (and behaviours) involved in the maintenance of social phobia. A detailed theoretical discussion of social phobia within a cognitive framework now follows.

A Cognitive Approach to Social Phobia

Cognitive theories propose that anxiety disorders result from distorted beliefs about the dangerousness of certain situations (e.g. Beck, Emery, & Greenberg, 1985). According to a cognitive analysis of fear and anxiety, socially phobic individuals become anxious when anticipating, or experiencing, social situations because they make dysfunctional assumptions which lead them to predict they will behave in a way which results in their rejection or loss of status (Stopa & Clark, 1993). In one of the earliest cognitive models of emotional disorders, Beck (1976) proposed that different emotional disorders were characterised by different schemata; cognitive structures which influence a person's perceptions, interpretations and memories. For example, Beck considered depression to be associated with schemata based around themes of loss or failure. In contrast, socially phobic individuals' schemata concern information about social threat and danger (i.e. negative evaluation; social rejection). Beck further proposed that individuals' cognitive processing of information becomes distorted so as to be consistent with their negative schemata. As such, social phobia should be characterised by increased attention to social threat cues, a tendency to interpret ambiguous social information in a threatening manner, and an increased propensity to remember social experiences in a negative fashion.

The contribution of Beck's early cognitive theories of emotional disorders to the development of effective cognitive treatment interventions cannot be underestimated. However, empirically testing certain predictions from schema theory has proved difficult. For example, uncertainty exists regarding the existence and form of schemata prior to the onset of a disorder. Furthermore, the conditions required for dysfunctional schemata to become reactivated once an emotional disorder has been experienced remain unclear (Williams, 1992).

In contrast to Beck's idea of disorder-specific dysfunctional schemata, Bower (1981) proposed a semantic network theory of emotions. Drawing particularly on the Human Associative Memory Network theory of Anderson & Bower (1973), Bower conceived of individual emotions as being represented by distinct nodes in an associative network in memory. Each node is connected to other representations in the network such as memories of happy or sad events. Activation of an emotion node increases the accessibility of associated nodes, thereby producing a processing bias favouring information congruent with the emotional state. Mood at the point at which new information is experienced influences the way in which connections between nodes are formed, favouring mood-congruent material rather than mood-incongruent material. As such, when socially phobic individuals anticipate, or enter a feared social situation, the increase in their anxious mood results in both enhanced processing of socially threatening information and greater retrieval of

previously encountered negative social experiences which in turn, further increases in their anxiety.

Common to both Beck (1976; Beck, Emery, & Greenberg, 1985) and Bower's information processing models of emotional disorders is the idea that emotional disorders are associated with emotion–congruent biases in similar aspects of information processing. Thus, emotional disorders do not differ in type of bias, but instead the emotional content of the bias. Specifically, while social phobia is considered to be characterised by attentional, interpretative and memory biases related to social threat (e.g. negative evaluation, rejection), in depression, these processing biases are related to information associated with loss or failure.

Empirical evaluations of these common predictions have not been consistently supportive. Early assessment of processing biases in emotional disorders frequently demonstrated that anxiety but not depression was associated with an attentional bias for threat (e.g. MacLeod, Mathews, & Tata, 1986). However, depression but not anxiety was associated with a memory bias for negative information (e.g. Mogg, Mathews, & Weinman, 1987). While a detailed review of the empirical limitations of schema and network theories is beyond the scope of the present thesis, the observation that information processing biases do not appear to operate consistently across the whole range of emotional disorders highlights limitations with the early cognitive theories of Beck and Bower (reviews by Williams, Watts, Macleod, & Mathews, 1988; Williams, Watts, Macleod, & Mathews, 1997). As a result, over recent years, a variety of cognitive models outlining the threat-processing biases common to anxiety disorders (Williams et al., 1988; Eysenck, 1992; Williams et al., 1997; Mogg & Bradley, 1998; Mathews & Mackintosh, 1998) and specifically related to social phobia have been developed (Clark & Wells, 1995; Wells & Clark, 1997; Rapee & Heimberg, 1997; Clark & Wells, 1999; Clark, 2001).

Williams, Watts, MacLeod and Mathews (1988, 1997)

Williams et al. (1988) propose that different emotional disorders are associated with different patterns of cognitive bias. Specifically, anxiety disorders are associated with a bias which favours threat stimuli in preattentive processes (prior to awareness) and in selective attention, while depression is associated with a bias in more strategic elaborative processes.

While Williams et al. (1988) describe their model with particularly reference to generalised anxiety, it can be extended to other anxiety conditions, such as social phobia. In the case of social phobia, the direction of preattentive and attentional biases to threat are influenced by the magnitude of the current levels of social anxiety, with highly fearful individuals orienting towards socially threatening information and low anxious individuals orienting away from negative social cues. In each case, the magnitude of the bias increases

when individuals experience elevations in state anxiety. Considered in this way, pre-attentive and attentional biases for threatening stimuli are an interactive function of state and trait anxiety, represented by the Affective Decision Mechanism and the Resource Allocation Mechanism, respectively, (see Figure 1).

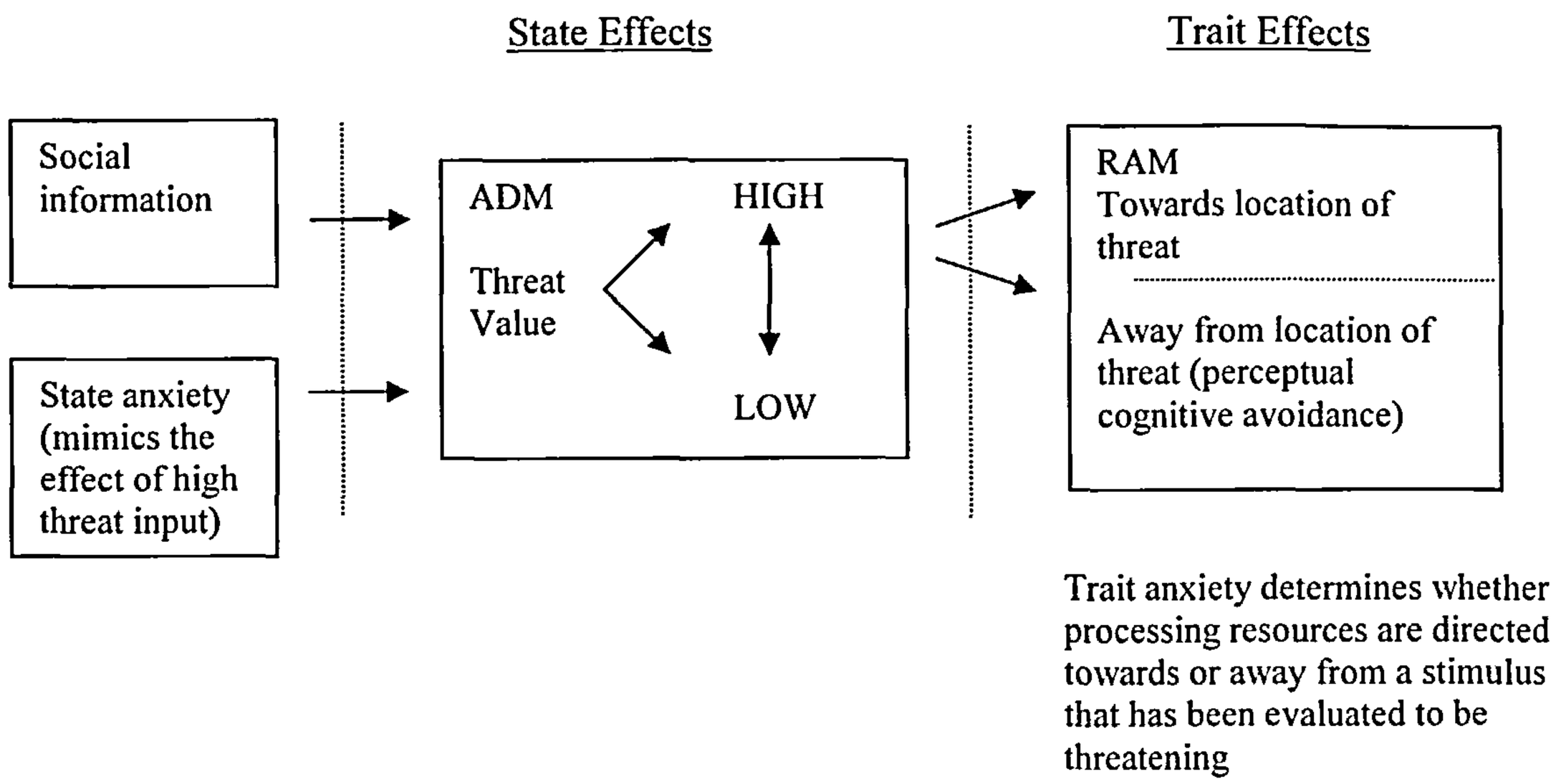

Figure 1. A cognitive model of threat processing in social anxiety (adapted from Williams et al., 1988)

The Affective Decision Mechanism (ADM) assesses the threat value of the environmental stimuli and is affected not only by stimulus characteristics but also an individual's current anxious mood state. The output from the ADM feeds into the Resource Allocation Mechanism (RAM) which in turn determines the allocation of processing resources to the stimulus. Trait anxiety is proposed to influence the RAM's allocation of resources to the appraised stimulus. As such, the bias resulting from the RAM's deployment of resources is thought to underlie an individual's vulnerability to anxiety. In the context of social phobia, an individual's tendency to demonstrate pre-attentive, automatic vigilance for socially threatening information when stressed, increases their susceptibility to develop social phobia.

The assumption that pre-attentive and attentional biases reflect an underlying cognitive vulnerability factor for clinical anxiety states, is also a key feature for Eysenck's (1992) hyper-vigilance theory. Eysenck proposes that in addition to increased environmental scanning, anxious individuals have a broader focus of attention prior to the detection of salient (e.g. threat) stimuli, but a narrowing of attention once salient stimuli have been

detected. Eysenck similarly proposes that anxious individuals not only preferentially attend to threat (specific hyper-vigilance) but also attend to motivationally less relevant stimuli (general hyper-vigilance/ distractibility). Similarly, Mathews (1990, 1993) suggests that each emotion imposes a specific mode of operation within the cognitive system that determines processing priorities and that in the case of anxiety the individual is proposed to be in a hyper-vigilant mode, scanning the environment for threat.

Williams et al.'s (1988) model has been recently revised (Williams et al., 1997) drawing on the Parallel Distributed Processing (PDP) model of Cohen, Dunbar and McClelland (1990). Within this framework the Affective Decision Mechanism is represented through the activation of input units (nodes) which are associatively tagged with a threat value. As with the Affective Decision Mechansim, threat assessment of environmental stimuli is influenced not only by stimulus characteristics but also state anxiety level. The Task Demand Unit (an update of the Resource Allocation Mechanism) receives inputs from the threat input units and determines the allocation of attentional resources towards or away from the stimulus judged to be threatening. As with the previous model, in response to increased activation of threat units at the pre-attentive stage, social phobia is characterised by an increased tendency to allocate resources towards the source of social threat. In contrast, low anxious individuals are predicted to direct processing resources away from material that has been judged to be socially threatening at the pre-attentive stage, doing so to a greater extent as state anxiety increases.

While Williams et al. (1988, and later 1997) considered the direction of the attentional bias (i.e. towards or away from threat) to be the principle source of vulnerability for anxiety disorders such as social phobia, more recent cognitive models make different predictions.

Mogg and Bradley (1998)

In their cognitive-motivational analysis of anxiety, Mogg and Bradley (1998) note that one of the main functions of an evolved attentional system is to detect danger in the environment and to help the organism respond promptly and effectively to threatening stimuli (see evolutionary models described earlier e.g. Öhman, 1993, 1996; Öhman & Soares 1993, 1994). Thus, from an evolutionary perspective, an effective threat detection system must ensure that an individual directs attention towards real or severe threats irrespective of their underlying trait characteristics. More specifically, even low trait anxious individuals should attend to threat stimuli that exceed some severity threshold. Thus, within this adaptive framework, Williams et al.s'(1988, 1997) assertion that as threat severity increases low anxious individuals become increasingly avoidant, appears to be counter-intuitive.

Consistent with recent neurobiological evidence for a basic cross-species motivation-related threat appraisal system (e.g. LeDoux, 1995), Mogg and Bradley (1998) highlight the importance of valence evaluation in mediating the range of cognitive, behavioural and physiological responses that characterise anxiety. They propose that cognitive and behavioural responses to emotional stimuli are mediated by two fundamental cognitive systems, namely, *Valence Evaluation* and *Goal Engagement,* (see Figure 2).

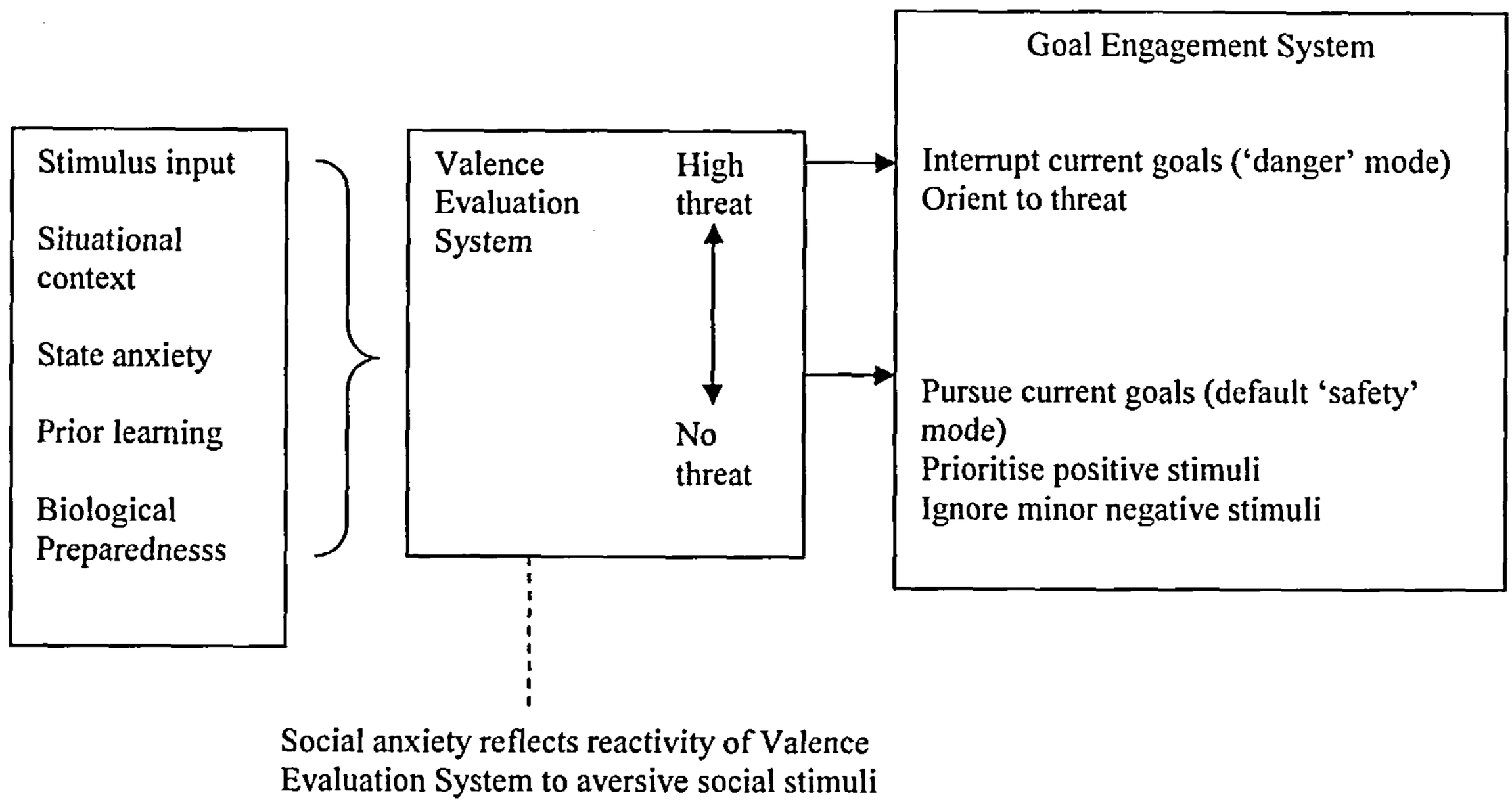

Figure 2. A cognitive-motivational view of the mechanisms underlying biases in initial orienting to threat in social anxiety (adapted from Mogg & Bradley, 1998)

The Valence Evaluation System (VES) assesses stimulus threat value. Several variables affect the output of the VES such as the nature of the stimulus, context and interoceptive information about current arousal level. The output from the VES feeds into the Goal Engagement System (GES) which allocates resources for cognitive processing and action if stimulus threat is deemed high enough. If a stimulus is tagged as having a high threat value, this mechanism automatically interrupts ongoing activities and allocates processing resources towards the threat. However, if the stimulus is evaluated as having little or no threat value, then the organism will disregard it, inhibit further processing of it and continue to focus processing on current goals. In the case where a stimulus is evaluated to be of mild threat value, attention may actually be directed away from the stimulus, in an attempt to promote positive mood. As such the relationship between subjective stimulus threat value and attentional bias may not be linear in nature (Mogg & Bradley, 1998).

Crucially, trait anxiety is considered to reflect the reactivity of the VES to threat. In the case of social phobia, high socially anxious individuals differ from low anxious individuals, regarding the extent to which they evaluate social stimuli as threatening. Therefore, socially phobic individuals' increased sensitivity in the VES, results in social information that others would consider neutral, being tagged with a relatively high subjective threat value and therefore oriented towards.

A crucial difference between this cognitive-motivational model and earlier models of anxiety, is that Mogg and Bradley (1998) consider an individual's willingness to evaluate a stimulus as threatening, underlies their susceptibility to anxiety (see also Mathews & Mackintosh, 1998), whereas Williams et al. (1988, 1997) emphasise the direction of attention to threat as the principle vulnerability factor. Whilst attentional biases may not necessarily play a causal role in the etiology of clinical anxiety states, the cognitive-motivational analysis of anxiety does not exclude the possibility that attentional processes are important in the maintenance of clinical anxiety states (Mogg & Bradley, 1998). Lang et al. (1990) suggest that the motivational state of an organism determines its readiness to avoid or approach a stimulus and that automatic vigilance for threat may co-occur with a tendency to engage in defensive avoidant behaviour. A *vigilance-avoidance* pattern of attentional processing might result in enhanced detection of minor threats in the environment, in the absence of prolonged exposure (Mogg et al., 1987; Williams et al., 1988). Thus, after initial orienting to threat, anxious individuals' focus of attention may become unstable with a tendency to shift attention repeatedly towards and away from the threat stimulus. Mogg and Bradley (1998) consider that such an unstable attentional response pattern may potentiate sensitisation, and interfere with habituation, thus maintaining anxiety in the long term.

To summarize, recent cognitive models propose that anxiety states such as social phobia, are characterised by pre-attentive and attentional biases that favour the processing of negative information. As such, social phobia is considered to be characterised by a tendency to overestimate the aversiveness of social information and allocate greater attentional resources towards these social *threat* cues. The role of these and other cognitive biases in the development and maintenance of social phobia have recently been clarified in a series of specific cognitive models of social phobia, a review of which now follows.

A Cognitive Model of Social Phobia: Clark & Wells (1995)

In their original cognitive model of social phobia Clark and Wells (1995; see also Wells & Clark, 1997; Clark 1999; Clark, 2001) outline a variety of factors that are proposed to prevent individuals with social phobia from changing their negative beliefs about the danger associated with certain social situations. Central to the model are four processes,

three of which (self-focussed attention, safety behaviours, performance deficits) occur within the phobic situation, the fourth (anticipatory and post-event processing) reflecting behaviours and cognitions that occur outside a social interaction. The most significant processing biases involved in maintaining the disorder are considered to occur when the phobic individual endures the feared social situation (see Figure 3).

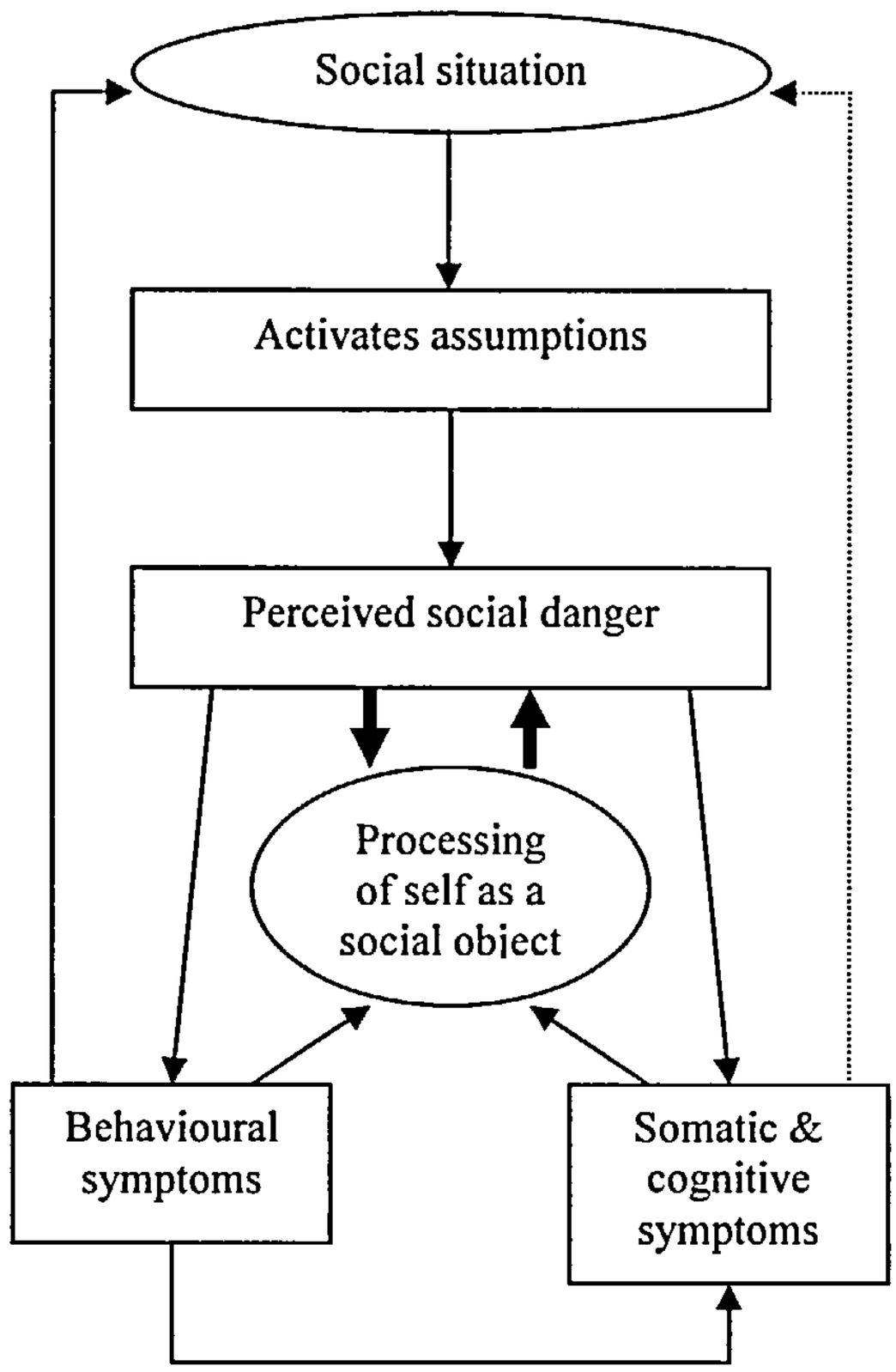

Figure 3. A cognitive model of social phobia (adapted from Clark & Wells, 1995).

Upon entering an already feared social situation, an individual with social phobia experiences a constellation of cognitive, somatic and affective behavioural changes. Preoccupations with these changes and the original negative beliefs increase the perception of danger and feelings of anxiety as well as interfering with task-relevant cognitive processing and social performance. These performance deficits, together with a series of safety/coping behaviours may then elicit less friendly behaviour from others and directly produce further feared sensations (e.g. talking quickly leading to hyperventilation and increased heart rate; Salkovskis, Clark, & Jones, 1986 cited from Clark & Wells, 1995).

Clark and Wells (1995) consider one of the most important occurrences when a social phobic enters a feared situation, to be a change in attentional focus. When an

individual with social phobia thinks they are in danger of negative evaluation by others, their attention shifts towards a detailed monitoring and observation of themselves. This increase in the awareness of self-referent, internally generated information is more generally known as 'self-focus' (Duval & Wicklund, 1972; Ingram, 1990). While increased self-focus is commonly associated with increases in negative affect (Mor & Winquist, 2002) and is considered relevant to many forms of psychopathology (Ingram, 1990), it is proposed to play a particularly important role in the maintenance of social phobia (Clark & Wells, 1995; Wells & Clark, 1997; Spurr & Stopa, 2002).

Clark and Wells emphasise that as a result of an increase in self-focus, socially anxious individuals become increasingly aware of feared anxiety responses which in turn interfere with the processing of the social situation and other people's behaviour. Importantly, the model suggests that socially phobic individuals use the interoceptive information produced by self-focus, to construct an impression of themselves which they assume reflects what other people actually notice and think about them (Clark & Wells, 1995). While some authors consider this constructed impression to be equivalent to a 'felt sense' (Teasdale & Barnard, 1993), Clark and Wells (1995) suggest that it is commonly experienced as a distinct visual image, taken from the so called 'observer-perspective' (equivalent to 'objective self-awareness' Duval & Wicklund, 1972; and 'public self-consciousness' Feningstein, Scheier, & Buss, 1975). Figure 3 graphically represents (by lines of varying thickness) the idea that individuals with social phobia use their own impression of how they appear to others ('Processing of self as a social object') rather than others responses ('Social situation' via 'Activates assumptions') as evidence for their negative beliefs ('Perceived social danger').

In addition to an increase in self-focussed attention Clark and Wells (1995; Wells & Clark, 1997) highlight several safety behaviours and avoidance strategies in which social anxious individuals maladaptively engage. Avoidance of eye contact is an established clinical observation in social phobia (e.g. Darwin, 1872) and a strategy commonly used by individuals with social phobia to feel less vulnerable and more in control of a feared social interaction. As discussed earlier, avoidance of other people's faces may have an evolutionary origin as an appeasement gesture triggered by unwanted attention from a conspecific perceived to be dominant (Trower & Gilbert, 1989). This reduced processing and motivated avoidance of external social cues limits social phobics' opportunity to observe other people's responses in detail. As a result, socially anxious individuals are unlikely to be able to obtain information from other people's reactions that might help them notice that they generally come across more positively than they think (Stopa & Clark, 1993). Interestingly, avoidance is considered a fundamental difference between shyness and social phobia. Whilst shy individuals may enter a social situation with similar anticipatory

concerns as individuals with social phobia, they proceed to notice other peoples' invariably positive responses which in turn curtail the sequence of negative thoughts and anxiety. In contrast, socially phobic individuals' attentional avoidance prevents the disconfirmation of their negative beliefs, and thus maintains their many social concerns (Stopa & Clark, 1993).

To summarize, Clark and Wells propose that upon entering a feared social situation, socially anxious individuals show a shift in attention characterized by intensified self-focussed attention, and adopt a variety of maladaptive safety behaviours such as actively avoiding eye contact. In addition to reducing the attention available for processing external information such as non-verbal facial feedback from other people, self-focus and safety behaviours also reduce processing resources required for acceptable social performance. As a result, socially anxious individuals are less likely to be viewed favourably, and instead, are more likely to receive negative audience feedback.

In addition to the in-situ information processing biases outlined above, Clark and Wells (1995) highlight a variety of processing biases that occur outside the social interaction that may help cause and maintain social phobia. When anticipating a social interaction, socially anxious individuals' thoughts become dominated by recollections of past failures, by negative images of themselves in the situation, and by other predictions of poor performance and rejection. If these ruminations lead the phobic individual to avoid the social interaction then they obviously forgo the opportunity to disconfirm their negative beliefs. Similarly, if upon entering a social situation self-focus is increased and safety behaviours adopted, socially phobic individuals' assessment of their performance is less likely to be informed by actual audience appraisal and instead identified through a detailed post-mortem of performance following the interaction. Unfortunately, socially phobic individuals' review of their performance is likely to favour recall of information that is consistent with their pre-existing negative beliefs, thereby encouraging the individual to add the recent interaction to a growing list of past failures.

The original cognitive model of social phobia put forward by Clark and Wells (1995) generates a number of specific predictions regarding the types of information processing bias that should be present in individuals with social phobia. For example, upon entering a feared social situation, individuals with social phobia are predicted to demonstrate a shift in attention, characterised by an increase in self-focussed attention and reduced attention to external social cues, compared to controls. As a result of self-focus and the use of a variety of coping behaviours, socially anxious individuals' reduced cognitive resources impair their processing of external social cues. Finally, reduced and impaired processing of audience feedback encourages socially anxious individuals to evaluate their social performance retrospectively, in such a way that favours both the recall of negative social information and interpretation of ambiguous social information, in a negative fashion.

A recent cognitive model of social phobia proposed by Rapee and Heimberg (1997) whilst sharing certain features with the model proposed by Clark and Wells (1995) also makes several important theoretical distinctions.

A Cognitive-Behavioural Model of Social Phobia: Rapee & Heimberg (1997)

Rapee and Heimberg (1997) propose a model that assumes social phobia lies mid way along a continuum ranging from low to extreme degrees of concern over social evaluation (e.g. shyness – social phobia – avoidant personality disorder). Whilst predominantly aimed at understanding social phobia, the cognitive-behavioural model is considered relevant to understanding all social fears along the continuum. Similar to Clark and Wells (1995), the model predominantly focuses on the information processing biases that underlie and maintain the anxiety experienced within a feared social situation.

Upon entering a feared situation, socially anxious individuals form a mental representation of their external appearance and behaviour as seen by the audience and simultaneously focus their attentional resources onto both this internal representation and any perceived threat in the social environment. Consistent with Clark and Wells' ideas of 'increased self-focus and observer perspective', the model suggests that the mental representation is formed from pre-existing negative beliefs and internal proprioceptive cues. However in contrast, Rapee and Heimberg (1997) also consider external cues such as audience feedback to be crucial in the formation and updating of the mental representation. Thus, attentional resources are allocated to both salient aspects of the self image (especially those which are potentially negative), and also the monitoring of potential external threat such as frowns, signs of boredom etc. (see Figure 4).

The phobic individual constantly uses the mental representation along with a representation of a perceived (unrealistically high) performance standard to provide an estimate of the audience's perception of the individual's current performance. The resulting perception of negative evaluation elicits further anxiety which affects physiological, cognitive and behavioural components that in turn influence the individual's mental representation, thus the cycle is renewed. Clear similarities are present between Rapee and Heimberg's (1997) and Clark and Wells' (1995) cognitive formulations of social phobia, especially in relation to the role of internal self-focus and the generation and monitoring of the self as a social object. However, the models differ when considering the allocation of attention to monitoring potentially threatening external social cues. Specifically, Rapee and Heimberg posit that social phobia is characterised by rapid and extensive allocation of attentional resources to the detection of threat. In considering the work of Öhman (1986) and earlier ethological models of social phobia (e.g. Trower & Gilbert, 1989; Mineka & Zinbarg,

1995) Rapee and Heimberg's (1997) cognitive – behavioural model emphasises the evolutionary significance of social fears.

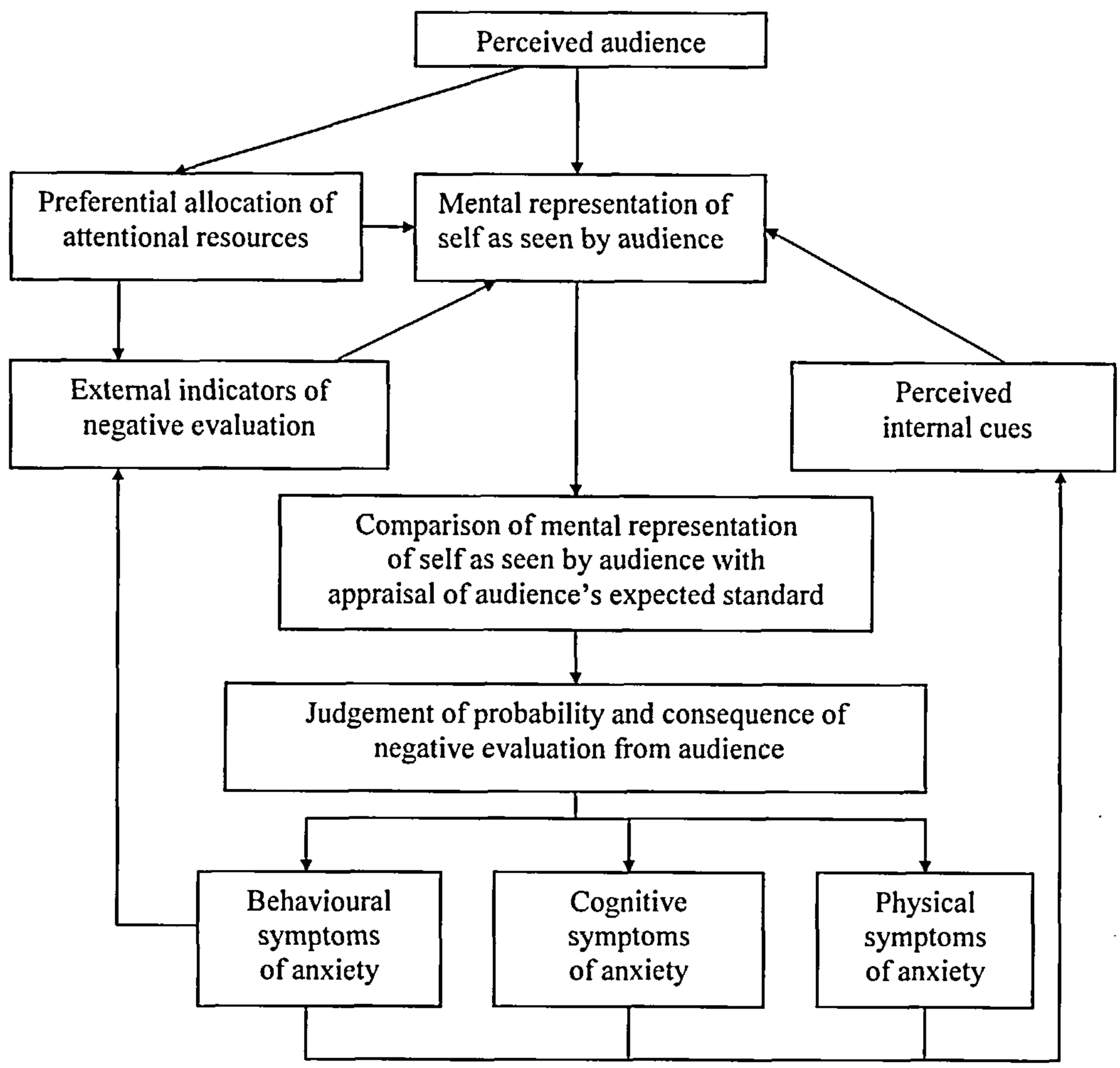

Figure 4. A cognitive-behavioural model underlying the generation and maintenance of anxiety in social/evaluative situations (adapted from Rapee & Heimberg, 1997).

As such, the purpose of the anxiety is to avoid unnecessary challenge of the dominant group member while submissive behaviours allow the subordinate to remain in the safety of the group. Thus, a socially anxious individual may be considered to be in a state of constant readiness, continually primed to detect threat from a dominant conspecific and respond with submission. Furthermore, Rapee and Heimberg suggest that when scanning the environment for any signs of impending negative evaluation, individuals with social phobia will detect such signs rapidly (facilitated by pre-attentive priming mechanisms, Öhman, 1986), and have difficulty disengaging attention from them.

To summarize, the specific cognitive models of social phobia reviewed earlier, stress that when entering a feared social situation, socially phobic individuals increase self-focused attention at the expense of resources available for processing the external social environment. However, the models importantly make different predictions regarding the allocation of available resources to monitoring potential external social threat cues. Clark and Wells (1995) consider the reduced allocation of attention and motivated avoidance of external social cues to be an important factor in maintaining socially phobic individuals' irrational social concerns. In contrast, Rapee and Heimberg (1997), along with general cognitive models of anxiety (e.g. Williams et al., 1988, 1997; Mogg & Bradley, 1998), predict that pre-attentive and attentional biases for external social threat play an important role in the maintenance of social phobia.

As outlined earlier, the refinement of existing treatment interventions for social phobia can hopefully be achieved through further understanding the factors that cause and maintain the irrational fear of social situations. Over recent years, the continued evaluations of both the general cognitive models of threat-processing in anxiety, and specific cognitive theories of social phobia, have produced an extensive empirical literature. The next chapter reviews the empirical evidence for the existence of the various information processing biases proposed by recent cognitive theories, to underlie social phobia.

Chapter 2

Information Processing Biases in Social Phobia: An Empirical Review

Overview

The previous chapter provided a detailed review of the different theoretical approaches to the understanding of social fears and social phobia. Current understanding of social phobia has been greatly enhanced by a series of cognitive theories that outline a variety of information processing biases considered to play a key role in the etiology and maintenance of social phobia (e.g. Clark & Wells, 1995; Rapee & Heimberg, 1997). These models, along with more general cognitive formulations of threat processing in anxiety, propose that social phobia is associated with cognitive biases in: selective attention (Clark & Wells, 1995; Rapee & Heimberg, 1997; Williams et al., 1988; Eysenck, 1992; Mogg & Bradley, 1998; Mathews & Mackintosh, 1998), stimulus evaluation (Mogg & Bradley, 1998; Mathews & Mackintosh, 1998), interpretation of ambiguity (Beck, Emery & Greenberg, 1985) and memory (Beck, et al., 1985; Clark & Wells, 1995). The aim of the present chapter is to provide a critical review of the many experimental studies that over recent years have attempted to clarify the information processing biases considered to characterise social phobia.

Attentional Processes in Social Phobia

Attention refers to the process (or processes) by which certain information is selected in favour of other information (James, 1890). As outlined in the previous chapter, a variety of attentional biases are proposed to play a key role in the cause and maintenance of social phobia. Cognitive models of social phobia (e.g. Clark & Wells, 1995; Rapee & Heimberg, 1997), along with general cognitive models of anxiety (e.g. Williams et al., 1997; Eysenck, 1992), similarly predict that social phobia is characterised by a tendency to selectively process various forms of negative information encountered during a feared social interaction. However, the models differ in terms of what they consider to be the principal source of negative information and threat in social phobia. For example, Rapee and Heimberg consider external social cues, such as facial expressions, to be a major source of threat to individuals with social phobia. As such, they predict that socially anxious individuals preferentially attend to these potentially negative social cues and have difficulty disengaging attention from them. In contrast, Clark and Wells (1995; Wells & Clark, 1997) consider the principle source of threat not to come from non-verbal audience feedback, but instead, from a negative self-image (taken from the observer perspective) generated from increased attention to internal proprioceptive cues interacting with pre-existing negative

beliefs. As such, Clark and Wells propose that attention is predominantly allocated to both physiological cues used to generate the self-image, and the self-image itself.

A variety of tasks have been used to examine selective processing of threatening information in social phobia. The attentional paradigms used, differ greatly regarding the attentional mechanism they investigate (e.g. cognitive interference, facilitated visuo-spatial attention), and the type of negative information addressed (words, faces, interoceptive cues, self-image). However, the studies reviewed are similar in their effort to clarify the biases in the selective processing of threat information considered to be an important factor within a cognitive understanding of social phobia.

The Emotional Stroop Paradigm

The Stroop task (Stroop, 1935) task has long been used by experimental psychologists to study attentional processes. In the modified Stroop colour naming task, participants are shown words printed in different colours. Participants are required to name the colour of the word and disregard its meaning. Conventional interpretations of the Stroop consider colour naming latencies reflect the extent to which processing resources are allocated to the meaning of the word, with longer latencies reflecting greater attention allocation compared to shorter latencies. The application of the Stroop task to understanding attentional processes in emotional disorders has tended to compare the colour naming latencies of disordered groups and controls on a variety of concern-relevant and neutral words. For example, use of the Emotional Stroop has provided evidence of greater selective attention (Stroop interference) for; spider words in spider phobic individuals (Watts, McKenna, Sharrock, & Trezise, 1986), catastrophic words in patients with PTSD (McNally, Riemann, Louro, Lukach, & Kim, 1992) and physical threat words in anxious patients with health worries (Mathews & MacLeod, 1985; Mogg, Mathews, & Weinman, 1989), (review by Williams, Mathews, & MacLeod, 1996).

Over recent years, several studies have used the Emotional Stroop paradigm to examine attentional processes in social phobia (e.g. Amir, et al., 1996; Hope, Rapee, Heimberg & Dombeck, 1990; Lundh & Öst, 1996a; Maidenberg, Chen, Craske, Bohn, & Bytritsky, 1996; Mattia, Heimberg, & Hope, 1993; McNeil et al., 1995; Van Niekerk, Moeller, & Nortje, 1999). An early study by Hope et al. (1990) compared the time taken for individuals diagnosed with social phobia and individuals diagnosed with panic disorder to name the colour of social threat words (e.g. humiliated) or physical threat words (e.g. disease) compared to neutral control words (e.g. cereal). Individuals with social phobia demonstrated longer colour-naming latencies for social threat words relative to neutral words. In contrast, individuals with panic disorder showed longer colour-naming latencies for physical threat words relative to neutral words (social and physical threat words were not

matched in terms of word length and frequency thus preventing direct comparison between threat types). Additional evidence of vigilance for threat in social phobia has since been reported. For example, socially phobic individuals have demonstrated greater interference for social threat words relative to neutral words, compared to non-anxious individuals (Mattia, et al., 1993 experiment 1), individuals with panic disorder (Maidenberg et al., 1996) and individuals previously diagnosed but effectively treated with CBT/drug interventions (Mattia et al., 1993 experiment 2). Thus, these findings of vigilance for socially threatening information in social phobia provide support for the cognitive model of Rapee and Heimberg, (1997) as well as predictions from more general cognitive models (e.g. Williams et al., 1997; Beck et al., 1985). In contrast, evidence that socially phobic individuals' Stroop interference for socially threatening words is suppressed when experiencing high levels of evaluative anxiety (prior to giving a short speech; Amir et al., 1996), does provide some support for cognitive models that suggest attentional processes in social phobia are better characterised by increased self-focussed attention, as opposed to greater vigilance for external threat (e.g. Clark & Wells, 1995).

However, the interpretation of the Stroop task as a measure of selective attention has been questioned. It is unclear whether colour-naming interference reflects competition at the attentional (input) stage or at the response selection (output) stage (MacLeod, 1991). de Ruiter and Brosschot (1994) further suggest that in the emotional Stroop task, early and late stages of processing are involved. Attentional bias towards threat may occur at early stages and cognitive avoidance (e.g. avoiding cognitive processing of threat information) at later stages. Whilst attentional bias to threat might play a role in the emotional Stroop interference effects reported above, the effect cannot be solely attributed to this attentional bias alone as such interference may instead reflect effortful avoidance of threat cues (de Ruiter & Brosschot, 1994). More recently, Kindt and Brosschot (1998; see also Fox, 1994) question whether anxious individuals' greater threat interference (in Stroop and other threat distracter tasks) reflects a preference to allocate processing resources to threat, or instead, a deficit in the effective inhibition of threatening distracters. Given the uncertainties surrounding the interpretation of Stroop results as a measure of attentional bias, researchers have increasingly turned to other experimental paradigms, such as the visual probe task, in an attempt to more directly measure attentional bias in anxiety and social phobia.

The Visual Probe Task and Other Paradigms

The visual probe task assesses the allocation of visual attention and, unlike the Stroop task, does not rely on interference effects. The original version (known as the dot probe task) was developed by MacLeod, Mathews and Tata (1986) from paradigms in experimental cognitive psychology which indicated that spatial attention can be assessed

from the speed of manual responses to visual probes (e.g. Posner, Snyder, & Davidson, 1980). The rationale underlying the dot probe task is that individuals are faster to respond to a probe stimulus that is presented in an attended rather than unattended region of the visual display. In a typical version of the task a series of word pairs are briefly presented on the screen (e.g. 500 ms). On critical trials one word is threat-related and the other neutral. Immediately after the words disappear, a small dot probe occurs in the location of one of the words and participants are requested to respond to the probe as quickly as possible.

Typically, anxious individuals are faster to respond to probes that replace threat rather than neutral words, considered to reflect vigilance for threat (e.g. Broadbent & Broadbent, 1988; MacLeod et al., 1986; Mogg, Bradley, & Williams, 1995). Evidence of selective attention towards threat cues has been observed in a variety of anxiety disorders, including specific phobia (Lavy, van den Hout, & Arntz, 1993), panic disorder (McNally, Reimann, & Kim, 1990) and generalised anxiety disorder (MacLeod, Mathews, & Tata, 1986; Bradley, Mogg, White, Groom, & de Bono, 1999). Vigilance for threat has also been demonstrated in non-clinical individuals with high levels of trait anxiety (e.g. Bradley, Mogg, Falla, & Hamilton, 1998; Mogg & Bradley, 1999; reviews by Williams et al., 1997; Mogg & Bradley, 1998).

In the first application of the dot probe paradigm in social phobia, Asmundsen and Stein (1994) presented social threat, physical threat and neutral words to individuals with generalized social phobia and normal controls. Results indicated that phobic individuals were not quicker in shifting their attention to the specific location of social threat words as might be expected in light of findings from the Stroop studies discussed above. Instead, phobic individuals, but not controls, were quicker at detecting the probe irrespective of its position, after reading the social threat word. While this initial finding has been interpreted (unconventionally) as evidence of a bias in selective attention to threat (Asmundsen & Stein, 1994), it is possible that reading the social threat word, simply heightened phobic individuals' environmental awareness (arousal) and/or encouraged rapid disengagement thereby facilitating probe detection.

Similar uncertainty surrounding the nature of attentional bias for social threat words has come from two recent studies using word based probe detection paradigms. Comparison of high and low socially anxious individuals on a visual probe task containing social threat, positive and neutral words did not reveal any significant results (Pishyar, Harris, & Menzies, 2004), while in a similar study, Mansell, Ehlers, Clark and Chen (2002) found no evidence of attentional bias for social-evaluative words in high socially anxious individuals, irrespective of whether or not participants were subjected to a social stressor condition.

The visual probe studies reviewed above, together with emotional Stroop studies assessing selective attention in social phobia, used single words to manipulate the emotional

valence of the stimuli presented in the task. A potential problem with using word stimuli is that the emotional valence of a word tends to be confounded with subjective word frequency effects. Individuals with social phobia are more likely to think about threatening events and to describe themselves as anxious, frightened and fearful. Thus, they are likely to be more familiar with, and show a higher frequency of use for, words that relate to social threat. Furthermore, it is unclear what effect these frequency effects (and therefore priming effects) may have on selective attention to emotional word stimuli.

A further problem with using word stimuli is that they lack ecological validity. Single words do not accurately represent the anxiety-provoking stimuli naturally occurring in a variety of feared situations, and as a result, tend to be evaluated as being weaker emotional stimuli compared to pictorial information (e.g. Kindt & Brosschot, 1997). For this reason, research has increasingly focussed on attentional bias to stimuli that are more directly related to stimuli likely to be encountered in a real-life feared situation.

As outlined in the previous chapter, ethological models of social fears and social phobia (e.g. Trower & Gilbert, 1989; Öhman, 1993) highlight the relevance of facial expressions, particularly threatening faces, to the motivations of individuals with social phobia. Consistent with an evolutionary framework, facial expressions have been shown to be a major source of information about the emotional reaction of others in a naturally occurring social situation (Planalp, DeFrancisco, & Rutherford, 1996).

To date, few studies have assessed attentional biases to external social face cues in individuals with social phobia, and the results from these studies are equivocal. Mansell, Clark, Ehlers and Chen (1999) compared sub-clinical individuals with high levels of social anxiety (Fear of Negative Evaluation scores, Watson & Friend, 1969) with low anxious individuals on a modified visual probe task pairing negative, positive and neutral faces with pictures of household objects. Results indicated that high socially anxious individuals showed avoidance of emotional faces (i.e. both positive and negative expressions) relative to household objects when tested under conditions of social evaluative stress. Similarly, Chen, Ehlers, Clark and Mansell (2002) found greater avoidance of face stimuli in general, relative to household objects in patients with social phobia compared with non-patient controls. This evidence, reflecting avoidance of social cues relative to non-social cues, provides support for Clark and Wells' proposal that social phobia is characterised by safety behaviours (and increased self-focus) that reduce attention to external social cues.

However, these findings contrast with predictions that suggest socially anxious individuals selectively attend to potential signs of negative evaluation, such as angry faces, and have difficulty disengaging attention from them (Rapee & Heimberg, 1997). The findings of Mansell et al. (1999) and Chen et al. (2002) also contrast with findings from

recent studies that have assessed attentional biases to emotional faces using neutral faces, as opposed to household objects, as control stimuli.

In an early study, Veljaca and Rapee (1998) requested high and low socially anxious to give a short presentation in front of three stooges. Stooges were briefed to provide an equal number of positive and negative non-verbal responses throughout each speech while participants were instructed to indicate (by pressing one of two buttons) when they identified either behaviour. Results indicated that high socially anxious individuals detected more negative audience behaviours while low anxious controls detected more positive behaviours. While ecologically valid, this study lacked the experimental control demonstrated in other attentional paradigms. For example, stooges were instructed to deliver responses whenever they considered it to be appropriate. Thus, the delivery (and subsequent detection) of non-verbal feedback was liable to be contaminated by both stooges' and participants' perception of performance quality.

Gilboa-Schechtman, Foa, and Amir (1999) compared individuals with generalised social phobia and non-anxious controls on a visual search task in which participants had to detect angry or happy faces that where presented in arrays of neutral faces. Results indicated that socially phobic individuals were quicker to detect the presence of angry compared to happy faces (when presented with neutral face distracters) consistent with vigilance for threat. Mogg and Bradley (2002) reported similar evidence of vigilance for threat faces in non-clinical social anxiety, using a masked version of the visual probe task in which face cues were presented subliminally, outside awareness. Thus, socially anxious individuals not only demonstrate vigilance for threat cues relative to non-threat cues, but also demonstrate a pre-attentive bias favouring the processing of social threat stimuli prior to awareness (Öhman & Soares, 1993; Rapee & Heimberg, 1997).

The evidence from attentional paradigms using neutral faces as control stimuli, are also consistent with robust evidence of vigilance for angry faces in individuals with generalized anxiety disorder (Bradley, Mogg, White, Groom, & de Bono, 1999), sub-clinical high trait anxious individuals (e.g. Bradley, Mogg, Falla, & Hamilton, 1998; Bradley, Mogg, & Miller, 2000; Byrne & Eysenck, 1995) as well as vigilance for threatening faces presented outside awareness, in high trait anxious individuals (Mogg & Bradley, 1999). Given that social anxiety and generalised anxiety are commonly correlated (Watson & Friend, 1969) the similarity between socially anxious, and more generally anxious, individuals' attentional processing of threat faces, is perhaps not surprising.

Direct comparison of the equivocal findings from studies assessing attention to external social cues in social phobia is difficult due to a variety of methodological differences (e.g. use of word versus picture stimuli, type of task and control stimuli). In addition, it remains unclear whether different patterns of attentional bias in social phobia

occur at different stages throughout the processing of a threatening stimulus. For example, initial vigilance for threat might be mediated by automatic processes, with subsequent avoidance instead mediated by more controlled strategies (e.g. Beck & Clark, 1997; Mogg, Bradley, de Bono, & Painter, 1997).

A recent study investigating the time course of attentional bias to emotional faces in social phobia was reported by Mogg, Philippot and Bradley (2004). Using a modified probe detection paradigm, individuals diagnosed with generalised social phobia and non-anxious controls were presented with angry and happy faces (again paired with neutral faces) at two exposure durations: 500 and 1250 ms. At 500 ms individuals with social phobia showed vigilance for angry faces, relative to happy and neutral faces, in comparison with normal controls. However, in the 1250 ms condition attentional responses to emotional faces were not significantly affected by social anxiety. While these findings support previous evidence identifying vigilance for threat in social anxiety at early stages of attentional processing (Gilboa-Schectman et al., 1999; Mogg et al., 2002), limitations of the probe detection paradigm prevent firm conclusions, regarding biases in initial orienting of attention, from being drawn.

As outlined earlier, studies employing probe detection paradigms, typically present stimuli for 500 ms in order to index initial orienting of attention, while 1250 ms has been used to assess the maintenance of attention. However, response latencies to probes following these picture presentations only provide a "snap-shot" of attentional biases, (Bradley et al., 2000). For example, during a 500 ms picture presentation, multiple shifts of attention may occur between the members of the stimulus pair. As such, an individual might initially orient toward the neutral stimulus (of a threat-neutral pair) but then shift attention to the threat stimulus and show an apparent bias for threat (indicated by faster reaction times in the currently attended location). If so, the bias may not reflect the direction of initial orienting.

To address limitations of the probe detection methodology, Mogg, Millar and Bradley (2000) monitored shifts in gaze during a probe detection task. Monitoring gaze has several advantages over probe detection methods of measuring attentional biases. Specifically, eye movements are rapid, naturalistic and normally automatic, such that individuals commonly look at stimuli that attract their attention (Jonides, 1981; Klein, Kingstone, & Pontefract, 1995). Furthermore, under normal viewing conditions eye movements closely follow and are guided by shifts in selective attention (Kowler, 1995). Monitoring eye movements during a modified probe detection task, Mogg, Millar and Bradley (2000) found that patients with generalised anxiety disorder were more likely to look first toward angry faces, rather than neutral faces, compared with both normal controls and individuals with depressive disorder. Anxious patients also shifted their gaze quicker toward angry faces than towards neutral faces, relative to the other two groups.

The literature reviewed above has focussed exclusively on biases in selective attention for externally presented threatening information, particularly information likely to be relevant to the concerns of individuals with social phobia and commonly encountered during a feared social interaction. Findings to date are mixed, with some studies providing support for Rapee and Heimberg's (1997) predictions of vigilance for threat faces in socially anxious individuals (e.g. Gilboa-Schechtman et al., 1999; Mogg & Bradley, 2004) but others supporting Clark and Wells' (1995) proposal that social anxiety is characterised by reduced processing of external social cues (e.g. Chen et al., 2002). While enhanced selective attention to external social threat is considered an important factor underlying the etiology and maintenance of social phobia (e.g. Rapee & Heimberg, 1997; Mathews & MacLeod, 1994), it is considered to be of less importance in other models which instead emphasise the role of an increase in self-focussed attention (Clark & Wells, 1995; Wells & Clark, 1997).

Self-focussed Attention and the Observer Perspective

A number of studies have used a variety of methods to assess the magnitude and characteristics of self-focus in socially anxious individuals. Findings commonly suggest that individuals with social phobia focus their attention towards themselves when confronted with fearful social situations (e.g. Beidel, Turner, & Dancu, 1985; Cacioppo, Glass, & Merluzzi, 1979; Hofmann, 2000; Glasgow & Arkowitz, 1975; Glass, Merluzzi, Biever, & Larsen, 1982; Hope, Gansler, & Hiemberg, 1989; Woody, 1996; Stopa & Clark, 1993, review by Spurr & Stopa, 2002). For example, Stopa and Clark (1993) found that individuals with social phobia appeared to focus more on negative self-evaluative thoughts (e.g. "I'm boring") than anxious or non-patient controls, but did not report more negative thoughts that explicitly mentioned the evaluation by the observer ("She thinks I'm boring").

Several studies have attributed socially anxious individuals' deficits in task performance to an increase in self-focussed attention. For example, Daly, Vangelisti and Lawrence (1989) demonstrated that increased self-focus attention during a speech was associated with poorer speaking performance (as measured by self-assessment and independent observers). Similarly, greater self-focus (reflected in more frequent pausing during a verbal presentation) has been reported in both socially phobic individuals compared to controls, and individuals diagnosed with a generalised sub-type of social phobia compared to non-generalised phobics (Hofman, Gerlach, Wender, & Roth, 1997). However, the extent to which deficits in task performance reliably index increases in self-focus, remains unclear. For example, increased (self-report) self-focus has been found to occur independently of deficits in self-report task-focused attention (Mellings & Alden, 2000) and both self-report and observer ratings of social performance (e.g. Woody & Rodriguez, 2000).

Studies using self-report measures commonly find that socially anxious individuals report greater levels of self-focus compared to less anxious individuals during social situations (e.g. Bogels, Rijsemus, & De Jong, 2002; Daly, Vangelisti, & Lawrence, 1989; Perowne & Mansell, 2002). For example, the Focus of Attention Questionnaire (FAQ, developed by Chambless & Glass, 1984; published in Woody, 1996) is a short self-report questionnaire containing 'self-focus' and 'other-focus' subscales. Studies using the FAQ have demonstrated greater 'self-focus' and reduced 'other-focus' in high socially anxious individuals giving a presentation compared to controls (Perowne & Mansell, 2002). However, while increased 'self-focus' is commonly found in socially anxious individuals, evidence of reduced 'other-focus' remains equivocal (e.g. Mellings & Alden, 2000; Woody & Rodriguez, 2000).

Other studies have sought to identify a causal relationship between self-focus and anxiety in social phobia (Woody 1996; Woody & Rodriguez, 2000). Woody (1996) manipulated self-focus in individuals with generalised social phobia in two social situations (while presenting a speech and while passively standing before an audience). Results indicated that intensifying self-focused attention increased anticipated anxiety and anxious appearance, regardless of social situation type. The self-focus manipulation also increased self-reported anxiety during the task, but only for individuals assigned to a passive role, however, consistent with previous studies, self-focused attention did not affect any measure of social performance. Manipulations of self-focus have also been shown to modulate self-report anxiety levels in low, as well as high socially anxious individuals (Woody & Rodriquez, 2000).

In addition, psychological interventions have been shown to reduce self-focus in socially phobic individuals receiving treatment. For example, exposure therapy reduced the amount of self-focussed thinking in socially phobic individuals anticipating a socially stressful situation (Hofmann, 2000), while cognitive-behavioural therapy has been shown to reduce self-focussed attention, but not affect the amount of attention allocated to external events and stimuli (Woody, Chambless, & Glass, 1997).

To summarize, it has been demonstrated that self-focussed attention is more common in high socially anxious individuals compared to low anxious individuals, is able to enhance subjective and observer rated levels of anxiety, and becomes attenuated following successful psychological intervention. These findings justify the emphasis cognitive models of social phobia (particularly Clark & Wells, 1995) place on the role of self-focus in social phobia. However, the predicted inverse relationship between self-focussed attention and external processing of environmental cues (Clark & Wells, 1995) has received little empirical investigation.

While findings from questionnaire-based studies suggest that increased self-focus is not associated with reduced 'other-focus' (e.g. Mellings & Alden, 2000; Woody & Rodriguez, 2000), such post-event self-report measures are likely to be contaminated by responder bias and confounded with memory biases. As such, Mansell, Clark and Ehlers (2003) developed a novel task in order to compare high and low speech-anxious individuals' attention to both external and internal cues during a feared social-evaluative situation. The external cue was a probe superimposed on either faces (angry, happy and neutral) or household objects. The internal cue was a pulse to the finger which participants were led to believe reflected significant changes in their physiology. Results indicated that speech-anxious individuals directed their attention more towards internal stimuli (relative to external cues) compared to low speech anxious individuals only when exposed to social-evaluative threat. This is consistent with evidence that self-focussed attention is characterised by increased awareness of physiological changes (Scheier, Carver, & Matthews, 1983), and with findings that socially anxious individuals report significantly more anxiety-related bodily sensations following a social interaction (Mellings & Alden, 2000) and are better at detecting such sensations (Johansson & Öst, 1982). The findings are also consistent with evidence that increased focussing on (mis-leading) somatic information enhances anxiety and negative thinking about the self (Wells & Papageorgiou, 2001).

However, it remains unclear whether increased self-focussed attention is functionally equivalent to drawing attention towards an internal sensory modality at the cost of external/environmental sensory modalities. Using a startle-reflex paradigm, Panayiotou and Vrana (1998) failed to demonstrate the reduced startle reflexes (eye blinks) expected to occur when high socially anxious individuals were exposed to a self-focus condition. Contrary to predictions that socially anxious individuals' increased self-focus should reduce startle responding, high socially anxious individuals in fact produced greater startle responses under social evaluative stress relative to no stress, compared to controls. Thus, these results suggest that socially anxious individuals were able to demonstrate enhanced monitoring of external sensory modalities during self-focus, relative to controls.

The 'attentional' nature of self-focus and its dysfunctional effect on external processing of the social environment is both of clinical and theoretical importance, and remains to be clarified. However, also central to Clark & Wells' (1995) cognitive model of social phobia is the proposal that socially anxious individuals' increased self-focussed attention is used to construct an image of the self as a social object, taken from the perspective of the observer. Numerous studies have demonstrated a tendency for socially anxious individuals to predominantly view their social performance from an 'observer-perspective' (e.g. Hackmann, Surawy, & Clark, 1998; Wells, Clark, & Ahmad, 1998; Wells & Papageorgiou, 1999). For example, when simply asked to rate the extent to which an

imagined social situation was viewed through their eyes or the eyes an observer, high socially anxious were more likely than controls to report viewing their performance from the observers' perspective (Wells et al., 1998). In a similar study, Wells & Papageorgiou (1999) found that individuals with social phobia were more likely to report 'observer perspectives' specifically for social situations, compared to blood-injury phobics and non-patient controls, whereas individuals with agoraphobia, tended to adopt an observer perspective for a variety of social and non-social situations.

To date, little research has assessed the extent to which socially anxious individuals use self-focussed monitoring of somatic changes to construct images of themselves from the observer-perspective. However, initial evidence suggests that high (but not low) socially anxious individuals do use perceived body sensations (as measured by the Autonomic Perception Questionnaire, Mandler, Mandler, & Uviller, 1958) to infer how they appear to others (Mansell & Clark, 1999). In addition, it is only when exposed to feared social situations (and thus increasing self-focus), that socially anxious individuals report fewer positive public self-referent (self-relevant observer-perspective) words compared to low anxious controls (Mansell & Clark, 1999).

The above section has reviewed recent empirical research examining attentional biases to external and internal threat in social phobia. The next section reviews information processing biases in other areas of cognition (namely interpretation, judgement and memory), considered to play a role in aetiology and maintenance of social phobia.

Interpretative Biases in Social Phobia

Cognitive models of social anxiety, particularly those derived from clinical practice, highlight the observation that individuals with social phobia commonly report anticipatory and retrospective judgements about social situations that are consistent with a negative interpretative bias (Wells & Clark, 1997). These observations are consistent with predictions from general cognitive models of anxiety (e.g. Beck, Emery, & Greenberg, 1985) and empirical findings from a variety of experimental paradigms, that suggest anxious individuals are more likely than non-anxious individuals to interpret ambiguous stimuli negatively (reviews by Mathews & MacLeod, 1994; Rusting, 1998).

For example, it has been demonstrated that clinically anxious patients, and sub-clinical individuals with high levels of trait anxiety, show a disproportionate tendency to write down the more threatening meanings of homophones (words that sound the same) in a simple spelling task, compared to controls (e.g. Eysenck, MacLeod, & Mathews, 1987; Mathews, Richards, & Eysenck, 1989). Using a delayed recognition-memory test, Eysenck, Mogg, May, Richards and Mathews (1991) found that anxious individuals were more likely

to interpret ambiguous sentences in a threatening manner, as opposed to a non-threatening manner, compared to non-anxious and previously anxious but recovered individuals.

Similar evidence of anxiety-related interpretative bias has been demonstrated in lexical decision tasks using homographs (e.g. Richards & French, 1992) and ambiguous sentences (e.g. Calvo, Eysenck, & Estevez, 1994; Calvo & Castillo, 1997; MacLeod & Cohen, 1993). For example, Richards and French (1992) found that ambiguous primes (with both threatening and neutral meanings) were more likely to facilitate response latencies to threat target words (relative to non-threat target words) in high anxious individuals compared to low anxious controls. Interestingly, this effect was only present when primes were presented for longer periods (i.e. 750 and 1250 ms but not 500 ms) suggesting that negative interpretative bias might reflect differences in strategic elaboration of equally probable interpretations at an automatic level (see also Calvo & Castillo, 1997).

Recently, several studies have assessed interpretative bias in socially anxious individuals. In an early study, Amir, Foa and Coles (1998) found that individuals diagnosed with generalised social phobia were more likely to choose a negative (as opposed to positive or neutral) justification of an ambiguous social occurrence, compared to individuals with obsessive compulsive disorder and non-anxious controls. Furthermore, this interpretative bias was only specific to self-referent social scenarios. In a similar study, Stopa and Clark (2000) presented a series of ambiguous social scenarios depicting mildly negative social events to individuals diagnosed with social phobia, equally anxious individuals (with another anxiety disorder), and non-patient controls. Results indicated that, compared to both control groups, patients with social phobia were more likely to interpret ambiguous social events in a negative fashion and to catastrophize unambiguous, mildly negative social events. While these findings are consistent with a negative interpretative bias in social anxiety, research using similar paradigms (interpretation of ambiguous vignettes) suggests that social anxiety might not be characterised by an outright negative interpretative bias, but instead the absence of a positive bias demonstrated by low anxious individuals (Constans, Penn, Ihen, & Hope, 1999).

Taken together, these studies suggest that individuals with social anxiety demonstrate a more negative interpretative bias compared to controls, when required to evaluate previously described social interactions *off-line.* However, it remains unclear whether socially anxious individuals jump to negative conclusions as an event unfolds (*on-line),* or whether they primarily make distorted judgements on the basis of their pre-existing negative beliefs/self-image after the social interaction. As a result, recent studies have assessed on-line interpretative processing of ambiguous information when it is initially encountered, in socially anxious and non-anxious individuals (e.g. Amir, Foa, & Coles, 1998; Hirsch & Mathews, 1997, 2000).

In a series of three experiments, Hirsch and Mathews (1997) requested individuals who were highly fearful of interviews and low fearful individuals to read personally involving descriptions of job interviews. Throughout the descriptions, participants were required to make speeded decisions regarding the grammatical compatibility of threatening and non-threatening target words with the ending of incomplete sentences. Results indicated that while high fearful individuals did not differ in their response latencies to classify threatening or benign target words, non-anxious participants were faster to identify words that matched a non-threatening (or positive) interpretation of the events they had just read about. Thus, the results are consistent with proposals that socially anxious individuals are not characterised by a tendency to negatively interpret ambiguous personal events, but instead by an interpretative style in which they refrain from making the positive judgements observed in non-anxious individuals (Taylor & Brown, 1988; Constans et al., 1999).

In a subsequent study, Hirsch and Mathews (2000) sought to replicate their initial findings in individuals diagnosed with social phobia and non-phobic controls. Participants again read a series of descriptions about job interviews during which they had to make lexical decisions for a variety of threat/non-threat probes. In an 'unforced-inference' condition, probes appeared at ambiguous parts in the text, and provided equally appropriate (i.e. unforced) resolutions to the ambiguous sentence. In a 'forced-inference' baseline condition, probes appeared at points in the text at which a particular inference was extremely likely (i.e. forced). Consistent with findings from Hirsch and Mathew (1997), results indicated that non-anxious individuals made positive on-line inferences, whilst individuals with social phobia did not. Furthermore, comparisons with the forced-inference baseline condition revealed that non-phobic participants' positive inferences were equivalent to forced-inferences, whereas phobic individuals' willingness to make emotional on-line inferences was significantly reduced compared to baseline. Taken together, the results of studies by Hirsch and Mathews suggest that social anxiety appears to be characterised by an impaired ability to make emotional inferences on-line, contrary to non-anxious individuals, who are instead characterised by a benign/positive on-line inferential bias. The findings can also be considered consistent with evidence suggesting that although socially anxious individuals tend to process threatening aspects of ambiguous social information automatically, initial negative interpretations are ultimately inhibited by more strategic avoidant processing strategies (Amir, Foa, & Coles, 1998).

Thus, taken together, findings from paradigms assessing on-line interpretative bias provide support for cognitive models of social phobia that suggest socially anxious individuals demonstrate reduced processing of social information encountered during threatening social situations (e.g. Clark & Wells, 1995). However, (prior to this thesis) few studies have assessed socially anxious individuals' sensitivity to/interpretation of other

sources of social information, such as facial expressions. In an early study, Winton, Clark and Edelmann (1995) found that high socially anxious individuals reported (on-line) substantially more faces as negative, even though an equal number of angry and neutral faces had been presented. Similarly, Pozo, Carver, Wellens and Scheier (1991) reported that high socially anxious participants ultimately considered (off-line) a series of positive and negative facial expressions to reflect negative audience appraisal, even though they were no better a detecting negative facial expressions during the task. However, it should be noted that these studies arguably assess individuals' ability to distinguish between different facial cues and not strictly differences in the interpretation of ambiguity. As a result, it remains unclear whether social anxiety is characterised by a tendency to interpret ambiguous facial expressions in a more negative (or less positive) manner relative to controls.

Judgement Biases in Social Phobia

Two kinds of judgement bias are considered to play a particularly important role the maintenance of anxiety disorders: exaggerated estimates for the occurrence of negative events, and exaggerated cost associated with such events (Beck, Emery, & Greenberg, 1985; Foa & Kozak, 1986). Consistent with theses biases, Wells and Clark (1997) suggest that individuals with social phobia engage in negatively biased catastrophic anticipatory thoughts prior to entering social interactions.

In a study examining judgement bias in social anxiety, Lucock and Salkovskis (1988) found that, compared to controls, individuals with untreated social phobia exhibited higher probability estimates of negative social events, but not of negative non-social events. Furthermore, following treatment, this negative anticipatory judgement bias was reduced. In a similar study, Foa, Franklin, Perry and Herbert (1996) compared individuals with generalised social phobia and non-anxious controls' expectancy biases using the Probability/Cost Questionnaire (PCQ; derived from Butler & Mathews, 1983; McNally & Foa, 1987). The scale requires participants to rate the probability that a variety of negative non-social and negative social events will occur, as well as the cost associated with their occurrence. Participants were tested twice, 14 weeks apart, during which time the individuals with social phobia received (effective) cognitive-behavioural treatment. Results indicated that individuals with social phobia overestimated both the likelihood and cost of social (but not non-social) events occurring compared to controls. In addition, phobic individuals' judgemental biases attenuated following treatment. These findings are consistent with evidence from other studies that indicate anxious individuals tend to exhibit judgemental biases for negative events, particularly when relevant to their specific fears (e.g. internal bodily sensations in agoraphobia: McNally & Foa, 1987; threat to health in generalized anxiety disorder: Butler & Mathews, 1983). However, it remains to be clarified

whether socially anxious individuals over-associate negative outcomes in relation to specific cues encountered during a feared social situation (e.g. angry faces; de Jong, Merckelbach, Boegels, & Kindt, 1998), or simply overestimate the likelihood/occurrence of threat when anticipating/reviewing social interactions.

The preceding sections have provided a brief review of empirical research into a variety of interpretative and judgemental biases evident in socially anxious individuals. To date, research suggests that social anxiety is characterised by a tendency to overestimate both the probability of, and cost associated with, negative social events occurring. In addition, socially anxious individuals tend to interpret ambiguous social situations in a negative manner, and lack a variety of the positive interpretative biases commonly identified in non-anxious individuals. The final section of this empirical review, briefly considers the evidence relating to memory biases for negative social information in social phobia.

Memory Biases in Social Phobia

Historically, evidence of memory biases in anxiety disorders has been mixed. Evidence of explicit memory biases for threat-relevant information exists in panic disorder (e.g. Cloitre & Liebowitz, 1991; McNally, Foa, & Donnell, 1989), obsessive-compulsive disorder (OCD; Wilhelm, McNally, Baer, & Florin, 1996; Radomsky & Rachman, 1999) and post traumatic stress disorder (PTSD; Vrana, Roodman, & Beckham, 1995; McNally, Metzger, Lasko, Clancy, & Pitman, 1998) but not consistently in generalized anxiety disorder (GAD; Mathews, et al., 1989; Mogg, Mathews, & Weinman, 1989; Mogg & Mathews, 1990). In contrast, implicit memory biases for threat-relevant information have been reported in panic disorder (e.g. Amir, McNally, Riemann, & Clements, 1996; Cloitre, Shear, Cancienne, & Zeitlan, 1994; but see Rapee, 1994), OCD (Foa, Amir, Gershuny, Molnar, & Kozak, 1997), PTSD (Amir, McNally, & Wiegratz, 1996) and GAD (e.g. Mathews, Mogg, May, & Eysenck, 1989; MacLeod & McLaughlin, 1995; but see Bradley, Mogg, & Williams, 1995; Mathews, Mogg, Kentish, & Eysenck, 1995).

In a series of four studies examining memory bias in social anxiety, Rapee, McCallum, Melville, Ravenscroft and Rodney (1994) compared individuals diagnosed with social phobia and non-clinical controls' retrieval of threat-relevant information across a variety of dependent measures (i.e. recall and recognition, cued-recall, recall of feedback from a hypothetical performance and autobiographical memory). All four studies consistently failed to provide any evidence for biased retrieval processes in social phobia. Cloitre, Cancienne, Holt and Liebowitz (1995) similarly failed to find evidence of recall and recognition biases for social threat words among individuals with social phobia (see also Becker, Roth, Andrich, & Margraf, 1999; Lundh & Öst, 1997), while Wenzel and Holt (2002) reported impaired recollection of social threat prose in socially phobic individuals.

However, while social anxiety does not appear to be associated with an explicit memory bias for social threat words/descriptions, it has been demonstrated using a noise judgement paradigm (Jacoby, Allan, Collins, & Larwill, 1988) that socially phobic individuals rate the noise associated with previously presented social threat sentences as less loud than noise accompanying new sentences, compared to controls, consistent with an implicit memory bias for social threat sentences in social phobia (Amir, Foa, & Coles, 2000; but see Rapee et al., 1994). Thus, there is some evidence of memory biases in social phobia which might again be considered to be consistent with a vigilance-avoidance pattern of processing bias, in which threatening material is initially processed automatically (perhaps enabling enhanced implicit recognition), before being strategically avoided, leading to reductions in elaborative stimulus processing (Mogg, Mathews, & Weinman, 1987).

More recently, authors have examined memory biases for emotional facial expressions in social phobia. While Lundh & Öst (1996) demonstrated that patients with social phobia were more likely to recognise faces that they perceived to be critical, than non-anxious controls, Mansell, et al. (1999) found that high and low socially anxious individuals did not differ in their recognition of negative, positive and neutral faces. Therefore, to summarize, research to date has failed to provide consistent evidence that social anxiety is characterised by greater (implicit or explicit) recall of negative social information (Wells & Clark, 1997).

The Present Thesis

The present chapter has provided a critical review of the many empirical studies that have attempted to clarify the information processing biases proposed to play an important role in the etiology and maintenance of social phobia. While the studies reviewed clearly suggest much progress has been made, various theoretical and empirical ambiguities remain (for additional review see Heinrichs & Hofmann, 2001). Perhaps most notable are the contrasting predictions from recent cognitive models regarding the allocation of attention to external threat cues in social phobia (i.e. Clark & Wells, 1995; Rapee & Heimberg, 1997). As discussed, limitations with various attentional paradigms have prevented unambiguous assessment of attention allocation and current evidence remains equivocal. Furthermore, only recently has attention to ecologically valid face stimuli been examined, while appraisal and interpretation of face stimuli has received negligible investigation. Thus, the principal aim of the present thesis is to extend promising, if limited, research into face processing biases in social phobia, with particular reference to theoretically relevant biases in attention and appraisal (Clark & Wells, 1995; Rapee & Heimberg, 1997; Mogg & Bradley, 1998; Mathews & Mackintosh, 1998).

Chapter 3: Experiment 1

Introduction

As outlined in the preceding chapters, recent cognitive models of social anxiety make competing predictions regarding biases in the initial orienting and maintenance of attention to external social and non-social cues (see also Heinrichs & Hofmann, 2001). Clark and Wells (1995; Clark, 1999; Wells & Clark, 1997) suggest that upon entering a feared social situation, socially anxious individuals shift their attention towards a detailed monitoring and observation of themselves which reduces processing resources available to monitor external information such as non-verbal feedback from other people, for example, facial expressions. Moreover, socially anxious individuals' motivation to avoid eye contact in feared social situations further reduces external monitoring and hampers accurate appraisal of audience feedback (Clark & Wells, 1995; see also Clark, 1999).

Rapee and Heimberg (1997) also emphasise the role of increased self-focus in their cognitive model of social anxiety. However, in contrast to Clark and Wells' (1995) prediction that external monitoring is further reduced by safety-seeking strategies like gaze aversion, Rapee and Heimberg (1997) propose that socially anxious individuals show enhanced selective attention for potential signs of negative evaluation (e.g. frowns and signs of boredom). General cognitive models of anxiety similarly predict that anxiety is associated with preferential allocation of attention to threatening information (e.g. Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Williams, Watts, MacLeod, & Mathews, 1997).

Recent empirical studies assessing attention to threat cues in social anxiety have generated equivocal findings. Modified Stroop paradigms suggest that socially anxious individuals demonstrate an attentional bias favouring negative social information (e.g. Maidenberg, Chen, Craske, Bohn, & Bystritsky, 1996; Mattia, Heimberg, & Hope, 1993). However, given that the Stroop task does not provide an unambiguous measure of selective attention (MacLeod, 1991; de Ruiter & Brosschot, 1994), other measures of selective attention such as the visual probe task (MacLeod, Mathews, & Tata, 1986) have been used to evaluate cognitive models of social anxiety. As discussed in Chapter 2, whilst visual probe studies have consistently demonstrated vigilance for a variety of threat stimuli (e.g. negative words, angry faces) in generalized anxiety (review by Mogg & Bradley, 1998), findings in social anxiety remain mixed (review by Heinrichs & Hofmann, 2001). Several studies have indicated enhanced vigilance for external social threat cues, such as angry faces, in social anxiety. For example, using masked face stimuli, Mogg and Bradley (2002) found an attentional bias favouring the location of angry faces relative to happy faces in high socially anxious individuals. Vigilance for angry faces, relative to happy faces, has also been found

in individuals with clinical social anxiety (Mogg, Philipott, & Bradley, 2004). These findings support correlational evidence linking increased social anxiety with a greater preference to look towards angry faces rather than neutral faces (Bradley, Mogg, & Millar, 2000), and evidence of enhanced detection of angry relative to happy faces (presented in arrays of neutral faces) in socially anxious individuals from a visual search paradigm (Gilboa-Schechtman, Foa, & Amir, 1999). These findings are consistent with predictions of vigilance for threat in social anxiety (Rapee & Heimberg, 1997). They are also compatible with findings of vigilance for threat faces in generalised anxiety (Bradley, Mogg, Falla, & Hamilton, 1998; Bradley, Mogg, White, Groom, & de Bono, 1999; Mogg & Bradley, 1999) and with predictions from general cognitive models of anxiety (e.g. Eysenck, 1997; Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Williams et al., 1997). In contrast, avoidance of external social cues in social anxiety has been found in studies pairing emotional faces with objects (e.g. Mansell, Clark, Ehlers, & Chen, 1999; Chen, Ehlers, Clark, & Mansell, 2002), which supports cognitive models that emphasise reduced processing of external social cues as an important maintenance factor in social anxiety (Clark, 1999).

Given the competing theoretical predictions (Clark, 1999; Clark & Wells, 1995; Rapee & Heimberg, 1997) and the equivocal findings discussed above, it is important to clarify the nature of attentional biases to emotional social cues in social anxiety, and to examine not only biases in initial orienting to threat, but also biases in the maintenance of attention to social cues. Heinrichs and Hofmann (2001) noted in their review that "a two-stage hypervigilance-avoidance model as suggested by Mogg, Bradley, DeBono and Painter (1997) seems to provide the best fit with the data" (p. 766), with a bias in initial orienting to threat being followed by subsequent avoidance. In contrast, Rapee and Heimberg (1997) predicted that socially anxious individuals have difficulty in disengaging attention from negative social cues. A limitation of the visual probe studies reviewed above is that they only provide a "snap-shot" of attentional biases. Most studies typically assess attentional biases by presenting a probe 500 ms after picture onset, which does not provide sufficient information on components of attentional processes, such as initial orienting and maintenance of attention (LaBerge, 1995).

A primary aim of the present experiment was to clarify the nature and time course of attentional biases to external social cues in social anxiety using eye movement monitoring. The stimuli were pairs of pictures, which included angry (i.e. threat-related), positive and neutral facial expressions. Biases in initial orienting were assessed from the direction and latency of the initial shift in gaze in response to the pictures, while biases in the maintenance

of attention were assessed from the duration of gaze on the picture that was initially fixated[1]. One main aim was to examine the effect of the emotional valence of social cues on attentional biases in social anxiety, by assessing eye movements to angry and happy faces, relative to neutral faces. Neutral faces have been widely used as control stimuli (e.g. Bradley et al., 1998; 1999; Mogg & Bradley, 1999; Mogg et al., 2004) because, for each face pair (which depicts the same person), the primary difference between the stimuli is their emotional valence; consequently, attentional responses are less likely to be confounded by extraneous stimulus variables (e.g. brightness, contrast), which are more difficult to control with other types of non-facial stimuli. Another specific aim of the study was to examine orienting responses to social stimuli relative to non-social stimuli, because findings of avoidance in social anxiety have uniquely been reported in visual probe studies which have paired faces with objects (e.g. Chen et al., 2002). Consequently, eye movements in response to pictures of neutral faces paired with household objects were also assessed.

With respect to attentional biases for emotional faces, it was predicted from Rapee and Heimberg's (1997) cognitive model of social anxiety and also from general cognitive models of anxiety (e.g. Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Williams et al., 1997) that socially anxious individuals will demonstrate enhanced initial orienting to angry faces relative to neutral faces, compared with low socially anxious individuals. This bias should be evident from shorter fixation latencies and more frequent initial shifts of gaze to social threat cues. Rapee and Heimberg (1997) also predict longer first fixations on threatening cues in socially anxious individuals (i.e. maintained attention on social threat cues); whilst a vigilant-avoidant response pattern in social anxiety, suggested in Heinrichs and Hofmann's (2001) review, predicts rapid initial shifts of gaze to threat cues, followed by shorter fixations on them.

With regard to predictions concerning attentional biases for social cues relative to non-social cues, Rapee and Heimberg's (1997) model suggests that socially anxious individuals should show increased initial orienting to neutral faces relative to objects, and also longer fixations on the face cues, as these social cues are likely to be more relevant to their anxious concerns than the inanimate objects. However, Clark and Wells (1995; Clark, 1999) conversely predict reduced orienting to neutral faces, relative to objects, in high socially anxious individuals compared to low socially anxious controls.

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[1] Reaction time data from probe classification tasks is not reported for Experiments 1-3. Whilst conventional visual probe studies have relied on response time data to generate indices of selective spatial attention, they have typically used a 500 ms Stimulus Onset Asynchrony (SOA). As discussed earlier in Chapter 2, such measures may not provide an accurate measure of initial orienting. In the present study, using longer SOAs (1500 ms) to encourage participants to make overt shifts of attention to stimuli was at the cost of generating conventional, interpretable reaction time indices of initial orienting.

Method

Participants

Sixty one undergraduate students filled in a shortened version of the Fear of Negative Evaluation Questionnaire (Leary, 1983) which correlates highly (0.96) with the full version of the Fear of Negative Evaluation Questionnaire (FNE, Watson & Friend 1969; data from Leary, 1983). To minimize the proportion of the sample with mid-range levels of social anxiety those students whose screening scores were below 30 or above 40 were invited to participate in the study (these scores corresponded to the 30th and 65th percentile, respectively, for the whole sample). A total of 40 participants were tested (5 men, 35 women) for which they received either course credits or cash payment. Additional selection criteria for all participants were that they spoke English as their first language and had visual acuity within normal limits.

Materials and Apparatus

The stimuli consisted of 48 different picture pairs each presented twice in the task. There were three types of picture pair. For two of the pair types, an emotional face (either angry or happy) was paired with a neutral face of the same model. Thus, there were 16 angry – neutral face pairs, and 16 happy – neutral face pairs. The third pair type consisted of 16 neutral faces paired with 16 household object pictures (e.g. chair, lamp, clock). A different model appeared in each of the 48 picture pairs and, for each pair type, half the faces were male, and half female. The faces were selected from a pool of over 600 photographs from several sources (e.g. Bradley et al., 1998; Ekman & Friesan, 1976; Matsumoto & Ekman, 1988). All faces were rated (1-9 point scale) by 12 independent judges for how happy and angry they were and the best exemplars were selected. Mean angry and happy ratings were 7.9 and 1.0, respectively, for angry faces (n = 16); 1.1 and 8.0 for happy faces (n = 16) and 1.2 and 1.1 for neutral faces (n = 48). An additional 9 pairs (reflecting the picture pairings used in the experimental session) were prepared as practice items.

The stimuli were presented using MEL version 2 software (Schneider, 1995) on a Pentium III 450 MHz PC and 15" VGA monitor, and reaction time (RT) responses obtained via a MEL version 2 response box. Participants' horizontal eye movements were monitored with a 60Hz infrared pan/tilt eye tracking system (Model 504 supplied by Applied Science Laboratories, Bedford, Massachusetts) and E5000 software (Applied Science Group, 2000) which was run on a Pentium 333 MHz PC. The room was dimly illuminated by a variable wattage bulb controlled to allow satisfactory eye pupil discrimination for each individual participant.

Procedure

Participants first completed a consent form and then their visual acuity was measured to check that each participant had acuity within normal limits (i.e. 6/12 or better on the Snellen Chart). Participants' mood was then assessed using visual analogue scales (ranging from 0 – 100) on which they indicated how happy, sad and anxious they felt. Participants sat 1.1 m away from the monitor. The Eye Tracker camera was positioned 50 cm in front of the participant, below the right eye. Participants were required to sit up straight and to keep their head still throughout the calibration and testing session. The Eye Tracking equipment was calibrated by presenting the numbers 1-9 on the screen in a 3 x 3 array (with number 1 at the top left of the screen, and 9 at the bottom right) and instructing participants to look at each number in turn whilst their position of gaze was recorded for each number.

Each trial of the attentional task started with a central fixation cross shown for 1000 ms which was replaced by a pair of pictures presented side by side for 1500 ms. The pictures measured 72 x 110 mm with their centres 186 mm apart. Immediately after the offset of the picture pair, a probe (either two vertical dots : or two horizontal dots ..) was presented until response or for a maximum of 10 seconds in the position of one of the preceding pictures (visual angle of 9.7 ° between the two probe positions). Participants were asked to press one of two response buttons as quickly as possible to classify the probe as vertical or horizontal. The main reason for requiring a response was to encourage participants to be attentive to the task whilst avoiding any emphasis on the picture content. The inter-trial interval varied randomly between 750 ms and 1250 ms. Participants were also instructed to look at the fixation cross at the start of each trial. Eye movement data were recorded from the onset of the fixation cross until the manual response. The 96 experimental trials were presented randomly. On half the trials for each type of picture pair, the critical stimulus was on the left and the control stimulus was on the right, and vice versa for the other half of trials. The position of the critical stimulus and the position and type of the probe were also balanced across trials, so that each appeared in each position with equal probability. After initial eye calibration (described above) there were 9 practice trials followed by the 96 experimental trials. If eye calibration quality deteriorated during the task, the task was temporarily interrupted and the calibration procedure repeated.

Following the attentional task, participants completed the following questionnaires: Fear of Negative Evaluation Scale (FNE; Watson & Friend, 1969), Social Avoidance and Distress Scale (SADS; Watson & Friend, 1969), state and trait versions of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), shortened state and trait versions of the Profile of Moods States containing 6 items for anxiety and

depression (POMS; McNair, Lorr, & Droppelman, 1981), social phobia subscale from the Fear Questionnaire (Fear- social; Marks, & Mathews, 1979) and a short form of the Social Desirability Scale (SDS; Strahan & Gerbasi, 1972; this 10-item form X1 was found by Fischer & Fick, 1993, to correlate .96 with the full SDS of Crowne & Marlowe, 1964). The SDS was included because defensiveness may be a confounding variable affecting measures of anxiety and attentional bias (e.g. Eysenck, 1997; Fox, 1993). Participants were finally debriefed.

Preparation of the Eye Movement Data

Data were prepared and analyzed using the Eyenal Data Analysis Program (Applied Science Group, 2000). The direction of gaze, measured in degrees, was measured once every 17 ms. If eye movements were stable within one degree of visual angle for 100 ms or more, this was classified as a fixation to that position, the duration of which was recorded. Fixations were classified as being directed at the left or right pictures if they were 3.0 degrees wide of the central position (previously occupied by the fixation cross) on the horizontal plane.

The dependent measures, i.e. direction and latency of the initial fixation, and the duration of gaze on the initially-fixated picture, were derived in the same way as in other recent eye movement studies (e.g. Mogg, Bradley, Field, & de Houwer, 2003). Fixations on either picture were identified if all three of the following conditions were satisfied: (i) participants were fixated in the central region before picture onset, (ii) EMs occurred at least 100 ms after picture onset and before picture offset, and (iii) participants fixated on one of the pictures, rather than the central position, during picture presentation. Participants made an initial fixation to either picture on 90% of trials (participants did not fixate on the fixation cross before picture onset on 2% of trials and fixated within 100 ms of picture onset for 2% of trials; a fixation was not made to either picture on 6 % of trials).

EM-direction bias scores were obtained for each type of picture pair by calculating, for each participant, the number of trials in which the first eye movement was towards the critical stimulus, as a percentage of the number of trials with eye movements. For example, the EM-direction bias score for angry faces was the number of trials when the first EM was directed toward the angry face, divided by the total number of trials with EMs to angry - neutral picture pairs (bias scores greater than 50% indicate a preference to look at angry rather than neutral faces, and 50% reflects no bias). EM-direction bias scores were similarly calculated for happy–neutral face and neutral face–object pair types.

The gaze duration measure is the time spent looking at the initially-fixated picture, before a shift in gaze away from it. For this measure, an additional criterion was that gaze at the picture was terminated by the participant, rather than picture offset, as the latter does not

reflect participants' behaviour. This resulted in the loss of a further 1% of data.The amount of missing EM data did not significantly differ between the social anxiety groups.[2] Kolmogorov-Smirnov (K-S) tests showed that the distributions of the EM data did not differ significantly from normality.[3]

Results

Group Characteristics

Participants were allocated to one of two groups according to whether their scores on the FNE and SADS were below, or above, the sample medians on both of the main measures of social anxiety[4]. The Low Social Anxiety group (LSA; $n = 16$) had FNE scores of less than 19 and SADS scores of less than 8. The High Socially Anxiety group (HSA; $n = 16$) had FNE scores of 19 or more and SADS scores of 8 or more. The HSA group had significantly higher scores on all social anxiety measures compared with the LSA group (see Table 1 for means and *t*-test results)[5]. The LSA group had higher social desirability scores than the HSA group, but the groups did not differ significantly in age or gender ratio.

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[2] Unless otherwise stated alpha level was .05, two-tailed, throughout all of the experiments reported in the present thesis.

[3] Throughout the present thesis, unless otherwise stated, Kolomogorov-Smirnov tests (or similar) confirmed that data distributions satisfied assumptions required for parametric analysis.

[4] The selection criteria used *both* FNE and SADS scores as these tap different aspects of social anxiety (Watson & Friend, 1969). The FNE assesses distress, apprehensiveness and expectations concerning others' negative evaluations. The SADS assesses actual and desired tendency to avoid being with, talking to and escaping from others for any reason. Whilst the scales fail to address certain specific fears common to social anxiety such as perceptions of being sick, odd and shaking, (Mattick & Clarke, 1998) the FNE and SADS are highly correlated with other more recent self report inventories e.g. $r = .61$ with Social Phobia Diagnostic Questionnaire, (Newman, Kachin, Zuellig, Constantino & Cashman-McGrath, 2003) and have continued to be extensively used in contemporary social anxiety research. Similar 'double-gate' selection procedures using both the FNE and SADS have been used in other studies of cognitive bias in social anxiety (e.g. Mogg & Bradley, 2002).

[5] Throughout the present thesis strong positive correlations were observed between all self-report measures of social anxiety (screening and full), state/trait anxiety and depression ($.52 < rs < .89$). Importantly, short FNE (screening) correlated with the full FNE ($r = .87$) and SADS ($r = .75$) across the whole sample and within both high (FNE: $r = .61$; SADS: $r = .57$) and low (FNE: $r = .58$; SADS: $r = .52$) social anxiety groups.

Table 1. Social Anxiety Group Characteristics

	Low social anxiety		High social anxiety			
	M	*SD*	*M*	*SD*	*t*(30)	*p*
Short FNE (screening)	24.4	5.1	46.4	4.5	7.7	< .001
FNE (experiment)	9.1	4.8	26.2	3.9	11.1	< .001
SADS	3.6	2.4	16.4	5.7	8.3	< .001
Fear-Social	11.3	6.4	17.9	5.6	3.1	< .01
STAI-state	30.8	5.4	46.5	10.9	5.2	< .001
STAI-trait	34.1	6.0	51.7	10.4	5.9	< .001
POMS-state anxiety	1.7	1.5	6.1	5.1	3.4	< .01
POMS-trait anxiety	4.5	2.3	8.3	3.7	3.4	< .01
POMS-state depression	1.3	3.2	5.5	4.6	3.0	< .01
POMS-trait depression	2.9	2.1	8.4	5.2	3.9	< .001
VAS-anxious-time 1	2.9	2.0	5.6	2.5	3.4	< .01
VAS-happy-time 1	9.2	2.5	8.6	1.9	1.6	*ns*
VAS-sad-time 1	2.3	1.6	3.1	2.5	1.4	*ns*
SDS	4.8	1.9	3.4	1.9	2.1	< .05
Age	20.8	3.0	20.3	2.2	0.5	*ns*
Gender ratio, m/f	1/15		3/13			

Note. FNE = Fear of Negative Evaluation Scale; SADS = Social Avoidance and Distress Scale; Fear - Social = Fear Questionnaire - social phobia subscale; STAI = State-Trait Anxiety Inventory; POMS = Profile of Mood States; VAS = Visual Analogue Scale; SDS = Social Desirability Scale (short form).

Eye Movement Data: Emotional vs. Neutral Faces

To aid comprehension, the main findings are summarised at the start of each section before describing the analyses in detail: On trials with emotional-neutral face pairs, participants showed a general bias to look preferentially at emotional faces, and to look longer at emotional faces, than at neutral faces. This bias was unaffected by social anxiety group.

EM-direction

EM-direction bias scores from angry-neutral and happy-neutral face trials were entered into a mixed design analysis of variance (ANOVA) with type of Emotional Face (angry vs. happy) as a within-subjects factor, and Group (high vs. low social anxiety) as a between-subjects factor (see Table 2 for means).[6] There were no significant results, $Fs(1, 30) < 2.46$, $ps > .05$.[7] Overall, participants directed their gaze more frequently to emotional faces than neutral faces (i.e. on 57% of trials); a one-sample t-test confirmed that this bias towards emotional faces was significantly greater than 50 %, $t(31) = 5.32$, $p < .001$.

[6] EM bias scores were analyzed in preference to the count of EMs in each condition because the number of EMs toward a particular picture cannot be assumed to be independent of the number of EMs away from it given the task demands (Mogg, Millar, & Bradley, 1998). Attentional bias scores overcame this problem of lack of independence between cells. However it is reassuring that an ANOVA of the raw EM data (summarized in Table 2) produced similar results to the bias scores: principally a nonsignificant Group x Gaze Direction x Face interaction, $F(1, 30) = 1.85$, $p > .05$.

[7] As the LSA group had higher SDS scores than the HSA group, the analyses of EM data in the present chapter were repeated using SDS scores as a covariate. The findings from ANCOVAs corroborated those from the ANOVAs (but see Miller & Chapman, 2001, regarding cautions in the use of ANCOVA when the covariate is meaningfully related to the independent variable).

Table 2. Summary of Eye Movement Data for each Social Anxiety Group

Variables		Low social anxiety		High social anxiety	
		M	*SD*	*M*	*SD*
		Number of initial fixations			
Pair type	Picture type				
Angry-neutral	Angry	17.4	4.2	16.1	2.8
	Neutral	12.0	4.6	13.0	3.7
Happy-neutral	Happy	14.8	4.0	16.5	4.2
	Neutral	13.1	3.9	12.4	3.8
Face-object	Neutral face	17.8	5.5	20.3	5.2
	Object	10.2	4.1	7.8	3.6
		EM-direction bias scores (%)			
Angry-neutral	Angry	59.7	14.1	56.0	9.3
Happy-neutral	Happy	53.0	5.8	57.4	9.7
Face-object	Neutral face	62.4	13.5	72.8	12.1
		Latency to initial fixations (ms)			
Angry-neutral	Angry	364.3	86.1	330.3	106.3
	Neutral	363.0	116.4	312.1	87.1
Happy-neutral	Happy	343.6	81.0	318.2	91.0
	Neutral	373.1	152.8	311.9	79.5
Face-object	Neutral face	358.8	76.2	321.9	67.6
	Object	381.8	172.5	310.3	55.5
		Gaze duration on initially-fixated picture (ms)			
Angry-neutral	Angry	405.0	74.7	393.3	51.8
	Neutral	355.7	73.6	335.5	83.5
Happy-neutral	Happy	364.8	62.0	375.7	57.1
	Neutral	345.2	53.3	343.6	79.5
Face-object	Neutral face	447.0	62.5	488.5	102.2
	Object	289.5	61.8	292.6	108.9

Fixation latency

Latency data from trials with emotional-neutral face pairs were entered into an ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and two within-subjects factors of Fixation Location (emotional face vs. neutral face) and type of Emotional Face (angry vs. happy). There were no significant results, Fs(1,29) < 3.7, *ns*; see Table 2 for means.

Gaze duration

Duration of initial gaze for emotional-neutral face pairs were entered into an ANOVA with Group (high vs. low social anxiety group), Fixation Location (emotional vs. neutral face) and type of Emotional Face (angry vs. happy) as independent variables. Results showed a significant main effect of Emotional Face, $F(1,28) = 5.58, p < .05$, as gaze durations were generally longer on trials with angry faces (374 ms) than happy faces (357 ms), irrespective of whether the emotional or neutral face was fixated. There was also a main effect of Fixation Location, as participants looked longer at emotional faces (385 ms) than neutral faces (345 ms), $F(1,28) = 12.71, p < .01$. There were no significant results involving social anxiety group.

Eye Movement Data: Neutral Faces vs. Objects

On trials with neutral face–object pairs, participants showed a general bias to look more frequently towards faces, and to look longer at faces, than objects. The bias to direct gaze initially towards faces was significantly greater in the high social anxiety group.

EM-direction

Comparison of the groups on their EM-direction bias scores showed that the HSA group made significantly more first fixations to neutral faces, relative to objects, in comparison with the LSA group, $t(30) = 2.29, p < .05$.[8] The HSA group looked initially at faces (rather than objects) on 73% of trials, and the LSA group did so on 62% of trials; one sample t-tests showed that each of these bias scores was significantly greater than 50 %; $t(15) = 7.55, p < .001$, and $t(15) = 3.68, p < .01$, respectively.

Fixation latency

An ANOVA of mean latencies of first fixations from trials with neutral face-object pairs, with Group (high vs. low social anxiety) and Fixation Location (face vs. object) as

[8] An ANOVA of the raw EM data (summarized in Table 2) produced similar results to the bias scores: that is, significant Group x Gaze Direction interaction for neutral faces, $F(1,30) = 4.13, p = .05$, which reflects more frequent looking toward, rather than away from, neutral faces in the high social anxiety group. This interaction was not significantly influenced by whether the object appeared on the left or right side of the display (Group x Gaze Direction x Face Position, $F(1,30) = 0.13$, *ns*. Throughout the present thesis, unless otherwise stated, analysis of raw EM data corroborates the findings based on EM bias scores reported in main text.

independent variables, showed no significant results, $Fs(1,29) < 2.93$, *ns*.

Gaze duration

An ANOVA of the duration of gaze on the initially-fixated face in neutral face-object pairs was carried out, with Group (high vs. low social anxiety) and Fixation Location (neutral face vs. object) as independent variables. Results indicated only a significant main effect of Fixation Location, as participants (regardless of group) fixated on neutral faces (468 ms) longer than objects (291 ms), $F(1,28) = 91.74$, $p < .001$.

Relationship Between Eye Movement and Questionnaire Scores

To examine the relationship between EM biases (in direction, latency and duration) and the questionnaire measures of anxiety and depression, attentional bias indices for initial fixation latency and duration were calculated for each pair type. The latency bias score for angry faces was the mean latency of fixations away from angry faces minus the mean latency of fixations toward angry faces. Thus, larger values indicate participants were faster in looking toward angry faces than away from them. Latency bias scores were also calculated for happy-neutral and neutral-object pairs. Similar summary measures for initial fixation durations were calculated for each pair type.

Correlations were calculated between the main questionnaire measures of anxiety and depression (FNE, SADS, STAI, Fear- social, POMS-anxiety and POMS-depression) and the attentional indices for the whole sample ($N = 40$; K-S tests showed that the distributions of the mood measures were within normal limits). Increased orienting towards neutral faces (relative to objects) was associated significantly with higher social anxiety as measured by SADS ($r = .37, p < .05$). EM–direction bias scores for happy faces correlated significantly with STAI-state ($r = .43, p < .01$), STAI-trait ($r = .48, p < .01$), FNE ($r = .39, p = .01$) and SADS ($r = .31, p = .05$), such that higher levels of state anxiety, trait anxiety and social anxiety were associated with a greater preference to look more towards happy facial expressions.

Discussion

Results from Experiment 1 indicate that high socially anxious individuals initially directed their gaze towards neutral faces, relative to objects, more often than the low socially anxious group. However, they did not show the predicted enhanced bias in initial orienting to angry faces, relative to neutral faces, compared with the low anxious group. In general, participants were more likely to look initially at, and maintain their gaze on emotional faces, relative to neutral faces, and they also looked longer at neutral faces than objects. The latter

findings may result from the greater interest value or salience of emotional faces relative to neutral faces, and neutral faces relative to objects (Vuilleumier, 2002).

These results do not support the prediction of vigilance for social threat from Rapee and Heimberg's model (1997), given that there was no evidence of enhanced orienting to angry faces in high social anxiety. Whilst replicating the failure to find biases for threat faces in non-clinical social anxiety reported by Bradley et al. (1997, experiment 1), the present findings seem inconsistent with recent studies showing attentional biases for angry faces, relative to happy faces, in social anxiety, such as those employing visual search or visual probe tasks (e.g. Gilboa-Schechtman et al., 1999; Mogg et al., 2004). However, the latter studies not only used different paradigms, but also examined individuals with clinical social anxiety, who had higher levels of social anxiety compared with the participants in the present study.

Another important aim of the present study was to investigate whether findings of face avoidance in social anxiety (e.g. Chen et al., 2002; Mansell et al., 1999) would be revealed when participants have the option of attending to non-social stimuli (objects) rather than social cues (faces). The present results indicate that high socially anxious individuals initially directed their gaze more frequently *towards* neutral faces relative to objects, compared with low anxious controls. This finding fails to support Clark and Wells' (1995) proposal that socially anxious individuals are more likely to show reduced initial orienting to external social cues (neutral faces) relative to external non-social cues (objects). The finding instead seems more consistent with the prediction from Rapee and Heimberg (1997) that socially anxious individuals allocate more attention to the monitoring of external social cues relative to low anxious individuals.

Moreover, the present finding of greater orienting to neutral faces (relative to objects) in high social anxiety contrasts with those from recent studies using face-object attentional paradigms. Mansell et al. (1999) found no difference between high and low (non-clinical) social anxiety groups in their attentional responses to social cues (faces) relative to objects. But when similar high and low social anxiety groups experienced social evaluative stress, the high anxious group showed greater avoidance of emotional faces relative to objects, compared to low anxious controls. Chen et al. (2002) found greater avoidance of faces (in general) relative to objects in patients with social phobia, compared to non-patient controls.

The present experiment used a non-clinical sample of participants who were tested under non-stressful conditions. Many of the studies which have shown attentional biases in social anxiety have used non-clinical samples with social stressors (e.g. Mansell et al., 1999) or clinical samples (e.g. Chen et al., 2002; Mogg et al., 2004). In addition, recent models of social anxiety (i.e. Rapee & Heimberg, 1997; Clark & Wells, 1995) highlight the cognitive

biases present when anxious individuals experience their feared social situation, whilst, general cognitive models of anxiety have increasingly considered the relevance of state factors in modulating attentional bias for threat (Mogg & Bradley, 1998; Mathews & Mackintosh, 1998). This suggests that it would be informative to enhance current anxiety levels in order to investigate further the predicted differences in initial orienting and maintenance of attention to external social cues in high and low socially anxious individuals. Thus, the main aim of Experiment 2 was to replicate the present study, with the exception that participants would be submitted to a social stressor, similar to that used by Mansell et al. (1999).

Chapter 4: Experiment 2

Introduction

Findings from Experiment 1 indicate that high socially anxious individuals initially oriented towards neutral faces relative to objects more often than low anxious controls. This finding provides partial support for Rapee and Heimbergs' (1997) prediction that social anxiety is associated with greater orienting of attention to external social cues, although Experiment 1 failed to identify greater orienting of attention to negative cues in social anxiety as predicted by this model. Moreover, evidence of vigilance for neutral faces relative to objects contrasts with evidence of avoidance of faces in social anxiety (e.g. Chen, Ehlers, Clark, & Mansell, 2002; Mansell, Clark , Ehlers, & Chen, 1999) and models that emphasise reduced monitoring of external social cues and avoiding eye contact as important maintenance factors in social anxiety (e.g. Clark, 1999; Clark & Wells, 1995).

However, as noted in the preceding chapter, specific cognitive models of social anxiety and findings from Mansell, Clark, Ehlers and Chen (1999) suggest that attentional biases may become more apparent when socially anxious individuals experience social evaluative stress similar to that encountered when entering a feared social situation. As discussed in Chapter 1, socially anxious individuals' primary concerns regard situations in which they anticipate behaving ineptly/unacceptably leading to negative evaluation and possible rejection, (Clark & Wells, 1995). These negative cognitions are commonly present in a variety of social situations, ranging from informal social interactions, to assessed public speaking (Holt, Heimberg, Hope, & Liebowitz, 1992; Turner, Beidel, & Larkin, 1986). In a recent assessment of cognitive self-statements across three types of social situation, socially anxious individuals reported more negative and fewer positive thoughts during an impromptu speech situation compared to both same sex and different sex social interactions (Beazely, Glass, Chambless, & Arnkoff, 2001; see also Turner et al., 1986). In addition to being most feared, assessed impromptu speeches perhaps best reflect the variety of the distinct social fears (e.g. formal speaking, being watched and stranger-authority anxiety) identified in a recent factor analysis of clinical outpatient's socially feared situations (Perugi et al., 2001). As such, impromptu speech paradigms (including those in which participants are told about, but don't actually give a speech) have been frequently and successfully used (e.g. Mansell et al., 1999) to investigate "in situ" cognitive processing biases proposed to maintain social anxiety (Clark & Wells, 1995).

A central aim of the present experiment is to extend findings from Experiment 1 by assessing high and low socially anxious individuals' eye movements to social cues in a social environment central to the concerns of individuals with social anxiety. The present

study repeats the eye tracking task used in Experiment 1 to investigate biases in initial orienting and maintenance of attention to social cues in high and low socially anxious individuals in a socially stressful situation, i.e. where they believe that they are just about to give a short presentation. Ideally, assessment of attentional bias would occur during an actual social interaction, however, in attempt to retain maximum experimental control, participants completed the attentional task in the few minutes immediately prior to the assessed speech. Although arguably anticipating, as opposed to ideally enduring, the feared social situation, participants were made aware that both their performance on the cognitive task was monitored by the experimenter (who remained in the room throughout the session) and recorded by the eye tracking camera positioned in front of them. These precautions extend methods used by other researchers, (e.g. Mansell et al., 1999), which similarly sought to place participants under social evaluative stress, and may therefore be considered a more ecologically valid setting to test predictions from cognitive models of social anxiety.

The primary prediction from Rapee and Heimberg's (1997) cognitive models of social anxiety and from general cognitive models of anxiety (e.g. Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Williams, Watts, MacLeod, & Mathews, 1997) is that socially anxious individuals will demonstrate increased initial orienting to angry faces compared to low anxious controls. Whilst increased initial orienting to neutral faces relative to objects would also be predicted from Rapee and Heimberg's (1997) cognitive model, Clark and Wells (1995; Clark, 1999) conversely predict reduced initial orienting to neutral faces relative to objects in high socially anxious individuals compared to low anxious controls. Regarding the maintenance of attention to external social cues in social anxiety, Rapee and Heimberg (1997) predict longer first fixations on threatening cues in socially anxious individuals whilst Heinrichs and Hofmann's (2001) vigilance-avoidance hypothesis predicts shorter initial fixations on threat cues.

Method

Participants

Sixty two undergraduate students were screened using a shortened version of the FNE (Leary, 1983) as in Experiment 1. Those scoring below 30 or above 40 were invited to take participate; a total of 40 participants were tested (8 men, 32 women) for which they received either course credits or cash payment. Additional selection criteria for all participants were that they spoke English as their first language and had visual acuity within normal limits. In addition, participants who scored above 20 on the Beck Depression Inventory II (considered to reflect moderate depression, Beck, Brown, & Steer, 1996) were excluded at the request of the local ethics committee.

Materials and Apparatus

These were the same as used in Experiment 1. In addition, a video camera was used for the social stress induction procedure.

Procedure

The procedure was similar to that in Experiment 1, except for the addition of the stressor. After completing the consent form and rating their mood on the Visual Analogue Scales (VAS, time 1), participants were given the following instructions: "One part of the experiment is designed to assess your social skills and public speaking ability. You will be asked to produce a short speech on a controversial topic, to be recorded by the video camera. I will stay here to watch you give the speech and rate you on several different measures of the effectiveness of your presentation. The tape will then be presented to other psychologists within the research team at a later date so they can make ratings regarding your public speaking skills and the effectiveness of your presentation. The topic of your speech will be given to you approximately thirty seconds before the camera begins to record." Participants then re-rated their mood using the Visual Analogue Scales (time 2) before completing the attentional task used in Experiment 1. Participants then re-rated their mood and completed the following questionnaires (used in Experiment 1): Fear of Negative Evaluation Scale (FNE; Watson & Friend, 1969), Social Avoidance and Distress Scale (SADS; Watson & Friend, 1969), state and trait versions of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), shortened state and trait versions of the Profile of Moods States containing 6 items for anxiety and depression (POMS; McNair, Lorr, & Droppelman, 1981), social phobia subscale from the Fear Questionnaire (Fear- social; Marks & Mathews, 1979) and a short form of the Social Desirability Scale (SDS; Strahan & Gerbasi, 1972). Participants were also asked to rate, on a 0-100% scale the extent to which they believed they would have to give a speech. They were finally told that giving the speech was optional before being debriefed.

Preparation of the Eye Movement Data

Fixations on either picture were identified and dependent measures, i.e. direction and latency of the initial fixation, and the duration of gaze on the initially-fixated picture, were derived in the same way as in Experiment 1. Participants made an initial fixation to either picture on 80.6 % of trials, as participants did not fixate on the fixation cross before

picture onset on 7.5 % of trials and fixated within 100 ms of picture onset for 2.9 % of trials. A fixation was not made to either picture on 9% of trials. A further 1.4 % of trials were removed from the fixation duration analysis as they contained initial fixations that were terminated by the offset of the pictures, rather than by the participant. These percentages were not significantly different in the high and low social anxiety groups. K-S tests showed that distributions of the EM data did not differ significantly from normality.

Results

Group Characteristics

Participants (who had been screened using the short-FNE to favour extreme social anxiety scorers, as described earlier) were allocated to one of two groups according to whether their scores were below, or above, the sample medians on both of the main measures of social anxiety, FNE and SADS, as in Experiment 1.[9] The Low Social Anxiety group (LSA; $n = 15$) had FNE scores of less than 19 and SADS scores of less than 8. The High Social Anxiety group (HSA; $n = 16$) had FNE scores of 19 or more and SADS scores of 8 or more. The HSA group had significantly higher scores on each social anxiety measure, compared with the LSA group (see Table 3 for means and *t*-test results). The groups did not differ significantly in social desirability scores, age or gender ratio. All participants in the final sample rated their belief that they were going to have to give a speech as more than 80%.[10]

Effect of Stressor on Mood

Mood ratings measured using visual analogue scales prior to and immediately after the social stress induction were entered into 2 x 2 mixed design ANOVAs with one between-subjects variable of Group (high vs. low social anxiety) and one within-subjects variable of Time (before vs. immediately after social stress induction). With respect to anxiety ratings, significant main effects of time, $F(1, 29) = 22.28, p < .001$, and social anxiety group, $F(1, 29) = 4.59, p < .05$), were subsumed under a significant Group x Time interaction, $F(1, 29) = 4.33, p < .05$. Post hoc tests indicated that the HSA and LSA groups did not differ significantly in anxiety at the start of the session (means were 5.4 and 4.0, respectively), $t(29) = 1.12$, *ns*; however, following the social stressor, HSA participants were

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[9] Analyses across all dependent measures using social anxiety groups formed from FNE and SADS median splits in Experiment 2, replicated group effects across all measures reported in the main text.

[10] Participants belief that they would have to give a speech was operationalised as a score of at least 80% and is consistent with cut-offs used in other studies (e.g. Mansell, Clark, Ehlers, & Chen, 1999).

significantly more anxious than LSA participants (means were 9.1 and 5.5, respectively), $t(29) = 2.67, p = .01$.

These findings are mirrored in the happiness ratings; i.e. there was a significant Group x Time interaction, $F(1, 29) = 4.61, p < .05$, and post hoc tests indicated significantly lower happiness ratings in HSA than LSA participants following the social stressor (7.0 vs. 9.6, respectively), $t(29) = 2.45, p < .05$, though not before, $t(29) = 0.86$, *ns*. Results from the sadness ratings indicated only a significant main effect of Group, as HSA participants (4.3) felt more sad than LSA participants (1.9), $F(1, 29) = 5.58, p < .05$.

Table 3. Social Anxiety Group Characteristics

	Low social anxiety		High social anxiety			
	M	*SD*	*M*	*SD*	*t*(29)	*p*
Short FNE (screening)	25.6	7.3	44.2	7.5	7.0	< .001
FNE (experiment)	6.3	3.5	24.7	3.5	14.6	< .001
SADS	2.0	1.9	11.6	4.2	8.2	< .001
Fear-Social	8.0	5.9	17.1	5.7	4.4	< .001
BDI-II (screening)	2.8	1.9	6.2	4.3	3.5	< .01
STAI-state	33.1	5.2	48.4	11.4	4.8	< .001
STAI-trait	32.5	6.4	48.5	10.9	4.9	< .001
POMS-state anxiety	4.8	2.2	11.1	5.1	4.4	< .001
POMS-trait anxiety	3.3	2.6	8.9	4.8	4.0	< .001
POMS-state depression	0.3	0.6	3.3	3.3	3.5	< .01
POMS-trait depression	1.3	1.8	5.1	3.3	4.0	< .001
VAS-anxious-time 1	4.0	2.9	5.4	3.7	1.1	*ns*
VAS-anxious-time 2	5.5	3.1	9.1	4.3	2.7	< .05
VAS-happy-time 1	8.9	3.6	7.9	2.6	0.9	*ns*
VAS-happy-time 2	9.6	2.8	7.0	3.1	2.5	< .05
VAS-sad-time 1	1.9	1.9	4.0	3.5	2.1	< .05
VAS-sad-time 2	2.0	1.8	4.6	3.5	2.5	< .05
SDS	4.1	2.2	5.1	2.0	1.2	*ns*
Age	21.7	2.4	22.4	3.3	0.8	*ns*
Gender ratio, m/f	5/10		1/15			

Note. FNE = Fear of Negative Evaluation Scale; SADS = Social Avoidance and Distress Scale; Fear - Social = Fear Questionnaire-social phobia subscale; BDI-II = Beck Depression Inventory version II; STAI = State-Trait Anxiety Inventory; POMS = Profile of Mood States; VAS = Visual Analogue Scale; SDS = Social Desirability Scale (short form).

EM Data: Emotional vs. Neutral Faces

The main findings indicated that the HSA group looked relatively faster at emotional than neutral faces, compared with the LSA group, but showed reduced maintenance of attention on emotional faces: i.e., the LSA group looked longer at emotional than neutral faces, whereas the HSA group lacked this bias.

EM-direction

EM–direction bias scores from emotional–neutral face trials (see Table 4) were entered into a mixed design ANOVA with Emotional Face (angry vs. happy faces) and Group (high vs. low social anxiety) as independent variables. There were no significant results, $Fs(1, 29) < 0.9, ps > .05$. Across the whole sample, participants looked more frequently towards emotional faces than neutral faces; overall mean bias score was 54.4% which was significantly greater than 50%, $t(30) = 3.22, p < .01$.

Fixation latency

Latency data from trials with emotional-neutral face pairs were entered into an ANOVA with Group (high vs. low social anxiety), Fixation Location (emotional vs. neutral face) and type of Emotional Face (angry vs. happy) as independent variables. Results showed a significant Group x Fixation Location interaction, $F(1, 29) = 6.15, p = .01$. As can be seen in Figure 5, the HSA group were relatively faster to fixate on emotional faces relative to neutral faces, in comparison with the LSA group, who tended to be faster to fixate on neutral faces relative to emotional faces. Whilst the interaction was significant, post hoc tests of the effect of fixation location in each group did not reach significance (LSA group: $t(14) = 1.85, p = .09$; HSA group, $t(15) = 1.86, p = .08$).

Table 4. Summary of Eye Movement Data for each Social Anxiety Group

Variables		Low social anxiety		High social anxiety	
		M	*SD*	*M*	*SD*
		Number of initial fixations			
Pair type	Picture type				
Angry-neutral	Angry	14.2	2.6	14.0	5.2
	Neutral	12.4	3.1	10.9	4.7
Happy-neutral	Happy	14.5	2.1	13.7	4.9
	Neutral	12.5	3.7	12.4	5.5
Face-object	Neutral face	18.7	5.2	14.8	6.3
	Object	7.7	2.8	10.0	5.3
		EM-direction bias scores (%)			
Angry-neutral	Angry	53.7	8.2	56.6	9.1
Happy-neutral	Happy	55.0	9.8	52.4	14.4
Face-object	Neutral face	69.1	11.3	59.2	13.6
		Latency to initial fixations (ms)			
Angry-neutral	Angry	397.7	99.2	364.3	122.7
	Neutral	382.8	94.9	430.4	223.4
Happy-neutral	Happy	389.0	96.5	384.8	148.6
	Neutral	352.2	72.1	410.6	240.2
Face-object	Neutral face	404.8	84.9	362.3	87.0
	Object	395.4	95.9	394.2	130.1
		Gaze duration on initially fixated pictures (ms)			
Angry-neutral	Angry	421.8	78.4	361.0	71.6
	Neutral	320.1	71.3	351.8	106.4
Happy-neutral	Happy	421.5	98.4	342.5	98.5
	Neutral	373.4	93.3	340.8	115.1
Face-object	Neutral face	498.0	77.7	389.8	86.7
	Object	323.1	98.9	315.3	88.8

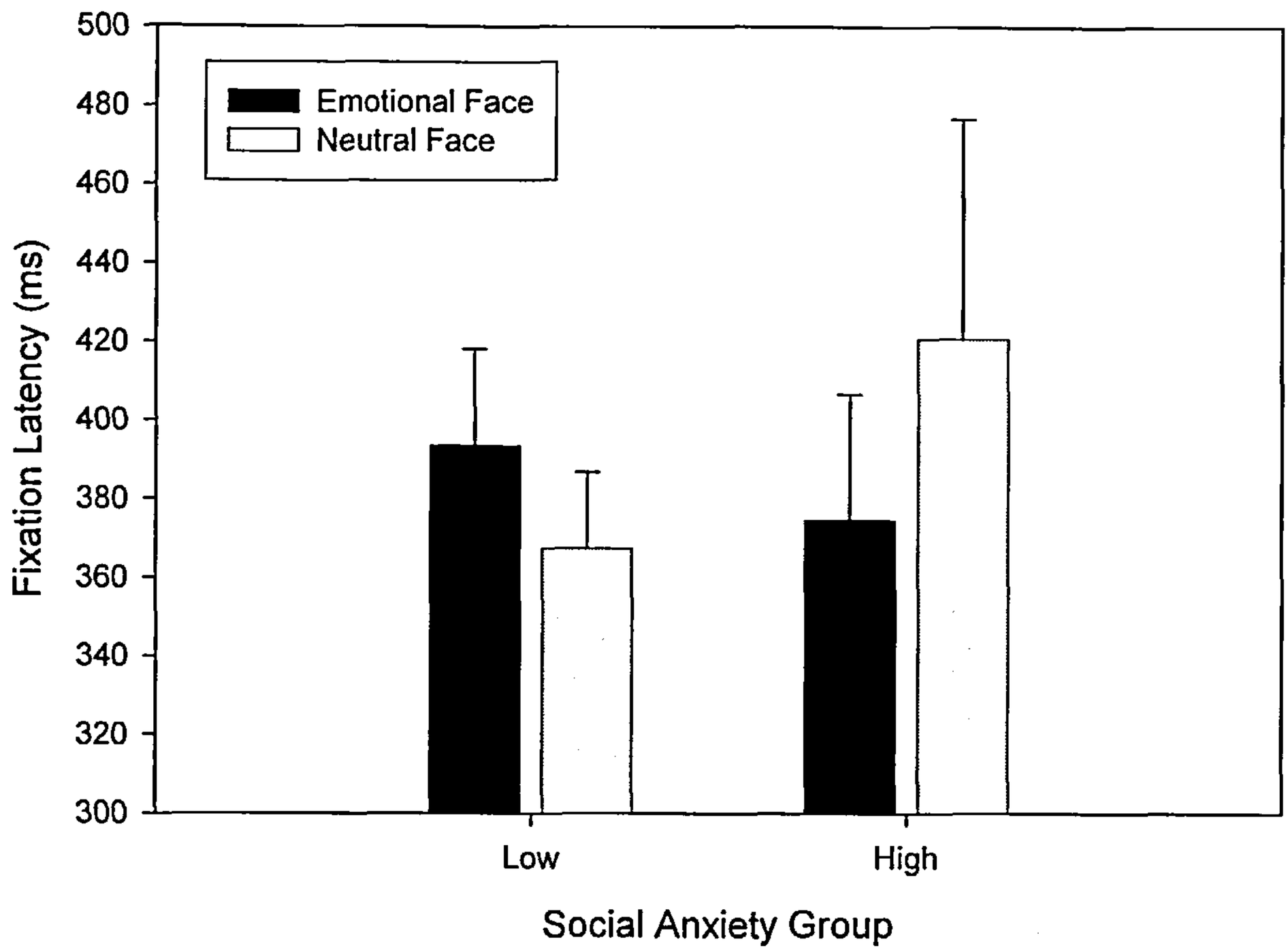

Figure 5. Mean latency of first fixation on emotional face-neutral face trials in low and high social anxiety groups.

Gaze duration

Duration data from trials with emotional-neutral face pairs were entered into an ANOVA with Group (high vs. low social anxiety), Fixation Location (emotional vs. neutral face) and Emotional Face type (angry vs. happy) as independent variables. There was a significant main effect of Fixation Location, as participants spent longer looking at emotional faces (386 ms) relative to neutral faces (347 ms), $F(1, 29) = 9.24, p < .01$. This effect was subsumed under a significant interaction between Group and Fixation Location $F(1, 29) = 6.91, p = .01$, see Figure 6. Post hoc tests indicated that the LSA group fixated significantly longer on emotional faces relative to neutral faces, $t(14) = 3.31, p < .01$, whereas the HSA group did not demonstrate such a bias, $t(15) = 0.38$, *ns*.

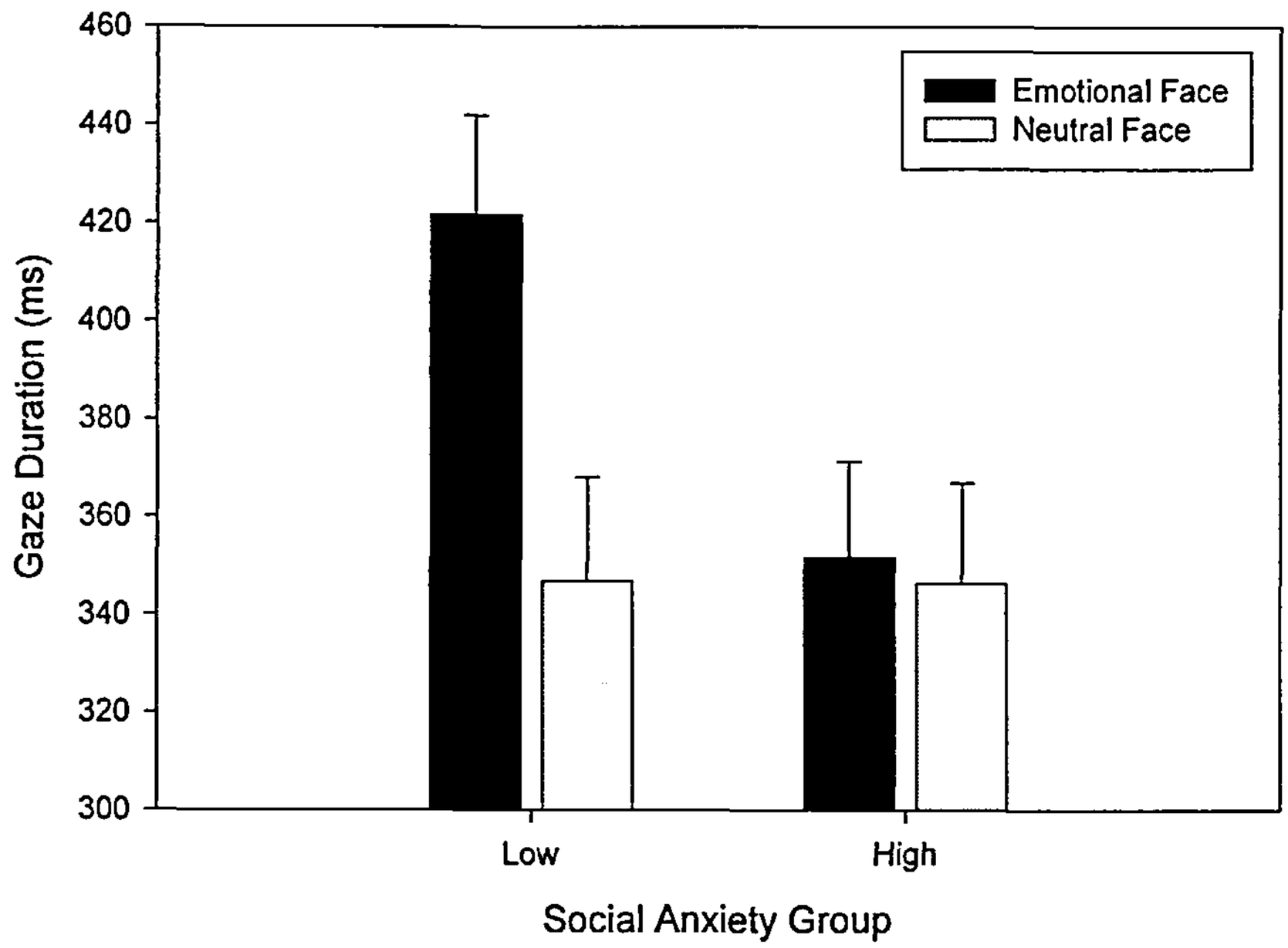

Figure 6. Mean duration of initial fixations on trials with emotional face-neutral face pairs in low and high social anxiety groups.

Neutral Faces vs. Objects

Overall, there was a general bias for participants to look more frequently at faces, rather than objects, and also to look longer at the faces. Both of these biases were attenuated in the HSA group: i.e. their bias to direct their gaze at the faces, and to maintain their fixation on them, was less than that found in the LSA group.

EM–direction

EM–direction bias scores from neutral face-object trials are displayed in Table 4. On trials with neutral face-object pictures, the HSA group made significantly fewer first fixations to neutral faces relative to objects, in comparison with the LSA group (means were 59% and 70 % of trials, respectively), $t(29) = 2.38, p < .05$. One sample t-tests indicated that both the LSA and HSA groups showed a significant preference to look towards neutral faces rather than objects, $t(14) = 6.85, p < .001$, and $t(15) = 2.73, p < .05$, respectively. Thus, both groups showed an attentional bias for faces rather than objects, but this bias was attenuated in the HSA group.

Fixation latency

An ANOVA of mean latencies from trials with face – object pairs, with Group (high vs. low social anxiety) and Fixation Location (face vs. object) as independent variables, showed no significant results, $Fs(1, 29) < 1.65, ps > .1$.

Gaze duration

Duration data from face–object trials were entered into an ANOVA with Group (high vs. low social anxiety) and Fixation Location (neutral face vs. object) as independent variables. Results indicated significant main effects of Group, $F(1,29) = 5.84, p < .05$, and Fixation Location, $F(1,29) = 36.05, p < .001$, which were subsumed under a significant Group x Fixation Location interaction $F(1, 29) = 5.84, p < .05$, see Figure 7. While both LSA and HSA groups fixated on neutral faces for longer than objects, $t(14) = 6.54, p < .001$, and $t(15) = 2.37, p < .05$, respectively, the LSA fixated on neutral faces for longer than the HSA, $t(29) = 3.65, p < .05$.

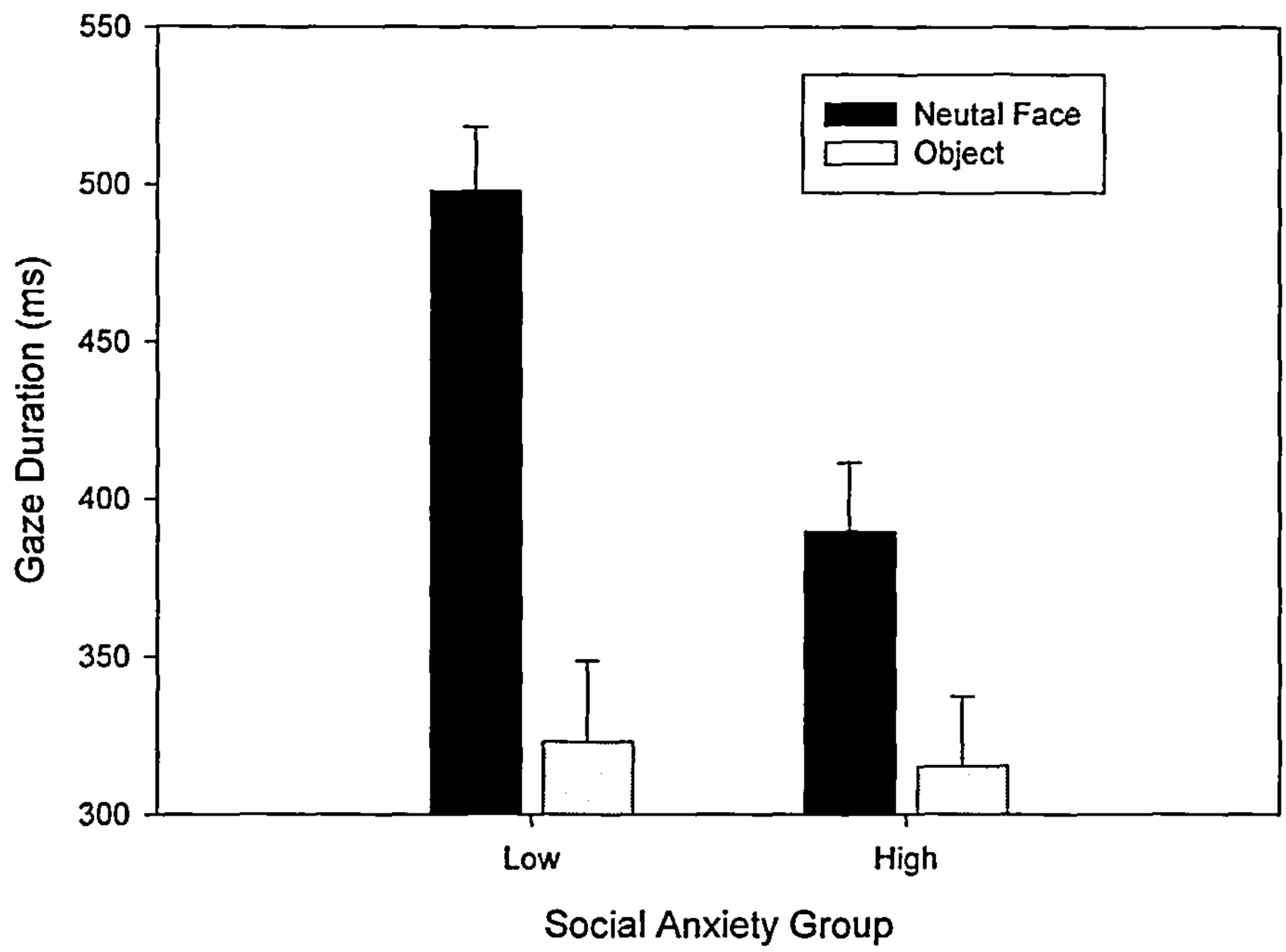

Figure 7. Mean duration of initial fixations on neutral face-object trials in low and high social anxiety groups (ms).

Relationship Between Eye Monitoring and Questionnaire Scores

Correlations were calculated between the main questionnaire measures of anxiety and depression (FNE, SADS, STAI, Fear-Social, POMS-anxiety and POMS-depression) and the summary attentional bias measures (see Experiment 1 for details) for the whole sample ($N = 40$). Increased FNE scores were associated with shorter fixations on neutral faces relative to objects ($r = -.41, p < .01$) and faster orienting towards angry faces relative to neutral faces ($r = .34, p < .05$). Increased SADS scores were associated with faster orienting to angry faces ($r = .31, p < .05$) but shorter initial fixations on angry faces ($r = -.29, p = .06$) relative to neutral faces.

Discussion

Results from Experiment 2 indicate that the social stressor was effective in increasing anxiety, particularly in the high social anxiety group. The EM data from trials with emotional–neutral face pairs showed that high socially anxious individuals were relatively faster to fixate on emotional faces than neutral faces, compared with the low social anxiety group. However, despite this rapid initial orienting bias to emotional faces, the HSA group subsequently fixated on emotional faces for less time than the LSA group. Results from neutral face–object trials indicated that whilst both groups directed their gaze more often towards, and fixated for longer on, neutral faces relative to objects, these biases were significantly reduced in the HSA group compared to low anxious controls.

Before discussing the results from Experiment 2 in detail, it is helpful to examine whether the pattern of attentional biases found under social stress (Experiment 2) differs significantly from that found under no stress (Experiment 1). Hence, the data from both experiments were analysed together, including an additional between-subjects variable of Stressor (i.e. stressor vs. no-stressor).

Comparison of Main Findings from Experiments 1 and 2

Effect of Stressor on Mood

Results relating to participants self report mood immediately prior to completing the attention task indicate that high socially anxious participants (7.4) were significantly more anxious immediately prior to the attention task than low anxious individuals (4.2), $F(1, 59) = 10.32, p < .01$, as too were participants in the social evaluative stress condition (7.3) relative to those in the no stress condition (4.2), $F(1, 59) = 19.50, p < .001$. However, Social Anxiety Group and Stressor did not interact $F(1, 59) = 1.82, p = .18$. In general high socially anxious participants were less happy (7.8) compared to the low anxious participants (9.4) $F(1, 59) = 6.54, p < .05$. Results regarding participants' sadness ratings were nonsignificant, $Fs(1, 59) < 1.40, ps > .2$.

Emotional vs. Neutral Faces

The latency data showed a significant Social Anxiety Group x Fixation Location x Stressor interaction, $F(1, 58) = 8.17, p < .01$, (illustrated in Appendix A Figure A1). Post hoc tests showed a significant Stressor x Fixation Location interaction for the HSA group, who were relatively faster to fixate on emotional faces than neutral faces under social stress, but not under no stress, $F(1, 30) = 4.91, p < .05$. The stressor did not significantly influence

the latency of fixations to emotional faces, relative to neutral faces, in LSA participants.

The duration data for emotional–neutral face pairs also showed a significant Social Anxiety Group x Fixation Location x Stressor interaction, $F(1, 58) = 4.09, p < .05$, (illustrated in Appendix A Figure A2). There was a general bias for participants to look longer at emotional faces than neutral faces, except for the HSA group under social stress who showed no bias (details of post hoc tests are given in the Results sections for Experiments 1 and 2).

Neutral faces vs. Objects

An overall analysis of EM-direction bias scores from both experiments showed that the Social Anxiety Group x Stressor interaction was significant, $F(1, 59) = 10.92, p < .001$ (illustrated in Appendix A Figure A3). Post hoc tests indicated that the stressor significantly decreased initial orienting towards neutral faces (relative to objects) in HSA individuals, $t(30) = 3.0, p < .01$, while it had no significant effect on initial orienting to faces in LSA individuals, $t(29) = 1.69$, *ns*.

An ANOVA of the fixation duration data for faces (relative to objects) confirmed that the Social Anxiety Group x Stressor x Fixation Location interaction was significant, $F(1, 58) = 6.18, p = .01$, (illustrated in Appendix A Figure A4). Post hoc tests showed a significant Stressor x Fixation Location interaction only for the HSA group, $F(1, 30) = 4.91$, $p < .05$. Thus, a general bias for participants to look longer at emotional faces than neutral faces, was reduced in the HSA group under social stress.

The results outlined in the above analyses support the view that the social stressor had selective effects on the orienting responses to social cues in high and low socially anxious individuals.

General Discussion

The present experiments addressed two main issues: one concerned biases in visual orienting to emotional faces, relative to neutral faces, in social anxiety; whereas the other focused on attentional biases to neutral face cues when participants were given the option of attending instead to non-social stimuli (i.e. objects). These will be considered in turn.

Orienting and Maintenance of Attention: Emotional vs. Neutral Faces

Comparison of eye movement measures across Experiments 1 and 2 indicates that the social evaluative stressor had a modulating effect on the latency and duration of initial fixations to emotional social cues in social anxiety. High socially anxious individuals under stress were relatively faster to shift their gaze towards emotional faces, compared with low anxious individuals under stress, or high anxious individuals not experiencing social stress.

This finding seems compatible with cognitive models of social phobia and general anxiety: Rapee and Heimberg (1997) propose that social anxiety is characterised by rapid detection of any signs of negative evaluation such as frowns and signs of boredom, whilst Williams et al. (1997) propose that enhanced orienting to threat may be an important vulnerability factor in anxiety. The present findings also seem compatible with the faster orienting to angry faces relative to neutral faces in generalized anxiety disorder reported by Mogg et al. (2000).

It is important to note that faster orienting in the present study was not restricted to angry expressions but extended to emotional faces in general. The present non-specific bias for emotional cues supports findings from other studies reporting similar attentional bias for positive and negative stimuli in anxiety (e.g. Bradley et al., 1999; Martin, Williams, & Clark, 1991; Mathews & Klug, 1993; Mogg & Marden, 1990). It is conceivable that socially anxious individuals evaluate happy expressions in a negative fashion (e.g. as sign of mocking) and thus allocate attentional resources towards them along with other stimuli evaluated as threatening (Bradley et al., 1999). However, whilst the ANOVA results in the present study did not indicate faster orienting specifically for angry faces, significant correlations were found between increased social anxiety scores (FNE and SADS) and faster orienting to angry faces relative to neutral faces, but not for happy faces, which provides some support for predictions of vigilance for threat in social anxiety (e.g. Rapee & Heimberg, 1997).

A novel feature of the present study is that it examined not only the speed of initial visual orienting responses, but also whether orienting responses were maintained on emotional stimuli. The results indicate that high socially anxious individuals under social stress fixated on emotional faces for significantly less time compared to low anxious controls. Whilst this reduction in fixation duration did not appear to be specific to angry faces (as indicated by the ANOVA results), higher social anxiety scores only significantly correlated with shorter fixations on angry faces, and not happy faces, relative to neutral faces. Taken together, these findings seem to contradict Rapee and Heimberg's (1997) proposal that socially anxious individuals have difficulty disengaging attention from signs of negative evaluation.

Reduced maintenance of attention for emotional cues in socially anxious individuals under social stress also contrasts with findings from a recent attentional cuing study by Fox, Russo, Bowles and Dutton (2001), which assessed manual RTs to probes presented after pictures of individual faces, which served as either valid or invalid cues for the probe location. Results suggested that high state anxiety increases the attentional dwell time on threat cues, i.e. a bias in the disengage component of attention. The discrepancy between quicker disengagement of attention from emotional faces in social anxiety (in the present study) and delayed disengagement from threat in state anxiety (Fox et al., 2001) may be

accounted for by differences between the paradigms used. Fox et al. examined attentional responses to single faces from RTs to probes appearing 100 – 250 ms after face onset. In the present study, the first overt shift of gaze occurred approximately 350 ms after face onset and the index of 'disengagement' was the termination of initial fixations, which occurred approximately 700 ms after face onset. Thus, Fox et al.'s (2001) results are likely to reflect covert attentional shifts prior to the initial eye movement. Covert attention plays an important role in monitoring the parafoveal and peripheral environment whilst eye movements permit more detailed foveal analysis of a selected stimulus (Liversedge & Findlay, 2000). Thus, it is plausible that anxiety may be associated with delayed disengagement of covert attention at early stages of attentional bias. However, anxious individuals, particularly when experiencing greater levels of stress, may strategically reduce attention to threatening stimuli (as reflected by subsequent overt disengagement of gaze) in an attempt to alleviate their discomfort.

Delayed disengagement of covert attention from threat might also partially account for latency bias effects reported earlier. It is possible that individual differences in latency biases reflect not so much speeded orienting towards threat, but instead slower orienting away from threat. Greater delayed covert disengagement from threat in anxious individuals would presumably retard their subsequent overt orienting away from threat and inflate any relative speeding bias towards, rather than away, from threat.

To summarise so far, high socially anxious individuals experiencing social evaluative stress were faster to orient towards emotional faces and also to subsequently disengage overt attention from emotional faces, relative to low socially anxious individuals. Correlations further suggest that increased social anxiety is associated with faster orienting and quicker disengagement from angry expressions, whereas this was not significant for happy expressions. Taken together these findings support the vigilance-avoidance pattern of attentional bias proposed to occur in social anxiety (Heinrichs & Hofmann, 2001). This pattern of bias may exert conflicting effects on the allocation of attention such that after the rapid orienting of attention to the location of stimuli evaluated to be threatening, the focus of attention of anxious individuals may become unstable, with a tendency repeatedly to shift towards and disengage from threat (Mogg & Bradley, 1998).

However, a vigilant-avoidant pattern of bias would also predict a greater preference to direct gaze towards angry faces (relative to neutral faces) in the high social anxiety group which was not found in the present study. It is uncertain whether this null result may be explained in terms of sample characteristics. In a recent study reporting vigilance for angry faces in social phobia, the clinical sample scored almost twice as high on measures of Social Avoidance and Distress compared to the present high social anxiety sample (means were 21.1 and 11.6, respectively; Mogg et al., 2004). It is conceivable that individual differences

in initial direction of gaze to threat may be more reliably apparent at extreme ends of the social anxiety spectrum.

Orienting and Maintenance of Attention: Neutral Faces vs Objects

An important aim of the present experiments was to identify whether the avoidance of face cues in social anxiety (e.g. Chen et al., 2002; Mansell et al., 1999) could result from the pairing of faces with household objects as control stimuli. To this end, the present study included a neutral face – object condition to clarify biases in orienting and maintenance of attention to faces relative to objects. The results indicated a general bias (in both experiments) for participants to look preferentially at faces, rather than non-social cues (i.e. mean direction bias scores were consistently greater than 50%). Under no-stress conditions (Experiment 1), the high social anxiety group directed their gaze more frequently at faces, rather than objects, compared with the low social anxiety group consistent with a bias in high social anxiety to orient preferentially towards external social cues, as predicted by Rapee and Heimberg (1997), but not by Clark and Wells (1995).

In contrast, under social stress (Experiment 2), this bias was significantly reduced in the high socially anxious individuals, compared with low socially anxious individuals. Furthermore, when experiencing social stress, high socially anxious individuals fixated on neutral faces for less time than low anxious controls. These findings - i.e. attenuated biases in initial orienting and maintenance of attention to faces, relative to objects, in socially anxious individuals under stress - provides some support for Clark and Wells' (1995; Wells & Clark, 1997) model, which suggests that when in a feared social situation socially anxious individuals demonstrate reduced processing of external social cues. Previous studies have found evidence of avoidance of emotional faces relative to objects (Mansell et al., 1999) and faces in general relative to objects (Chen et al., 2002) in social anxiety. However, in the present experiment, it is important to note that outright avoidance of neutral faces was not demonstrated. Instead, high socially anxious individuals demonstrated enhanced orienting to faces relative to objects, albeit less so than low anxious controls. The different findings across studies may stem from methodological differences such as the indices of attentional bias taken (i.e. initial shift in gaze versus manual RT time at 500 ms). However, a reduction in both attending towards, and maintaining attention on, faces remains of potential theoretical and clinical relevance.

The cognitive model of social phobia proposed by Clark and Wells (1995) suggests that reduced monitoring of external social cues is an important factor in maintaining the irrational concerns of socially anxious individuals. Reduced orienting to faces would limit socially anxious individuals' opportunity to observe people's non-verbal responses in detail and thus obtain information from other people's reactions that would help them see that they

generally come across more positively than they think (Stopa & Clark, 1993). In contrast, low anxious individuals' increased attention towards, and longer fixations on, social cues would facilitate accurate assessment of audience feedback and correction of any existing concerns.

Clark and Wells (1995) suggest a variety of mechanisms that might account for reductions in attention to face cues in social anxiety. Firstly, when entering a feared social situation, socially anxious individuals shift attention inwards to favour increased self-focused processing. Cognitive resources recruited in monitoring the self are at the expense of resources available for monitoring the external environment. Whilst a reduction in resources would certainly affect the processing of external social cues, it would presumably equally limit processing of all other external cues, including non-social items. Thus, increased self-focus cannot account for the reduced biases in initial orienting and maintenance of attention for faces relative to objects found in the present experiment or reported by Mansell et al. (1999) and Chen et al. (2002).

Secondly, Clark and Wells (1995; Clark, 1999) suggest that socially anxious individuals' motivation to avoid eye contact whilst in a feared situation further reduces external monitoring and hampers accurate appraisal of audience feedback. Trower and Gilbert (1989) similarly suggest that social cues may elicit defensive and avoidant response patterns in socially 'submissive' individuals. Strategies such as avoiding eye contact could account for both reductions in orienting towards and maintenance of attention in socially anxious individuals under social stress, as indicated in the present study.

Concluding Comments

In summary, findings from the present study indicate that socially anxious individuals experiencing social evaluative stress demonstrate quicker orienting to and disengagement from emotional faces relative to neutral faces. This seems most consistent with a two stage pattern of attentional bias: initial rapid orienting towards emotional faces followed by avoidance or rapid disengagement of attention. In addition, high socially anxious individuals under social stress demonstrate both reduced orienting and maintenance of attention to neutral faces relative to objects.

Interestingly, Clark and McManus (2002) have recently suggested a theoretical revision that appears to incorporate assumptions from Clark and Wells' (1995) model, as well as other cognitive models of social and general anxiety which predict biases in initial orienting to threat in anxious individuals (e.g. Rapee & Heimberg, 1997; Williams et al., 1997). This account suggests that socially anxious individuals' (reduced) processing of external social cues is biased in favour of detecting negative responses from others. Thus, when there are competing social stimuli that are relevant to the individual's concerns,

socially anxious individuals may demonstrate a negative attentional bias (e.g. they may preferentially attend to the more negative expression in a pair of faces). However, avoidant responses to faces may instead be revealed when there is an option of attending to external inanimate objects, rather than the faces (Chen et al., 2002). The latter might explain the reduced biases in initial orienting and maintenance of attention on faces, relative to objects, in high socially anxious under stress in the present study. While this proposal may go some way in accounting for some of the findings of attentional biases in social anxiety, it also seems important to consider the roles of specific attentional mechanisms in more detail, such as distinctions between covert versus overt orienting, and between initial orienting and maintained attention. This latter distinction is highlighted by findings from the present study which suggest that opposing biases may operate in different aspects of attentional responses (e.g. relatively more rapid orienting to, but reduced maintenance of attention on, emotional faces in socially anxious individuals under stress).

To conclude, the present findings and previous evidence from empirical studies assessing attentional biases in social anxiety might best be reconciled by proposing two cognitive mechanisms that operate in parallel: one mechanism controlling an unstable vigilant–avoidant pattern of attention allocation, which is evident when there is competition for attentional resources between different types of social cues that vary in emotional valence; and a second mechanism mediating defensive (or socially submissive) behaviours when socially anxious individuals are given the opportunity to avoid social cues.

Chapter 5: Experiment 3

Introduction

Findings from Experiments 1 and 2 suggest that socially anxious individuals differ from low anxious individuals in the processing of emotional social cues relative to neutral social cues, and social cues relative to non-social cues. Biases in selective attention cannot be accounted for simply in terms of the processing capacity limitations which are suggested to occur when socially anxious individuals increase self-focus when experiencing social evaluative stress (e.g. Clark & Wells, 1995). Such limitations would result in reduced processing resources being available for external stimuli, but would not explain why certain types of external stimuli are differently processed. Thus attentional biases in social anxiety must instead result from an interaction between attributes of the external stimuli and processing style/motivations of anxious and non-anxious individuals. In the next section, mechanisms which might underlie these attentional biases will be considered, in particular, the role of stimulus evaluation processes.

Initial Orienting to Threat: The Role of Stimulus Evaluation

In a recent cognitive–motivational model of anxiety Mogg and Bradley (1998) propose that pre-attentive stimulus evaluation mechanisms significantly influence allocation of attention to external stimuli. They propose that a Valence Evaluation System (VES) assesses stimulus threat value. Several variables affect the output of the VES such as the nature of the stimulus, context and interoceptive information about current arousal level. The model considers trait anxiety to reflect the reactivity of the system to aversive stimuli, such that increased sensitivity results in negative stimuli that others would consider neutral being tagged with a relatively high subjective threat value (Mogg & Bradley, 1998).

The Goal Engagement System (GES), allocates greater cognitive resources for stimulus processing if a stimulus is evaluated to be sufficiently threatening by the VES. Thus, attentional responses to emotional stimuli are largely influenced by the subjective appraisal of stimulus threat value, (see also Mathews & Mackintosh, 1998). Considered in terms of a cognitive-motivational model of anxiety, the individual differences in initial orienting reported in earlier chapters might be assumed to result from differences in evaluations of stimuli as threatening.

Maintenance of Attention: The Role of Arousal

Once a stimulus has been preattentively evaluated and oriented towards, further evaluation of a stimulus is required to continually assess the stimulus' motivational

relevance in relation to other stimuli. Attention is more likely to be sustained on stimuli that have motivational significance compared to routine, affectively neutral events (Lang, Greenwald, Bradley, & Hamm, 1993). Theoretical approaches to emotion and motivation identify two drive systems that modulate attention and perception. Emotions are hierarchically organised under super-ordinate classifications of positivity and negativity (e.g. Lang, Bradley, & Cuthbert, 1990) and are best considered distributed along a bipolar dimension of affective valence ranging from attraction and pleasure to aversion and displeasure. However, a further dimension of activation from calm to aroused, also accounts for substantial variance in behavioural modulation (Osgood et al., 1957). Thus, Lang (2000; Lang, Bradley, & Cuthbert, 1998) propose that distinct, orthogonal factors of subjective stimulus valence and arousal modulate orienting and maintenance of attention.

Of particular relevance to the biases in gaze duration identified in Experiment 2, are findings which link individuals' stimulus viewing time with physiological measures of phasic arousal (e.g. skin conductance response). In a free viewing context, individuals viewed similarly arousing pictures for the same amount of time irrespective of whether the picture was positively or negatively valenced (Lang, Bradley, & Cuthbert, 1990). However, evidence from Tolin, Lohr, Lee and Sawchuck (1999) suggests that when pictures invoke very high levels of distress, such as spider and blood injury, phobic individuals' show a reduction in viewing time relative to neutral pictures, consistent with an avoidant viewing pattern. Similarly, Daly (1978) found that high socially anxious individuals held gaze for less total time and for shorter durations whilst listening to a confederate and spent less time looking at others during conversations. In a study monitoring gaze towards audience members while giving a speech, Farabee, Holcom, Ramsey and Cole (1993) noted that individuals with high social anxiety spent less time overall looking at audience members particularly those with beliefs incongruent with speech content. In contrast, low anxious controls attended more towards audience members with incongruent beliefs. Thus, subjective stimulus appraisal might be considered to play an important role in modulating maintenance of attention in high and low socially anxious individuals.

To summarize, socially anxious individuals' motivation to limit orienting and maintenance of attention to social cues relative to low anxious individuals must, in part, result from appraisal mechanisms that assess stimulus valence and arousal. Explicit ratings of stimuli along dimensions of valence and arousal have been shown to covary with subsequent attentional allocation (e.g. Lang, Bradley, & Cuthbert, 1998). However, explicit appraisals together with more general self-report measures have several limitations (e.g. de Jong, Pasman, Kindt, & van den Hout, 2001). For example, they are likely to be contaminated by participants' self presentational strategies and response bias. In addition, self-report measures largely reflect conscious beliefs and are less likely to assess potentially

dysfunctional implicit attitudes the individual is unaware of (De Houwer, 2002). A review of the experimental paradigms developed to assess implicit stimulus appraisal follows.

Implicit Attitudes and Automatic Affective Stimulus Processing

During recent years, a number of reaction time paradigms have been developed that allow investigation of individual differences in attitudes to stimuli. The Implicit Association Test (IAT; Greenwald, McGhee, & Scwartz, 1998) requires participants to categorize stimuli according to one of four categories (e.g. flowers, insects, positive and negative adjectives) by pressing one of two keys. Greenwald et al. (1998) found that individuals were faster to press one key for both flower names and positive adjectives and another key for both insect names and negative adjectives (compatible task), than to press one key for flower names and negative adjectives and the other key for insect names and positive adjectives (incompatible task). The authors concluded that participants more closely associated the attribute 'positive' in memory with the target category 'flower' than with the target category 'insect' and/or more closely associated the attribute 'negative' with the target category 'insect' than 'flower'. Assuming that an attitude reflects an association between the representation of the target category and the representation of positive and negative valence, (e.g. Fazio, Sanbonmatsu, Powell, & Kardes, 1986), the IAT provides an indirect measure of attitudes.

In a recent application of the IAT, de Jong, Pasman, Kindt and van den Hout (2001) assessed high and low socially anxious individuals' beliefs regarding social situations. Social situation and neutral words (e.g. date vs. hall) were used as target categories and positive and negative outcomes (e.g. compliment vs. rejection) as the associated attributes. High socially anxious individuals demonstrated the predicted deterioration of task performance if the required responses were switched from ["social situation word" & "negative" (together with "non-social word" & "positive")] to ["social situation" & "positive" (together with "non-social word" & "negative")] suggesting that they related negative outcomes to social situations. In contrast, low anxious individuals demonstrated the opposite pattern of results (de Jong et al., 2001). Other studies have identified IAT differences between high and low socially anxious individuals with respect to their self esteem and their general evaluations of others (de Jong, 2002) whilst dysfunctional implicit attitudes for fear relevant stimuli are evident in individuals with specific phobia (e.g. Teachman, Gregg, & Woody, 2001; Teachman & Woody, 2003). Taken together, these findings suggest that the modified IAT can be a useful tool in implicitly assessing complaint-specific dysfunctional associations in psychopathology.

However, a limitation of the IAT is that the index of affective association it provides reflects the relative strengths from pairs of associations (i.e. social situation words - negative concept *relative to* nonsocial words - positive concept) rather than the strength of separable

single associations (i.e. social – negative *independent of* nonsocial – positive) see detailed review by De Houwer (2001).

To complement extensive, if conceptually ambiguous research using the IAT, De Houwer and Eelen (1998) developed an alternative reaction time task to index individuals' automatic affective stimulus processing. In the Affective Simon Task participants are able to press one of two buttons to control the movements of a small digitised animated character (manikin). De Houwer and Eelen (1998) instructed participants to move the manikin towards nouns and away from adjectives (irrespective of the valence of the word). It is assumed that running away (i.e. avoidance or escape) is linked with negative valence, whereas running towards (i.e. approach) is linked with positive valence (Cacioppo, Priester, & Bernston, 1993). Given that the response was related to the irrelevant (to be ignored) stimulus feature (word valence) it was predicted that participants would need more time to make the manikin move away from positive words and towards negative words than to make it move towards positive words and away from negative words. Results indicated that reaction times were significantly shorter on congruent (towards positive, away from negative) than incongruent (away from positive, towards negative) trials. This finding supports the hypothesis that stimulus valence is linked to behavioural approach-avoidance action tendencies (Cacioppo et al., 1993; Lang, Bradley, & Cuthbert, 1990). The Affective Simon effect has proved robust when participants verbalize positive and negative responses as opposed to controlling a manikin, when semantic category, grammatical category, and letter-case of words are used as the task relevant feature and, when semantic category of photographs is relevant, (De Houwer, Crombez, Beyens, & Hermans, 2001).

Using a modified version of the Affective Simon Task (Extrinsic Affective Simon Task: EAST[11]) De Houwer (2003) demonstrated that participants held positive attitudes towards the concept 'self' and a marginally negative attitude towards the concept 'others'. Indices of automatic affective processing for each stimulus category (e.g. 'self') were based on various exemplars e.g. first names ('Matt') and generic words ('me', 'myself'). Interestingly, an inspection of implicit attitudes for specific exemplars of the category 'self' suggested that individuals held more positive attitudes for their first name than for more generic exemplars ('me', 'myself'). Thus, a benefit of the EAST is that it allows assessment of absolute attitudes towards distinct exemplars of a category as well as the category in general.

[11] The main structural difference between the EAST and the conventional Affective Simon Paradigm is that participants give responses that are not intrinsically but instead extrinsically related to valence because of task instructions (i.e. press left or right key as opposed to say pleasant or unpleasant; see De Houwer, 2003).

In summary, recent years have seen the development of a variety of reaction time paradigms that assess implicit attitudes towards both individual, and categories of stimuli. Obtaining simple response time indices of implicit attitudes for concern relevant stimuli in anxiety disorders is useful in evaluating cognitive models of anxiety that emphasise the role of subjective stimulus evaluation in attentional bias to threat (e.g. Mathews & Mackintosh, 1998; Mogg & Bradley, 1998). Specifically, for cognitive models of social phobia it is of theoretical importance to assess differences in affective evaluation of external social cues (and differences in subsequent deployment of attention) as a function of social anxiety. Thus a primary aim of Experiment 3 is to clarify individual differences in orienting and maintenance of attention to social threat cues in terms of differences in automatic affective stimulus evaluation.

High and low socially anxious individuals experiencing social evaluative stress completed three tasks used to measure biases in attention, automatic affective processing and explicit evaluation of external social and non social cues. Firstly, participants completed a modified visual probe task similar to that reported in Experiments 1 and 2 of the present thesis. However, a limitation of Experiments 1 and 2 is that angry and happy faces were only ever paired with neutral faces and objects only paired with neutral faces. This design did not permit investigation of the possibility that socially anxious individuals' strategic avoidance of faces might be moderated by the emotional significance of the facial expression (e.g. Clark & McManus, 2002). Therefore, in order to assess the specificity of reductions in attention to external social cues as a function of stimulus threat, in the present experiment a social cue (angry, happy, neutral face) was paired with a non social cue (object) on every trial, during which the participant's eye movements were monitored. In addition, to increase ecological validity when assessing individuals' maintenance of attention, stimulus presentation time was increased from 1500 ms to 5000 ms.

The second task was an Extrinsic Affective Simon Task used to assess participants' automatic affective appraisal of face and object stimuli used in the eye movement task. In the third task, individuals rated the same face and object stimuli (as used in attention and EAST tasks) using explicit valence and arousal rating measures.

In line with Clark and McManus' (2002) revised cognitive model of social anxiety, it is predicted that high socially anxious individuals experiencing social evaluative stress will demonstrate reduced initial orienting and maintenance of attention to faces relative to objects. However, it remains unclear whether the predicted overall reduction in attention to faces might be moderated by stimulus threat. More specifically, whether increased stimulus threat severity is associated with: increased initial orienting of attention (as predicted by Mogg & Bradley, 1998; Mathews & Mackintosh, 1998), or, increased socially submissive attentional avoidance (Clark & Wells, 1995; Trower & Gilbert, 1989). Regarding anxiety

related differences in stimulus appraisal, it is predicted from general cognitive models of anxiety (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998) that socially anxious individuals will evaluate face stimuli more negatively than low anxious individuals (as measured by Extrinsic Affective Simon and explicit valence/arousal tasks).

Method

Participants

Seventy undergraduate students were screened using the shortened version of the Fear of Negative Evaluation Questionnaire (FNE; Leary 1983) and the Beck Depression Inventory II (Beck, Brown, & Steer, 1996). To minimize the proportion of the sample with mid-range levels of social anxiety those students whose questionnaire scores were below 30 or above 40 were invited to participate in the study. A total of 42 participants were tested (6 men and 36 women) for which they received either course credits or cash payment. Additional selection criteria for all participants were that they spoke English as their first language and had visual acuity within normal limits. Participants who scored above 20 on the Beck Depression Inventory II (considered to reflect moderate depression, Beck et al., 1996) were excluded at the request of the local ethics committee.

Task 1: Orienting and Maintenance of Gaze to Facial Expressions

Materials and Apparatus

The stimuli consisted of 48 different picture pairs each presented twice in the task. Each pair consisted of a household object and a face. For one third (16) of the pairs the household objects were paired with neutral faces (8 male, 8 female) another third paired with happy faces (8 male, 8 female) and the final third paired with angry faces (8 male, 8 female). Each pair contained a different object however within each third, an instance of an object category appeared (e.g. mug, chair). The faces were selected from a pool of over 600 photographs which contained three face sets (Bradley et al., 1998; Ekman & Friesen, 1976; Matsumoto & Ekman, 1988). All faces had been previously rated (1-9 scale) regarding how happy and angry they were and the best exemplars were selected. Means for angry and happy ratings were 7.4, 1.0 respectively for angry faces (n=16) ; 1.1, 7.9 for happy faces (n=16) and 1.2, 1.1 for neutral faces (n=16). The photographs were mounted side by side, such that for each pair type and gender, half the faces were on the left and half were on the right. An additional 9 pairs (3 examples of each face-object pair) were prepared as practice items.

The stimuli were presented using MEL version 2 software (Schneider, 1995) on a Pentium III 450 MHz PC and 15" VGA monitor, and reaction time (RT) responses obtained via a MEL version 2 response box. Participants' horizontal eye movements were monitored with a 120Hz infrared pan/tilt eye tracking system (Model 504 supplied by Applied Science Laboratories, Bedford, Massachusetts) and E5000 software (Applied Science Group, 2000) which was run on a Pentium 333 MHz PC. The room was dimly illuminated by a variable

wattage bulb controlled to allow satisfactory eye pupil discrimination for each individual participant.

Procedure

Participants sat 1.1 m away from the testing monitor and 50 cm from the Eye Tracker camera which was positioned below their right eye before completing the eye calibration procedure (see Experiment 1 for details). Each trial of the attention task started with a central fixation cross shown for 1000 ms which was replaced by a pair of pictures presented side by side for 5000 ms. The pictures measured 72 x 110 mm with their centres 186 mm apart. Immediately after the offset of the picture pair, a probe (either two vertical dots : or two horizontal dots ..) was presented until response or for a maximum of 10 seconds in the position of one of the preceding pictures (visual angle of 9.7 ° between the two probe positions). Participants were asked to press one of two response buttons as quickly as possible to classify the probe as vertical or horizontal. The inter-trial interval varied randomly between 750 ms, 1000 ms and 1250 ms. Participants were instructed to look at the fixation cross at the start of each trial. Eye movement data were recorded from the onset of the fixation cross until the manual response. On half the trials for each picture type, the face was on the left and the object on the right, and vice versa for the other half of trials. The position of the face and the position and type of probe were also balanced across trials, so that each appeared in each position with equal probability for each face type. After initial eye calibration (see Experiment 1) there were nine practice trials during which eye calibration was assessed followed by the 96 experimental trials presented in a random order. If eye calibration quality deteriorated during the task, the task was temporarily interrupted and the calibration procedure repeated.

Task 2: Extrinsic Affective Simon Task (EAST)

Materials and Apparatus

Eight positive and eight negative pictures taken from the International Affective Picture Set (Lang, Bradley, & Cuthbert, 1999) were converted to greyscale and presented in the 'Valence Training' block (described below). Sixteen neutral pictures taken from the International Affective Picture Set (Lang, Bradley, & Cuthbert, 1999) were prepared in both green and blue filters and presented in the 'Colour Training' block (described below). The green colour was created by setting the RGB (red, green and blue) values in CorelDRAW v 9.0 (Corel Corporation, 2000) to 173, 223, 202 respectively. The RGB values for the blue colour were 173, 203, 223 respectively. As a result the green and blue colour appeared quite similar (this prevented participants operating at ceiling levels which would render the task insensitive to predicted valence effects under investigation). For the 'Experimental' block (described below), the 16 angry, happy and neutral faces and 16 randomly selected

household objects from the Eye Movement Task were prepared in both green and blue filters. An additional 16 positive and 16 negative IAPS were converted to greyscale and presented as 'white' filler trials during the experimental block. All stimuli were resized to 72 x 110 mm and were presented in the centre of the screen on a black background using MEL version 2 software (Schneider, 1995) on a Pentium III 450MHz PC. Presentation was on a 15" VGA monitor and RT responses obtained via a MEL version 2 response box.

Procedure

The EAST began with participants reading written instructions presented on the screen. These informed participants that pictures would be presented in the middle of the computer screen. Their task was initially to classify these pictures by pressing the left button or the right button depending on the meaning of the presented picture (e.g. "press the left button for white positive pictures and press the right button for white negative pictures"). Participants then completed the 'Valence Training' block during which the 8 positive and 8 negative 'white' IAPS were randomly presented twice.

Following the 'Valence Training' block, participants were informed that they would be presented with colour filtered pictures and were instructed to press the left or right button on the basis of the colour of the picture (e.g. "press the left button for green pictures and press the right button for blue pictures"). During the 'Colour Training' block the 16 coloured neutral IAPS were randomly presented twice, once in green, once in blue.

In the subsequent 'Experimental' block, participants were informed that they would be presented with a mixture of white and coloured pictures and were instructed to press the left or right button on the basis of the meaning/colour mappings they had previously been trained on. It was again clarified that if the picture was white (unfiltered) the picture should be classified on the basis of meaning, however, if coloured (filtered) the picture should be classified on the basis of colour. During the experimental block the 16 angry, happy and neutral faces and the 16 household objects were each presented twice, once in green once in blue. In addition to 128 coloured trials there were 64 white trials in which the 16 positive and 16 negative IAPS were presented twice.

There were 4 versions of the task; participants were instructed to press the left button for either positive/green pictures, positive/blue pictures, negative/green or negative/blue pictures depending on the task version, the right button being assigned to the opposite valence/colour response. Participants were randomly assigned to a version of the task and all trials within a block were presented in a random order. Each training/experimental trial began with the presentation of white fixation cross for 500 ms followed by the picture until response or for a maximum of 10 seconds. Participants were asked to respond as quickly and accurately as possible. The inter-trial interval varied randomly between 750 ms, 1000 ms and 1250 ms.

Task 3: Explicit Valence and Arousal Ratings

Materials and Apparatus

The 16 angry, happy and neutral faces and 16 randomly selected household objects used in the EAST were presented in greyscale (as in the Eye Movement Task) and presented in the centre of the screen against a black background using MEL version 2 software (Schneider, 1995) on a Pentium, III 450 MHz PC. Rating responses were obtained via a keyboard.

Procedure

Each trial of the Valence rating task started with a fixation cross shown for 500 ms which was replaced by a picture presented for 2 s. Immediately after the offset of the picture a 9 point (-4 to +4) rating scale was displayed on the screen until response. Participants were asked to rate how pleasant or unpleasant they found the picture. Anchors were presented beneath numbers across the scale at regular intervals: Very unpleasant (-4), Slightly unpleasant (-2), Slightly pleasant (+2) and Very pleasant (+4). Participants were asked to select a rating from the scale and press the corresponding key labelled on the keyboard in front of them. There were two practice trials followed by 64 experimental trials containing the 16 angry, happy and neutral faces and 16 household objects used in the EAST each presented once in a random order.

Trial events in the Arousal rating task were similar to those used in the Valence rating task except that participants were asked to rate how emotionally arousing they found each picture on a 9 point scale (0 to 8). Anchors were presented beneath numbers across the scale at regular intervals: Not at all (0), Moderately (4) and Extremely (8). Participants were asked to select a rating and press the corresponding key labelled on the keyboard. There were two practice trials followed by 64 experimental trials containing the 16 angry, happy and neutral faces and 16 household objects used in the EAST and Valence rating task each presented once in a random order.

Session Order

Visual acuity was first measured with a Snellen chart and participants rated their mood using Visual Analogue Scales (Time 1; see Experiment 1 for details). Participants then read and signed a consent form. The consent form informed the participants of the tasks they would be required to complete in the session and included a modified version of the social threat induction used in Experiment 2, see below:

"One part of the experiment is designed to assess your social skills and public speaking ability. You will be asked to produce a short speech on a controversial topic, to be recorded by the video camera. I will stay here to watch you give the speech and rate you on

several different measures of the effectiveness of your presentation. The tape will then be presented to other psychologists within the research team at a later date so they can make ratings regarding your public speaking skills and the effectiveness of your presentation. You will complete the speech after one of the following four computer tasks. The topic of your speech will be given to you approximately thirty seconds before the camera begins to record."

Immediately after reading and signing the consent form, participants re-rated their mood (Time 2) before completing the Eye Movement Task. Following completion of the EM Task, participants re-rated their mood using the visual analogue scales administered earlier (Time 3) before completing the EAST. After again rating their mood (Time 4), participants completed the Valence and Arousal rating tasks (presented in counterbalanced order across participants). Participants finally completed the following questionnaires: Fear of Negative Evaluation Scale (FNE; Watson & Friend, 1969), Social Avoidance and Distress Scale (SADS; Watson & Friend, 1969), State and Trait versions of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), social phobia subscale from the Fear Questionnaire (Marks & Mathews, 1986) and a short form of the Social Desirability Scale (SDS; Strahan & Gerbasi, 1972). Participants were then asked to rate, on a 0-100 % scale the extent to which they believed they would have to give a speech. Participants were finally instructed that they did not have to deliver a speech and debriefed.

Preparation of the Eye Movement Data

Fixations on either picture were identified and dependent measures, i.e. direction and latency of the initial fixation, and the duration of gaze on the initially-fixated picture, were derived in the same way as in Experiment 1. Participants made an initial fixation to either picture on 86.2 % of trials, as participants did not fixate on the fixation cross before picture onset on 9.6 % of trials and fixated within 100 ms of picture onset for 4.2 % of trials. A further 1.8 % of trials were removed from the fixation duration analysis as they contained initial fixations that were terminated by the offset of the pictures, rather than by the participant. These percentages were not significantly different between the high and low social anxiety groups.

Results

Group Characteristics

Participants were allocated to one of two groups according to whether their scores on the FNE and SADS were below, or above, the sample medians on both of the main measures of social anxiety (these had been administered under standardised conditions, in contrast to the shortened screening FNE measure). The low social anxiety group (LSA; n = 20), had FNE scores of less than 18 and SADS scores of less than 8. The high socially anxious group (HSA; n = 19), had FNE scores of 18 or more and SADS scores of 8 or more. Group characteristics are summarized in Table 5. Independent t-tests indicated that the two groups differed significantly on each social anxiety measure with the HSA group having significantly higher scores than the LSA (see Table 5 for results). The groups did not differ significantly in age, SDS scores or gender ratio. All participants in the final sample rated their belief that they were going to have to give a speech as more than 80%.

Table 5. Social Anxiety Group Characteristics

	Low social anxiety		High social anxiety			
	M	*SD*	*M*	*SD*	*t*(37)	*p*
Short FNE (screening)	24.1	5.0	47.2	5.1	9.2	< .001
FNE (experiment)	8.2	5.2	24.8	4.2	10.9	< .001
SADS	4.7	4.9	11.5	6.9	3.6	< .001
Fear-Social	12.0	6.2	19.6	4.9	3.8	< .001
STAI-State	36.9	9.5	54.3	10.2	5.6	< .001
STAI-Trait	33.9	8.7	52.0	9.1	6.4	< .001
BDI-II	2.4	2.0	11.2	5.1	5.7	< .001
SDS	4.1	2.4	3.8	1.9	0.4	*ns*
Age	20.4	2.6	20.1	2.4	0.5	*ns*
VAS–anxious-time 1	2.9	1.8	5.8	2.9	3.5	< .001
VAS–anxious-time 2	5.0	3.0	7.4	2.5	4.4	< .001
VAS–anxious-time 3	5.2	2.9	7.4	3.7	2.0	*ns*
VAS–anxious-time 4	4.8	3.1	6.7	3.7	1.7	*ns*
VAS–happy-time 1	9.5	2.7	8.6	1.8	1.3	*ns*
VAS–happy-time 2	9.4	2.6	6.9	2.5	3.1	< .01
VAS–happy-time 3	8.0	3.2	6.6	2.7	1.4	*ns*
VAS–happy-time 4	7.8	3.2	7.0	1.9	0.9	*ns*
VAS–sad-time 1	2.2	1.9	3.2	2.8	1.2	*ns*
VAS–sad-time 2	2.1	1.8	3.5	2.2	2.2	< .05
VAS–sad-time 3	2.0	1.7	3.8	2.8	2.4	< .05
VAS–sad-time 4	2.0	1.8	3.1	2.4	1.6	*ns*
Gender ratio, m/f	3/17		2/17			

Note. FNE = Fear of Negative Evaluation Scale; SADS = Social Avoidance and Distress Scale; Fear - Social = Fear Questionnaire-social phobia subscale; STAI = State-Trait Anxiety Inventory; BDI-II = Beck Depression Inventory version II; SDS = Social Desirability Scale (short form); VAS = Visual Analogue Scale.

Mood Throughout Experimental Session

Mood ratings (measured using visual analogue scales) taken throughout the session were entered into separate 2 x 4 mixed design ANOVAs with one between-subjects variable of Group (high vs. low social anxiety) and one within-subjects variable of Time (Time 1: before stress induction, Time 2: before EM task, Time 3: before EAST, Time 4: before explicit ratings).

With respect to anxiety ratings, high socially anxious individuals (6.8) were significantly more anxious than low anxious individuals (4.5), $F(1, 37) = 14.81, p < .001$. A main effect of Time $F(3, 111) = 8.23, p < .001$ indicated that participants were similarly more anxious both immediately after the stress induction (6.2) and before the EAST (6.3), compared to before the stress induction (4.4), *ps* < .05. There was no interaction between Group and Time $F(3, 111) = 1.5$, *ns*.

With respect to happiness ratings, a main effect of Time $F(3, 111) = 13.84, p < .001$ was subsumed under a significant Group x Time interaction $F(3, 111) = 3.35, p < .05$. Follow-up one way ANOVAs at each level of Group were significant for both groups, *Fs* > 7.4, *ps* < .001. HSA individuals were happier before the stress induction compared to all times following the induction (*ps* < .05), in contrast, LSA individuals were significantly happier prior to and immediately following the stress induction relative to the end of the session (time 4) *ps* < .05, (see Table 5).

Similar analysis of participants' sadness ratings did not reveal a main effect of Time or an interaction between Group and Time, *Fs*(3,111) < 1, *ps* > .4 although there was a non-significant trend for high socially anxious participants to give greater sadness ratings overall (3.4) compared to low anxious individuals (2.1) $F(3,111) = 3.34, p = .06$. To summarize, the stress induction procedure was initially effective in elevating anxiety levels in both groups and reducing happiness ratings in high socially anxious individuals.

EM-direction

EM-direction bias scores were obtained for each pair type by calculating, for each participant, the number of trials in which the first eye movement was towards the face stimuli, as a proportion of the number of trials with fixations for that pair type (see Table 6 for means, see Experiment 1 for more details). K-S tests showed that the distributions of EM-direction bias scores did not differ significantly from normality.

EM-direction bias scores for angry, happy and neutral faces were entered into a mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and one within-subjects factor of Face Type (angry, happy, neutral). There were no significant results from the ANOVA (Fs < 1). One sample t-tests for each group, (comparing each bias score against a value of 50%), indicated that both LSA and HSA groups made more initial fixations towards all face types relative to household objects $ts(19) > 3.58, p < .01$ and $ts(18) > 4.08, p < 0.01$ respectively, (see Table 6).

Fixation Latency

Mean latency of initial fixations in each condition are displayed in Table 6. Kolmogorov-Smirnov tests indicated that the distributions of latencies to initial fixations for each condition differed significantly from normality. Latency data was log-transformed to avoid distorting the calculation of condition means.

Transformed latency data were entered into a mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and two within-subjects factors of Fixation Location (face vs. object) and Pair Type (angry, happy, neutral), see Appendix B, Table B1 for transformed means. There were no significant results from the ANOVA (Fs < 2.1, ns).

Table 6. Summary of Untransformed Eye Movement Data for each Social Anxiety Group

Variables		Low social anxiety		High social anxiety	
		M	*SD*	*M*	*SD*
Pair type	Picture type				
		Number of initial fixations			
Angry-object	Angry	19.2	5.5	19.1	4.4
	Object	7.9	3.4	9.0	2.6
Happy-object	Happy	18.9	6.0	18.8	6.1
	Object	9.0	4.4	8.5	3.3
Neutral-object	Neutral	18.2	6.4	18.8	6.3
	Object	9.0	4.7	9.0	3.5
		EM-direction bias scores (%)			
Angry-object	Angry	69.9	14.8	67.6	9.6
Happy-object	Happy	66.9	18.8	67.6	13.6
Neutral-object	Neutral	66.1	20.1	65.9	17.0
		Latency to initial fixations (ms)			
Angry-object	Angry	431.0	185.0	434.5	243.5
	Object	378.3	121.1	486.8	569.6
Happy-object	Happy	429.1	170.0	412.4	259.8
	Object	455.4	270.0	526.0	439.2
Neutral-object	Neutral	464.9	211.5	460.6	321.8
	Object	434.7	196.6	494.4	440.2
		Gaze duration on initially fixated pictures (ms)			
Angry-object	Angry	729.9	230.3	780.4	298.2
	Object	494.1	356.7	419.2	255.2
Happy-object	Happy	727.6	268.3	692.8	254.2
	Object	508.9	320.8	454.2	269.1
Neutral-object	Neutral	701.4	261.5	687.5	177.9
	Object	534.0	334.0	458.5	283.2

Gaze Duration

Mean duration of first fixations in each condition are displayed in Table 6. Kolmogorov-Smirnov tests indicated that the distributions of the fixation durations for each condition differed significantly from normality. Fixation duration data was log-transformed to avoid distorting the calculation of condition means, (see Appendix B, Table B1 for transformed means).

Transformed duration data were entered into a mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and two within-subjects variables of Fixation Location (face vs. object) and Pair Type (angry, happy, neutral). Results showed a main effect of Fixation Location $F(1, 37) = 44.23, p < .001$ such that participants fixated for longer on faces (730 ms) compared to household objects (490 ms). Results further indicated a significant interaction between Fixation Location and Pair Type, $F(2, 74) = 3.42, p < .05$, see Figure 8. Follow-up within-subjects ANOVAs indicated that duration of gaze on faces significantly differed across pair types, $F(2, 76) = 3.41, p < .05$, as participants initially looked longer at angry faces relative to neutral faces, ($p < .05$). Duration of gaze on objects did not significantly differ across pair types, $F(2, 76) = 1.28$, *ns*.

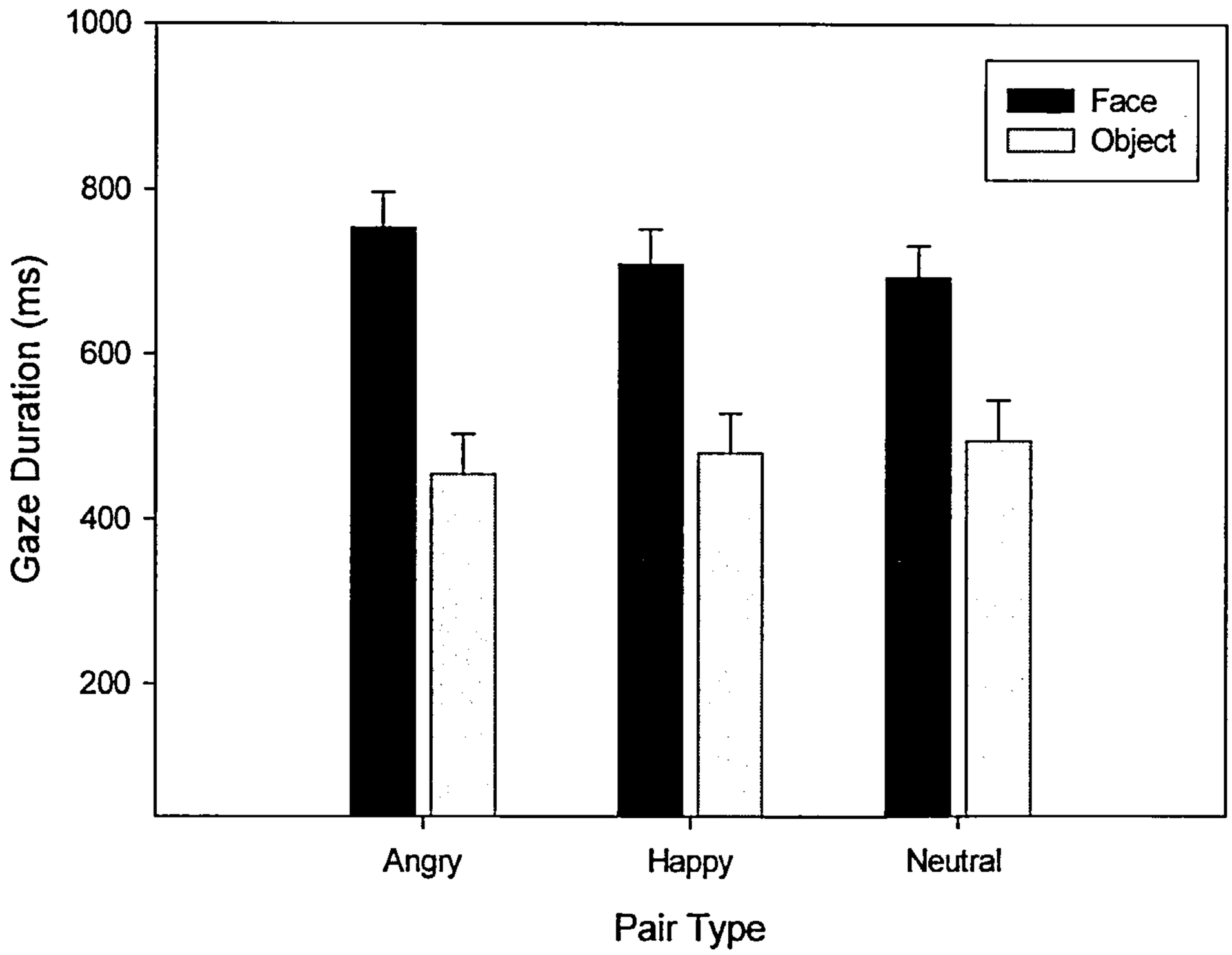

Figure 8. Mean duration of initial fixations.

Extrinsic Affective Simon Task

Only reaction times (RT) and accuracy data from experimental trials on which coloured (filtered) stimuli were presented were analysed. RT data from incorrect responses were discarded. In accordance with Greenwald, McGhee and Schwartz (1998) reaction times below 300 ms and above 3000 ms were recoded to 300 ms and 3000 ms respectively, and latencies were log-transformed. Mean log-transformed RTs and percentage of errors were calculated for the eight extrinsic valence/picture type conditions (i.e. extrinsically negative and positive responses for angry, happy, neutral faces and household objects). Mean untransformed RTs and percentage errors in each condition are displayed in Table 7 (see Appendix B, Table B2 for means of transformed RTs).

Table 7. Mean Reaction Time (ms) and Percentage Errors on Target Stimulus Trials for each Picture Type and Extrinsic Response Valence.

Variables		Low social anxiety		High social anxiety	
		M	*SD*	*M*	*SD*
Picture type	Response valence				
		Reaction Time (ms) with > 3000 = 3000 and < 300 = 300			
Angry	Positive	784.9	188.8	735.2	215.6
Angry	Negative	771.7	206.9	756.7	152.3
Happy	Positive	755.6	171.1	705.5	162.4
Happy	Negative	725.0	149.3	740.2	165.5
Neutral	Positive	778.4	181.2	708.3	172.1
Neutral	Negative	744.8	178.3	725.3	137.4
Object	Positive	887.9	236.7	846.1	271.4
Object	Negative	1105.2	493.4	1030.5	486.2
		Percentage Errors			
Angry	Positive	9.7	12.6	4.0	6.0
Angry	Negative	3.4	4.3	3.6	6.4
Happy	Positive	6.6	7.2	1.3	2.6
Happy	Negative	8.4	11.0	5.3	6.0
Neutral	Positive	6.6	9.4	6.3	6.9
Neutral	Negative	5.6	7.6	3.0	3.8
Object	Positive	4.4	7.3	5.6	9.3
Object	Negative	46.9	39.7	26.3	29.7

Inspection of Table 7 indicates that participants' response latencies and percentage errors on object trials were substantially greater than on trials when faces were presented. A one-way repeated measures ANOVA of response latencies with Picture Type (angry, happy, neutral face and object) as the IV produced a significant main effect of Picture Type, $F(3, 114) = 44.49, p < .001$ in which latencies were significantly greater for objects (967 ms) relative to angry (762 ms), happy (731 ms) and neutral faces (739 ms), (Bonferonni post hocs *ps* < .001). A similar ANOVA of percentage errors produced an equivalent main effect of Picture Type, $F(3, 114) = 28.23, p < .001$, in which percentage errors were significantly greater for object (21%) relative to angry (5%), happy (5%) and neutral faces (5%), (Bonferonni post hocs *ps* < .001). To preserve homogeneity of variance in subsequent parametric analyses and given the absence of specific theoretical predictions regarding social anxiety and automatic affective processing of objects, it was necessary to remove object data from omnibus ANOVAs and analyse these data separately.

Reaction time data

Mean log-transformed RTs for angry, happy and neutral face trials were entered into a 2 x 3 x 2 mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and two within-subjects factors of Face Type (angry, happy, neutral) and Extrinsic Response Valence (positive vs. negative). The Extrinsic Response Valence factor refers to the valence (either positive or negative) associated with the response (based on colour) on 'Experimental colour' trials. Results indicated a main effect of Face Type $F(2, 74) = 6.51, p < .01$ which reflects participants slower responses on angry face trials (762 ms) relative to trials containing happy (731) and neutral faces (739) (Bonferroni pair-wise comparisons $p < .01$ and $p < .05$ respectively). A significant interaction between Group and Extrinsic Response Valence, $F(1, 37) = 7.06$, $p = .01$ reflected high socially anxious individuals' quicker positive valence responses (716 ms) compared to low anxious controls (773 ms; $p < .05$); while negatively valenced responses in high (741 ms) and low (773 ms) socially anxious individuals were comparable. However, the interaction between Face Type and Extrinsic Response Valence was non-significant $F(2, 74) = 0.25$, *ns*, as too, was the predicted interaction between Group, Face Type and Extrinsic Response Valence, $F(2, 74) = 1.01$, *ns*. Thus, there was no evidence that high socially anxious individuals implicitly appraised negative social cues more negatively than low anxious individuals.

RTs from object trials were entered into a 2 x 2 mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and one within-subjects factor of Extrinsic Response Valence (positive vs. negative). Results indicate that participants were significantly quicker to make positively valenced responses (867 ms) than negatively valenced responses (1067 ms), $F(1, 37) = 7.26, p < .05$. All other results were non-significant $F(1, 37) = 0.12$, *ns*.

Error rates

Percentage errors for each condition were entered into a 2 x 3 x 2 mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and two within-subjects factors of Face Type (angry, happy, neutral) and Extrinsic Response Valence (positive, negative). The interaction between Face Type and Extrinsic Response Valence was significant, $F(2, 74) = 5.02, p < .01$, see Figure 9 (all other results were non-significant Fs < 2).

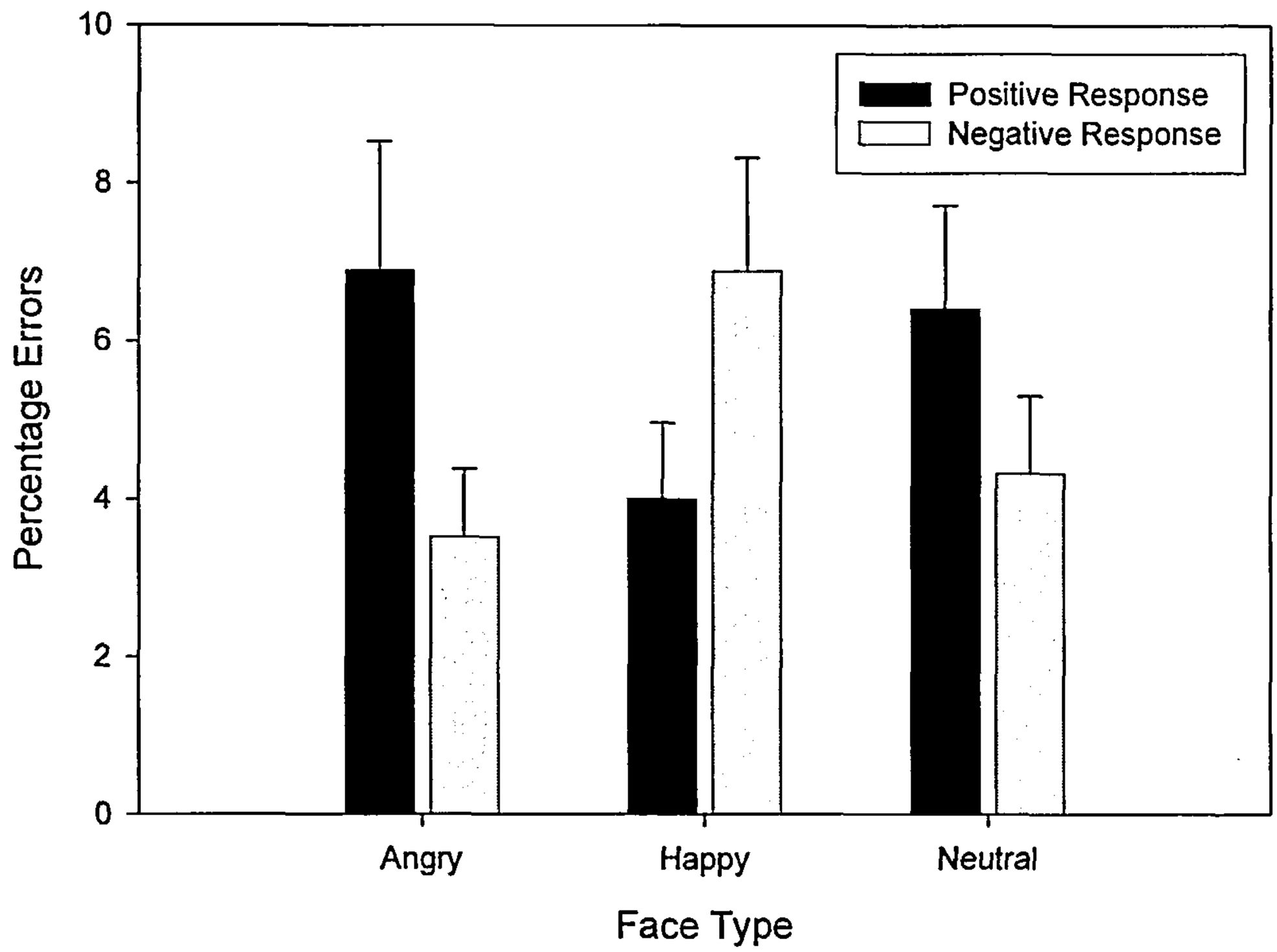

Figure 9. Percentage errors as a function of face type and extrinsic response valence.

To investigate the significant two-way interaction paired sample t-tests were carried out comparing the error rates for positive and negative extrinsic valence responses within each face type. On angry face trials, performance was significantly worse when positively valenced extrinsic responses were required compared to when negative extrinsic responses were required, $t(38) = 2.02, p = .05$. On neutral face trials, there was a non-significant trend for performance to be worse when positive extrinsic responses were required compared to when negative extrinsic responses were required, $t(38) = 1.6, p = .1$. In contrast, on happy face trials, participants demonstrated a non-significant tendency to make more errors when negatively valenced responses were required, compared to when positive responses were required, $t(38) = 1.70, p = .1$.

Regarding percentage errors from object trials, a 2 (Group) x 2 (Extrinsic Response Valence) mixed design ANOVA revealed only a significant main effect of Extrinsic Response Valence $F(1, 37) = 26.25, p < .001$ such that participants made more errors when making negative extrinsic responses (37%) compared to positive extrinsic responses (5%), (all other results were non-significant, Fs < 1).

Explicit Valence Ratings

Mean valence ratings for the four picture types (see Table 8) were entered into a 2 x 4 mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and one within-subjects factor of Picture Type (angry, happy, neutral face, object).

Results indicated only a significant main effect of Picture Type $F(3, 111) = 274.85$, $p < .001$, see Figure 10, (all other results were non-significant Fs < 1). Subsequent Bonferroni pair-wise comparisons indicated that participants rated angry faces as more negative compared to happy faces, neutral faces and objects (ps < .001). In addition, happy faces were rated as more positive compared to angry faces, neutral faces and objects (ps <.001). There was no difference in valence ratings between neutral faces and objects.

Table 8. Mean Valence and Arousal Ratings for each Picture type and Social Anxiety Group.

	Low social anxiety		High social anxiety	
Picture Type	*M*	*SD*	*M*	*SD*
	Explicit Valence Ratings (-4 to +4)			
Angry face	-1.9	0.6	-1.9	0.9
Happy face	2.2	0.8	2.3	0.9
Neutral face	0.2	0.4	0.3	0.7
Object	0.3	0.3	0.2	0.3
	Explicit Arousal Ratings (0 to 8)			
Angry face	4.9	1.4	5.4	1.1
Happy face	5.1	1.4	5.2	1.2
Neutral face	3.3	1.1	3.5	0.8
Object	1.3	0.4	1.5	0.7

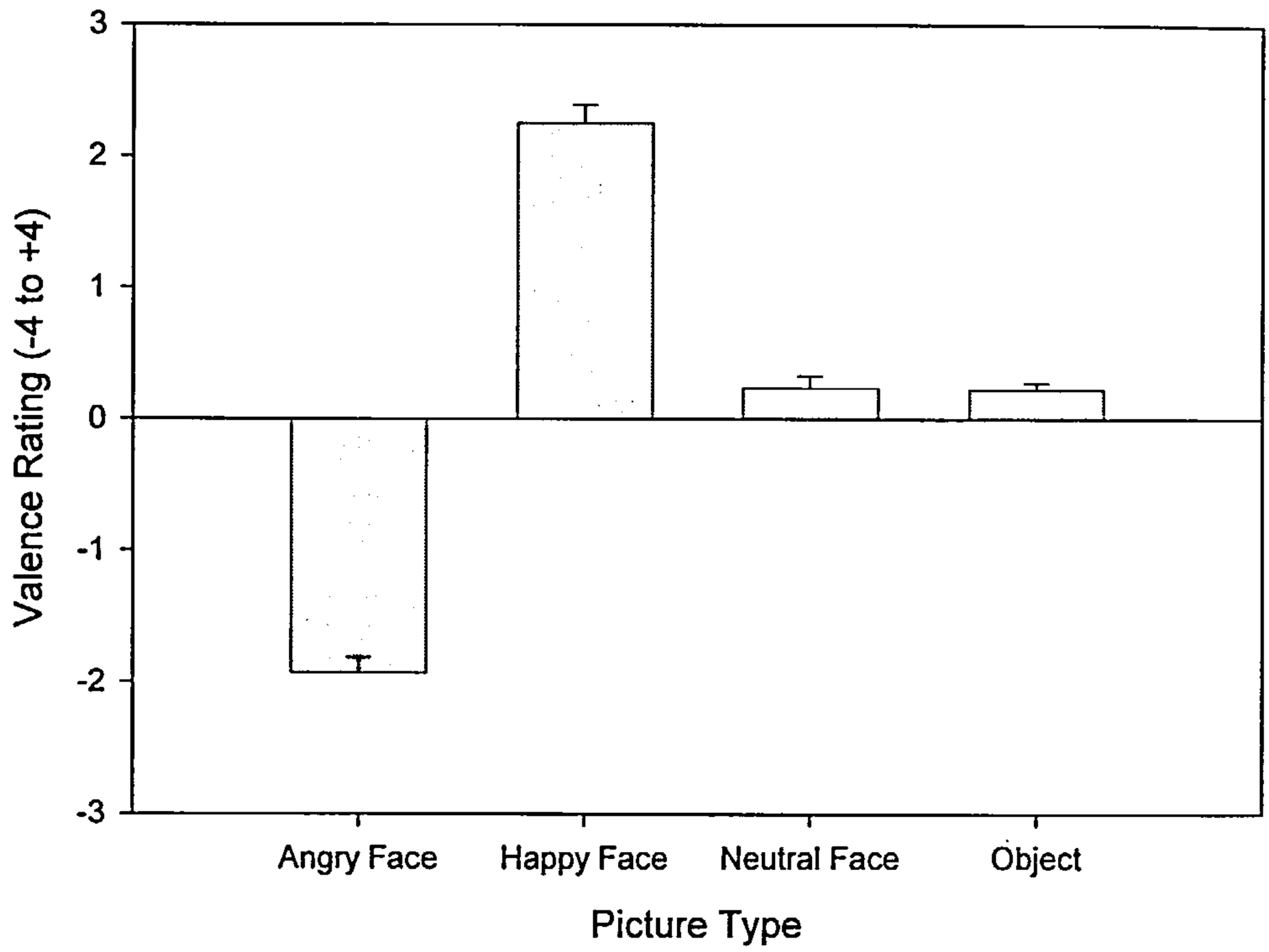

Figure 10. Valence ratings for each picture type.

Explicit Arousal Ratings

Mean arousal ratings for the four picture types (see Table 8) were entered into a 2 x 4 mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and one within-subjects factor of Picture Type (angry, happy, neutral face, object). Results only indicated only a significant main effect of Picture Type $F(3, 111) = 170.19$, $p < .001$, see Figure 11, (all other results were non-significant Fs < 1). Subsequent Bonferroni pair-wise comparisons indicated that participants rated angry and happy faces as significantly more arousing than both neutral faces and objects, and rated neutral faces as significantly more arousing than objects (ps < .001).

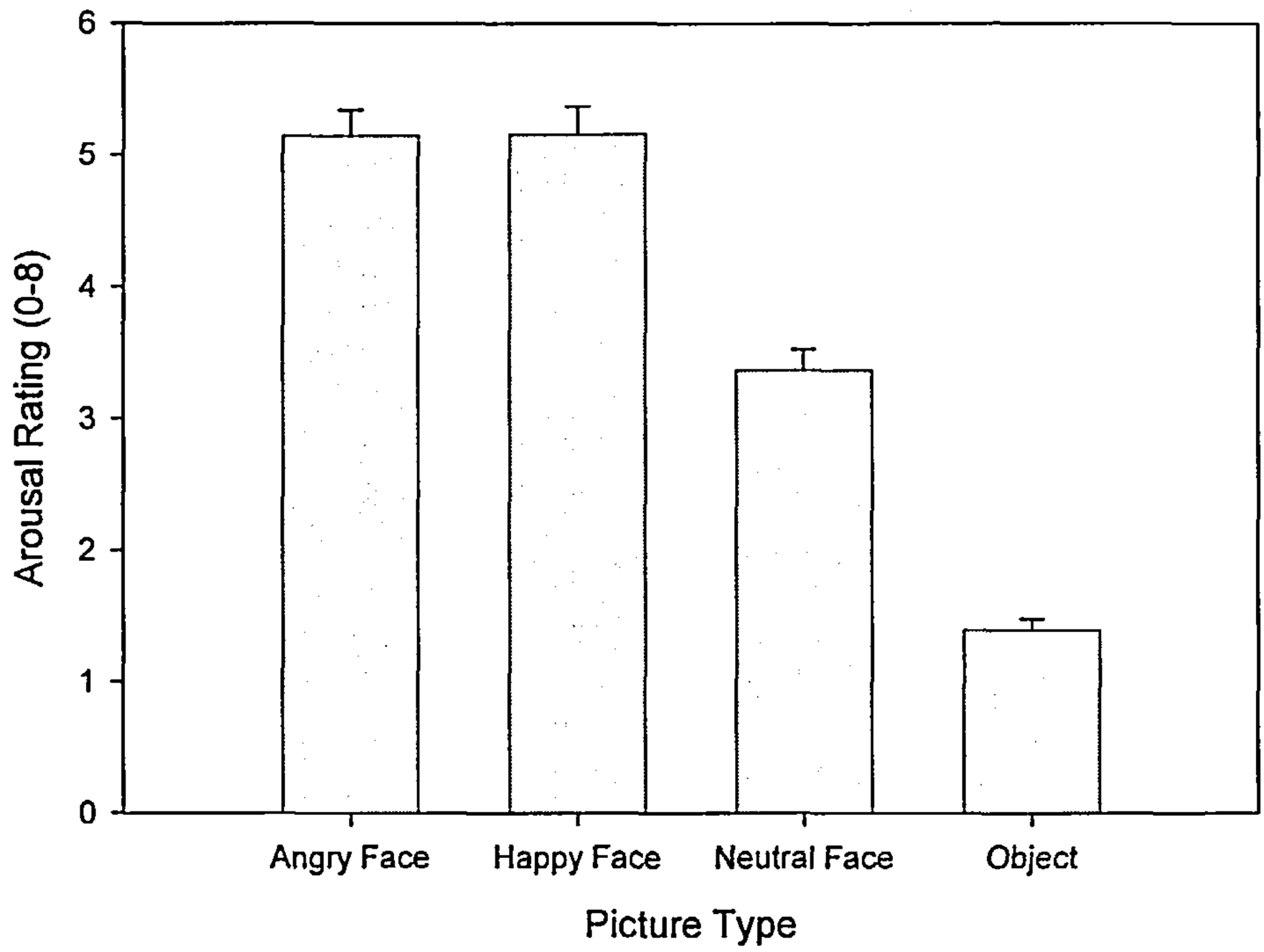

Figure 11. Arousal ratings for each picture type.

Relationships Between Questionnaire, EM-bias and Implicit/Explicit Appraisal Measures

In order to examine the predicted relationships between EM-biases and stimulus appraisal measures, EM-bias scores for fixation latency and duration were calculated for each emotional face type (see Experiment 1 for details). EAST effect biases were calculated by subtracting the mean error rate for negative responses, from the mean error rate for positive responses, for each stimulus (e.g. De Houwer, 2003). Thus, more positive values reflect increasingly positive appraisals of a stimulus class, whereas more negative values reflect increasingly negative appraisals. An additional summary bias measure representing the mean bias score across the three face types was also calculated for each task.

There were no significant correlations between questionnaire measures and biases in EM-direction and duration of fixation. Increased State anxiety (STAI; $r = .33, p < .05$) and state sadness immediately prior to the attention task (VAS time 2; $r = .41, p < .02$) was associated with faster orienting to happy faces relative to objects. State anxiety prior to the attention task was associated with faster latencies to neutral faces relative to objects (VAS time 2; $r = .44, p < .001$). In contrast increased happiness prior to the EM task (VAS time 2) negatively correlated with latency bias to happy faces ($r = -.36, p < .05$) and neutral faces ($r = -.56, p < .001$) relative to objects.

Increased state sadness (VAS; time 3) was associated with more negative appraisal of neutral faces (EAST bias score; $r = -.36, p < .05$). In contrast, increased state happiness

prior to the explicit rating tasks (VAS; time 4) was associated with more positive valence ratings of neutral faces, ($r = .38, p < .05$).

Greater arousal ratings for neutral faces were associated with a greater preference to look more towards all face types relative to objects ($.41 < rs < .44, ps < .01$). However, neither valence nor arousal rating measures significantly correlated with duration bias scores or latency scores for the various face types.

EAST bias scores for objects correlated with duration bias for happy faces relative to objects $r(37) = -.41, p < .01$ such that increased negative appraisal of objects was associated with increased maintenance of attention for happy faces relative to objects. However, EAST bias scores failed to correlate with EM-direction and latency bias scores.

Discussion

In the present study high and low socially anxious individuals (subjected to an evaluative stressor) completed a series of tasks that measured orienting and maintenance of attention, automatic affective appraisals and explicit valence and arousal ratings for different facial expressions and objects. There were no significant effects of social anxiety across any of the attention and appraisal measures. Participants in general made substantially more initial eye movements towards faces than objects. Similarly, participants' initial fixations were longer on faces relative to objects, with this effect being more pronounced for angry faces compared to neutral faces. There were no significant results relating to participants' latency to first fixation.

Error data from the EAST indicates that participants implicitly evaluated angry faces as negative whilst demonstrating a trend to evaluate neutral faces as negative and happy faces as positive. Whilst reaction time data suggested high socially anxious individuals were quicker to evaluate faces in general as positive compared to controls, the absence of any interactions with face emotion questions the validity of the response time measure. Regarding explicit ratings, all participants rated angry faces as more negative and happy faces as more positive than both neutral faces and objects. Angry and happy faces were similarly more arousing than neutral faces which in turn were considered more arousing than objects.

Orienting and Maintenance of Attention to Social Cues

Findings from the Eye Monitoring task fail to support predictions from recent cognitive models that suggest social anxiety is characterised by reduced attention towards external social cues. The present null results also fail to replicate findings of reduced initial orienting and maintenance of attention to face cues relative to objects observed in Experiment 2, and also evidence of avoidance of emotional faces (Mansell, Clark, Ehlers, & Chen, 1999) and faces in general (Chen, Ehlers, Clark, & Mansell, 2002) relative to non-social cues. Contrary to expectations, the present findings replicate the main effects and lack of individual differences reported in socially anxious individuals not experiencing social evaluative stress (Bradley et al., 1997 experiment 1; Mansell et al., 1999).

Comparison of Experiments 1 and 2 demonstrated the importance of social evaluative stress interacting with social anxiety to elicit individual differences in orienting and maintenance of attention to facial expressions. The stress induction procedure in Experiment 3 was similar to that used in Experiment 2 and adopted by Mansell et al. (1999). Results indicate that all participants' anxiety ratings were greater prior to both the EM task and EAST, compared to before the induction. However, contrary to Experiment 2, the social

stress manipulation did not differentially affect high and low socially anxious individuals' state anxiety. Furthermore, whilst present participants' anxiety scores were greater relative to scores before the stress induction and anxiety ratings for participants in Experiment 1, their anxiety levels prior to the EM task were significantly lower compared to participants in Experiment 2.[12] Thus it remains unclear whether the modified stress induction used in the present study (which aimed to last the 30 minute testing session) sufficiently tapped the social fears of socially anxious individuals and therefore encouraged increased self-focus and the additional reductions in attention to social cues proposed to maintain social anxiety (e.g. Clark & Wells, 1995).

The lack of individual differences in the present study might be further explained by considering additional characteristics of the high and low social anxiety groups. The present high social anxiety group had significantly higher scores of depression (BDI II) compared to low anxious controls. Whilst this measure was taken at screening and not during the testing session, greater negative affect in the high socially anxious group at time of testing was suggested by their greater sadness ratings throughout the session compared to controls.

Social anxiety is highly comorbid with other psychiatric disorders (Kessler et al., 1994; Schneier et al., 1992), particularly anxiety and mood disorders (Brown & Barlow, 1992). Studies in social anxiety invariably report that groups significantly differ on both general measures of anxiety and depression (e.g. Mansell et al., 1999; Experiment 2 of present thesis). However in the present study, the high social anxiety group had significantly higher depression scores compared with the high anxious individuals in experiment 2 of the present thesis (mean BDI II scores for HSA participants were: 11.2 in Exp. 3 and 6.2 in Exp. 2).[13]

Whilst attentional avoidance of faces has been shown to be robust after statistically controlling for the influence of depression, (Mansell et al., 1999) individual differences in selective attention can be abolished when depression approaches clinical levels. Mogg,

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[12] Visual analogue state anxiety scores immediately following the stress induction were entered into a 3 x 2 between-subjects ANOVA with Experiment (1, 2, 3) and Group (high vs. low social anxiety) as between-subjects factors. Results indicate the high socially anxious individuals (7.0) were significantly more anxious than low anxious individuals (4.4), $F(1, 96) = 20.82, p < .001$. Bonferonni post hoc comparisons of a main effect of Experiment $F(2, 96) = 12.76, p < .001$ indicate that participants were more anxious in Experiment 2 (7.3) than participants in Experiment 3 (6.2) who were in turn more anxious than those in Experiment 1 (3.8), ($ps < .05$). There was no significant interaction between Group and Experiment $F(2, 96) = 1.24, p = .3$.

[13] To test whether social anxiety groups' depression scores differed across experiments compared to controls, participants' BDI-II scores were entered into a 2x2 between-subjects ANOVA with Experiment (2 vs. 3) and Group (high vs. low social anxiety) as between subjects factors. Main effects of Experiment and Group $Fs(1, 66) > 17.3, ps < .001$ were subsumed under a significant Experiment x Group interaction $F(1, 66) = 22.45, p < .001$. Follow-up independent samples t-tests at each level of Group indicate that the low socially anxious groups did not differ in depression scores across experiments $t(33) = .69, p = .49$. In contrast, high socially anxious participants in experiment 3 were significantly more depressed than those in experiment 2 $t(33) = 4.91, p < .001$.

Millar and Bradley (2000) identified greater initial orienting to angry faces in individuals with Generalized Anxiety Disorder (GAD) without depressive disorder, however the clinically depressed group (most of whom had a co-morbid diagnosis of GAD) failed to show the bias in overt orienting to angry faces. Similarly Musa, Lepine, Clark, Mansell and Ehlers, (2003) found an attentional bias for threat words in patients with social phobia, but not in patients with social phobia and concurrent depressive disorder, and non-patient controls. These findings support the general consensus that whilst vigilance for threat remains a robust, highly replicable phenomenon in anxiety, findings of attentional bias in depression and anxious individuals with concurrent depression remain mixed. Thus, whilst not at clinical levels, the unusually high levels of depression in the present high socially anxious group compared to other studies (e.g. Mansell et al., 1999, Experiment 2 of present thesis) might partly explain the lack of individual differences in selective attention reported above.

Implicit and Explicit Evaluations of Face Stimuli in Social Anxiety

The Extrinsic Affective Simon Task (EAST) and valence/arousal rating tasks were used to provide indices of individuals' implicit and explicit affective evaluations of the different face and object stimuli. EAST effects generated from error data suggest that individuals tended to appraise happy faces and household objects in a positive fashion but angry and neutral faces negatively. These findings support those from previous studies examining implicit appraisal of facial expressions (De Houwer, Hermans, & Eelen, 1998) and extend an already promising literature regarding behavioural indices of implicit stimulus appraisal.

However, a limitation of the EAST, evident in the present data set and often observed in IAT studies, is that participants can recode the task in order to improve task performance. Specifically, the present findings of greatly retarded and error-strewn responding on object trials, suggest participants made use of obvious perceptual dissimilarities between faces compared to objects and perceptual similarities between objects and the emotional scenes from the IAPS. Thus, the results relating to objects might be attributed to participants confusing colour classification on object trials with valence classifications on the perceptually similar IAPS scenes.

The lack of any individual differences in implicit stimulus appraisal is unexpected. The present findings are contrary to predictions from general cognitive models which suggest that biases in the preattentive appraisal of stimuli as threatening are an important vulnerability factor in anxiety disorders. The lack of individual differences also contrast with recent word-based IAT studies that have identified dysfunctional implicit attitudes towards

social situations, self esteem and general evaluations of others in social anxiety (de Jong, 2002; de Jong, Pasman, Kindt, & van den Hout, 2001).

Whilst there exist various methodological differences between the EAST and the IAT (see De Houwer, 2003) there is evidence that both tasks produce similar measures of implicit appraisal. De Jong, van den Hout, Rietbroek and Huijding (2003) recently compared spider fearful and non-fearful participants on both the IAT and Affective Simon Paradigm. Results from both tasks indicate that participants, irrespective of prior fear, displayed similar negative appraisals for spiders at the implicit level. The authors suggest that whilst automatic responding is sensitive to categorical differences based on cultural stereotype (e.g. spiders = negative; happy faces = positive) such paradigms might not differentiate individuals' strength of affective associations. They further suggest that disorder-specific individual differences are more likely to be identified when dysfunctional attitudes are in the opposite direction to the cultural stereotype. This is important given that in the present study high and low socially anxious individuals were predicted to differ only in the *extent* to which they consider angry faces as negative (and/or happy faces positive) and not the direction. Support for this interpretation comes when considering the conditions under which socially anxious individuals' implicit negative appraisals were observed regarding social situations, self esteem and general evaluations of others (de Jong, 2002; de Jong, Pasman, Kindt, & van den Hout, 2001). Perhaps critically for these studies, the negative views held by socially anxious individuals were opposite (not just different in magnitude) to the positive attitudes predominantly held by the non-phobic individuals (for discussion of how this rationale accounts for individual differences found in other IAT spider studies see de Jong et al., 2003).

Similar ceiling effects may account for the lack of individual differences regarding explicit valence and arousal ratings. Contrary to predictions, both high and low socially anxious individuals explicitly rated angry faces as negative and happy faces, neutral faces and objects as positive whilst rating angry and happy faces as substantially more arousing than neutral faces and objects. Positive explicit ratings for neutral faces contrast with both negative appraisals implicitly measured by the EAST and recent evidence from multidimensional scaling which suggests neutral faces are closer to angry faces in multidimensional affective space, (Bimler & Kirkland, 2001). The lack of individual differences in face ratings also contrast with findings in other studies of greater negative explicit ratings for fear-relevant stimuli in phobic individuals compared to non phobic controls (de Jong et al., 2003; Thorpe & Salkovskis, 1995). It is possible that social anxiety is not so much associated with more negative appraisal of specific face cues at an explicit level, but instead explicit concerns for more general social, environmental and interoceptive cues (Boegels, Alberts, & de Jong, 1996).

One aim of the present study, was to investigate whether biases in evaluation and bias in selective attention covary. Cognitive models of anxiety (e.g. Mathews & Mackintosh, 1998; Mogg & Bradley, 1998) propose that individuals orient attention towards stimuli evaluated to be threatening. The present study failed to find evidence of attentional or evaluative biases in high relative to low socially anxious individuals. Even though fixations were longer on angry faces relative to neutral faces, the present findings fail to provide support for predictions that attention is maintained for longer on arousing stimuli. Specifically, happy faces were rated as more arousing than neutral faces, but participants did not maintain attention on happy faces for longer. However, it remains interesting to note the association between explicit arousal ratings for neutral faces and biases in orienting towards all face types. It is conceivable that an individual's tendency to find conventionally neutral, emotionally ambiguous faces arousing, might reflect the reactivity of preattentive appraisal mechanisms which subsequently encourage greater orienting to similar stimuli. While such conclusions should be considered with caution and require both replication and further investigation, they do extend a new but increasing literature seeking to clarify individual differences in stimulus appraisal and its role in modulating the orienting of attention.

To conclude, the present study aimed to clarify differences in selective attention predicted to occur in social anxiety through considering the role of implicit and explicit stimulus appraisal. Throughout the study, social anxiety did not influence orienting and maintenance of attention, automatic affective appraisal and explicit valence and arousal ratings for different facial expressions and objects. Whilst these findings contribute little to an already mixed literature, limitations of the present study particularly regarding the stress induction procedure and unexpectedly high levels of depression in the socially anxious participants may partly account for the present null results.

Chapter 6: Experiment 4

Introduction

The primary aim of Experiment 3 was to clarify individual differences in orienting and maintenance of attention to social threat cues in terms of differences in automatic affective stimulus evaluation. Results from Experiment 3 did not provide evidence of attentional or evaluative biases for social threat cues in socially anxious individuals. However, as discussed, various methodological limitations question the validity of these null results. For example, the high socially anxious group had significantly higher levels of depression compared to samples of socially anxious individuals recruited in other studies (e.g. Mansell et al., 1999; Experiment 2 of the present thesis). Comorbid depression has been shown to attenuate socially anxious individuals' negative biases in selective attention (Musa, Lepine, Clark, Mansell, & Ehlers, 2003). Further uncertainty surrounds the effectiveness of the social stress induction in elevating and maintaining social anxiety (and therefore self-focus) throughout the duration of the lengthy testing session. Finally, participants' apparent tendency to recode the Extrinsic Affective Simon Task in order to simplify task performance contaminated reaction time and error rate indices of stimulus evaluation. Given these limitations, the primary aim of the present study is to investigate further the predicated relationship between social anxiety-related differences in attention to threat, and biases in stimulus appraisal using improved measures of participants' stimulus evaluation.

As outlined in Chapter 1, anxiety disorders such as social phobia reflect inappropriate exaggeration of a normal fear response (e.g. Barlow, 1988) characterised by hypervigilance, autonomic changes and reflexive responses (startle) to sensory stimuli (Rosen & Schulkin, 1998). Over recent decades, animal studies using a variety of lesion and electro-physiological techniques have increasingly clarified the underlying neural circuitry and autonomic/endocrine characteristics of threat detection and subsequent fear-responding (Cohen & Randall, 1984; Kapp, Whalen, Pascoe, Supple, & Pascoe, 1992; LeDoux, 1986; LeDoux, Cicchettie, Xagoraris, & Romanskie, 1990; review by LeDoux, 1995). This research has identified two neural pathways through which threatening information is processed from initial sensory inputs, to reflexive autonomic and somatic response outputs. Upon initially encountering threat, auditory and visual sensory signals are relayed to the sensory thalamus where sub-cortical and cortical pathways diverge (LeDoux, Sakaguchi, & Reis, 1984). The sub-cortical pathway relays signals from the thalamus directly to the amygdala (LeDoux, Farb, & Ruggiero, 1990) enabling a 'quick and dirty' analysis of stimulus characteristics facilitating the rapid (if crude) detection of environmental threat. In

contrast, the cortical pathway relays signals from the thalamus to sensory and association cortices allowing more detailed stimulus processing. Afferent connections subsequently relay cortical information to the amygdala (and hippocampal structures) where emotional information is integrated with information from the sub-cortical pathway. Following the integration of stimulus information from sub-cortical and cortical pathways the amygdala triggers the central nucleus which, via connections to various brainstem control structures (e.g. medulla oblongata), elicits a wide range of autonomic (e.g. increased heart-rate, blood pressure, electrodermal) and behavioural responses (e.g. freezing, startle reflex; Fanselow, 1994). To the extent these adaptive autonomic and behavioural responses accurately reflect sub-cortical and cortical appraisal mechanisms, physiological monitoring of these responses indexes an individual's emotional processing (affective appraisal) of environmental stimuli.

Over recent years, different physiological systems (e.g. electrodermal, electromyographic, cardiovascular) have been shown to covary significantly with the emotional characteristics of a stimulus defined by explicit evaluative judgements of valence and arousal (e.g. Lang, Greenwald, Bradley, & Hamm, 1993, reviews by Bradley, 2000; Lang, Simons, & Balaban, 1997). For example, skin conductance (reflecting cholinergic sympathetic activation of the eccrine sweat glands, Dawson, Schell, & Fillion, 1990) has been shown to covary with reports of stimulus arousal, irrespective of picture valence. In a series of studies, comparison of participants' explicit picture ratings and electrodermal responses showed a positive correlation between arousal reports and electrodermal reactivity regardless of valence ratings (Lang, Greenwald, Bradley, & Hamm, 1993). Winton, Putnam and Krauss (1984) also reported equivalently large skin conductance responses to slides that were rated as highly pleasant or highly unpleasant, while skin conductance responses have also been found to vary with the arousal associated with mental images (e.g. Cook, Hawk, Davis, & Stevenson, 1991; Fiorito & Simons, 1994), pleasant and unpleasant words (Manning & Melchiori, 1974), sounds (Bradley & Lang, 1993), and stimuli conditioned using appetitive (Lipp, Sheridan, & Siddle, 1994) and aversive conditioning paradigms (Hamm & Vaitl, 1996).

Taken together these findings support the use of skin conductance response as a measure of participants' non-specific emotional arousal in response to external stimuli. However, evidence that electrodermal responding does not differentiate between the aversiveness or appetitivness of stimuli, limits its use for tapping the *valence* evaluation systems considered to underlie the dysfunctional attentional processes that characterize anxiety disorders (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998). As a result, researchers have recently looked to more direct measures of sub-cortical stimulus appraisal mechanisms (i.e. the amygdala) to better assess the valence (aversiveness or appetitiveness) of external stimuli.

The role of the amygdala in the appraisal of environmental threat and initiation of defence is supported by evidence demonstrating that electrical stimulation of the amygdala increases the likelihood that events are perceived as fearful (Gallagher & Hooland, 1994; Rosen, Hamerman, Sitcoske, Glowa, & Schulkin, 1996) and findings that neurons within the amygdala are reactive to conditioned signals of threat (Rogan & LeDoux, 1996). Furthermore, stimulation of the central nucleus of the amygdala has been shown to directly activate the neural circuitry that underlie defensive startle responses (nucleus reticularis pontis caudalis) such that increased stimulation of the amygdala is linearly related to the amplitude of the startle response (e.g. Rosen & Davis, 1988).

The startle response is a cross-species primitive reflex consisting of a rapid sequential muscle contraction that serves a protective function, reducing the risk of organ injury, and acting as a behavioural interrupt thereby enabling an organism to deal with possible threat (Graham, 1979). In humans, rapid eye closure is one of the most reliable components of the defensive cascade that constitutes the startle (Landis & Hunt, 1939; cited from Grillon & Baas, 2003). Startle reflexes (such as eyeblink) are elicited when individuals are exposed to aversive (brief and intense) auditory, visual, or tactile stimuli. In human studies, brief bursts (up to 50 ms) of white noise with high intensity (e.g. 90 – 110 dB) are often used to elicit startle responses which are then typically quantified in terms of response amplitude (though occasionally reflex onset latency, peak latency and probability).

Given the involvement of the amygdala in emotion processing and its role in the modulation of defensive responses such as startle, research has increasingly used startle magnitude to index sub-cortical stimulus appraisal processes. Central to such *affective startle modulation paradigms* is the notion that when the sub-cortical fear-network is activated (i.e. when unpleasant or threatening information has been identified) defensive startle responses are primed (potentiated). In contrast, when the fear-network is less active, perhaps even inhibited, (i.e. in the presence of appetitive stimuli) startle reflexes are inhibited (e.g. Lang, Bradley, & Cuthbert, 1990).

When startle probes are administered while participants view affective pictures results consistently support this motivational priming hypothesis. Vrana, Spence and Lang (1988) assessed startle in participants viewing aversive/unpleasant (spiders, multilated bodies), neutral (household objects), and appetitive/pleasant slides (erotica, baby faces). Consistent with a motivational priming hypothesis, startle was enhanced during unpleasant slides compared to neutral slides, but inhibited during pleasant slides. Equivalent findings are evident in studies demonstrating positive correlations between explicit ratings of picture valence and startle magnitude (e.g. Bradley, Cuthbert, & Lang, 1990; Cook, Davis, Hawk, Spence, & Gauter, 1992). While these findings are commonly considered as evidence that startle is a measure of stimulus valence as opposed to arousal, recent findings suggest that

startle is only potentiated or inhibited for aversive or pleasant cues that are highly arousing. For example, Cuthbert, Bradley and Lang (1996) demonstrated that potentiation of the blink reflex only occurred for highly arousing unpleasant pictures, whereas reflex inhibition increased with the arousal level of attractive pictures. Similarly, participants with specific phobias typically show greater startle potentiation when exposed to pictures of their feared objects such as spiders (Hamm, Cutherbert, Globisch, & Vaitl, 1997; Globisch, Hamm, Esteves, & Ohman, 1999) and personal injury (Hamm et al., 1997) than when viewing other unpleasant material.

To summarize, physiological measures informed by current understanding of neurobiological appraisal mechanisms can provide a useful tool with which to index the evaluative biases considered to underlie a variety of information processing biases in anxiety disorders. Thus, a primary aim of the present experiment is to clarify individual differences in orienting and maintenance of attention to social threat cues in terms of differences in physiological components of stimulus evaluation.

High and low socially anxious individuals experiencing social evaluative stress completed a task designed to provide concurrent measures of attention allocation and physiological responding to external social and non-social cues. Throughout the task, participants were presented with pairs of pictures containing faces (angry, happy, neutral) and household objects, randomly interspersed with trials containing centrally presented single pictures of faces or objects. On two thirds of single picture trials, a startle probe (burst of white noise) was presented either 300 ms (short lead SOA) or 3000 ms (long lead SOA) after picture onset. Short and long lead SOAs were used in order to examine whether appraisal biases might occur at relatively early stages of stimulus processing or emerge following more strategic evaluation of stimulus content (e.g. Globisch, Hamm, Esteves, Öhman, 1999). Consistent with earlier studies in the present thesis, biases in initial orienting were assessed from the direction and latency of participants' initial shift in gaze on double picture trials, while biases in the maintenance of attention were assessed from the duration of gaze on the picture that was initially fixated. In order to obtain a measure of stimulus arousal, electrodermal skin conductance responses were measured on single picture trials that did not contain a startle probe. Facial electromyographic (EMG) startle responses to auditory startle probes were used to index valence evaluation. In a separate task, participants rated face and object stimuli in terms of valence and arousal consistent with previous psychophysiological studies of picture processing and Experiment 3 of the present thesis.

The design employed in the present psychophysiology study is structurally similar to conventional covariation bias paradigms (e.g. Tomarken, Cook, & Mineka, 1989) in that both paradigms involve the random (i.e. fully counter-balanced) presentation of aversive events (e.g. startle probes) throughout a series of picture slides. In covariation paradigms,

following the series of picture/startle presentations participants are requested to estimate the association between aversive events and each category of picture. Proposals from preparedness theory suggest that certain (biologically prepared) stimuli are more readily associated with threat than others and are thus more likely to become the object of phobic fear (Seligman, 1971; see also Öhman, 1986). Consistent with preparedness theory, participants in covariation bias studies typically over-estimate the occurrence of aversive events during exposure to fear-relevant stimuli (e.g. spiders, Tomarken et al., 1989; angry faces, de Jong, Merckelbach, Bogel, & Kindt, 1998). As such, social phobia might be characterised (and maintained) by a greater readiness to associate social stimuli with threat. Thus, a secondary aim of the present study was to investigate the extent to which socially anxious and non-anxious individuals differed in their tendency to associate social and non-social stimuli with aversive events (i.e. startle).

In line with Clark and McManus' (2002) revised cognitive model of social phobia, it is predicted that high socially anxious individuals experiencing social evaluative stress will demonstrate reduced initial orienting and maintenance of attention to faces relative to objects compared to low anxious individuals. However, following Experiment 3, it remains unclear whether this reduction in attention to faces might be moderated by stimulus threat. Specifically, whether stimuli evaluated to be threatening are associated with increases in initial orienting (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998), or a greater degree of socially submissive attentional avoidance (Clark & Wells, 1995; Trower & Gilbert, 1989).

Given that anxiety is proposed to be characterised by inappropriate exaggeration of normal fear responses (Barlow, 1988) and a tendency to evaluate stimuli as threatening (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998) it is further predicted that high socially anxious individuals will produce greater skin conductance responses and startle potentiation to angry faces, and explicitly rate angry faces as more negative and arousing than other face/object stimuli, compared to low anxious individuals.

Method

Participants

Seventy four undergraduate students were screened using the shortened version of the Fear of Negative Evaluation Questionnaire (FNE; Leary 1983) and the Beck Depression Inventory II (Beck, Brown, & Steer, 1996). To minimize the proportion of the sample with mid-range levels of social anxiety those students whose questionnaire scores were below 30 or above 40 were invited to participate in the study. A total of 50 participants were tested (5 men and 45 women) for which they received either course credits or cash payment. Additional selection criteria for all participants were that they spoke English as their first language and had visual acuity within normal limits. Participants who scored above 20 on the Beck Depression Inventory II (considered to reflect moderate depression, Beck et al., 1996) were excluded at the request of the local ethics committee.

Materials and Apparatus

The stimuli consisted of 12 (6 male, 6 female) angry, happy and neutral facial expressions, matched with 36 household objects. The faces were selected from a pool of over 600 photographs which contained three face sets (Bradley et al., 1998; Ekman & Friesen, 1976; Matsumoto & Ekman, 1988). All faces had been previously rated by 12 judges (1-9 scale) regarding how happy and angry they were and the best exemplars were selected. Means for angry and happy ratings were 7.5 and 1.1, respectively for angry faces (n=12); 1.1 and 7.4 for happy faces (n=12), and 1.2, 1.1 for neutral faces (n=12). Each face was matched as closely as possible for brightness and contrast with a picture of a household object (e.g. mug, chair). These stimuli were used to generate two stimulus sets, one used for attention trials and the other used for trials on which startle/skin conductance responses were measured.

For attention trials, 36 different picture pairs were presented twice in the task. Each pair consisted of a household object and a face. Pictures measured 72 x 110 mm with their centres 186 mm (9.7 °) apart. For one third (12) of the pairs, the household objects were paired with neutral faces; another third paired with happy faces and the final third paired with angry faces. Each pair contained a different object. Within each third an instance of an object category appeared (e.g. mug, chair). The photographs were mounted side by side, such that for each pair type and gender, half the faces were on the left and half were on the right.

Participants' horizontal eye movements were measured electro-occulographically using Ag/AgCl electrodes filled with electrolyte (Biopac System Inc.) attached 1.5 cm from

the outer canthus of each eye. Electro-oculographic (EOG) signal was amplified (1902 bio-amplifier and 1401 A/D Converter; Cambridge Electronic Devices, CED, UK) and sampled at 1000 Hz throughout the task using Spike2 software v3.21 (CED, 1998).

For startle and skin conductance trials, the 36 facial expressions and 12 objects (containing a randomly selected example of each object type) were presented once in the centre of the screen. The acoustic startle probe was a 50 ms burst of 96 dB white noise with near instantaneous rise/fall time. Startle probes were produced using a white noise generator, presented through DR-3A head-phones (Sony, Japan) and were calibrated prior to each session using a 1405C sound level meter (Dawe Instruments Limited, UK). The presentation of startle probes was controlled using Spike2 v3.21 software (CED, 1998).

Eye blink startle response was measured electro-myographically from the orbicularis oculi, using Ag/AgCl electrodes and electrolyte (Biopac System, Inc) placed approximately 0.8 cm below the pupil and outer canthus of the left eye. Electro-myographic (EMG) signal was amplified (1902 bio-amplifier and 1401 A/D Converter; Cambridge Electronic Devices, CED, UK) and sampled at 1000 Hz during the 200 ms before startle probe onset and 400 ms after startle probe off-set using Spike2 software v3.21 (CED, 1998).

Skin conductance was measured using domed Ag/AgCl electrodes and 0.05-M NaCl isotonic electrolyte. Electrodes were placed on masked areas on the distal phalanges of the index and second fingers of the left hand, between which a constant voltage of 0.5V was passed. Skin conductance was pre-amplified (CED) and sampled at 20 Hz throughout the task. Prior to each session, SCR signal was calibrated to detect activity ranging from 0 to 20 microSiemens (mS).

Picture stimuli were presented using Inquisit version III software (Millisecond software, 2002) on a Pentium III 1.2 GHz PC and 17" VGA monitor. EOG, EMG and SCR data were acquired using Spike2 software on a Pentium III 1.7 GHz PC. Participants completed all tasks in a dimly lit testing cubicle.

Procedure

Visual acuity was first measured with a Snellen chart and participants rated their mood using Visual Analogue Scales (Time 1; see Experiment 1 for details). Participants then read and signed a consent form. The consent form informed the participants of the tasks they would be required to complete in the session and included a modified version of the social threat induction used in Experiment 3, see below:

"One part of the experiment is designed to assess your social skills and public speaking ability. You will be asked to produce a short speech on a controversial topic, to be recorded by the video camera. I will stay here to watch you give the speech and rate you on several different measures of the effectiveness of your presentation. The tape will then be

presented to other psychologists within the research team at a later date so they can make ratings regarding your public speaking skills and the effectiveness of your presentation. You will complete the speech after either the psychophysiology task or rating tasks that follow. The topic of your speech will be given to you approximately thirty seconds before you are to begin talking. In addition, throughout the entire session, you will be recorded via the video-camera in front of you as part of a separate study investigating non-verbal behaviours during psychophysiological assessment."

Immediately after reading and signing the consent form, participants were prepared for the psychophysiological task (see below) before re-rating their mood (Time 2).

Orienting and Physiological Responding to Facial Expressions

Participants were seated 1 m away from the testing monitor. EOG, EMG and SCR electrode sites were cleaned using alcohol solution with an abrasive pad, electrodes were attached and signal quality visually inspected after requesting participants blink and look towards the left and right edge of the testing monitor. The task began with a 5 minute baseline condition during which participants were asked to keep as still as possible and focus on a centrally presented white fixation cross. Following the baseline, participants again viewed the fixation cross while six startle probes were presented randomly over 60 seconds. This enabled participants to become familiar with startle probes such that EMG responses in the experimental task were less likely to be at ceiling level. Participants were then presented with two experimental blocks of 84 trials. Each block contained 36 double-picture (attention) trials interspersed with 48 single-picture (psychophysiology) trials. Within each block, double-picture (attention) trials were fully counterbalanced regarding pair-type (i.e. angry face-object, happy face-object, neutral face-object), face gender (male, female) and face location (left, right). On single picture trials an equal number of angry, happy, neutral faces and objects were presented. On two thirds of single picture trials (within each block and picture-type) an acoustic startle probe was presented. Half of the startle probes were presented 300 ms after picture onset (short-lead startle) and half presented 3000 ms after picture onset (long-lead startle). Within each block, double and single pictures were randomly interspersed and presented in a random order. On all trials pictures were presented for 4 seconds after which they disappeared and were replaced by a white fixation cross presented in the centre of the screen for a 6 second inter-trial interval. Throughout the task, participants were instructed to remain as still as possible while remaining comfortable, and to look at the fixation cross whenever it was on the screen.

A Posteriori Covariation Estimates

Immediately following the attention/psychophysiology task electrodes were removed after which participants completed a series of visual analogue scales (0 – 100%) assessing their covariation estimates for each single picture type-shock contingency (i.e. 8

scales, one for each contingency, e.g. "During the single picture trials when an angry face was shown, how often do you think a loud noise occurred?"). Participants also provided base rate estimates (0 - 100%) regarding the occurrence of each picture-type (e.g. "During the single picture trials, how often do you think and angry face was shown?") and noise (e.g. "During the single picture trials, how often do you think a loud noise occurred?"

Participants again re-rated their mood (Time 3) before completing the explicit valence and arousal rating tasks (presented in counterbalanced order across participants).

Explicit Valence and Arousal Ratings

Each trial of the Valence rating task started with a fixation cross shown for 500 ms which was replaced by a picture presented for 2 s. Immediately after the offset of the picture a 9 point (-4 to +4) rating scale was displayed on the screen until response. Participants were asked to rate how pleasant or unpleasant they found the picture. Anchors were presented beneath numbers across the scale at regular intervals: Very unpleasant (-4), Slightly unpleasant (-2), Slightly pleasant (+2) and Very pleasant (+4). Participants were asked to select a rating from the scale and press the corresponding key, labelled on the keyboard in front of them. There were two practice trials followed by 48 randomly presented experimental trials containing the 12 angry, 12 happy and 12 neutral faces and 12 household objects used on single picture trials in the attention/psychophysiology task.

Trial events in the Arousal rating task were similar to those used in the Valence rating task except that participants were asked to rate how emotionally arousing they found each picture on a 9 point scale (0 to 8). Anchors were presented beneath numbers across the scale at regular intervals: Not at all (0), Moderately (4) and Extremely (8). Participants were asked to select a rating and press the corresponding key labelled on the keyboard. There were two practice trials followed by 48 experimental trials presenting stimuli used in the valence rating task in a new random order.

Participants finally completed the following questionnaires: Fear of Negative Evaluation Scale (FNE; Watson & Friend, 1969), Social Avoidance and Distress Scale (SADS; Watson & Friend, 1969), State and Trait versions of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), shortened state and trait versions of the Profile of Moods States containing 6 items for anxiety and depression (POMS; McNair, Lorr, & Droppelman, 1981), social phobia subscale from the Fear Questionnaire (Marks & Mathews, 1986) and a short form of the Social Desirability Scale (SDS; Strahan & Gerbasi, 1972). Participants were then asked to rate, on a 0-100 % scale the extent to which they believed they would have to give a speech. Participants were finally instructed that they did not have to deliver a speech and debriefed.

Data Preparation

EOG signal was filtered using a low pass (20 Hz) filter. Fixations to each picture were identified if changes in EOG trace ranged between 0.04 and 0.4 mV with a rate of change greater than 0.3 mV/s within 60 ms (equivalent to a valid shift in gaze towards though not beyond pictures) and a subsequent trace decay rate of no greater than 1 mV/s over 100 ms (equivalent to the natural decay trace when eye gaze remained static for 100 ms). Consistent with previous studies in the present thesis, dependent measures included the direction and latency of the initial fixation, and the duration of gaze on the initially-fixated picture. Participants made an initial fixation to either picture on 95.7 % of trials, as participants did not fixate on the fixation cross before picture onset on 3.0 % of trials and fixated within 100 ms of picture onset for 1.3 % of trials. These percentages were not significantly different between the high and low social anxiety groups. EMG signal was filtered using a Finite response (90-250 Hz) bandpass filter, and subsequently rectified and integrated with a constant of 8 Hz.

Results

Group Characteristics

Participants were allocated to one of two groups according to whether their scores on the FNE and SADS were below, or above, the sample medians on both of the main measures of social anxiety (these had been administered under standardised conditions, in contrast to the shortened screening FNE measure). The low social anxiety group (LSA; n = 20) had FNE scores of less than 16 and SADS scores of less than 7. The high socially anxious group (HSA; n = 19) had FNE scores of 16 or more and SADS scores of 7 or more. Group characteristics are summarized in Table 9. Independent t-tests indicated that the two groups differed significantly on each social anxiety measure with the HSA group having significantly higher scores than the LSA group (see Table 9 for results). The groups did not differ significantly in age, SDS scores or gender ratio. All participants in the final sample rated their belief that they were going to have to give a speech as more than 80%.

Mood Throughout Experimental Session

Mood ratings (measured using visual analogue scales) taken throughout the session were entered into separate 2 x 3 mixed ANOVAs with one between-subjects variable of Group (high vs. low social anxiety) and one within-subjects variable of Time (Time 1: before stressor, Time 2: before EM/psychophysiology task, Time 3: before explicit ratings).

With respect to anxiety ratings, high socially anxious individuals (5.6) were significantly more anxious than low anxious individuals (4.0), $F(1, 37) = 6.84, p = .01$. A main effect of Time, $F(2, 74) = 12.56, p < .001$, indicates that participants were similarly more anxious before the stress induction (5.1) and immediately after the stress induction (5.6), compared to after the EM/psychophysiology task (3.4), $ps < .01$. There was no interaction between Group and Time $F(2, 74) = 1.4$, *ns*.

With respect to happiness ratings, high socially anxious individuals (7.7) were significantly less happy than low anxious individuals (9.8), $F(1, 37) = 11.71, p < .01$. A main effect of Time, $F(2, 74) = 9.07, p < .001$, indicates that participants were similarly less happy immediately after the stress induction (8.5) and at the end of the task (8.2) compared to before the stress induction (9.5), $ps < .01$. There was no interaction between Group and Time $F(2, 74) = 0.25$, *ns*.

Similar analysis of participants' sadness ratings did not reveal a main effect of Time or interaction between Time and Group, $Fs(2, 74) < 2.32, ps > .11$, although there was a non-significant trend for high socially anxious participants to give greater sadness ratings overall (3.2) compared to low anxious individuals (2.1) $F(1, 37) = 3.23, p = .08$. To summarize, the stress induction procedure appeared to be partially effective, in that it

reduced positive mood in both groups. Anxiety levels were similarly high prior to the psychophysiology task compared to the end of session, although the stress induction did not enhance anxiety levels.

Table 9. Social Anxiety Group Characteristics

	Low Social Anxiety		High Social Anxiety			
	M	*SD*	*M*	*SD*	*t*(37)	*p*
Short FNE (screening)	23.3	5.2	48.1	5.8	6.2	< .001
FNE (experiment)	8.7	4.9	26.4	4.5	11.8	< .001
SADS	1.8	1.4	12.4	6.0	7.8	< .001
Fear-Social	10.8	5.5	19.4	5.5	4.9	< .001
STAI-State	33.8	11.1	46.5	7.3	4.1	< .001
STAI-Trait	32.6	5.7	54.7	9.0	9.2	< .001
BDI-II	5.5	4.8	7.4	4.5	2.5	< .05
POMS-state anxiety	3.5	3.5	6.2	3.9	2.3	< .05
POMS-trait anxiety	3.5	2.2	7.9	5.3	3.4	< .01
POMS-state depression	0.9	1.4	3.1	3.2	2.8	< .01
POMS-trait depression	1.2	1.6	5.2	5.0	3.4	< .01
VAS–anxious-time 1	4.0	2.1	6.2	2.3	2.9	< .01
VAS–anxious-time 2	4.5	2.6	6.7	3.5	2.1	<.05
VAS–anxious-time 3	3.0	2.2	3.9	2.4	1.2	*ns*
VAS–happy-time 1	10.5	2.3	8.6	1.7	2.9	< .01
VAS–happy-time 2	9.7	2.4	7.4	2.2	3.2	< .01
VAS–happy-time 3	9.2	2.6	7.2	1.9	2.7	< .01
VAS–sad-time 1	2.2	1.6	3.0	2.0	1.4	*ns*
VAS–sad-time 2	1.7	1.0	3.3	2.4	2.7	<.05
VAS–sad-time 3	2.5	2.1	3.2	2.2	1.0	*ns*
SDS	4.1	2.3	3.5	2.2	0.8	*ns*
Age	20.3	2.4	20.2	2.4	0.6	*ns*
Gender ratio, m/f	3/17		1/18			

Note. FNE = Fear of Negative Evaluation Scale; SADS = Social Avoidance and Distress Scale; Fear - Social = Fear Questionnaire-social phobia subscale; STAI = State-Trait Anxiety Inventory; BDI-II = Beck Depression Inventory version II; POMS = Profile of Mood States; VAS = Visual Analogue Scale; SDS = Social Desirability Scale (short form).

EM-direction

Eye movement data was lost for one participant in the low socially anxious group due to EOG electrode failure. EM-direction bias scores were obtained for each pair type by calculating, for each participant, the number of trials in which the first eye movement was towards the face stimuli, as a proportion of the number of trials with fixations for that pair type (see Table 10 for means, see Experiment 1 for more details). Kolmogorov-Smirnov tests showed that the distributions of EM-direction bias scores did not differ significantly from normality.

EM-direction bias scores for angry, happy and neutral faces were entered into a mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and one within-subjects factor of Face Type (angry, happy, neutral). There were no significant results from the ANOVA (Fs < 1). One sample t-tests for each group, (comparing each bias score against a value of 50%), indicated that both LSA and HSA groups made more initial fixations towards all face types relative to household objects, ts(18) > 6.71, ps < .001 and ts(18) > 5.97, ps < 0.01 respectively, see Table 10.

Fixation Latency

Mean latency of initial fixations in each condition are displayed in Table 10. Kolmogorov-Smirnov tests indicated that the distributions of latencies to initial fixations for each condition differed significantly from normality. Latency data were log-transformed to avoid distorting the calculation of condition means.

Transformed latency data were entered into a mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and two within-subjects factors of Fixation Location (face vs. object) and Face Type (angry, happy, neutral), see Appendix C, Table C1 for transformed means. Results indicate, that irrespective of social anxiety and face type, participants were quicker to fixate on faces (413 ms) compared to objects (712 ms) , $F(1, 36) = 27.41$, $p < .001$. All other results were non-significant Fs(2, 72) < 2.42, *ns*; Fs(1, 36) < 1.

Gaze duration

Mean duration of initial fixations in each condition are displayed in Table 10. Kolmogorov-Smirnov tests indicated that the distributions of the fixation durations for each condition differed significantly from normality. Fixation duration data were log-transformed to avoid distorting the calculation of condition means, (see Appendix C, Table C1 for transformed means).

Transformed duration data were entered into a mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and two within-subjects

variables of Fixation Location (face vs. object) and Face Type (angry, happy, neutral). Results showed a main effect of Fixation Location, $F(1, 36) = 44.13, p < .001$, such that participants fixated for longer on faces (1402 ms) compared to household objects (910 ms). Results further indicated a significant interaction between Fixation Location and Group, $F(1, 36) = 4.22, p < .05$, all other results were non-significant $Fs(2, 72) < 2.62$, *ns*, $F(1, 36) = 0.1$, *ns*. Inspection of Figure 12 indicates that high socially anxious individuals viewed faces for significantly less time (relative to objects) compared to low socially anxious individuals. However, while both HSA and LSA groups initially viewed faces for significantly longer than objects ($t(18) = 2.96, p < .01$ and $t(18) = 6.89, p < .001$ respectively) the low socially anxious group looked at faces 678 ms longer than objects, whereas, the high socially anxious group looked at faces 307 ms longer than objects. Group contrasts showed that groups did not differ in their durations to either faces $t(36) = 1.46$, *ns*, or objects $t(36) = 1.54$, *ns*.

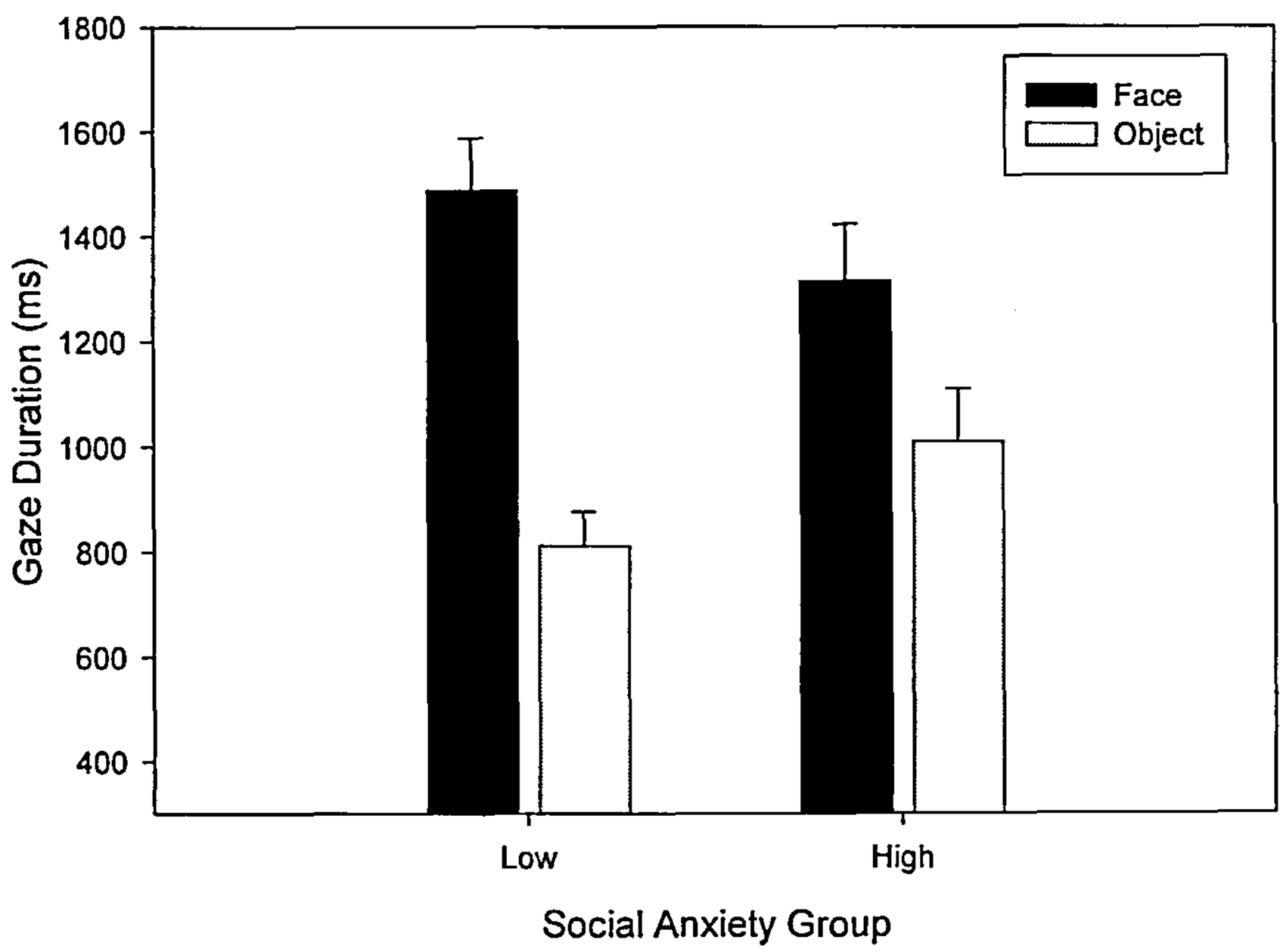

Figure 12. Mean duration of initial fixations on face-object trials in low and high social anxiety groups (ms).

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Table 10. Summary of Untransformed Eye Movement Data for each Social Anxiety Group

Variables		Low social anxiety		High social anxiety	
		M	*SD*	*M*	*SD*
Pair type	Picture type				
		Number of initial fixations			
Angry-object	Angry	17.5	3.7	16.5	4.5
	Object	6.1	3.4	6.1	2.4
Happy-object	Happy	16.8	3.3	15.8	4.6
	Object	6.7	3.1	6.6	3.1
Neutral-object	Neutral	17.1	3.9	16.8	4.9
	Object	6.3	3.0	5.5	2.5
		EM-direction bias scores (%)			
Angry-object	Angry	74.0	14.7	71.2	13.6
Happy-object	Happy	71.2	13.1	69.7	12.3
Neutral-object	Neutral	72.5	14.6	73.0	16.8
		Latency to initial fixations (ms)			
Angry-object	Angry	360.3	232.3	486.8	630.1
	Object	746.1	365.2	775.8	667.5
Happy-object	Happy	366.1	221.8	363.8	302.0
	Object	591.1	322.0	902.8	516.5
Neutral-object	Neutral	383.0	179.3	522.6	521.6
	Object	761.7	459.8	676.9	345.5
		Gaze duration on initially fixated pictures (ms)			
Angry-object	Angry	1550.5	461.8	1337.4	551.5
	Object	817.9	456.1	913.8	479.8
Happy-object	Happy	1479.7	484.3	1387.4	678.2
	Object	753.4	421.5	1048.0	394.0
Neutral-object	Neutral	1436.4	458.0	1224.7	482.2
	Object	861.5	332.0	1067.8	579.6

Startle Response Amplitude

Startle response amplitude was defined as the difference in amplitude between the mean EMG in the 150 ms prior to the startle response (excluding the valley), and the maximum EMG response between 20 ms and 150 ms after startle probe presentation. Mean startle response amplitudes in each condition are displayed in Table 11. Kolmogorov-

Smirnov tests indicated that the distributions of startle amplitudes for each condition differed significantly from normality. Startle amplitudes were log-transformed to avoid distorting the calculation of condition means (see Appendix C, Table C2 for transformed means)[14]. Transformed startle amplitude data were entered into a mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and two within-subjects factors of Picture Type (angry, happy neutral face, object) and startle probe SOA (300 ms, 3000 ms). Results indicate that high socially anxious individuals produced significantly larger startle amplitudes to all stimuli compared to low socially anxious individuals (means are 122.8 and 69.3 respectively) $F(1, 37) = 4.87, p < .05$. In addition, irrespective of social anxiety group, participants' startle responses were significantly reduced at the short-lead, 300 ms SOA (88.0) relative to the long lead, 3000 ms SOA (104.1), $F(1, 37) = 10.06, p < .005$. All other results were non-significant $Fs(3, 111) < 1.06$, *ns*, $Fs(1, 37) < 1$.

Table 11. Summary of Untransformed Startle and Skin Conductance Responses for each Social Anxiety Group

		Low social anxiety		High social anxiety	
Picture type	Startle SOA	*M*	*SD*	*M*	*SD*
Startle Response Amplitude (arbitrary Analogue to Digital A-D Units)					
Angry	300	61.73	74.42	111.60	129.63
	3000	77.72	98.18	140.57	157.76
Happy	300	63.81	78.33	109.20	117.93
	3000	74.94	82.14	134.79	149.31
Neutral	300	62.62	83.07	109.32	121.26
	3000	72.78	89.20	127.84	145.61
Object	300	69.78	90.01	115.68	156.62
	3000	71.07	79.98	133.14	149.68
Skin Conductance Response Amplitude (μS)					
Angry		0.025	0.027	0.032	0.044
Happy		0.027	0.045	0.026	0.041
Neutral		0.015	0.027	0.011	0.038
Object		0.024	0.038	0.054	0.086

[14] Startle amplitudes were log transformed in favour of within-subject z transformations as this allowed startle amplitudes to be compared between groups. However, it is reassuring to note that the pattern of within-subjects effects following z-transformation is similar to that obtained using log transforms. Specifically, z-transformed startle amplitudes were significantly reduced for 300 ms probe SOAs compared to 3000 ms probe SOAs, $F(1, 37) = 30.00, p < .001$. Again, all other results were non-significant $Fs(3, 111) < 1.38$, *ns*; $Fs(1, 37) < 1$.

Skin Conductance Response Magnitude

Consistent with previous studies (e.g. Hermann, Ziegler, Birbaumer, & Flor, 2002; Lang, Greenwald, Bradley, & Hamm, 1993) skin conductance responses were defined as the maximum response occurring between 1 and 4 s after picture onset minus the mean baseline response during the 1 s prior to picture onset. Mean skin conductance responses (SCR) in each condition are displayed in Table 11. The SCR data was normalized using a log(1 + SCR) transformation (see Appendix C, Table C2 for transformed means).

Transformed SCR data entered into a mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and one within-subjects factor of Picture Type (angry, happy neutral face, object). Results revealed a significant main effect of Picture Type, $F(3, 111) = 2.65, p = .05$ (all other results were non-significant Fs < 1). Follow-up Bonferonni pair-wise comparisons suggest that participants demonstrated a non-significant tendency to produce greater SCR responses to angry faces (0.0286) compared to neutral faces (0.0128; $p = .07$), but not happy faces (0.0266) or objects (0.0389); all other comparisons ps > .1.

A Posteriori Covariation Estimates

In general, participants tended to underestimate the occurrence of outcomes for each picture type. For example, their overall estimates of aversive noise and no-noise outcomes for neutral faces were 32% and 60%, respectively, which total 92% (rather than 100%). To account for this, the scores were calculated as a percentage of the total outcome estimate for each person and each picture type, as this allows comparison of the noise outcome estimates in each condition against the veridical contingency (i.e., 66% of trials for noise outcome). Mean adjusted scores for the *a posteriori* covariation estimates are given in Table 12. (see Appendix C, Table C3 for unadjusted scores). For completeness, all analyses were conducted using both adjusted and non-adjusted covariation estimates. Findings using non-adjusted estimates are similar to those based on adjusted estimates with the exception of comparisons against the veridical for which non-adjusted estimates were more likely to be evaluated as significant.

Table 12. Mean A Posteriori Estimates of Covariation and Summary Bias Measures

	Low Social Anxiety				High Social Anxiety			
	Aversive noise		No noise		Aversive noise		No noise	
Picture	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Angry	53.6	16.2	46.4	16.2	54.0	22.3	46.0	22.2
Happy	39.1	12.8	60.9	12.9	39.2	17.7	60.8	17.7
Neutral	36.8	18.3	63.2	18.4	33.4	18.2	66.6	18.2
Object	27.5	18.4	72.6	18.4	39.4	20.7	60.6	20.7
Bias measure	38.3	38.4			33.3	47.9		

Note. Bias measure reflects tendency to selectively associate aversive noise outcomes with angry faces.

In-line with recent studies of covariation bias (de Jong et al., 1998; Tomarken et al., 1995), summary bias measures of post-experimental contingency estimates were computed for angry face-aversive noise outcomes. This bias measure indicates whether participants' tendency to associate angry face slides with aversive noise was greater than their tendency to associate the other three stimuli (happy, neutral faces and objects) with aversive noise outcomes (for more details see Tomarken et al., 1995).

Social anxiety groups did not differ regarding the magnitude of covariation bias $t(37) = 0.36$, *ns*. Both high and low social anxiety groups demonstrated significant a posteriori covariation bias for angry faces and aversive noise (compared to zero, no selective association), $t(18) = 3.03, p < .01$, $t(19) = 4.46, p < .001$, respectively.

Base Rate Estimates

The base rate estimates of the frequency of occurrence of each picture type and each outcome were adjusted, as described earlier, so that the total picture and outcome estimates for each participant equalled 100% (see Table 13). The adjusted base-rate estimates of the percentage of trials on which each picture type occurred (Appendix C, Table C4 for unadjusted scores) were entered into a mixed design ANOVA with Group (high vs. low social anxiety) and Picture Type (angry, happy, neutral)[15] as independent variables. A

[15] One of the four levels of the within-subjects variable (Picture Type) was excluded from the ANOVA because it is redundant in this analysis. That is, the values of one condition (e.g. estimated percentage of trials with objects) can be predicted from the combined data in the other three conditions (e.g. estimated percentage of trials with angry, happy and neutral faces), as the four conditions add up to 100%.

significant main effect of Picture Type, $F(2, 74) = 19.19, p < .001$ reflected participants' tendency to underestimate the occurrence of neutral faces (16%) compared to angry faces (28%), happy faces (32%) and objects (24%) ($ps < .001$). In general, participants overestimated the occurrence of happy faces and underestimated the occurrence of neutral faces, $ts(38) > 3.89, ps < .001$ relative to the veridical contingency (25%) but were relatively accurate in their estimations regarding angry faces and objects, $ts(38) < 1.96$, *ns*. All other results from the ANOVA were non-significant $Fs < 1$.

With respect to base-rate estimates, high and low socially anxious did not report significantly different estimates regarding the occurrence of aversive noise $t(37) = 0.57$, *ns*. In general, participants underestimated the occurrence of aversive noise and overestimated the absence of noise compared to the veridical contingencies (noise = 66.7 %, no noise = 33.3 %) $t(38) = 8.87, p < .001$.

Table 13. Mean Base-Rate Percentage Estimates in Low and High Social Anxiety Groups

	Low social anxiety		High social anxiety	
	M	*SD*	*M*	*SD*
Picture				
Angry	30.5	12.4	26.7	10.6
Happy	29.6	10.3	34.5	12.0
Neutral	18.2	9.8	13.4	8.6
Object	21.7	10.3	25.4	11.9
Outcome				
Aversive noise	45.8	15.0	42.8	16.8
No noise	54.2	15.0	57.2	16.8

Explicit Valence Ratings

Mean valence ratings for the four picture types (see Table 14) were entered into a 2 x 4 mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and one within-subjects factor of Picture Type (angry, happy, neutral face, object).

Results indicated that low socially anxious individuals rated stimuli in general as more positive (1.2) than high socially anxious individuals (-0.1), $F(1, 37) = 4.33, p < .05$. In addition, a significant main effect of Picture Type, $F(3, 111) = 226.12, p < .001$, reflected participants' tendency to rate angry faces more negatively and happy faces more positively

than all other pictures types (*ps* < .001; see Figure 13). The interaction between Picture Type and Group was non-significant $F(3, 111) = 0.77$, *ns*.

Table 14. Mean Valence and Arousal Ratings for each Picture type and Social Anxiety Group.

	Low social anxiety		High social anxiety	
Picture Type	*M*	*SD*	*M*	*SD*
	Explicit Valence Ratings (-4 to +4)			
Angry face	-2.1	0.9	-2.5	0.6
Happy face	1.9	0.7	1.8	1.0
Neutral face	0.5	0.7	0.2	0.5
Object	0.2	0.4	0.2	0.4
	Explicit Arousal Ratings (0 to 8)			
Angry face	4.5	2.0	4.7	2.5
Happy face	4.0	1.4	3.5	2.1
Neutral face	2.5	1.2	2.3	1.6
Object	0.4	0.6	0.7	0.9

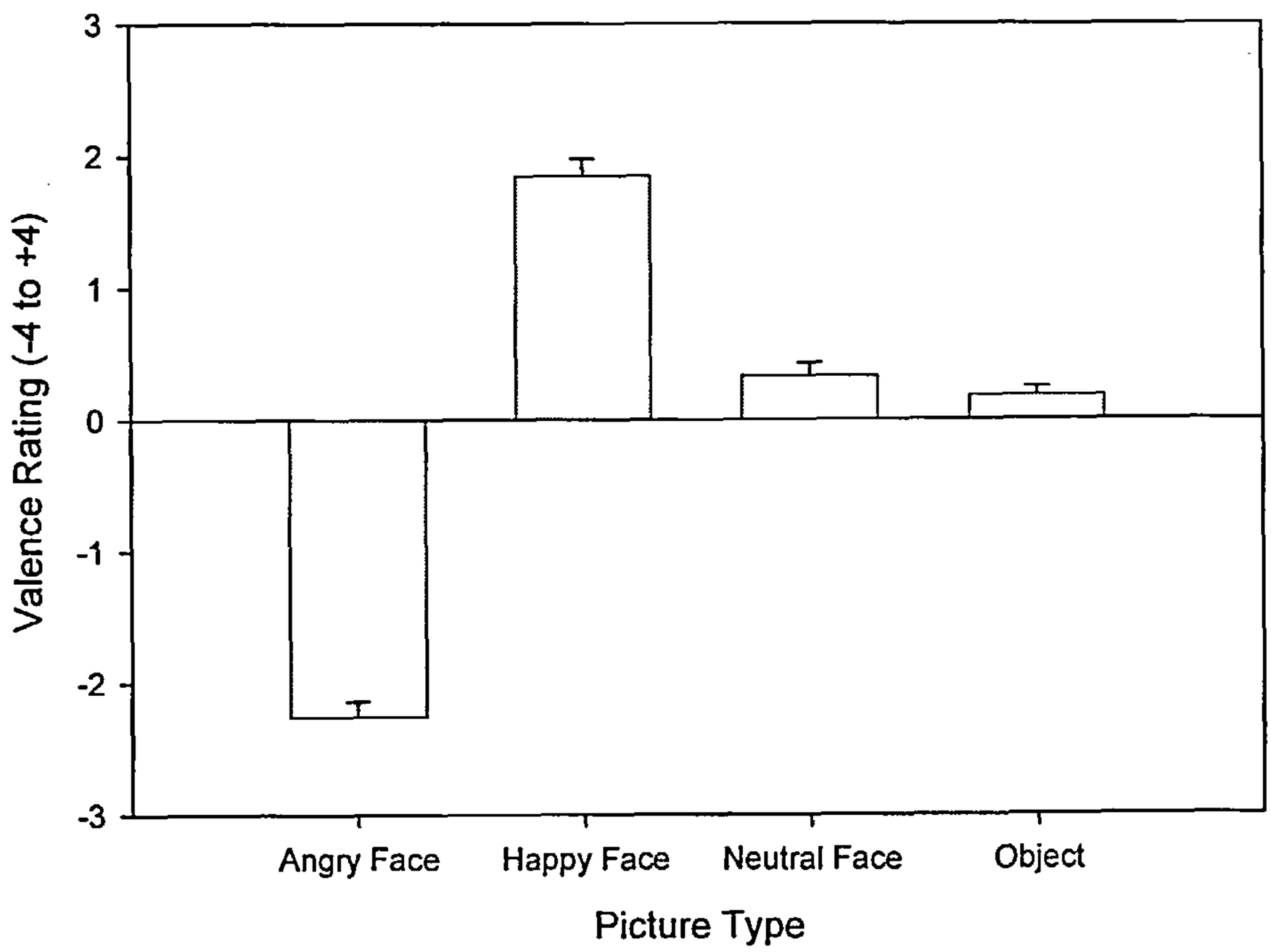

Figure 13. Valence ratings for each picture type.

Explicit Arousal Ratings

Mean arousal ratings for the four picture types (see Table 14) were entered into a 2 x 4 mixed design ANOVA with one between-subjects factor of Group (high vs. low social anxiety) and one within-subjects factor of Picture Type (angry, happy, neutral face, object). Results only indicated a significant main effect of Picture Type, $F(3, 111) = 98.75, p < .001$, see Figure 14, (all other results were non-significant Fs < 1). Subsequent Bonferroni pair-wise comparisons revealed that arousal ratings for all picture types were significantly different (ps < .001) with angry faces considered the most arousing and objects the least arousing.

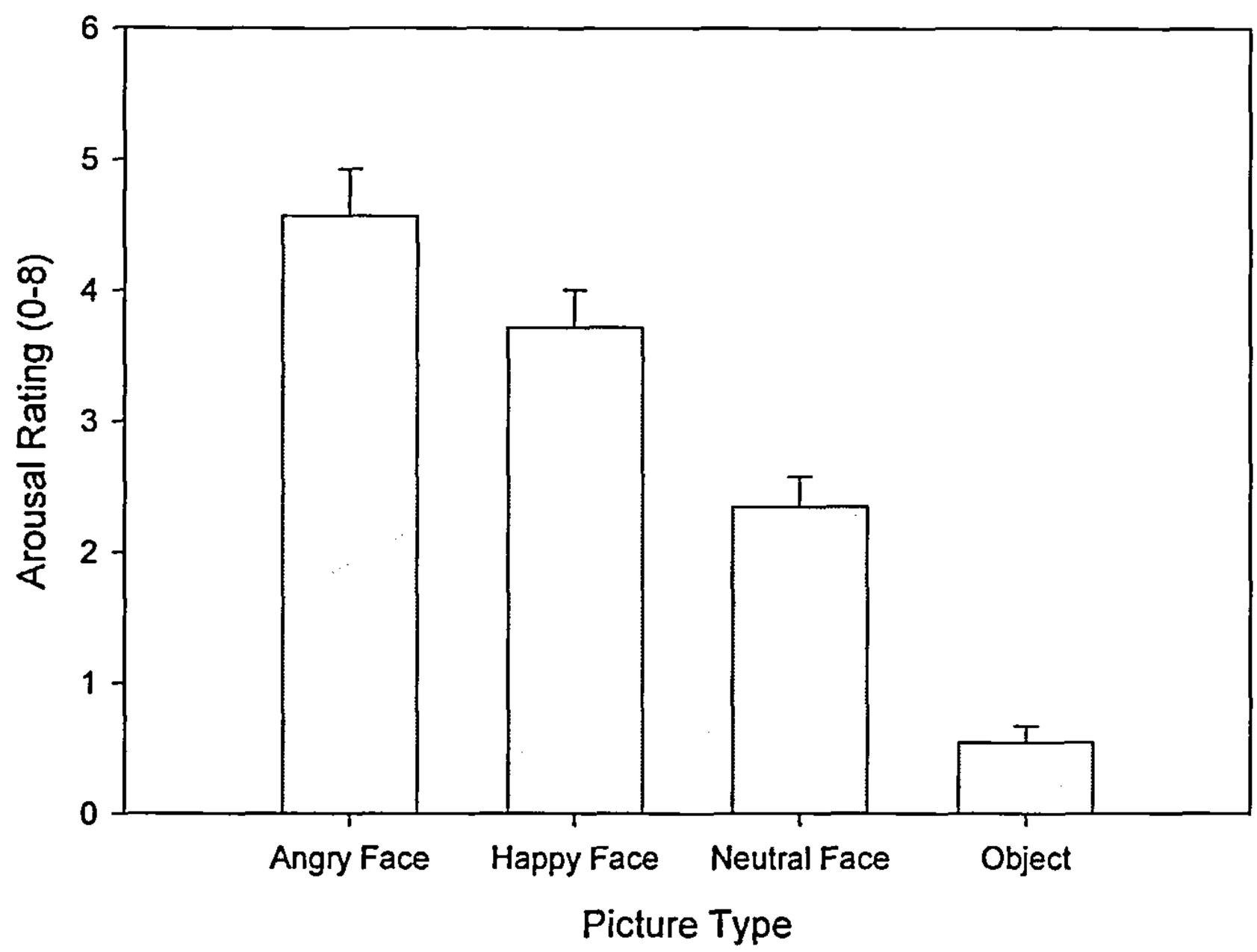

Figure 14. Arousal ratings for each picture type.

Relationship Between Eye Monitoring, Startle, SCR, Ratings and Questionnaire Scores

Correlations were calculated between the main questionnaire measures of anxiety and depression (FNE, SADS, STAI, Fear-Social, POMS-anxiety and POMS-depression) and summary attentional bias measures (see Experiment 1 for details) for the whole sample. In addition, startle, SCR and explicit rating bias measures equivalent to the difference between average responses for each face type relative to objects were also calculated. There were no significant relationships between questionnaire scores and any of the attentional, physiological or explicit appraisal measures. Correlations between dependent measures were also non-significant, thus failing to provide evidence of an association between physiological/self-report measures of stimulus appraisal and measures of attentional bias.

Discussion

In the present study high and low socially anxious individuals were exposed to a social stress induction procedure before completing a hybrid task that provided psychophysiological measures of attentional orienting and maintenance, startle potentiation and electrodermal skin conductance in response to facial expressions and objects. Participants subsequently estimated the covariation between each picture type and the occurrence of aversive startle probes, and provided explicit ratings regarding the valence and arousal of all faces and objects.

The main findings from the present study can be summarized as follows: (i) Participants, irrespective of social anxiety group initially oriented more often towards all face types compared to objects, and were faster in doing so. (ii) Participants initially maintained their gaze on faces for longer than objects (irrespective of face type), however, high socially anxious individuals did so to a lesser extent than low socially anxious individuals. (iii) High socially anxious individuals were characterised by larger startle amplitudes (irrespective of picture type and startle SOA) compared to low anxious individuals, however in general, startle amplitudes were smaller for probes presented at short lead 300 ms compared to long lead 3000 ms SOAs. (iv) Participants over-estimated the covariation between angry faces and aversive startle probes relative to other face types, and explicitly rated angry faces as more negative and happy faces as more positive compared to neutral faces and objects. Overall, high socially anxious individuals rated stimuli as less pleasant than low anxious individuals. (v) Participants, irrespective of social anxiety group, tended to produce larger skin conductance responses to angry compared to neutral faces and explicitly rated angry, happy, neutral faces and objects as decreasing in arousal intensity (vi) Correlations provided no evidence of relationships between measures of anxiety/mood, attention allocation and stimulus appraisal.

Orienting and Maintenance of Attention to Social Cues in Social Anxiety

The present findings from the eye movement data provide partial support for recent cognitive models that emphasise the reduced processing of social cues as an important factor involved in the etiology and maintenance of social phobia (e.g. Clark & Wells, 1995). While participants in general maintained their gaze for longer on faces relative to objects, this bias was significantly reduced in high socially anxious compared to low anxious individuals. This finding is consistent with those from Experiment 2 that also demonstrated reduced maintenance of attention to neutral faces relative to objects in socially anxious individuals under social-evaluative stress. However, present findings extend those from experiment 2 as socially anxious participants' reduction in gaze duration generalized across all face types

(i.e.angry, happy and neutral). The present findings share some common features with existing evidence of avoidance of faces in general (Chen, Clark, Ehlers, & Mansell, 2002) and emotional faces (Mansell, Clark, Ehlers, & Chen, 1999) relative to objects in social anxiety, and provide further support for cognitive models that suggest social anxiety is characterised by maladaptive reductions in the processing of social cues (e.g. Clark & Wells, 1995; Wells & Clark, 1997).

However, reduced processing of faces relative to objects in socially anxious individuals was not evident across all aspects of selective attention. Both high and low social anxiety groups initially looked more often and were quicker to orient towards faces relative to objects. Within an evolutionary framework, increased and faster orienting of attention to social cues (relative to objects) might well be expected, however, these findings are inconsistent with those demonstrating socially anxious individuals' avoidance of faces in probe detection paradigms (e.g. Chen et al., 2002) and reduced initial orienting (EM-direction) for faces in eye tracking studies (Experiment 2 of the present thesis). Factors underlying these equivocal findings remain unclear, however it is perhaps relevant that, despite modification to the stress induction procedure (i.e. informing participants their facial expressions were monitored throughout the task), anxiety levels in the present study were lower than those in Experiment 2 (in which reduced vigilance for faces was evident in socially anxious individuals).[16] It is possible that individual differences in the maintenance of attention emerge at relatively low levels of social evaluative stress (e.g. present study), when socially anxious individuals remain motivated to remain in a social situation but only moderately process concern-relevant social cues in an attempt to alleviate distress. In contrast more severe avoidant strategies such as a reduced tendency to even orient towards faces may only become apparent when phobic individuals experience particularly high levels of anxiety (e.g. Experiment 2 of the present thesis).

It remains unclear why anxiety levels in the present study were unaffected by the stress induction procedure (especially given anxiety scores upon entering the session were comparable with earlier studies in the present thesis). As such, future studies are encouraged to consider further modifications to the present social stress induction procedure (or alternative paradigms) in order to more accurately assess in-situ processing biases in social anxiety.

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[16] Visual analogue state anxiety scores immediately before the main task were entered into a 4 x 2 between-subjects ANOVA with Experiment (1, 2, 3, 4) and Group (high vs. low social anxiety) as between-subjects factors. Results indicate the high socially anxious individuals were significantly more anxious than low anxious individuals, $F(1, 131) = 24.99, p < .001$. A main effect of Experiment $F(3, 131) = 7.84, p < .001$ reflects participants elevated anxiety levels in Exp. 2 compared to Exps. 3 and 4 which were in turn higher than in Exp. 1 ($ps < .05$). There was no significant interaction between Experiment and Group $F(3, 131) < 1$.

Appraisal of Social Cues in Social Anxiety: Psychophysiology and Explicit Ratings

A unique feature of the present study regards the use of both psychophysiological and self-report measures of stimulus appraisal to clarify the processes that underlie the fear responses (and behaviours) elicited when socially anxious individuals enter social situations. In addition to explicit ratings, startle amplitudes were used to index stimulus of valence whereas skin conductance responses supplemented explicit arousal ratings. Present results indicate that socially anxious individuals' response amplitudes to startle probes were greater than low anxious individuals' startle magnitudes, irrespective of picture type. These findings are consistent with models that suggest anxiety disorders are characterised by inappropriate exaggeration of normal fear responses (Barlow, 1988) and cognitive models that emphasise the role of negative appraisal processes in the etiology and maintenance of anxiety disorders (e.g. Mogg & Bradley, 1998). One possible interpretation of this finding is that socially anxious individuals evaluated faces and objects as more aversive than low anxious individuals. Valence ratings were more positive in low socially anxious individuals, consistent with this interpretation. Another possible interpretation of group differences in startle magnitudes is that high socially anxious individuals' increased startle magnitudes were independent of stimulus properties and instead reflected more diffuse perceptions of threat associated with the testing situation. While the absence of an appropriate baseline startle measure, (e.g. response amplitude to startles presented during blank inter-trial intervals), renders this interpretation purely speculative,[17] findings that the high social anxiety group explicitly rated their mood throughout the testing session less positively than low anxious individuals, provides some support for the interpretation that perceptions of contextual threat may have primed the defence responses to startle probes. The modulatory effect of contextual threat is evident in studies reporting participants' greater startle responses when tested in dark as opposed to light environments (Grillon, Pellowski, Merikangas, Davis, 1997; Grillon et al., 1999). Similarly, verbal threat of an aversive outcome has been shown to potentiate startle to a greater extent in high state anxious individuals than less anxious participants (Grillon, Ameli, Foot, & Davis, 1993). Thus, findings of greater startle potentiation in high socially anxious individuals might simply reflect their elevated levels of state anxiety presumably in response to the evaluative threat posed by the physiological assessment itself, the threat of the speech, or from an increase in

[17] The author notes that startles were presented in the absence of visual stimuli during the habituation block. However, this startle sequence was used to familiarize participants with startle probes such that response amplitudes in subsequent experimental blocks were unlikely to be at ceiling (and therefore appropriate for affective modulation). Given that startle amplitudes during the familiarization period tended to be at ceiling they were considered to provide an insensitive index of baseline startle responding.

self-focus (Woody, 1996). Panayiotou and Vrana (1998) recently demonstrated that self-focus potentiates startle in high but not low socially anxious individuals though predominantly considered these findings to reflect enhanced external attention in social anxiety. A more likely explanation is that self-focus potentiates startle by increasing negative affect directly or through its role in constructing a negative self-image (possibly taken from the observer-perspective) that then primes startle responses.

However, why startle magnitude was unaffected by picture type in the present study remains unclear. Consistent with a motivational priming hypothesis (Lang et al., 1990) several studies have demonstrated that startle magnitudes are enhanced by negative images relative to neutral images but inhibited during pleasant pictures (e.g. Lang, 1995; Vrana et al., 1988). Furthermore, individuals with specific phobias tend to demonstrate enhanced startle potentiation when viewing images of their feared object relative to other unpleasant material (e.g. Hamm et al., 1997; Globisch et al., 1999). While the absence of affective startle modulation in the present study, might reflect participants' similar appraisal of faces and objects, participants' explicit valence ratings clearly suggest that angry faces were considered more negative, and happy faces more positive, than neutral faces and objects. Comparison of explicit ratings for the present set of face/object stimuli with those for stimuli that have been shown to modulate startle responses (e.g. Lang, Bradley, & Cuthbert, 1990; see also Vrana et al., 1988) clearly indicates that the present stimuli (particularly angry and happy faces) are weaker in terms of both valence and arousal[18]. Recently, Cuthbert, Bradley and Lang (1996) only found potentiation of the blink reflex for unpleasant images that were highly arousing. Thus, the 'emotional' faces (and objects) used in the present study may have simply lacked the potency required to affectively modulate startle magnitude.

In contrast, these moderate differences in stimulus affect, were found to modulate electrodermal skin conductance responses. Results indicate that skin conductance responses (SCRs) differed across pictures, with a near-significant tendency for angry faces to elicit greater SCRs than neutral faces. These findings are consistent with previous studies which have also reported enhanced SCRs for angry faces relative to other face types, irrespective of social anxiety level (Clark, Siddle, & Bond, 1992). Similarly in the present study, SCR data indicated that angry faces tended to be more arousing than neutral faces, irrespective of social anxiety group. Thus, while SCRs are similarly large for highly arousing positive and negative stimuli (e.g. Lang et al., 1993; Winton et al., 1984), they may provide a sensitive index of adaptive physiological responding to mild threat. Taken together, the present findings and those from Clark et al. (1992) fail to provide support for the hypothesis that

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[18] Data from similar rating scales (converted to -4 to +4) in Figure 4 of Lang et al., 1990 indicate that subjective ratings for angry faces (≈ -1 on converted scale) were considerably less negative than other 'aversive' images e.g. violent death (≈ -3.5 on converted scale).

social anxiety is characterised by enhanced negative appraisal of social cues, and that such bias underlies subsequent attentional processes (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998). Furthermore, the present findings question the view that socially anxious individuals conditioning history of repeated failures in social interactions results in a conditioned fear response characterized by increased electro-dermal orienting to social threat cues (Öhman, 1986).

In examining the time-course of defence responses to stimulus threat, the present startle paradigm assessed startle response magnitude to face/object stimuli at early and late stages of stimulus processing. Results indicate that startle magnitudes were smaller when probes were presented shortly after face/object pictures (300 ms) than when occurring after a longer duration (3000 ms). Smaller startle magnitudes might reflect relatively limited stimulus appraisal at initial stages of stimulus processing, compared to more detailed evaluations obtained following more prolonged (perhaps strategic) assessment of stimulus characteristics (Bradley, Cuthbert, & Lang, 1993).

A subsidiary aim of the present study was to investigate the extent to which social anxiety is characterised by a tendency to over-associate aversive events with social cues relative to low anxious individuals. In the present study, both high and low socially anxious individuals over-estimated the covariation between the occurrence of aversive events (i.e. startle probes) and angry faces relative to other face and object stimuli. These findings are consistent with previous demonstrations of covariation biases between angry faces and aversive outcomes (Sutton, Luten, Pury & Mineka, 1990 cited in Öhman & Mineka, 2001) and evidence that such biases are not moderated by social anxiety level (Tomarken et al., 1998). Taken together these findings fail to support the notion that socially anxious individuals' social fears are likely to be confirmed and therefore maintained by a greater tendency to associate social cues with threat (Öhman & Mineka, 2001).

To conclude, the present findings provide partial support for models that emphasise the role of reduced processing of external social cues in the maintenance of social phobia (e.g. Clark & Wells, 1995). However, the extent to which reductions in the processing of social cues result from negatively biased stimulus appraisal mechanisms remains unclear. Instead, reduced processing of social cues may simply be characteristic of a wider range of defensive behaviours adopted by socially anxious individuals in response to perceptions of more contextual, evaluative threat.

Chapter 7: Experiment 5

Introduction

The present thesis has so far focused on the biases in selective attention proposed to play an important role in the etiology and maintenance of social anxiety (e.g. Clark & Wells, 1995). In addition, biases in stimulus appraisal suggested to underlie these dysfunctional attentional processes have also been considered (Mogg & Bradley, 1998; Mathews & Mackintosh, 1998). While these studies have specifically investigated the selective processing of cues relevant to the social concerns of individuals with social phobia (e.g. angry faces, Trower & Gilbert, 1989), socially anxious individuals are rarely likely to receive such unambiguous non-verbal signals of negative evaluation. Instead the social cues commonly encountered in social situations are likely to be ambiguous and therefore require subjective interpretation.

Interpretation of Ambiguity in Social Anxiety

As highlighted in earlier chapters of this thesis, cognitive models of social anxiety, particularly those derived from clinical practice, note that individuals with social phobia commonly report judgments about social situations that are consistent with a negative interpretative bias that serves to exacerbate and maintain their social concerns (Clark & Wells, 1995; Wells & Clark, 1997). Consistent with this view, recent evidence suggests that individuals with social phobia exhibit interpretational biases that favor socially threatening information (Amir, Foa, & Coles, 1998a; 1998b; Stopa & Clark, 2000; see Chapter 2 of the present thesis and review by Heinrichs & Hofmann, 2001). For example, Amir et al. (1998a) found that individuals with generalized social phobia were more likely to judge a series of previously described ambiguous social scenarios as negative (as opposed to positive or neutral) compared to individuals with obsessive-compulsive disorder and low anxious controls (see also Stopa & Clark, 2000). Although consistent with a negative interpretative bias in social anxiety, other research (using similar paradigms) suggests that social anxiety might not be characterized by an outright negative interpretative bias, but instead the absence of a positive bias demonstrated by low anxious individuals (Constans, Penn, Ihen, & Hope, 1999).

These studies suggest that individuals with social anxiety demonstrate a more negative interpretative bias, compared to controls, when retrospectively reviewing social interactions *off-line*. However, it remains unclear whether socially anxious individuals jump to negative conclusions as an event unfolds (on-line), or whether they primarily make distorted interpretations after the interaction (Clark & McManus, 2002). In a recent

assessment of on-line processing biases, Hirsch and Mathews (1997, 2000) used lexical decision tasks to measure participants' speed to assess the grammatical compatibility of (threatening or non-threatening) target words with the endings of socially relevant sentences. Results suggested that non-patient control participants demonstrated a positive on-line inferential bias, whilst patients with social phobia failed to demonstrate either positive or negative on-line inferences. Thus, high socially anxious individuals appeared to lack the on-line positive bias characteristic of low anxious controls. While this positive inferential bias may serve an important protective role in maintaining high levels of self-esteem and low levels of social anxiety, it remains unclear whether this bias extends to other forms of ambiguous social information, such as facial expressions. In an initial study Winton, Clark and Edelmann (1995) reported that socially anxious individuals were more likely to classify (on-line) briefly presented neutral and angry faces as negative, compared to low-anxious individuals. While the brief (60 ms) stimulus presentation arguably rendered the faces ambiguous, the design did not realistically model the ambiguity inherent in the sustained and subtle expressions commonly encountered in social situations. One aim of the present study (described later) was to extend the limited research into on-line interpretative processing of ambiguous non-verbal social cues by assessing high and low socially anxious individuals' interpretation of emotionally ambiguous positive and negative facial expressions.

While a tendency to negatively interpret ambiguous social information may confirm (and therefore maintain) the concerns of socially anxious individuals, other forms of judgment bias may additionally ensure pre-existing fears of negative evaluation prove particularly resistant to extinction. For example, phobic individuals' social fears might be more likely to be confirmed and therefore maintained by their greater readiness to associate certain types of social cue (particularly those signaling negative evaluation) with threat (Öhman & Mineka, 2001). While various studies suggest socially anxious individuals over-estimate the likelihood/occurrence of threat when anticipating/reviewing social interactions (e.g. Lucock & Salkovskis, 1988; Foa, Franklin, Perry, & Herbert, 1996), little research has investigated whether socially anxious individuals over-associate negative outcomes in relation to the specific social cues encountered during a social situation.

Judgment Biases in Social Anxiety: Fear-Relevant Selective Associations

The illusory correlation/covariation bias paradigm was developed by Tomarken, Mineka and Cook (1989) to assess individual differences in the association of fear-relevant stimuli with threat. In a series of studies, Tomarken et al. (1989) showed high and low spider-fearful participants slides of fear-relevant stimuli (i.e. spiders) and fear-irrelevant stimuli (i.e. flowers and mushrooms) that were followed by either a threat/aversive outcome (electric shock), a tone, or nothing at all (neutral outcomes). Across 72 slide-outcome trials,

the three categories of slide were randomly related to the type of outcome that followed the slide. At the end of the sequence, participants were asked to judge the degree of covariation between the various slide categories and outcomes. Results indicated that spider-fearful participants substantially overestimated the association between slides of spiders and the aversive shock outcome relative to both the estimations of low fear participants and the veridical contingency (p = .33; Tomarken et al., 1989). Evidence supporting Tomarken et al.'s (1989) findings has been reported in studies using similar covariation paradigms (e.g. Amin & Lovibond, 1997; Kennedy, Rapee, & Mazurski, 1997; Tomarken, Sutton, & Mineka, 1995).

It has also been proposed that selective associations may play an important role in the maintenance of phobic disorders. For example, de Jong, Merckelbach and Arntz (1995) reported significant correlations between residual covariation bias after treatment and return of phobic fear two years later (see also de Jong, Merckelbach, Arntz, & Nijman, 1992). These findings are consistent with the view that a tendency to associate threat outcomes with stimuli central to the concerns of anxious individuals is likely to confirm and maintain perceptions of danger.

However, fear-relevant selective associations found in specific animal phobia and also in panic disorder (e.g. Pauli, Montoya, & Marks, 1996) have not been observed in all anxiety disorders. Pury and Mineka (1997) found elevated selective covariation estimates between mutilation slides and aversive shocks, irrespective of participants' prior blood-injury fear. Sutton, Luten, Pury and Mineka (1990, cited in Öhman & Mineka, 2001) found evidence of covariation bias for fear-relevant social stimuli (such as slides of angry or disgusted facial expressions) and aversive outcomes in four separate experiments, but no evidence of covariation bias for fear-irrelevant stimuli (i.e. happy and neutral faces). Contrary to findings in specific animal phobias, the magnitude of covariation bias was not affected by participants' levels of social anxiety (see similar findings from Experiment 4 of the present thesis). In a similar study, de Jong, Merckelbach, Bogels and Kindt (1998) assessed high and low socially anxious individuals' initial and *a posteriori* (retrospective) covariation estimates for angry, happy and neutral faces, and aversive shock outcomes. In addition, participants' outcome expectancies were also monitored on a trial by trial basis. Results indicated that, irrespective of prior social anxiety levels, participants demonstrated *a priori* and *a posteriori* covariation bias between angry faces and shocks. These findings, together with the pattern of participants' on-line outcome expectancies suggest that *a posteriori* covariation biases arose from initial expectancies that survived extinction (see also de Jong et al., 1995).

The failure to find enhanced negative covariation biases in social anxiety (e.g. de Jong et al., 1998; Sutton et al., 1990; Exp. 4 of the present thesis) contrasts with findings

from studies that suggest socially anxious individuals make negative judgments when reviewing previously encountered social material off-line (Amir et al., 1998, Stopa & Clark, 2000). However, as noted earlier, the inferential processes of socially anxious individuals may be better characterized by the absence of positive on-line (Hirsch & Mathews, 1997; 2000) and positive retrospective biases (Constans et al., 1999) present in non-anxious individuals. As such, failures to demonstrate predicted dysfunctional selective-associations in social anxiety may, in part, be due to previous covariation bias paradigms only using negative and neutral outcomes (e.g. cutaneous shocks, lights and tones) and not the positive outcomes required to investigate individual differences in processing positive information. Therefore, a second aim of the present study was to further investigate initial, on-line and off-line judgment biases in social anxiety using a covariation detection paradigm modified to assess the extent to which positive and negative outcomes are associated with non-verbal social cues.

The Present Study: Interpretation of Ambiguity and Fear-Relevant Selective Associations

In an attempt to extend previously limited empirical investigation into the interpretative and judgment biases proposed to be involved in the maintenance of social anxiety, two tasks were developed. To assess the interpretation of emotionally ambiguous positive and negative emotional faces in social anxiety, high and low socially anxious participants classified ambiguous faces in terms of how angry or happy they appeared. Faces were computer manipulated such that they contained either a greater proportion of angry expression, or a greater proportion of happy expression. Given that recent cognitive models propose that social anxiety is associated with a tendency to interpret ambiguous social information in a negative fashion (e.g. Clark & Wells, 1995), it was predicted that socially anxious individuals would classify more ambiguous emotional faces as angry compared to low anxious individuals.

To assess initial, on-line and retrospective selective-associations between social cues and positive and negative outcomes, a second study presented high and low socially anxious individuals with a series of angry, happy and neutral faces. Following each face, participants were presented with one of four outcomes which were either, aversive, pleasant or neutral emotional images, selected from the International Affective Picture Set (IAPS: Lang, Bradley, & Cuthbert, 1995), or nothing at all. Three measures of covariation bias were assessed: initial expectancies, on-line outcome expectancies on a trial by trial basis, and *a posteriori* covariation estimates (cf. de Jong et al., 1998). Given that overestimated probabilities and exaggerated costs of threat may play an important role in the maintenance of anxiety disorders (Foa & Kozak, 1986), it was predicted that high socially anxious individuals would demonstrate a greater covariation bias for negative social cues and

unpleasant outcomes, throughout, and after the task, compared to low anxious individuals. Furthermore, following Hirsch and Mathews (1997, 2000), it was predicted that high socially anxious individuals would show a reduced bias in positive outcome expectancies on-line, and following the task, particularly in relation to positive social cues, compared with low socially anxious individuals.

Cognitive Predictors of Social Anxiety

Central to the investigation of interpretative and judgment biases outlined above, and attentional biases investigated in earlier chapters of the present thesis, is the notion that such biases play a crucial role in the etiology and maintenance of social anxiety (e.g. Clark & Wells, 1995; Wells & Clark, 1997; Rapee & Heimberg, 1997). Such proposals imply that to the extent an individual is characterized by such information processing biases, they are likely to experience dysfunctional levels of anxiety in social situations. Thus, a subsidiary aim of the present study was to investigate the extent to which biases in attention, interpretation and judgment might underlie vulnerability to experience social anxiety.

In addition to the two tasks outlined above, participants completed a probe classification variant of the eye tracking task used in Experiments 1 and 2 of the present thesis. Reaction times to classify probes appearing behind neutral faces paired with objects were used to index the attentional processing of external social (relative to non-social) cues considered to be reduced in socially anxious individuals (Clark & Wells, 1995). In addition, response latencies to classify probes appearing behind angry (and happy) faces relative to neutral faces were used to index the selective processing of threat cues thought to be enhanced when socially anxious individuals process competing external social stimuli (Wells & Clark, 1997; Rapee & Heimberg, 1997).

Indices of bias in attention, judgment and interpretation of ambiguity obtained from the three tasks described above were used to predict participants' level of state anxiety immediately prior to delivering an assessed oral presentation to fellow students and members of staff (as part of their undergraduate programme). As discussed in earlier chapters, socially anxious individuals' fears of negative evaluation are particularly prominent when social situations involve assessed public performance (e.g. speaking; Holt, Heimberg, Hope, & Liebowitz, 1992; Turner, Beidel, & Larkin, 1986; Beazely, Glass, Chambless & Arnkoff, 2001). Furthermore, the assessed speech used in the present study provides a social environment that contains many of the components (e.g. formal speaking, being watched and stranger-authority anxiety) identified in a recent factor analysis of clinical outpatient's feared social situations (Perugi et al., 2001).

Method

Participants

These were 46 undergraduate students (5 men, 41 women) with a mean age of 20.2 years (range = 18 – 23 years). All participants spoke English as their first language and had visual acuity within normal limits. Participants received either course credit or cash payment.

Task 1: Probe Classification Task

Materials and Apparatus

The stimuli consisted of 48 different picture pairs each presented twice in the task. For one third of the pairs, angry faces were paired with neutral faces of the same model. Another third paired happy faces with neutral faces, the third picture pair type paired 16 neutral faces with 16 household object control pictures (e.g. chair, lamp, clock). For each pair type, half the faces were male, and half female.

The faces and objects were the same as those used in Experiments 1 and 2 of the present thesis and were selected from a pool of over 600 photographs containing three face sets (Bradley, Mogg & Millar, 1998; Ekman & Friesan, 1976; Matsumoto & Ekman, 1988). All faces had been previously rated (1-9 point scale) regarding how happy and angry they were. Mean angry and happy ratings were 7.9, 1.0, respectively, for angry faces (n = 16); 1.1, 8.0 for happy faces (n = 16) and 1.2, 1.1 for neutral faces (n = 48). The photographs in each pair were mounted side by side, such that for each pair type and gender, half the critical stimuli were on the left and half were on the right. An additional 9 pairs (reflecting the picture pairings used in the experimental session) were prepared as practice items.

Procedure

Each trial of the probe detection task started with a central fixation cross shown for 500 ms which was replaced by a pair of pictures presented side by side for 500 ms. The pictures measured 72 x 110 mm with their centers 186 mm apart. Immediately after the offset of the picture pair, a probe (either an up arrow ↑, or down arrow ↓) was presented until response or for a maximum of 10 seconds in the position of one of the preceding pictures (visual angle of 9.7 % between the two probe positions). Participants were asked to press one of two response buttons as quickly as possible to classify the probe as up or down. The inter-trial interval varied randomly between 750 ms and 1250 ms. Following the practice trials, the 96 experimental trials were presented in a random order. The position of the critical stimulus and the position of the probe were counterbalanced across trials so that each appeared in each position with equal probability for each critical stimulus.

Task 2: Covariation Bias Paradigm

Materials and Apparatus

Happy, angry and neutral expressions from two male and two female models were selected from Ekman and Friesen's (1976) series (models were EM, WF, A and PF). All six faces had been previously rated for how happy and angry they were, on a scale ranging from 1-9. Mean angry and happy ratings were 6.9 and 1.0 respectively, for angry faces; 1.0 and 7.4 for happy faces, and 1.7 and 1.7 for neutral faces. Four pleasant pictures (e.g. butterfly; image no. 1440, 1463, 1602, 1710), four unpleasant pictures (e.g. physical injury; 3053, 3063, 3130, 3170) and four neutral pictures (e.g. mushroom; 5500, 5510, 5531, 5532) were taken from the International Affective Picture Set (IAPS; Lang, Bradley, & Cuthbert, 1995) and represented the positive, aversive and neutral outcomes, respectively. The IAPS pictures were selected on the basis of valence/arousal ratings while ensuring images did not contain/emphasize faces. Mean valence and arousal ratings (on a 1-9 scale; Lang et al., 1995) for each outcome were: 7.6 and 4.6, respectively, for the pleasant pictures, 1.5 and 6.9 for unpleasant pictures and 5.2 and 3.4 for the neutral pictures. A fourth outcome in which no picture was presented was also included.

Procedure

Following the procedure used in previous covariation bias paradigms (e.g. Tomarken et al., 1989), participants were informed that it was their task to determine the relationship between three categories of face and four different outcomes. There were 96 trials divided into eight blocks of 12 trials. Each trial began with a central fixation cross shown for 500 ms which was replaced by a centrally presented face for 5000 ms. Participants were instructed to indicate the outcome they expected during the presentation of each face, by pressing one of four outcome buttons (labeled "Pleasant", "Unpleasant", "Neutral" or "Nothing") on the keyboard. One of four outcomes, lasting 2500 ms, occurred immediately after face offset: an unpleasant picture, a pleasant picture, a neutral picture or nothing at all. The inter-trial interval was 5000 ms. Across all trials and within each block, the probability of any face type occurring was 33%. The probability of any outcome occurring was 25%; the conditional probability of any outcome given the prior occurrence of any category of face was also 25%. Immediately following the face-outcome sequence, participants completed a series of visual analogue scales (0 – 100%) assessing their covariation estimates of each face-outcome contingency (i.e. 12 scales, one for each contingency; e.g. "Given that you saw an angry face, on what percentage of trials was the angry face followed by an unpleasant picture?"), and base rate estimates for each face type (3 scales) and each outcome (4 scales), across the whole task (see Tomarken et al., 1989 for more details).

Task 3: Interpretation of Ambiguous Emotional Expressions

Prototype angry and happy expressions from four male and four female models were selected from Ekman and Friesen's (1976) series (models were EM, GS, JB, JJ, A, C, JM, MF). All faces had been previously rated by 12 independent judges for how angry and happy they were on a scale ranging from 1-9. Mean angry and happy ratings were 6.1, 1.1 respectively for angry faces and 1.0, 7.8 for happy faces. These prototypes were used to create two morphed (computer-manipulated) images for each model that had either a dominant angry expression (60% angry: 40% happy) or a weak angry expression with the happy expression being dominant (40% angry: 60% happy), see Figure 15. The preparation of each continuum used Gryphon Morph v2.5 software (Gryphon Software Corporation, 1994) and is similar to the methods of delineation and interpolation used in studies investigating categorical perception of emotional expression (e.g. Young et al., 1997). Stimuli were 120 mm high and 90 mm wide.

Angry Prototype Angry Dominant Happy Dominant Happy Prototype

60% Angry: Happy 40% 40% Angry: Happy 60%

Figure 15. Prototype angry and happy expressions together with computer generated morphs

Procedure

Each trial began with a fixation cross shown for 500 ms which was replaced by a face until response, followed by an inter-trial interval of 1000 ms. Participants were informed that their task was to classify each presented face using one of six response options labeled on the keyboard in front of them: "Very Angry", "Moderately Angry", "Slightly Angry", "Slightly Happy", "Moderately Happy" or "Very Happy". The angry dominant and happy dominant expressions from the eight continua were each presented eight times in 128 randomly presented trials.

Session Order

Assessment 1: Cognitive Tasks

Visual acuity was first measured using a Snellen chart and participants completed the State version of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) and the shortened state version of the Profile of Mood States containing 6 items for anxiety and depression (POMS; McNair, Lorr, & Droppelman, 1981). Participants then completed the probe classification task, covariation bias task and finally the interpretation of ambiguous faces task in fixed order. The probe classification task was presented first in order to minimize the risk of participant fatigue contaminating response time measures of visual attention. Similarly, the covariation bias task was considered more intensive than the relatively simple face classification task that followed. All tasks were presented in a darkened testing room on a 15" VGA monitor using Inquisit version 1.33 software on a Pentium III 8000 MHz PC. At the end of the session, participants completed the following questionnaires: Fear of Negative Evaluation Scale (FNE; Watson & Friend, 1969), Social Avoidance and Distress Scale (SADS; Watson & Friend, 1969), trait version of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), shortened trait versions of the Profile of Moods States containing 6 items for anxiety and depression (POMS; McNair, Lorr, & Droppelman, 1981), social phobia subscale from the Fear Questionnaire (Marks & Mathews, 1986) and a short form of the Social Desirability Scale (SDS; Strahan & Gerbasi, 1972).

Assessment 2: State Anxiety Prior to Presentation

Approximately three (at least two, but no more than four) weeks after completing the attention, covariation and interpretative tasks, all first year undergraduates were required to give an assessed ten minute presentation as part of their degree programme. The presentation, on a psychological topic of the individual's choice, was delivered to an audience of between ten and fifteen fellow undergraduates and a member of staff. Participants were aware of the assessment criteria which included content, clarity and use of visual aids etc. Undergraduates participating in the present study completed the State version of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) during the two minutes immediately before standing to give their presentation.

Results

Group Characteristics

Participants were allocated to one of two groups according to whether their scores on the FNE and SADS were below, or above, the sample medians on both of the main measures of social anxiety (i.e. similar criteria as in Mogg & Bradley, 2002)[19]. Participants in the Low Social Anxiety (LSA) group had FNE scores of less than 15 and SADS scores of less than 6 ($n = 23$), while those in the High Social Anxiety (HSA) group had FNE scores of 15 or more and SADS scores of 6 or more ($n = 23$). The two groups differed significantly on each social anxiety measure with the LSA group having significantly lower scores than the HSA group (see Table 15 for results). The groups did not differ significantly in age, SDS scores or gender ratio.

Table 15. Social Anxiety Group Characteristics.

	Low social anxiety		High social anxiety			
	M	*SD*	*M*	*SD*	*t*(44)	*p*
Assessment 1						
FNE	7.6	4.5	23.3	4.4	12.0	< .001
SADS	3.3	2.8	9.1	4.1	8.3	< .001
Fear Q-Social	9.0	4.6	15.4	5.8	4.1	<.001
STAI-State	28.6	5.7	36.0	7.7	3.8	< .01
STAI-Trait	32.5	6.1	45.5	7.7	6.4	<.001
POMS – state – anx.	2.1	2.4	4.0	4.4	1.8	*ns*
POMS – state – dep.	0.3	0.6	1.2	2.1	1.9	*ns*
POMS – trait – anx.	2.6	2.2	6.0	3.1	3.8	<.001
POMS – trait – dep.	1.4	1.4	3.1	3.3	2.4	<.05
SDS	4.6	2.0	4.9	2.3	0.5	*ns*
Age	20.1	2.5	20.3	2.6	0.6	*ns*
Assessment 2						
STAI – State	40.5	10.8	51.0	10.4	3.4	<.01
Gender ratio, m/f	3/20		2/21			

Note. FNE = Fear of Negative Evaluation Scale; SADS = Social Avoidance and Distress Scale; Fear Q = Fear Questionnaire-social phobia subscale; STAI = State-Trait Anxiety Inventory; POMS = Profile of Mood States; SDS = Social Desirability Scale (short form).

[19]Somewhat surprisingly the double-gate procedure did not exclude any of the participants originally tested.

Task 1: Probe Classification Task

Data from trials with errors were eliminated,[20] (3.8 % of data) and following inspection of box and whisker plots Reaction Times (RTs) of more than 1000 ms were excluded as outliers[21] (2% of data). One participant had an excessive number of outliers (30 % of data outside cut-offs) so was excluded from the analysis. For the remaining 45 participants, 2.8 % of data were lost as errors and 1.0 % as outliers; the overall mean RT was 599ms. Mean RTs were calculated for each condition (see Table 16).

Table 16. Mean Reaction Times (ms) in Each Condition for Each Social Anxiety Group.

Variables			Low Social Anxiety		High Social Anxiety	
Critical-control pictures	Critical picture location	Probe location	*M*	*SD*	*M*	*SD*
Angry-Neutral	Left	Left	596	81	594	59
		Right	632	79	613	80
	Right	Left	590	73	580	70
		Right	624	90	595	72
Happy-Neutral	Left	Left	584	82	583	78
		Right	613	94	602	69
	Right	Left	591	80	588	82
		Right	627	69	591	79
Face-Object	Left	Left	593	83	570	70
		Right	627	88	601	72
	Right	Left	605	75	589	68
		Right	619	83	591	79

Mean RTs from angry and happy face conditions were entered into a 2 x 2 x 2 x 2 mixed design ANOVA with Group (high vs. low social anxiety) as a between subjects-factor and Emotional Face (angry vs. happy), Emotional Face Location (left vs. right) and Probe

[20] Error rates were generally low and did not suggest any confounds, such as speed accuracy trade-off. Distribution of errors was skewed due to floor effects, as expected from the simple nature of the task.

[21] Box and whisker plots were obtained for each RT using SPSS. These identified "extreme" values as RTs more than 3 box lengths from the 75th percentile (box length = inter-quartile range). The upper cutt-off value was that which excluded extreme values and included as many non-outlying values as possible across the whole data set. Similar results were obtained with alternative methods of identifying outliers, such as the SD cut-off method (Ratcliff, 1993).

Location (left vs. right) as within-subjects factors. The only significant result indicates that participants were quicker to classify probes appearing on the left (588 ms) compared to those appearing on the right (612 ms), $F(1, 43) = 8.43, p < .01$. All other results, including the Group x Emotional Face x Emotional Face Location x Probe Location, were non-significant $Fs(1, 43) < 3.51, ps > .07$.

Mean RTs from neutral face-object conditions were entered into a 2 x 2 x 2 mixed design ANOVA with Group (high vs. low social anxiety) as a between subjects-factor and Face Location (left vs. right) and Probe Location (left vs. right) as within-subjects factors. Results indicate that regardless of anxiety level, participants were again quicker to classify probes appearing on the left (589 ms) than on the right (609 ms) $F(1, 43) = 9.2, p < .001$. All other results, including the Group x Face Location x Probe Location, were non-significant $Fs(1,43) < 3.32, ps > .08$.

Relationship Between Attentional Measures and Questionnaire Scores

Attentional bias indices (for each pair-type) were calculated to express the degree to which RTs were reduced for probes appearing in the location of critical pictures, compared to control pictures. This attentional bias was computed using the following equation (cf. Bradley et al., 1998; MacLeod & Mathews, 1988):

$$\frac{(PL \mid AFR - PL \mid AFL) + (PR \mid AFL - PR \mid AFR)}{2},$$

where PL | AFR corresponds to classification latencies from trials involving the probe left and angry face right conditions. Thus, attentional bias scores will be 0 in the absence of a bias in selective attention, positive in the presence of an attentional bias toward critical face stimuli, and negative in the presence of an attentional bias away from critical face stimuli.

Correlations were calculated between the main questionnaire measures of anxiety and depression (FNE, SADS, STAI, Fear Q-Social, POMS-anxiety and POMS-depression) and the attentional bias measures. All correlations were non-significant.

Task 2: Covariation Bias Task

Initial Expectancies

Data from two participants in the LSA group were lost due to computer failure during the covariation task. The initial aversive expectancy bias measure was derived from the number of participants in each group who indicated that they expected an aversive outcome on the first trial of each class of face, consistent with previous studies (de Jong et al., 1995; de Jong et al., 1998). A chi-square test indicated that the two groups did not differ significantly with respect to the number of participants expecting an aversive outcome following the first angry face, $\chi^2(1, N = 44) = 0.74$, *ns*. Consequently, two contrasts were examined for the initial aversive outcome expectancy data from the overall sample: (a) the first angry face versus the first happy face and (b) the first angry face versus the first neutral face. Results from sign tests indicated that participants more often expected an unpleasant outcome following the first angry face (73%) compared with both the first happy face (21%), and the first neutral face (14%) ($ps < .001$).

The initial pleasant expectancy bias measure was derived from the number of participants in each group who indicated that they expected a pleasant outcome on the first trial of each class of face. A chi-square test indicated that the groups did not differ significantly with respect to the number of participants expecting a pleasant outcome following the first happy face, $\chi^2(1, N = 44) = .74$, *ns*. Two sign tests revealed that, irrespective of social anxiety group, participants more often expected a pleasant outcome following the first happy face (73%), compared to both the first angry (18%) and neutral (5%) face ($ps < .001$).

On-line Expectancies

Aversive outcome expectancies

The on-line aversive outcome expectancies were expressed as the mean percentage of trials on which participants expected an aversive outcome to follow each face, calculated for each block (see Figure 16). Participants' on-line aversive outcome expectancies were entered into a mixed design analysis of variance (ANOVA) with Group (high vs. low social anxiety), Face Type (angry, happy, neutral) and Block (1–8), as independent variables. Results showed significant main effects of Face Type, $F(2, 84) = 17.78, p < .001$, and Block, $F(7, 294) = 2.39, p < .05$, and a significant Face Type x Block interaction, $F(14, 588) = 3.70$, $p < .001$, which were subsumed under a significant Group x Face Type x Block interaction, $F(14, 588) = 2.04, p < .05$ (see Figure 16). To clarify the three-way interaction, a Group x Block ANOVA was conducted separately for each face type.

For aversive outcome expectancies for angry faces, there was only a significant main effect of Block, $F(7, 294) = 7.11, p < .001$ (i.e., effects of Group and the Group x Block interaction were non-significant, $Fs < 1$). Post hoc paired comparisons showed that

the expectancy of an aversive outcome following angry faces significantly decreased between block 1 and blocks 4, 5, 6, 7 and 8 ($ps < .01$). However, for aversive outcome expectancies for happy faces, there was a significant interaction between Group and Block, $F(7, 294) = 2.20, p < .05$. Consequently, a one-way ANOVA for each group was conducted. This showed a significant main effect of Block for the HSA group, $F(7, 154) = 2.92, p < .01$, as their expectancy of an aversive outcome following happy faces was initially lower at the beginning of the task relative to subsequent blocks (i.e., block 1 versus blocks 2 and 5, $ps < .05$); see right panel of Figure 16. In contrast, the low social anxiety group showed no significant effect of Block, $F < 1$, as they reported a consistently low likelihood of aversive outcomes following happy faces throughout the task. For neutral faces, all results were non-significant ($Fs < 1$).

Pleasant outcome expectancies

The on-line pleasant outcome expectancy data in each condition are summarised in Figure 17. These data were entered into a mixed design ANOVA with Group (high vs. low social anxiety), Face Type (angry, happy, neutral) and Block (1 – 8) as independent variables. Results showed a significant main effect of Face Type, $F(2, 84) = 44.55, p < .001$, and a Face Type x Block interaction, $F(14, 588) = 3.64, p < .001$, both of which were subsumed under a significant Group x Face Type x Block interaction, $F(14, 588) = 2.00, p < .05$ (see Figure 17). To clarify the latter three-way interaction, a Group x Block ANOVA was conducted separately for each face type.

All results were non-significant for angry faces, ($Fs < 1.47$, *ns*) and neutral faces, ($Fs < 1$). However, for happy faces, there was a significant main effect of Block $F(7, 294) = 4.41, p < .001$, which was subsumed under a significant Group x Block interaction, $F(7, 294) = 2.92, p < .01$. A subsequent one-way ANOVA showed that the effect of Block on pleasant outcome expectancies following happy faces was not significant in the LSA group, $F < 1$. As can be seen in the left panel of Figure 17, low socially anxious individuals consistently expected pleasant outcomes to follow happy faces throughout the task. A similar analysis for the HSA group revealed a significant main effect of Block on pleasant outcome expectancies for happy faces, $F(7, 154) = 6.40, p < .001$. Post hoc contrasts showed that the expectancy of pleasant outcomes following happy faces significantly decreased between block 1 and all subsequent blocks in the HSA group ($ps < .01$). Furthermore, group contrasts indicated that, in the final block, the HSA group expected significantly fewer pleasant outcomes following happy faces, compared to the LSA group, $t(42) = 3.31, p < .01$ (group contrasts for earlier blocks were non-significant).

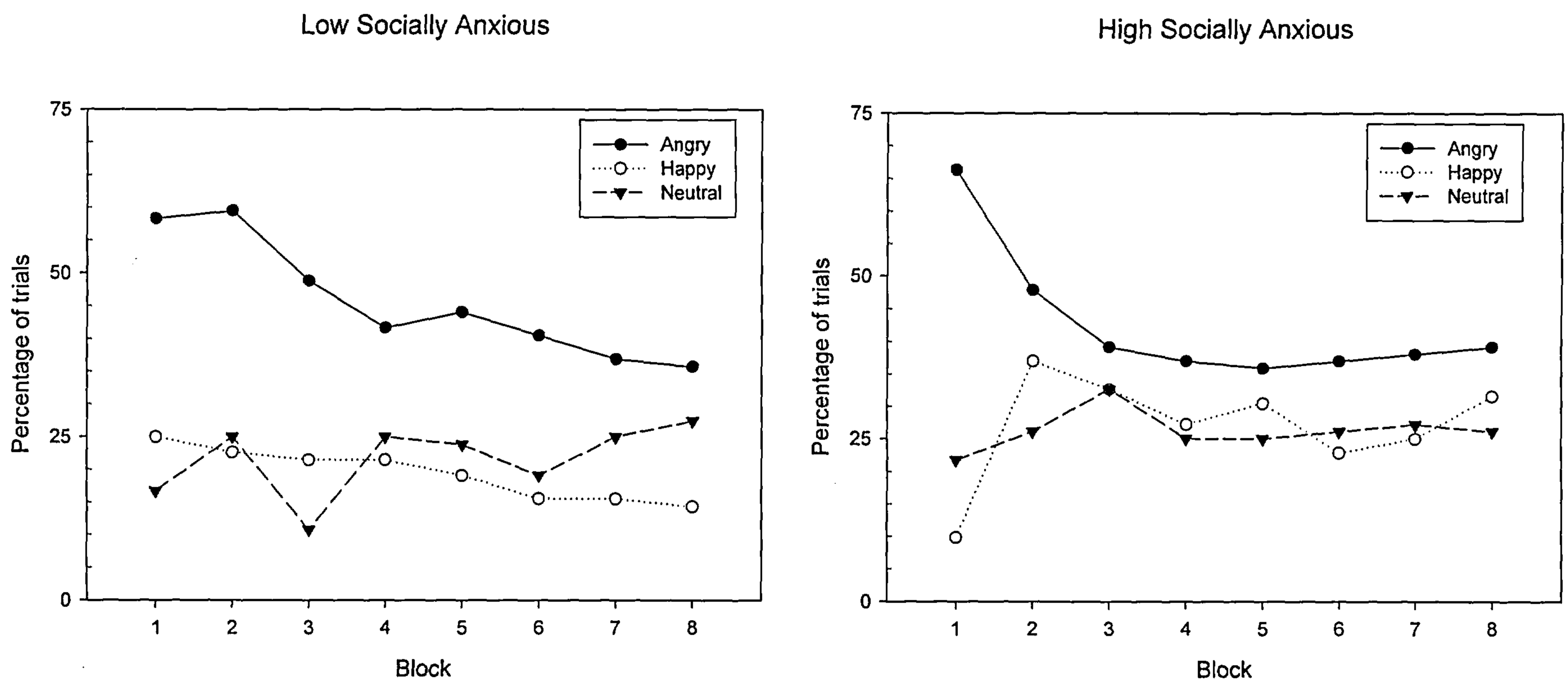

Figure 16. On-line reported expectancies of aversive outcomes. Expectancies are expressed as the mean percentage of trials on which participants expected an aversive outcome to follow the face (25% reflects random outcome selection). Left and right panels depict expectancy data for low and high social anxiety groups respectively.

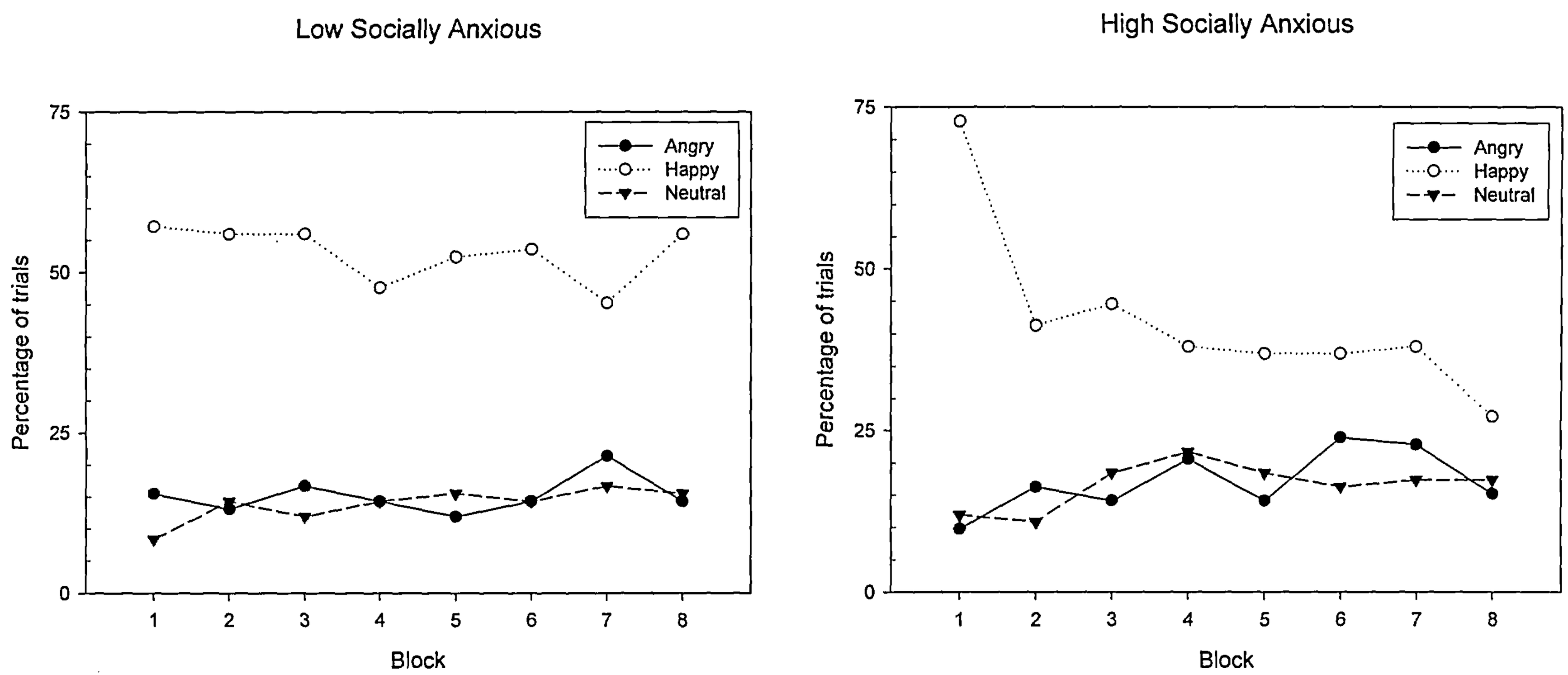

Figure 17. On-line reported expectancies of pleasant outcomes. Expectancies are expressed as the mean percentage of trials on which participants expected a pleasant outcome to follow the face (25% reflects random outcome selection). Left and right panels depict expectancy data for low and high social anxiety groups respectively.

A Posteriori Covariation Estimates

In general, participants tended to overestimate the occurrence of outcomes for each face type. For example, their overall estimates of aversive, pleasant, neutral and no outcomes for angry faces were 40%, 23%, 27%, 19% of trials respectively, which total 119% (rather than 100%). Similar inflated estimates are evident in the data of previous studies (e.g. de Jong et al., 1995 Figure 1). To account for this, the scores were calculated as a percentage of the total outcome estimate for each person and each face type, as this allows comparison of the estimates in each condition against the veridical contingency (i.e., 25% of trials for each outcome). Mean adjusted scores for the *a posteriori* covariation estimates are given in Table 17 (see Appendix D, Table D1 for unadjusted scores). For completeness, all analyses were conducted using both adjusted and non-adjusted covariation estimates. Findings using non-adjusted estimates are similar to those based on adjusted estimates with the exception of comparisons against the veridical in which non-adjusted estimates were more likely to be evaluated as significant.

In-line with recent studies of covariation bias (de Jong et al., 1998; Tomarken et al., 1995), summary bias measures of post-experimental contingency estimates were computed for the following conditions: i) angry face-aversive outcome estimates; ii) neutral face-aversive outcome estimates; iii) happy face-pleasant outcome estimates.[22]

The social anxiety groups did not differ on any summary bias measure, $ts(42) < 1.57$, *ns*, and, across the whole sample, participants' summary bias measures were not significantly different from zero (no selective association), $ts(43) < 1.30$, *ns*.

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[22] For example for angry face – aversive outcome contingencies, this measure indicates whether participants' tendency to associate angry face slides with aversive outcomes was greater than their tendency to associate the other two face stimuli (happy and neutral faces) with aversive outcomes:

P[aversive | angry] – [(P[pleasant | angry] + P[neutral | angry] + P[nothing | angry]/3] (a)
Minus
(P[aversive | happy] – [(P[pleasant | happy] + P[neutral | happy] + P[nothing | happy]/3]
Plus (b)
P[aversive | neut] – [(P[pleasant | neut] + P[neutral | neut] + P[nothing | neut]/3])/2

Quantity (a) denotes the tendency to overestimate the covariation between target stimuli (e.g. angry faces) and aversive outcomes, relative to the covariation between target stimuli and other outcomes. Quantity (b) denotes the average tendency to overestimate the covariation between the non target faces (happy and neutral) and aversive outcomes relative to the covariation between such stimuli and other outcomes. Thus, it follows that the difference between quantities (a) and (b) reflects overall bias in estimates of covariations between angry faces and aversive outcomes. One advantage of this measure is its insensitivity to the effects of between-stimulus or between-outcome differences in base-rate estimates. For example, if participants generally overestimate covariations involving angry faces or aversive outcomes, the bias index would equal 0 (Tomarken et al., 1995). This measure was calculated for each individual's angry face – aversive outcome, happy face – pleasant outcome, and neutral face - aversive outcome contingency estimates.

Table 17. Mean A Posteriori Estimates of Covariation and Summary Bias Measures

	Low social anxiety						High social anxiety					
	Angry		Happy		Neutral		Angry		Happy		Neutral	
Outcome	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Aversive	35.4	15.7	28.5	10.5	31.3	14.0	33.6	19.5	40.0	16.9	30.8	16.9
Pleasant	27.1	14.7	31.2	13.1	26.2	10.0	28.3	13.1	23.9	12.8	25.1	14.1
Neutral	21.9	10.7	24.9	9.5	24.0	13.3	22.8	12.1	21.6	11.8	21.3	12.0
Nothing	15.5	9.1	15.4	9.1	18.5	11.4	15.3	8.2	14.6	9.3	22.9	14.2
Bias measure	7.4	24.7	6.1	18.4	-0.4	21.6	-2.3	29.1	-3.8	22.8	-6.7	21.6

Note. Bias scores for angry and neutral faces relate to aversive outcome estimates whilst happy face bias scores relate to pleasant outcome estimates.

Base Rate Estimates

The base rate estimates of the frequency of occurrence of each face type and each outcome were adjusted, as described earlier, so that the total face and outcome estimates for each participant equaled 100%. The adjusted base-rate estimates of the percentage of trials on which each face type occurred (see Table 18) were entered into a mixed design ANOVA with Group (high vs. low social anxiety) and Face Type (angry, happy)[23] as independent variables. Results showed a significant interaction between Group and Face Type $F(1, 42) = 7.07, p = .01$, see Table 18 (see Appendix D, Table D2 for unadjusted scores). Paired comparisons of all three face types for each group indicated that HSA participants reported that angry faces occurred on a greater percentage of trials than both happy and neutral faces, $ts(22) > 2.30, ps < .01$; results for LSA participants were non-significant, $ts(20) < .94$, *ns*. Furthermore, group comparisons indicated that the HSA group reported a greater percentage of trials with angry faces, $t(42) = 2.29, p < .05$, and fewer with happy faces, $t(42) = 2.19, p < .05$, relative to the LSA group. Finally, the HSA group overestimated the occurrence of angry faces, $t(22) = 3.01, p < .05$, and marginally underestimated the occurrence of happy faces, $t(22) = 1.92, p = .07$, compared to the veridical contingency (33%) whilst low anxious participants did not report estimates significantly different from the veridical $t(20)s < 1.12$, *ns*.

An ANOVA of adjusted base-rate estimates of the outcomes (see Table 18) showed a significant main effect of Outcome Type, $F(2, 84) = 4.26, p < .05$. Bonferonni corrected pairwise comparisons revealed that unpleasant and neutral outcomes (means 29% and 28%, respectively) were estimated more often than nothing (19%; $ps < .01$). In general, participants overestimated the occurrence of unpleasant and neutral outcomes, and underestimated the occurrence of no-outcome, relative to the veridical contingency (25%), $t(43)s > 2.16, ps < .05$. The overall estimate of positive outcomes (24%) did not significantly differ from the veridical $t(43) = 1.81$, *ns*.

[23]One of the three levels of the within-subjects variable (type of face) was excluded from the ANOVA because it is redundant in this analysis. That is, the values of one condition (e.g. estimated percentage of trials with neutral faces) can be predicted from the combined data in the other two conditions (e.g. estimated percentage of trials with angry and happy faces), as the three conditions add up to 100%. For the same reason, one level of the within-subjects variable (type of outcome) was not included in the ANOVA of base-rate estimates for the four outcomes (positive, negative, neutral, no outcome).

Table 18. Mean Adjusted Base-Rate Percentage Estimates in Low and High Social Anxiety Groups.

	Low social anxiety		High social anxiety	
	M	*SD*	*M*	*SD*
Face Type				
Angry	33.4 [a]	6.9	39.4 [b]	10.2
Happy	34.7 [a]	6.8	29.8 [b]	8.1
Neutral	31.9	8.3	30.8	9.4
Outcome Type				
Aversive	28.1	8.2	30.9	13.5
Pleasant	23.5	6.8	21.9	9.4
Neutral	30.2	9.2	26.6	11.0
Nothing	18.2	6.2	20.5	9.4

Note. In each row, values with different superscripts differ at the $p < .05$ level.

Relationship Between Covariation Measures and Questionnaires Scores

Summary measures for both initial and on-line expectancy biases were computed in the same way as described in previous studies (see de Jong et al., 1998, for more details). There were no significant correlations between the initial expectancy estimates and the main questionnaire measures of social anxiety, state and trait anxiety, and depression (FNE, SADS, Fear-Social, STAI, POMS-anxiety and POMS-depression). A lower (on-line) expectancy of pleasant outcomes following happy faces (averaged across the task) was associated with increased levels of state anxiety ($r = -.36, p = .01$). Reduced *a posteriori* covariation biases between happy faces and pleasant outcomes were associated with increased social anxiety (FNE; $r = -.31, p < .05$), trait anxiety (STAI; $r = -.32, p < .05$). A greater tendency to report a higher frequency of occurrence of angry faces (after the task) was associated with increased social and trait anxiety (FNE, $r = .31, p < .05$: STAI, $r = .32, p < .05$). The only significant relationship across covariation estimates was between initial and on-line aversive outcome expectancy for angry faces, ($r = .41, p < .01$). There were no other significant results.

Task 3: Classification of Ambiguous Emotional Expressions

The mean proportion of faces classified as angry [24] was entered into a mixed design analysis of variance (ANOVA) with Group (high vs. low social anxiety) as a between-subjects factor and Anger Intensity (weak vs. dominant) as a within-subjects factor. The main effect of Group was non-significant, $F(1, 44) = 1.32$, *ns*. There was a significant main effect of Anger Intensity, reflecting a greater proportion of dominant angry faces being classified as angry than those with weak angry expressions (48 % vs. 31 %), $F(1, 44) = 125.50$, $p < .001$. This was subsumed under a significant Group x Anger Intensity interaction $F(1, 44) = 3.93$, $p = .05$, see Figure 18. Post hoc paired comparisons indicate that both HSA and LSA individuals classified significantly more dominant angry faces as angry than weak angry faces, $t(22) = 6.49$, $p < .001$; $t(22) = 9.36$, $p < .001$, respectively. Post hoc comparisons showed that anxiety groups did not differ significantly on the proportion of angry classifications made for angry dominant faces $t(44) = 0.64$, *ns*. However, HSA individuals tended to classify more weak angry faces as angry, compared to LSA individuals $t(44) = 1.91$, $p = .06$.

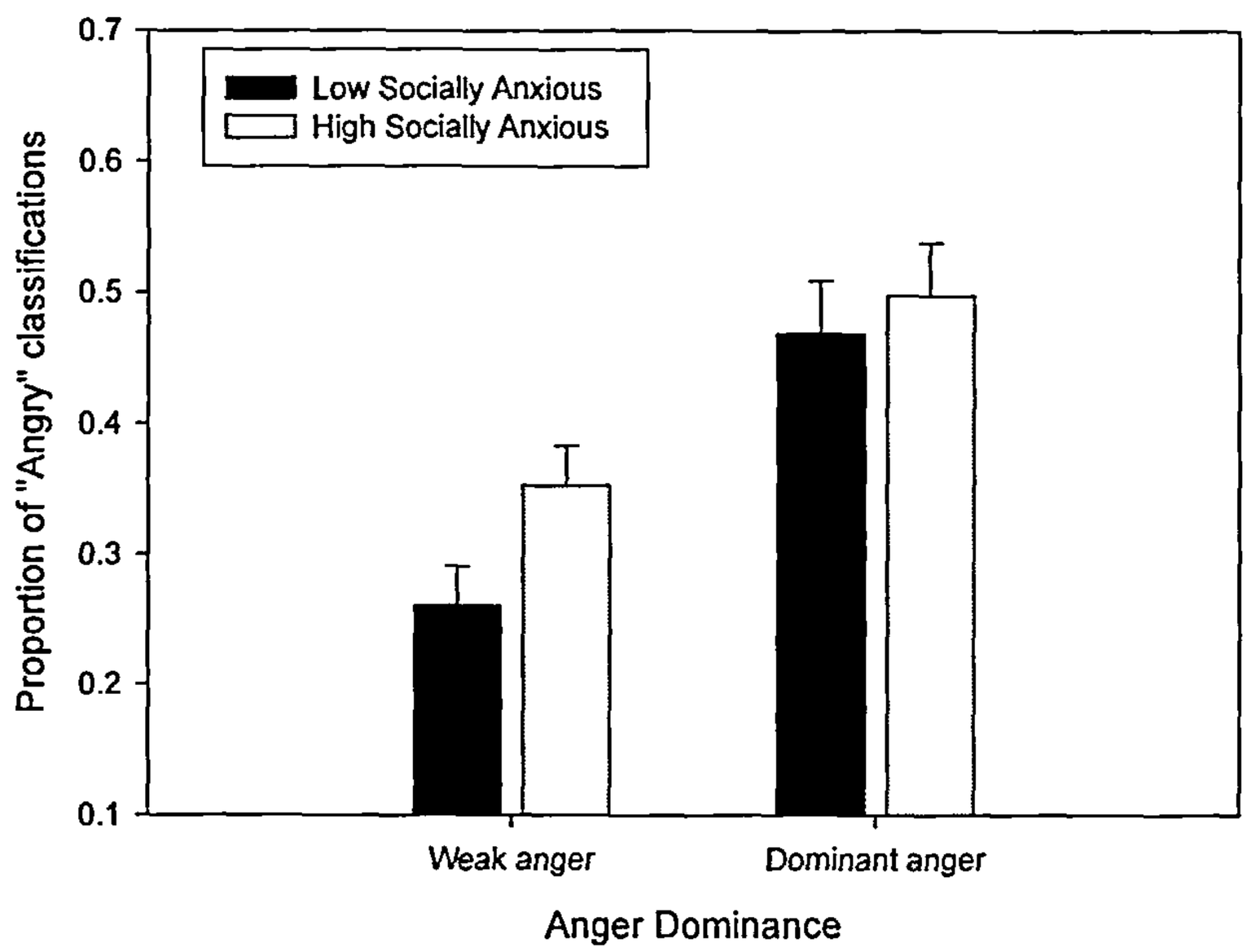

Figure 18. Mean proportion of "Weak" and "Dominant" anger faces classified as "angry" in low and high social anxiety groups.

[24]Very few participants classified the ambiguous faces as "very" angry or happy. To ensure all participants contributed to the data analysis, participants' ratings regarding the *extent* to which a face reflected either angry or happy expressions (i.e. "slightly", "moderately", "very") were collapsed into two responses: "angry" or "happy".

For the purpose of signal detection analyses, *hit* and *false alarm* rates were calculated as follows: *hit rate* = proportion of angry dominant faces correctly classified as angry and the *false alarm rate* = proportion of weak angry (i.e. happy dominant) faces incorrectly classified as angry. Following MacMillan and Creelman (1991), sensitivity (d') was computed using the formula: $d' = z(\text{hit rate}) - z(\text{false alarm rate})$, and response bias (criterion) was computed using the formula: $c = -0.5[z(\text{hit rate}) + z(\text{false alarm rate})]$. Results indicate that HSA individuals were significantly less sensitive at distinguishing happy from angry facial expressions ($M = .41$, $SD = .29$) than LSA individuals ($M = 0.60$, $SD = .29$), $t(44) = 2.25$, $p < .05$. The two groups did not significantly differ in their response bias (lower c scores reflect a tendency to classify the ambiguous faces as angry irrespective of emotional content), (HSA group: $M = .20$, $SD = .60$; LSA group: $M = .42$, $SD = .54$) $t(44) = 1.34$, *ns*.

Relationship Between Emotion Classification Measures and Questionnaire Scores

FNE scores were associated with increased classification of weak angry faces as angry, ($r = .38$, $p < .01$). Increased FNE scores were also significantly correlated with lower response bias scores suggesting that high social anxiety was associated with a general tendency to classify faces as angry ($r = -.33$, $p < .05$). FNE scores were only marginally associated with poorer discrimination of negative relative to positive expressions ($r = -.26$, $p = .08$).

Cognitive Predictors of Social Anxiety

Correlations between pre-speech state anxiety and the principle self-report measures of social anxiety (FNE and SADS) indicated that increased social anxiety (FNE) was associated with increased pre-speech state anxiety ($r = .38$, $p < .01$)[25]. In contrast, SADS scores did not significantly correlate with pre-speech state anxiety ($r = .27$, *ns*).

Correlations demonstrated that theoretically relevant attentional biases (threat-neutral; face-object) were not significantly associated with pre-speech state anxiety ($r = .04$, *ns*; $r = -.10$, *ns* respectively). Correlations also demonstrated that measures of threat sensitivity ($r = -.06$, *ns*) and response bias ($r = -.04$, *ns*), (obtained from the classification of ambiguous faces paradigm) were not significantly associated with pre-speech state anxiety. Similarly, retrospective angry face-aversive outcome covariation biases ($r = -.14$, *ns*), along with angry face base rate estimates ($r = -.06$, *ns*) did not significantly correlate with pre-speech state anxiety. However, although not directly predicted from recent cognitive models

[25] Note that r values from zero order correlations are equal to $\sqrt{R^2}$ obtained from simple regressions containing a single predictor variable. Therefore R^2, reflecting the amount of variance explained in the dependent measure (pre-speech state anxiety) by the predictor (e.g. FNE), can be inferred from r values reported in the main text. Correlations are reported in favour of simple regression analyses to aid readability and to make explicit the positive/negative nature of any relationship.

of social anxiety, increased tendency to selectively associate positive social cues with pleasant outcomes was associated with lower levels of state anxiety prior to the assessed presentation ($r = -.32, p < .05$). However, when controlling for pre-existing social anxiety (using a partial correlation controlling for FNE) the relationship between happy face-positive outcome covariation bias and pre-speech state anxiety was no longer significant ($r = -.24$, *ns*). Thus, positive covariation bias was only significantly associated with pre-speech state anxiety as a result of its significant association with FNE. In contrast the significant relationship between FNE and pre-speech state anxiety remained when controlling for positive covariation bias ($r = .32, p < .05$).[26] [27]

[26] *r* values from partial correlations are equal to the *Beta* weights obtained from a multiple regression analysis with FNE and happy face/positive outcome covariation bias as predictors of pre-speech state anxiety. Results from this multiple regression indicate that together, both factors account for significant variance in pre-speech state anxiety $R^2 = .19$, $F(2, 45) = 5.13, p < .01$, however, only FNE significantly predicted pre-speech state anxiety *Beta* = .32, $p < .05$, while positive covariation bias did not *Beta* = -.24, *ns*.

[27] The use of several correlations (equivalent to simple regressions) to assess the predictive relationship between cognitive factors and speech related anxiety, was used in preference to other forms of regression analysis (e.g. hierarchical regression or multiple linear regression) that require specific (preferably theoretically derived) models (combinations of variables) to be tested. Given there was no theoretical prescription to inform the linear combination of the many cognitive measures obtained in the present study, multiple correlations were used albeit at the increased risk of Type I error. However, it is reassuring to note that a multiple linear regression containing principle factors derived from Clark & Wells (1995) i.e. attentional bias for faces relative to objects, sensitivity to detect negative emotion (d') and selective recall of negative social cues (angry face base rate estimates) failed to account for a significant proportion of variance in pre-speech state anxiety $R^2 = .02$, $F(3, 45) < 1$.

Discussion

In order to retain clarity and consider in detail the findings from the various tasks featured in the present study, results and their theoretical/empirical implications will be discussed separately for each paradigm.

Interpretation of Ambiguous Emotional Expressions in Social Anxiety

To assess the interpretation of emotionally ambiguous positive and negative emotional faces in social anxiety, high and low socially anxious individuals classified emotionally ambiguous (computer manipulated angry/happy) faces in terms of how angry or happy they appeared. Results indicate that high socially anxious individuals tended to classify more weak angry (happy dominant) faces as angry, than low anxious individuals. Signal detection analysis suggested that high socially anxious individuals were less sensitive at distinguishing between ambiguous angry and happy facial expressions than low anxious individuals, but were not more likely to classify a face as angry irrespective of the emotional content. Thus, high anxious participants' preference to specifically evaluate emotional faces containing low levels of anger (blended with high levels of happiness) in a negative fashion appeared to reduce their sensitivity to discriminate between angry and happy face cues.

The present results differ in several respects from those reported in a recent study by Richards et al. (2002) that also assessed high and low socially anxious individuals' classification of morphed emotional expressions. Results indicated that high socially anxious individuals classified significantly more faces (comprising fear) as fearful compared to low anxious individuals, particularly when faces contained proportions of fear greater than 30 % (Experiment 1, Richards et al., 2002). Contrary to the present findings there was no evidence that high anxious individuals were more likely to detect anger in faces comprising anger, nor happiness in faces comprising happiness. However, when exposed to a social stress induction procedure, all participants, irrespective of social anxiety level reported more anger in faces containing components of anger. In addition, low anxious individuals not experiencing the social stress induction classified more faces comprising happy expressions as happy compared to low anxious individuals under stress (Experiment 2, Richards et al., 2002).

It remains unclear why socially anxious individuals' enhanced detection of negative facial expressions was restricted to fearful faces in Richards et al., (2002) but evident for angry faces in the present study. There were several methodological differences between the studies (e.g. type and intensity of emotional blend, different response options) which might

possibly account for the different results, and future studies need to replicate findings and consider in detail the interaction of state and trait characteristics in modulating threat detection. It also remains unclear whether the present findings reflect high socially anxious individuals improved detection of mildly negative expressions, or low anxious individuals improved detection of strongly positive expressions (see Experiment 2, Richards et al,. 2002; see also Hirsch & Mathews, 1997, 2000). However, taken together these findings support proposals that socially anxious individuals have a tendency to interpret ambiguous social cues in a more negative (less positive) fashion which may play an important role in the maintenance of their social fears (e.g. Clark & Wells, 1995; Wells & Clark, 1997).

In the present task, although the anxiety groups did not significantly differ in response bias, correlations suggested that high levels of social anxiety were associated with a general tendency to classify a given face as angry. Other evidence of a negative response bias in social anxiety is reported by Winton et al. (1995). They found high socially anxious individuals were biased towards classifying briefly presented neutral and angry faces as angry, but were not better at discriminating between the two expressions. However, it remains to be clarified whether socially anxious individuals' more negative response bias predominantly reflects a bias in response selection (i.e. tendency to more frequently report the negative response option irrespective of stimulus content), or instead a bias in the threshold required to *perceive* and therefore classify an expression as negative. This latter interpretation is of more clinical relevance, and warrants further research using paradigms designed to assess absolute detection thresholds.

To summarize, in the present study, socially anxious participants showed a greater tendency to classify ambiguous emotional faces as angry relative to low anxious individuals when faces contained a low rather than high level of anger. These findings are consistent with proposals from cognitive models that suggest social anxiety is characterized by a tendency to interpret ambiguous cues in a negative fashion (Clarks & Wells, 1995; Wells & Clark, 1997). Furthermore, these findings contribute to a limited but increasing empirical literature seeking to clarify biased interpretative processing of ambiguous non-verbal cues in social anxiety.

Judgement Biases in Social Anxiety: Fear-Relevant Selective Associations

Using a modified covariation detection paradigm, individuals were presented with a series of angry, happy and neutral facial expressions that were followed equally often by either aversive, pleasant, neutral outcomes, or nothing at all. Participants' initial pre-experimental expectancies, on-line outcome expectancies and *a posteriori* covariation/base rate estimates were tested to assess the occurrence and maintenance of selective associations between social cues and aversive or pleasant outcomes.

The main findings from the covariation bias paradigm can be summarized as follows: (i) Participants in general, irrespective of social anxiety level, demonstrated initial expectancy biases between both angry faces and aversive outcomes, and happy faces and pleasant outcomes. (ii) On-line aversive outcome expectancies for angry faces decreased throughout the task in both the high and low social anxiety groups. (iii) High anxious individuals' initial bias to over-estimate the occurrence of pleasant outcomes following happy faces decreased during the task; whereas low anxious individuals continued to overestimate the occurrence of pleasant outcomes following happy faces across the task. This pattern of bias was partly mirrored in the aversive outcome expectancy data, as the HSA group initially reported that aversive outcomes were unlikely to follow happy faces (compatible with their initial positive expectancy bias), but subsequently amended this expectancy over the course of the task. (iv) Neither group demonstrated significant *a posteriori* covariation estimates between angry faces and aversive outcomes, or between happy faces and pleasant outcomes. (v) High socially anxious individuals overestimated the percentage of trials on which angry faces were presented relative to the veridical contingency and low anxious controls.

Aversive Outcome Expectancies

The present findings indicate that individuals, irrespective of social anxiety levels, were initially more likely to expect an aversive outcome following the presentation of the first angry face (relative to other facial expressions). These results replicate findings of an initial covariation bias reported by de Jong et al. (1998). However, whilst de Jong et al. reported that at the end of the slide presentation, participants continued to over-associate the angry face-aversive outcome relationship, the attenuation, and ultimate absence of biased covariations between aversive outcomes and angry faces relative to other face types, indicate that participants in the present study did not do so. Inspection of on-line outcome expectancies suggest that participants learnt that contrary to their initial expectations, there was in fact no relationship between angry faces and aversive outcomes. In addition, there was no evidence of *a posteriori* biases between angry faces and aversive outcomes which is consistent with the extinction of initial expectancy biases over the course of the task.

Thus, there was no evidence from the present study to support the view that social anxiety is characterized by a greater tendency to selectively associate negative social stimuli with threat outcomes. While this is consistent with findings from de Jong et al. (1998), it contrasts with evidence of fear-relevant selective associations in simple animal phobias (e.g. Amin & Lovibond, 1997; Tomarken et al., 1989, 1995) and panic disorder (Pauli et al., 1996). One possible explanation for these discrepant findings is that the extent to which a negative outcome is associated with a negative cue depends on the extent to which the cue stimulus is evaluated as being aversive by the individual (Tomarken et al., 1995). If so, then

one might expect evidence of individual differences in covariation bias when the cue stimuli (e.g. spiders) are evaluated as aversive by phobic individuals, but not by non-phobic individuals. However, angry faces tend to be rated as similarly aversive by both high and low anxious individuals, (de Jong et al., 1998; see Exp 3 of the present thesis). Thus, perhaps the high and low social anxiety groups judged the angry faces used in the present study to be similarly aversive and therefore reported similar patterns of covariation bias for these stimuli (see also Pury & Mineka, 1997).

With regard to the relationship between happy faces and aversive outcomes, the on-line aversive outcome estimates for happy faces did not vary across the task in the low social anxiety group, whereas the high social anxiety group appeared to correct, during the course of the task, their initial tendency to expect that negative outcomes would be unlikely to follow happy faces. This finding appears to complement the results from the positive outcome expectancy data, which are discussed in more detail next.

Pleasant Outcome Expectancies

Previous covariation detection studies have investigated associations between different types of emotional cue stimuli, and aversive and neutral outcomes. A unique aspect of the present study was that it monitored participants' expectancy and covariation estimates for pleasant outcomes. Results indicated that, at the beginning of the task, both high and low socially anxious individuals were more likely to expect a pleasant outcome following the first happy face relative to angry and neutral faces. Both the on-line expectancy data and the *a posteriori* ratings, clearly suggest that, high socially anxious individuals' inflated initial estimation of the relationship between happy faces and pleasant outcomes became extinguished over the course of the task. In contrast, the results from on-line expectancy data from the low anxious participants suggest they continued to over-associate happy faces and pleasant outcomes throughout the session. In addition, correlations indicated that increased *a posteriori* selective associations between happy faces and pleasant outcomes were associated with lower levels of social and trait anxiety.

The general absence of *a posteriori* covariation biases in the present study contrasts with findings from earlier studies of illusory correlation in social anxiety (e.g. de Jong et al., 1998, Experiment 4 of the present thesis). Participants may have been unable to maintain their distorted initial expectancy biases in the present study, because outcome base rates were too low. Although the number of critical pairings between angry faces and aversive outcomes (and happy faces and pleasant outcomes) was the same as in de Jong et al. (1998), the overall proportion of trials across the task on which critical outcomes occurred was considerably less (25% compared to 33%). Previous research suggests that higher outcome base rates may result in greater *a posteriori* covariation estimates. For example, Tomarken et al. (1989) found evidence of fear-relevant selective associations in both high and low fear

participants when aversive outcomes were presented on 50% of trials, whereas only high fearful participants showed this bias when the outcome base rate was 33% (see also Alloy & Abramson, 1979). Thus, the absence of *a posteriori* covariation biases in the present study may result from the low frequency of critical outcome presentations.

It is also important to note that the present study used IAPS pictures as outcomes, whereas previous studies of covariation bias in social anxiety have commonly used electric shocks (e.g. de Jong et al., 1998) or loud bursts of white noise (Exp 4 of the present thesis). It is conceivable that the greater aversiveness of shocks/white noise could maintain covariation bias for longer than aversive picture outcomes, as habituation to shock outcomes may be slower than to aversive pictures.

To summarize, the present findings suggest that social anxiety is characterized not so much by a tendency to over-associate negative social stimuli and aversive outcomes, but instead by the absence of the positive bias (over-association between positive social cues and pleasant outcomes) displayed by low anxious individuals. These results complement an increasing literature demonstrating positive biases in other aspects of cognition in low social anxiety, which are absent in high social anxiety (Hirsch & Mathews, 2000, 1997).

The specific mechanisms underlying the positive judgment biases observed in the present study, and biases in interpretation of ambiguity found by Hirsch and Mathews (2000) remain to be clarified. Whilst the strong semantic link between happy faces and pleasant outcomes may be sufficient to maintain an initial expectancy bias in low anxious individuals (e.g. Chapman, 1967), recent evidence suggests selective associations are more likely to reflect participants' similar *affective* appraisals of certain cues and outcomes (Tomarken et al., 1995). An *affective matching* account highlights the importance of appraisal processes in a variety of the judgmental and interpretative biases for positive information observed in low, but not high socially anxious individuals, and warrants further research.

Base Rate Estimates

Results from the off-line base rate estimates clearly indicate that high socially anxious individuals overestimated the percentage of trials on which angry faces occurred relative to both low anxious controls and the veridical contingency. Interestingly, the social anxiety groups did not differ in their overestimation of aversive and neutral outcomes relative to the veridical. Although the social threat cues and aversive outcomes differed in both content and base rate, the present findings may suggest that social anxiety is not so much characterized by an over-reporting of negative stimuli in general, but instead a bias specific to negative social cues (i.e. angry faces).

Previous covariation bias studies have not reported individual differences in base rate estimates (e.g. de Jong et al., 1998; Tomarken et al., 1989), however, other paradigms

have revealed increased reporting of negative social stimuli in social anxiety. Winton, Clark and Edelmann (1995) found that high socially anxious individuals reported (online) substantially more faces as negative, even though an equal number of angry and neutral faces had been presented. Research investigating memory biases has also identified a selective memory bias for socially threatening information in non-clinical social anxiety (e.g. Breck & Smith, 1983; Mansell & Clark, 1999; see review by Heinrichs & Hofmann, 2001). Lundh and Öst (1996) found increased recognition of faces previously evaluated as critical, as opposed to accepting, in socially anxious individuals. It remains unclear whether these, and the present findings, reflect individual differences in the encoding, retention or retrieval of social threat information, or a more general response bias favoring the reporting of negative social information. However, although the underlying mechanisms remain unclear, the present finding that socially anxious individuals report more frequent occurrences of negative social cues, supports cognitive models that suggest selective recall, together with ruminatory processes, help maintain and increase social anxiety (e.g. Clark & Wells, 1995; Wells & Clark, 1997).

To summarize, in general, individuals showed initial illusory correlation biases between emotional cues and subsequent outcomes which matched those cues (e.g. they believed negative events were more likely to follow negative cues). Low anxious individuals showed a relatively persistent bias during the task to over-associate pleasant outcomes and positive social cues. In contrast, high socially anxious individuals lacked this persistant positive bias, and their subsequent retrospective assessment was biased in favor of stereotyped judgments consistent with pre-existing social concerns (Stopa & Clark, 1993). It has been argued that the presence of positive biases in inferential processes may play a key role in protecting against high levels of social anxiety (Hirsch & Mathews, 2000). Correspondingly, the absence of on-line positive covariation biases, that facilitate potentially beneficial and positive conditioning to social stimuli in the future, may have a detrimental effect in maintaining the concerns of individuals with social anxiety.

Attentional Bias in Social Anxiety

Results from the probe classification paradigm do not support predictions that socially anxious individuals selectively attend to social threat cues (Rapee & Hiemberg, 1997) or demonstrate reduced processing of external social cues relative to non-social cues (Clark & Wells, 1995). The lack of individual differences observed in the present study replicate similar null results from previous studies of attentional bias in sub-clinical socially anxious individuals not experiencing social stress (e.g. Experiment 1, Bradley et al., 1997; Mansell, Clark, Ehlers, & Chen, 1999). However, the failure to find evidence of selective attention for emotional relative to neutral faces, and faces relative to objects contrasts with

the simple stimulus effects evident when the direction of first eye movement is used to index initial orienting to similar stimuli (Experiment 1 of the present thesis). Thus, from a methodological perspective, although several studies have successfully used reaction time paradigms to index initial orienting (see Mogg & Bradley, 1998 for review) future studies are encouraged to consider incorporating contemporary eye tracking paradigms to improve task sensitivity (see Bradley, Mogg, & Millar, 2000, for data regarding the concordance of RT and eye-movement measures of initial orienting).

Cognitive Predictors of Social Anxiety

A subsidiary aim of the present study was to investigate the extent to which biases in attention, interpretation and judgment might underlie vulnerability to experience anxiety in a social situation particularly feared by individuals with social anxiety. Results from correlation analyses provide negligible evidence of a predictive relationship between cognitive bias measures and speech-related anxiety. Indeed, only prior levels of social anxiety as measured by the FNE (though not the SADS) reliably predicted anxiety prior to the presentation. Differences in the predictive validity of FNE and SADS are likely to be attributable to the different components of social anxiety each measure assesses. Specifically, distress and apprehensiveness regarding the negative evaluation of others (assessed by the FNE; Watson & Friend, 1969) is more likely to reflect the negative cognitions that underlie speech-related state anxiety than the extent to which an individual tends to avoid specific social situations (as measured by the SADS; Watson & Friend, 1969). These findings extend those from a recent study that reported only a moderate (non-significant) predictive relationship between FNE and performance anxiety in a small (arguably under-powered) analogue sample of 19 students (Croft, Gonsalvez, Gander, Lechem, & Barry, 2004).

It remains unclear why biases in attention, interpretation and judgment did not reliably predict social anxiety in the present study (after controlling for FNE). As outlined earlier, the social interaction was considered to elicit a variety of the social concerns commonly reported by individuals with social anxiety (Perugi et al., 2001). Furthermore, the cognitive factors used to predict social anxiety, particularly those relating to attentional and interpretative processes, represented those biases considered most characteristic of socially anxious individuals' dysfunctional processing of non-verbal social cues (e.g. Clark & Wells, 1995). However, it is perhaps pertinent to note that measures of cognitive bias were not taken while participants anticipated/experienced social evaluative stress. As such, future research should examine whether *in-situ* (stress induced) processing biases reliably predict anxiety experienced *in-situ*. In addition, studies should assess whether other information processing biases emphasized in cognitive models of social anxiety (e.g. Clark

& Wells, 1995) better predict the extent to which anxiety is manifest within ecologically valid feared social situations (e.g. self-focus, and formation of a negative image of the self from the observer perspective).

To conclude, the present findings provide evidence of negative (less positive) interpretative and judgment biases in individuals with high levels of social anxiety. While novel aspects of the paradigms developed in the present chapter require replication and extension, these initial findings provide support for a variety of processing biases considered to play an important role maintaining the concerns of individuals with social anxiety. Furthermore, to the extent these and other information processing biases predispose individuals to experience repeatedly dysfunctional levels of anxiety, can the cognitive factors proposed to maintain social anxiety be ratified.

Chapter 8: General Discussion

Overview

Cognitive theories of social phobia outline a variety of information processing biases considered to play a key role in the etiology and maintenance of social phobia (e.g. Clark & Wells, 1995; Rapee & Heimberg, 1997). These models, along with more general cognitive formulations of threat processing in anxiety propose that social phobia is associated with cognitive biases in: selective attention (Clark & Wells, 1995; Rapee & Heimber, 1997; see also Eysenck, 1992; Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Williams et al., 1988), stimulus evaluation (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998) and interpretation of ambiguity (Clark & Wells, 1995 see also Beck, Emery, & Greenberg, 1985). The studies reported in the present thesis have specifically examined the extent to which these biases are evident when socially anxious individuals process social cues encountered within feared social interactions. This closing chapter integrates findings across studies and discusses theoretical and empirical implications in relation to each of the cognitive biases investigated (i.e. attention, appraisal, interpretation/judgment).

Attentional Bias in Social Anxiety

A central aim of the present thesis was to examine competing predictions from recent cognitive models of social phobia regarding the attentional processing of external social cues in social anxiety (e.g. Clark & Wells, 1995; Rapee & Heimberg, 1997). Prior to the present thesis, studies of selective attention in social anxiety had typically used reaction time paradigms such as Emotional Stroop (e.g. Hope et al., 1990), visual probe tasks (e.g. Mansell et al., 1999) and visual search paradigms (e.g. Gilboa-Schechtman et al., 1999) to index attention allocation at relatively early stages of attentional processing. These studies generated equivocal findings, with vigilance for social threat demonstrated in studies examining selective processing of competing social cues (e.g. angry vs. neutral faces; Gilboa-Schectman et al., 1999) but findings of avoidance in social anxiety uniquely reported in studies assessing selective attention to external social relative to non-social cues (e.g. Chen et al., 2001).

The present thesis extended these paradigms and used eye monitoring techniques to clarify the nature and time course of attentional biases to external social cues relative to other social and non-social stimuli in high and low socially anxious individuals. Specifically, biases in initial orienting were assessed from the direction and latency of the initial shift in gaze to pictures, while biases in the maintenance of attention were assessed from the duration of gaze on stimuli that were initially fixated. Before discussing the theoretical

implications of results from various attentional measures and studies in this thesis, the major findings (and methodologies) from each experiment are briefly summarized below (see Table 19).

Experiment1 specifically compared high and low socially anxious individuals' initial orienting and maintenance of attention to external social cues (neutral face) relative to non-social cues (objects) and emotional social cues (angry, happy faces) relative to neutral social cues (neutral faces). High socially anxious individuals initially directed their gaze towards neutral faces, relative to objects more often than low socially anxious individuals. Both groups looked longer at neutral faces relative to objects. Irrespective of social anxiety, participants were more likely to initially look at, and maintain their gaze on emotional faces relative to neutral faces.

Experiment 2 replicated the methodology used in study 1, with the exception that participants were submitted to a social stressor in an attempt to examine the attentional processing biases likely to occur when high and low socially anxious individuals enter a (feared) social situation. Contrary to study 1 (no social stressor) both social anxiety groups directed their gaze more often towards, and fixated for longer on neutral faces relative to objects, however, these biases were significantly reduced in high socially anxious individuals. The social stressor also modulated participants' orienting and maintenance of attention to competing social cues (angry, happy faces vs. neutral faces). High socially anxious individuals were relatively faster to fixate on emotional faces relative to neutral faces compared with low anxious individuals. However, despite this rapid initial orienting bias to emotional faces, high socially anxious individuals subsequently fixated on emotional faces for less time than low anxious individuals.

Experiment 3 examined the extent to which socially anxious individuals reduced processing of neutral faces relative to objects when experiencing social stress (evident in Experiment 2) extends to negative and positive emotional expressions (i.e. angry, happy faces). Contrary to findings in Experiment 2, participants' general tendency to look initially more often towards and fixate for longer on faces (i.e. angry, happy and neutral faces) relative to objects, was unaffected by social anxiety.

Experiment 4 incorporated the attention trials used in Experiment 3 with single picture trials on which physiological indices of stimulus appraisal were taken. Consistent with Experiment 3, participants (irrespective of social anxiety group) initially oriented more often towards face cues (angry, happy and neutral faces) than objects. However, contrary to Experiment 3, and instead consistent with findings from Experiment 2, high socially anxious individuals maintained attention on faces, relative to objects, for significantly less time than low anxious individuals (see Table 19).

Table 19. Summary of Tasks Examining Attentional Bias in Social Anxiety

			Initial Orienting of Attention		Maintenance of Attention
			Direction of first EM	*Latency*	*Gaze Duration*
	Competing Social Cues				
Exp.	*Measure/conditions*	*Stressor*			
1	Infra-red EM Angry/happy vs. neutral faces	No	Vigilance for emotional faces irrespective of social anxiety	Results *ns*	Greater gaze duration on emotional faces in both HSA and LSA
2	Infra-red EM Angry/happy vs. neutral faces	Yes	Vigilance for emotional faces irrespective of social anxiety	**Faster orienting to emotional faces (cf. neutral faces) in HSA cf. LSA**	**Reduced gaze duration on emotional faces in HSA cf. LSA**
5	Reaction Time Angry/happy vs. neutral faces	No		Results *ns*	
	Social vs. Non-social cues				
Exp.	*Measure/conditions*	*Stressor*			
1	Infra-red EM Neutral faces vs. objects	No	**Enhanced vigilance for social cues (neutral faces) in HSA cf. LSA**	Results *ns*	Greater gaze duration on social cues (neutral faces) irrespective of social anxiety
2	Infra-red EM Neutral faces vs. objects	Yes	**Reduced vigilance for social cues (neutral faces) in HSA cf. LSA**	Results *ns*	**Reduced gaze duration on social cues (neutral faces) in HSA cf. LSA**
3	Infra-red EM Angry, happy, neutral faces vs. objects	Yes	Vigilance for faces in general irrespective of social anxiety	Results *ns*	Greater gaze duration on social cues (particularly angry faces) irrespective of social anxiety
4	EOG Angry, happy, neutral faces vs. objects	Yes	Vigilance for faces in general irrespective of social anxiety	Faster orienting to faces in general irrespective of social anxiety	**Reduced gaze duration on social cues (in general) in HSA cf. LSA**
5	Reaction Time Neutral faces vs. objects	No		Results *ns*	

Experiment 5 examined the extent to which attentional bias for social relative to non-social cues and emotional social relative to neutral social cues (assessed using a visual probe task) in an unselected sample of undergraduates not experiencing social stress predicted levels of anxiety prior to a formal presentation. Contrary to findings from other studies in the present thesis, there was no evidence of biased initial orienting to either emotional faces relative to neutral faces (see Exp. 1 & 2), or neutral faces relative to objects (Exp. 1, 2, 3 & 4). Furthermore, attentional biases did not covary with either levels of social anxiety or state anxiety prior to the formal presentation.

Implications for Theories of Attentional Bias in Social Anxiety

In their initial cognitive model of social phobia Clark and Wells (1995) make several predictions regarding attentional processing of external social cues in social anxiety. Specifically, the model proposes that upon entering a feared social situation, socially anxious individuals shift their attention towards a detailed monitoring and observation of themselves which reduces processing resources available to monitor external information such as non-verbal feedback from other people (i.e. facial expressions). Furthermore, socially anxious individuals' motivation to avoid eye contact in feared social situations further reduces external monitoring and hampers accurate appraisal of audience feedback (Clark & Wells, 1995). As such, recent presentations of the 1995 cognitive model explicitly predict that "Social phobics show reduced processing of external social cues when anxious." (pg. 413, Clark, 2001).

Several findings from the present thesis are consistent with this prediction. As noted above, following a social stressor high socially anxious individuals initially oriented towards neutral faces (relative to non-social cues) significantly less than low anxious individuals (Experiment 2). Furthermore, high socially anxious individuals maintained attention on neutral faces (Experiment 2) and faces in general (Experiment 4) for significantly less time relative to non-social cues than low anxious individuals. However, there was no evidence of reduced initial orienting to social cues relative to non-social cues in Experiment 3 (eye movements) or Experiment 5 (visual probe task), nor reduced maintenance of attention on social cues (cf. non-social cues) in Experiment 3. Furthermore, socially anxious individuals in experiment 1 actually looked more frequently towards social cues than low anxious individuals.

Consideration of various methodological differences between studies may help account for inconsistent demonstrations of socially anxious individuals reduced processing of external social cues throughout the present thesis. Firstly, it is important to note that in Experiments 1 and 5 (which did not show reduced processing of social cues in high socially anxious individuals) participants were not explicitly subjected to social evaluative stress.

Moreover, participants in experiment 5 were not pre-selected for high and low levels of social anxiety. Nonetheless, findings from experiment 1 suggest that when there is no stressor, social anxiety is associated with greater orienting to external social cues. The relevance of this finding is unclear, especially as situations in which socially anxious individuals encounter social cues but do not fear negative evaluation are likely to be rare. In contrast, when social cues are encountered within a typically fearful situation, reduced orienting and maintenance of attention on social cues is evident (Experiment 2).

Interestingly, reduced initial orienting to social cues was only demonstrated in Experiment 2 and not Experiments 3 and 4, while reductions in the maintenance of attention occurred in two Experiments (2 & 4). Reductions in initial orienting to social cues may only become apparent when social stress is particularly high (as in Experiment 2 relative to Experiments 3 and 4). In contrast, when threat of social evaluation is more moderate (as in Experiments 3 and 4), socially anxious individuals' safety behaviours may be less pervasive and only evident in later (perhaps more strategic) components of attention allocation (i.e. maintenance of gaze, Experiment 4). Alternatively, reduced initial orienting to social cues in Experiment 2 may characterise socially anxious individuals readiness to avoid social cues when frequently presented with social cues from which it is more difficult to avert gaze (note in Experiments 1 and 2, two thirds of trials contained face-face picture pairs). Finally, the failure to find any evidence of reduced processing of social cues in Experiment 3 may reflect the relatively high levels of depression reported by high socially anxious individuals in Experiment 3 relative to previous studies (Exp 2, 4; Mansell et al., 1999). As noted in earlier chapters, high levels of depression have been found to ablate attentional biases in social anxiety (Musa et al., 2003). Thus, consistent with proposals that depression impairs engagement with external goals and motivation more generally (Tellegen, 1985), the absence of reduced processing of social cues in Experiment 3, might simply reflect depressed socially anxious individuals limited motivation to use safety behaviours to alleviate discomfort.

Despite these inconsistent findings, evidence from the present thesis of reduced orienting and maintenance of attention to external social cues in social anxiety shares some common features with previous findings of: avoidance of emotional faces (relative to objects) in non-clinical high socially anxious individuals experiencing social evaluative stress (Mansell et al., 1999); avoidance of faces in general in individuals diagnosed with social phobia (Chen et al., 2002); reduced attention to faces relative to interoceptive cues (Mansell, Clark, & Ehlers, 1999) and reduced viewing of a conversation partner (Daly, 1978) and audience (Holcom, et al., 1993) in high socially anxious individuals. The extent to which socially anxious individuals' reduced processing of external social cues is characterised by attenuation of enhanced monitoring of social cues (as in the present thesis),

or outright avoidance of social cues (Chen et al., 2002; Mansell, et al., 1999) remains to be clarified. Nonetheless, taken together these findings support predictions that individuals with social anxiety show reduced processing of external social cues during feared social situations (Clark & Wells, 1995; see also Clark, 2001; Clark & McManus, 2002; Wells & Clark, 1997).

Clark and Wells (1995) propose two mechanisms that might underlie socially anxious individuals' reduced processing of external social cues: a) increased self-focussed attention and b) motivation to avoid eye contact. As noted earlier in this thesis, increased self-focus cannot account for *selective* reductions in socially anxious individuals' processing of external cues. Instead, it is more likely that selective attention away from social cues is characteristic of a wider set of defensive and avoidant response patterns adopted by socially 'submissive' individuals in response to perceptions of social-evaluative threat (Trower & Gilbert, 1989). Clark (1999) discusses the extent to which certain forms of anxiety are associated with vigilance for threat (e.g. spider phobia, Lavy, van den Hout, 1993; panic disorder and hypochondriasis, Ehlers & Breuer, 1992) while others, particularly social anxiety, are predominantly characterised by reduced processing of threat cues (i.e. faces). Clark's (1999) suggestion that social anxiety is characterised by "attention away from threat cues" (pg. 10) appears to contrast with predictions from Rapee and Heimberg's (1997) cognitive model of social anxiety and general cognitive models of anxiety that suggest anxiety disorders are characterized by selective processing of threatening information. Furthermore, evidence of vigilance for threat in social anxiety (e.g. Gilboa-Schechtman et al., 1999; Mogg & Bradley, 2002) questions Clark's (1999) suggestion that social anxiety is characterised by attention away from threat.

Recent presentations of Clark and Wells' (1995) early cognitive model (e.g. Clark, 2001; Clark & McMcManus, 2002) have extended initial, perhaps over-simplified, descriptions of reduced face-processing in social anxiety to include other forms of maladaptive attentional bias considered to occur when socially anxious individuals encounter external social cues. Specifically, Clark (2001) proposes that "social phobics' (reduced) processing of social cues is biased in favour of detection (and recall) of cues that can be interpreted as signs of disapproval from others" (pg. 416, Clark, 2001). Importantly, this theoretical extension (clarification) appears to incorporate assumptions from Clark and Wells (1995; Clark, 1999) with cognitive models of social and general anxiety that predict biases in initial orienting to threat in anxious individuals (e.g. Rapee & Hiemberg, 1997; see also Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Williams et al., 1997).

Findings from Experiment 2 provide some evidence of biased initial orienting to potentially threatening social cues when socially anxious individuals attend to competing facial expressions (e.g. angry-neutral face pairs). High socially anxious individuals under

stress were relatively faster to shift their gaze towards emotional faces, compared to low anxious individuals under stress, and high anxious individuals not experiencing social stress. These findings are largely consistent with findings from other paradigms that demonstrate selective orienting to threat cues when socially anxious individuals process competing face cues (e.g. Gilboa-Schechtman et al., 1999; Mogg & Bradley, 2002; Mogg, Philippot, & Bradley, 2004; Veljaca & Rapee, 1998). However, it remains to be clarified to what extent (and under what experimental conditions) socially anxious individuals biased initial orienting occurs specifically for angry faces (e.g. Mogg & Bradley, 2002) or extends to a variety of social cues likely to indicate evaluation (i.e. happy and angry faces, see Experiment 2 for discussion).

Following rapid initial orienting of attention to emotional cues, high socially anxious individuals (experiencing social-evaluative stress) rapidly disengaged attention from emotional faces relative to low anxious individuals (Experiment 2). This finding is inconsistent with proposals that socially anxious individuals have difficulty disengaging attention from social threat cues (Rapee & Heimberg, 1997). Instead, findings from Experiment 2 provide some support for a vigilance-avoidance pattern of attentional bias proposed to occur in social anxiety (Heinrichs & Hofmann, 2001) and suggestions that following rapid initial orienting of attention to the location of stimuli evaluated to be threatening, anxious individuals' focus of attention may become unstable, with a tendency repeatedly to shift towards and disengage from threat (Mogg & Bradley, 1998). Additional evidence which is compatible with unstable attention allocation comes from two recent studies examining attentional responses to social cues in social anxiety. Using a visual probe task, Mogg, Philippot and Bradley (2004) found that whilst individuals with social phobia showed initial vigilance for angry faces (at 500 ms), attention at latter stages of stimulus processing (e.g. 1250 ms) was unaffected by social anxiety. Convergent evidence of unstable processing is evident in a scan-path analysis of face processing in social phobia (Horley, Williams, Gonsalvez, & Gordon, 2003). Phobic individuals showed a distinctive "hyperscanning" characterised by reduced fixation durations on face cues and particularly those facial features predominantly used to convey emotional meaning (e.g. eyes and mouth). While the present thesis exclusively focuses on initial orienting and maintenance of attention, it is important that future studies assess viewing strategies throughout prolonged, ecologically valid stimulus presentations in order to examine further the unstable, maladaptive patterns of attention proposed to characterise social anxiety.

Current Status of Attentional Bias in Social Anxiety

The preceding integration of empirical findings from the present thesis with those from other studies of attentional bias in social anxiety, appears to support two primary

predictions from updated cognitive models of social anxiety (Clark, 2001; Clark & McManus, 2002). Firstly, research to date provides substantial support for proposals that individuals with social anxiety demonstrate reduced processing of external social cues when anxious. Importantly, this defensive attentional style, characterised by reduced initial orienting (Exp 2, Mansell et al., 1999; Chen et al., 2002) and maintenance (Exp 2, Exp 5, Daly, 1978; Holcom et al., 1993) of attention to social cues is likely to occur when socially anxious individuals have the opportunity (or a facilitated) to attend elsewhere (i.e. objects). However, when there is competition for attentional resources between different types of social cue (and opportunity to avoid social cues is more difficult), socially anxious individuals appear to adopt a vigilant-avoidant pattern of attention allocation characterised by rapid initial orienting (Exp 2; Gilboa-Schechtman et al., 1999; Mogg & Bradley, 2002; Mogg, Philippot, & Bradley, 2004) and disengagement from the location of threatening cues signalling evaluation (Exp 2; Horley et al., 2003). As such, future research wishing to extend current findings might consider the existence of two distinct cognitive mechanisms that operate in parallel: one, mediating defensive, socially submissive behaviours and a second controlling vigilant-avoidant (potentially unstable) processing of external threat.

Appraisal of Social Cues in Social Anxiety

A secondary aim of the present thesis was to examine stimulus appraisal mechanisms proposed to underlie individual differences in the selective processing of external social cues outlined above (e.g. Mathews & Mackintosh, 1998; Mogg & Bradley, 1998). Experiments 3 and 4 specifically compared high and low socially anxious individuals across a range tasks providing explicit and implicit indices of face/object valence and arousal (see summary in Table 20).

Results from explicit rating tasks in Experiment 3 indicate that irrespective of social anxiety, participants evaluated angry faces as more negative, and happy faces as more positive, than both neutral faces and objects. Participants rated angry and happy faces as similarly more arousing than neutral faces which in turn were considered more arousing than objects. Implicit measures of valence evaluation taken from error data on an Extrinsic Affective Simon Task (EAST) suggested that participants implicitly evaluated angry faces as negative and tended to evaluate neutral faces as negative and happy faces as positive.

One complication with Experiment 3 was an apparent tendency for participants to recode the EAST in an attempt to simplify (though contaminate) task performance. Consequently, Experiment 4 supplemented explicit ratings with physiological measures of valence evaluation (startle response amplitude) and stimulus arousal (skin conductance response). As in Experiment 3, irrespective of social anxiety group, participants explicitly evaluated angry and happy faces as more arousing than neutral faces and objects (though

angry faces were considered most arousing). Skin conductance measures of stimulus arousal only differentiated between the arousal intensity of angry and neutral faces, however, as with explicit arousal ratings (Exp 3 & 4) responses were again unaffected by social anxiety group. While the pattern of explicit valence ratings across the various stimulus types (i.e. faces/objects) replicated that found in Experiment 3, high socially anxious individuals rated stimuli in general less positively than low anxious individuals. Consistent with socially anxious individuals' more negative explicit valence ratings, startle amplitudes in response to picture stimuli were significantly larger in the high social anxiety group compared to low anxious controls.

Taken together, the present findings suggest that high and low socially anxious individuals implicitly and explicitly appraise social cues *relative* to non-social cues in a similar manner compared to low anxious individuals (see also Clark, Siddle, & Bond, 1992). However, evidence of more negative explicit stimulus evaluation and larger response startle response amplitudes in high socially anxious individuals (Exp. 5) provides some support for cognitive models that emphasise the role of negative appraisal processes in the etiology and maintenance of anxiety disorders (e.g. Mogg & Bradley, 1998). As noted in earlier chapters, it remains to be clarified whether these findings reflect socially anxious individuals' negative appraisals of external face/object stimuli, or simply modulation of responses (irrespective of stimulus characteristics) by more general perceptions of contextual threat and/or differences in baseline anxiety.

A further aim of Experiments 3 and 4 of the present thesis was to examine the relationship between selective attention and stimulus appraisal mechanisms outlined in general cognitive models of anxiety (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998). None of the studies reported in the present thesis demonstrated a relationship between measures of attentional bias and valence evaluation. Indeed, the only relationship that reached conventional significance levels was that associating increased arousal ratings for neutral faces with increased orienting to faces in general (Exp. 3). However, tendency to orient to faces was not found to covary with explicit ratings nor skin conductance indices of stimulus arousal in Experiment 4. Therefore, taken together, findings from the present thesis provide no clear support for proposals from general cognitive models of anxiety that suggest (socially anxious individuals') selective attention to concern-relevant cues results from biased stimulus appraisal mechanisms (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998).

Table 20. Summary of Tasks Examining Appraisal of Social and Non-Social Cues in Social Anxiety

		Stimulus Valence	Stimulus Arousal
	Explicit Measures		
Exp. 3	Explicit Ratings	Angry faces < (Neutral faces ≈ Objects) < Happy faces (irrespective of social anxiety)	(Angry faces ≈ Happy faces) > Neutral faces > Objects (irrespective of social anxiety)
Exp. 4	Explicit Ratings	(i) Angry faces < (Neutral faces ≈ Objects) < Happy faces (ii) **HSA valence ratings < LSA valence ratings**	Angry faces > Happy faces > Neutral faces > Objects (irrespective of social anxiety)
	Implicit Measures		
Exp. 3	Extrinsic Affective Simon Task	Error data (irrespective of social anxiety): Angry faces ≡ Negative Neutral faces ≈≡ Negative Happy faces ≈≡ Positive	N/A
Exp. 4	Psychophysiology	Affective Startle Modulation: (i) **HSA startle magnitude > LSA startle magnitude** (ii) No effect of face-type on startle magnitude	Skin Conductance Response (irrespective of social anxiety): Angry faces > Neutral faces ≈ Happy faces ≈ Objects

Note: x < y (x less than y); x > y (x greater than y); x ≈ y (x non-significantly different from y); x ≡ y (x equivalent to y); x ≈≡ y (trend for x to be equivalent to y).

It is important to consider whether the failure to identify predicted differences in high and low socially anxious individuals' appraisal of social relative to non-social cues might partly reflect the appropriateness of methods used throughout this thesis to index stimulus appraisal. The explicit rating scales used in the present thesis to measure stimulus valence and arousal replicated those used in previous studies of emotional picture processing (e.g. Lang, Bradley, & Cuthbert, 1993). Indeed, similar scales have been shown to be sensitive in detecting greater negative (valence) evaluations of fear-relevant stimuli in specific phobias (e.g. de Jong, van den Hout, Rietbroek, & Huijding, 2003; Thorpe & Salkovskis, 1995). Individual differences in implicit stimulus evaluation have also been demonstrated in specific phobias using stimulus response compatibility tasks such as the EAST and IAT (de Jong et al., 2003) and physiological indices of stimulus processing (e.g. Globisch et al., 1999; Hamm, et al., 1997). Given the similarities between methods used to index appraisal processes in the present thesis, and those demonstrating individual differences in other anxiety disorders, the present findings question the extent to which socially anxious individuals evaluate external social cues as more threatening relative to non-anxious individuals. It is possible that socially anxiety is characterised not so much by greater negative evaluations of emotionally unambiguous (angry, happy and neutral) face stimuli, but instead a tendency to interpret ambiguous facial expressions as threatening. Indeed, cognitive models of social anxiety suggest "social phobics interpret external social events in an excessively negative fashion" (pg. 412, Clark, 2001).

Interpretation and Judgement Bias in Social Anxiety

Experiment 5 developed a novel task specifically to compare high and low socially anxious individuals' interpretation of emotionally ambiguous positive and negative facial expressions. Results indicated that high socially anxious individuals tended to be more likely to classify weak angry faces (i.e. those expressions manipulated to contain more happiness than anger) as angry compared to low anxious individuals thereby reducing their sensitivity to distinguish between ambiguous emotional expressions. Although, group comparisons suggested social anxiety groups did not demonstrate a general tendency to interpret faces in general as angry, correlations did provide some evidence of an association between negative response bias and degree of social anxiety. These findings share some common features with other studies examining interpretative processing of ambiguous facial expressions in social anxiety. Winton et al. (1995) reported that high socially anxious individuals were biased towards classifying briefly presented neutral and angry faces as angry, whereas Richards et al. (2002) provided some evidence of increased sensitivity to fearful facial expressions in socially anxious individuals (see Chapter 5 for more discussion). While future studies need to clarify the extent to which interpretative bias in social anxiety is characterised by

sensitivity to detect, or simply tendency to report, more negative (or less positive) audience feedback, findings from the present thesis and similar studies provide some support for proposals that socially anxious individuals interpret ambiguous social cues in a negative fashion (Clark, 2001; Clark & McManus, 2002).

In addition to assessing interpretation of ambiguous facial expressions in social anxiety, two tasks in the present thesis examined other forms of judgement bias proposed to maintain/validate the social fears of individuals with social anxiety. Extending previous studies that suggest socially anxious individuals over-estimate the likelihood/occurrence of threat when anticipating/reviewing social interactions (e.g. Lucock & Salkovskis, 1988), covariation bias paradigms (Exp. 4 and 5) examined whether socially anxious individuals over-associate aversive outcomes with social cues likely to be encountered in social situations.

Covariation estimates following the startle probe task in Experiment 4 suggested that irrespective of social anxiety group, participants over-estimated the covariation between the occurrence of aversive events (i.e. startle probes) and angry faces relative to other face and object stimuli (consistent with previous findings from Sutton et al., 1990; Tomarken et al., 1998). Experiment 4 extended the covariation paradigm of Tomarken et al. (1998) to examine initial, on-line and retrospective selective associations between social cues and positive and negative outcomes. Results indicate that both high and low socially anxious individuals initially overestimated the occurrence of aversive outcomes following angry faces and positive outcomes following happy faces. However, these initial expectancy biases were corrected over the course of the task with the exception of low anxious individuals who continued to over-associate pleasant outcomes with positive social cues (happy faces) throughout, and to a lesser extent after the task. Contrary to previous findings (Exp. 4, Sutton et al., 1990; Tomarken et al., 1998), participants did not selectively associate aversive outcomes with angry faces when retrospectively reviewing the task, however, socially anxious individuals overestimated the percentage of trials on which angry faces were presented compared to low anxious individuals.

Various methodological differences between covariation bias studies (e.g. combinations of outcome, outcome modality and base-rate) have been discussed in previous chapters, however, results to date provide no evidence that socially anxious individuals over-associate aversive outcomes with cues signalling negative evaluation (i.e. angry faces) compared to non-anxious individuals. In contrast, findings generally suggest that socially anxious individuals not only lack a potentially beneficial positive on-line bias in judgment (Exp. 5) and interpretation (Hirsch & Mathews, 2000), but also retrospectively review previously encountered social information in a negative fashion (Exp. 5; Lundh & Öst, 1996; Stopa & Clark, 2000). As such, these findings provide additional support for proposals

that socially anxious individuals evaluate ambiguous social events (i.e. unrelated face-outcome relationships) in a negative (less positive) fashion and selectively recall negative external social cues (Clark, 2001).

On-line and Offline Processing Biases in Social Anxiety: An Integration of Present Findings

The present thesis has examined a variety of cognitive biases proposed to occur when individuals with social anxiety process external social cues. In this section, these findings will be integrated and clinical implications discussed. Findings from the present thesis (and other studies) suggest that when experiencing social-evaluative stress, individuals with social anxiety are characterised by reduced processing of external social cues (i.e. reduced initial orienting and maintenance of attention on social, relative to non-social, cues; Exp. 2). However, this reduced processing of social cues is likely to be biased in favour of rapid detection though subsequent avoidance of cues signalling evaluation (particularly if negative; Exp. 2). Furthermore, when attending to other's facial expressions, individuals with social anxiety are more likely to incorrectly interpret ambiguous cues in a negative fashion (Exp. 5) and less likely to associate cues signalling positive feedback with positive outcomes (Exp. 5). Finally, when reviewing previously encountered social material, individuals with social anxiety are likely to selectively retrieve cues that provided unambiguous negative evaluation (Exp. 5).

As noted earlier, these findings can be considered to provide some support for a variety of factors proposed to play an important role in maintaining the concerns of individuals with social anxiety (Clark, 2001; Clark & McManus, 2002). Several of these biases may simply hamper socially anxious individuals obtaining information likely to correct their pre-existing negative beliefs, while others directly exacerbate perceptions of social threat and negative evaluation providing confirmation of social fears.

Reduced processing of external social cues under stress (i.e. reduced initial orienting to faces and maintenance of attention on them) is likely to limit socially anxious individuals' opportunity to observe people's non-verbal responses in detail and thus obtain information from other people that would help them see that they generally come across more positively than they think. In contrast, low anxious individuals' greater attention towards social cues would facilitate accurate assessment of audience feedback and correction of any existing concerns. Similarly, socially anxious individuals' vigilant-avoidant (potentially unstable) pattern of attentional bias when processing competing social cues (i.e. relatively faster orienting towards signs of social evaluation, followed by rapid disengagement) may further interfere with habituation/feedback appraisal, thus maintaining anxiety in the long term. When attending towards the many ambiguous social cues commonly encountered in social interactions, socially anxious individuals' tendency to interpret such cues in a negative

fashion not only serves to confirm pre-existing fears of negative evaluation, but also to exacerbate negative cognitions and physiological responses that are themselves a source of threat. Fears of negative evaluation are likely to be further confirmed when individuals with social anxiety selectively recall negative social cues upon leaving the social situation. This information is likely to add to an increasing list of previous social failings which are repeatedly retrieved when anticipating and reviewing subsequent social interactions. In contrast, low anxious individuals' less negative (perhaps more accurate) appraisal of ambiguous social cues, together with a readiness to associate positive non-verbal feedback with positive outcomes, is likely to protect against social anxiety and facilitate beneficial conditioning to social stimuli that may help maintain positive cognitions throughout, following and prior to future social interactions.

Treatment Implications

As noted in the introductory chapters of the present thesis, existing cognitive-behavioural interventions for social phobia are likely to be greatly improved through the continued empirical verification of cognitive factors hypothesised to be involved in the etiology and maintenance of the disorder. While the present findings provide support for the existence of *supposedly* dysfunctional information processing biases in socially anxious individuals, they in no way demonstrate that social anxiety is caused or maintained by such biases. Instead, it is necessary to experimentally manipulate/induce these biases and show that such manipulation modulates the severity or persistence of social anxiety (Clark & McManus, 2002; see also Mathews & Macleod, 2002).

Recent years has seen the development of an exciting literature that suggests manipulation of certain cognitive biases can modulate levels of state anxiety. For example, MacLeod, Rutherford, Campbell, Ebsworthy and Holker (2002) experimentally induced different attentional responses to emotional stimuli by manipulating the contingency between the spatial location of probes and words differing in emotional content in a modified visual probe task. Results indicated that participants trained to display attentional avoidance of negative information subsequently reported lower levels of negative mood in response to an anagram stress task, relative to individuals trained to attend to threat. Similar elevations in self-reported negative mood have been demonstrated in participants trained to interpret ambiguous scenarios in a threatening fashion, relative to those trained to make benign inferences (Mathews & Mackintosh, 2000). With regard to social anxiety, recent studies by Hirsch and colleagues, have demonstrated that non-anxious individuals who had been trained to hold in mind a negative self-image, experienced higher levels of state anxiety and failed to make non-threat inferences regarding a social situation (job interview) compared to participants whose self-images were not manipulated (Hirsch, Mathews, Clark,

Williams, & Morrison, 2003). Indeed, individuals with social phobia reported greater anxiety, rated anxiety symptoms as more visible and evaluated their social performance more negatively when holding a negative image in mind than when holding a control image (Hirsch, Clark, Mathews, & Williams, 2003).

Taken together, these findings provide evidence that certain types of cognitive bias play a causal role in the generation and maintenance of a variety of negative mood states and cognitions. While future research needs to assess the causal nature of specific biases in relation to distinct emotional disorders, psychological interventions for social anxiety should continue to attempt to modify the dysfunctional information processing biases so far demonstrated to characterise the disorder. For example, findings from the present thesis provide support for the continued use of attention retraining techniques that encourage individuals with social anxiety to interrogate in more detail external aspects of the social interaction, particularly other peoples' responses. In doing so, anxious individuals are likely to generate a more accurate (less threatening) impression of social performance throughout and following the social interaction.

Issues for Future Research

The present thesis has developed and used a series of experimental paradigms in an attempt to clarify further the biased cognitive processing of external social cues proposed to underlie social anxiety. In doing so, high and low socially anxious individuals have completed attention, appraisal, interpretation and judgment tasks containing photographic images of facial expressions, several of these while anticipating an evaluative social situation. In addition to specific research questions identified in relation to specific paradigms (see earlier discussions), the present thesis highlights a number of general issues relevant to future investigations of information processing biases in social anxiety.

Perhaps most notable, is that studies in the present thesis have compared non-clinical high and low socially anxious undergraduate samples pre-selected for high and low levels of social anxiety (FNE) and subsequently allocated to groups according to median scores on the FNE and SADS. The extent to which patterns of cognitive bias identified in these samples generalizes to clinical populations remains unclear. However, in a recent review of the viability and validity of analogue research in relation to social anxiety, Stopa and Clark (2001) note that psychological processes that differentiate high and low scorers (on the FNE) are essentially the same as those that differentiate patients with social phobia from non-patient controls. Furthermore, there appear to be no demonstrations of differences between patients with social phobia and non-patient control samples that have failed to be demonstrated in comparisons between high and low FNE subjects (see Stopa & Clark, 2001 for brief review). Thus, while findings from analogue samples always require replication in

clinical samples, studies in the present thesis demonstrate the utility of analogue research in developing/piloting novel paradigms to clarify the dysfunctional processes suggested to underlie social phobia.

As a result of recruiting non-clinical undergraduate student samples (predominantly from the social sciences), gender composition of high and low social anxiety groups in the present thesis was naturally biased in favour of females (average m/f ratio ≈ 1/6). While this imbalance clearly exceeds reported gender differences in lifetime prevalence for social phobia (e.g. 11.1/15.5; data from Weinstock, 1999), such imbalance is common in non-clinical studies of cognitive bias in social anxiety (e.g. LSA = 0/28 and HSA = 0/32; de Jong et al., 1998), and not always controlled for (e.g. LSA = 17/19 and HSA = 12/23; Mansell et al., 1999). It is important to note that throughout the present thesis (i.e. within each study and across studies) high and low social anxiety groups did not significantly differ in gender ratio. However, it is acknowledged that future non-clinical studies should recruit samples that more closely reflect the demographics of the populations under investigation (e.g. age, gender, ethnicity, education) as commonly seen in clinical studies of cognitive bias in social phobia (e.g. Chen et al., 2002).

The ability to generalise current findings is further limited by the fact that studies throughout the present thesis have examined cognitive processing of greyscale photographic images of prototypical angry, happy and neutral facial expressions. As noted earlier, such unambiguous expressions of social appraisal (in particular, intense anger) are unlikely to be encountered in everyday social situations. As such, it is important that future studies assess information processing biases to more ecologically valid, emotionally subtle external social cues. In addition to examining interpretation of ambiguous social cues (e.g. Exp. 5; Richards et al., 2002), research has recently begun assessing attentional bias to naturalistic cues varying from mild to more extreme levels of threat severity (Wilson & MacLeod, 2003). Initial results suggest that vulnerability to trait anxiety appears to be associated with a tendency to selectively orient towards moderately threatening, but not highly threatening facial expressions. These findings provide support for cognitive models that suggest an individual's willingness to evaluate a stimulus that others consider relatively neutral, as threatening, underlies susceptibility to anxiety (Mathews & Mackintosh, 1998; Mogg & Bradley 1998). As such, future studies of social anxiety are encouraged to examine cognitive processing of naturalistic social cues varying in emotional intensity and, to the extent they prove amenable to experimental control, dynamic human facial expressions.

Improving stimulus validity feeds into a broader need to refine the socio-experimental conditions under which *in-situ* information processing biases in social anxiety are assessed. A limitation of the present thesis regards the relative inconsistency with which social-evaluative stress was induced. While induction procedures faithfully replicated

previously successful bogus presentation paradigms (e.g. Mansell et al., 1999) and in many cases featured additional components relevant to anxious individuals' evaluative concerns (i.e. use of cameras to monitor eye movements and non-verbal behaviour during the physiology task), post-induction levels of social anxiety significantly differed across experiments (see discussion of Exp. 3 & 4). As such, future studies might attempt to model more accurately the social situations commonly feared by individuals with social phobia.

Finally, a major goal of future research is to develop paradigms that examine interactions between the component cognitive mechanisms shown to characterise social anxiety. One outstanding issue relevant to the present thesis regards socially anxious individuals' *selective* appraisal, attention, interpretation and recall of the *competing* external, interoceptive and cognitive representations of threat. Indeed, to the extent empirical investigation can delineate but reintegrate dysfunctional component processes, can comprehensive models of social anxiety continue to be developed and theory-driven treatment interventions refined.

Closing Remarks

To conclude, the present thesis has examined a variety of cognitive biases proposed to occur when individuals with social anxiety process external social cues. Findings from a series of paradigms suggest social anxiety is characterised by reduced processing of external social cues. However, when there is competition for attentional resources between different types of social cue, individuals with social anxiety are more likely to rapidly detect but subsequently avoid emotional cues (particularly if negative). When attending to others' facial expressions, individuals with social anxiety are more likely to incorrectly interpret ambiguous cues in a negative fashion and less likely to associate cues signalling positive feedback with positive outcomes. Finally, when reviewing previously encountered social material, individuals with social anxiety are more likely to selectively retrieve cues indicating unambiguous negative evaluation. Taken together, these findings provide support for several features of recent cognitive models and contribute to an increasing empirical literature seeking to clarify further the dysfunctional basic processes involved in the etiology and maintenance of social anxiety.

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Appendices: Appendix A (Experiments 1 & 2)

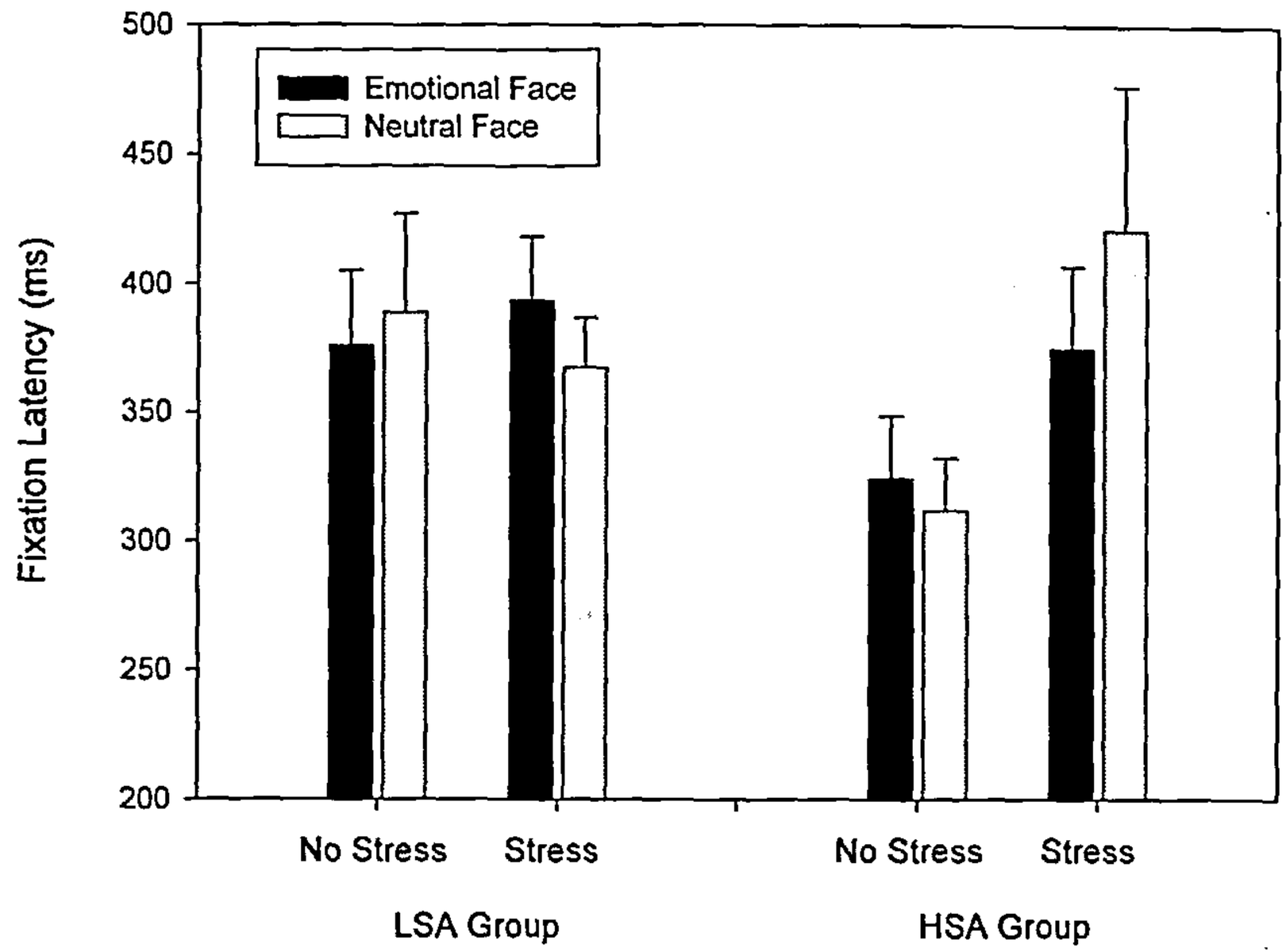

Figure A1. Mean latency (ms) of initial fixation on emotional face – neutral face trials, in low social anxiety (LSA) and high social anxiety (HSA) groups tested under conditions of no stress and social-evaluative stress.

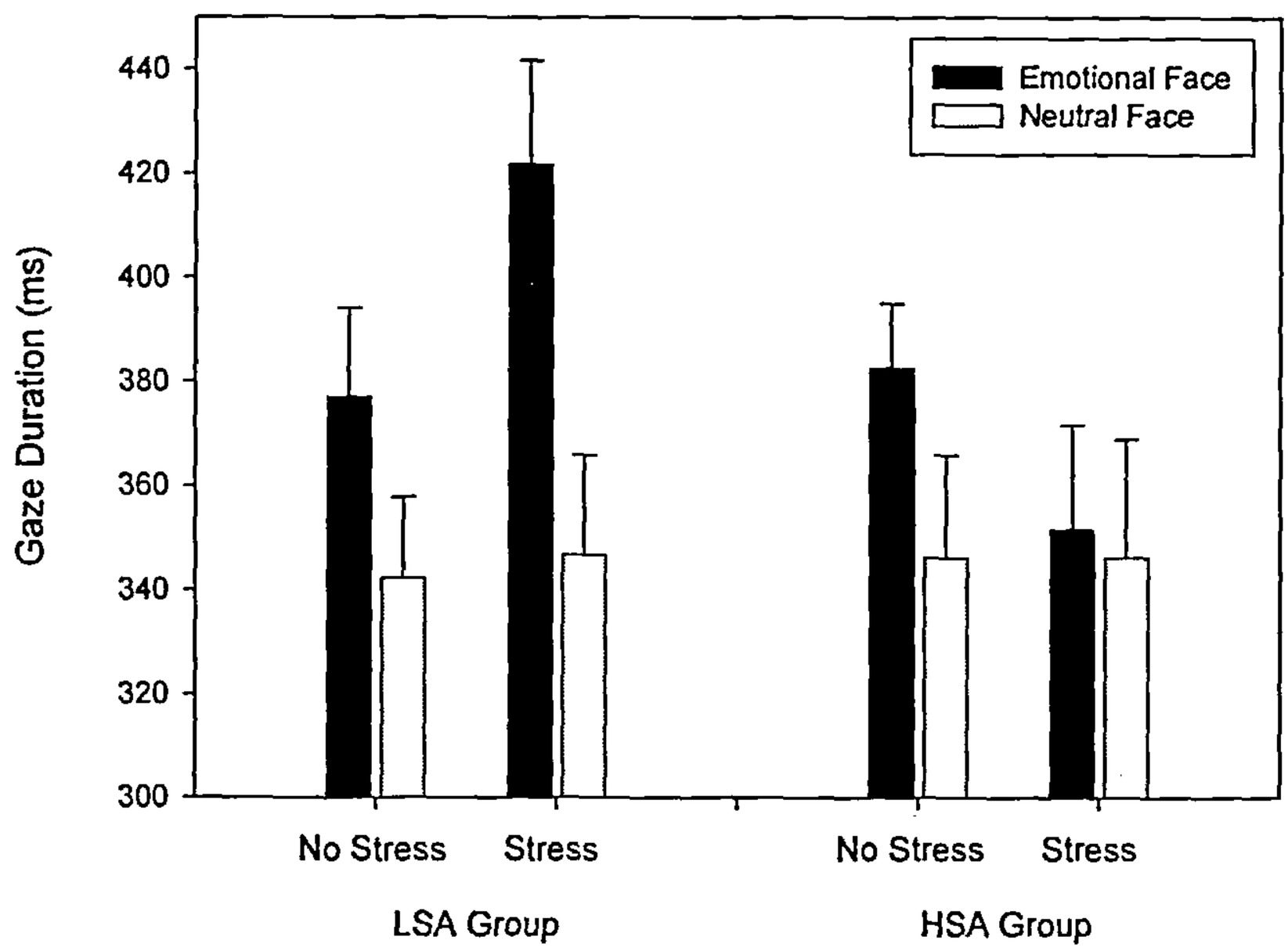

Figure A2. Mean gaze duration (ms) on initially-fixated picture on emotional face – neutral face trials, in low social anxiety (LSA) and high social anxiety (HSA) groups tested under conditions of no stress and social-evaluative stress.

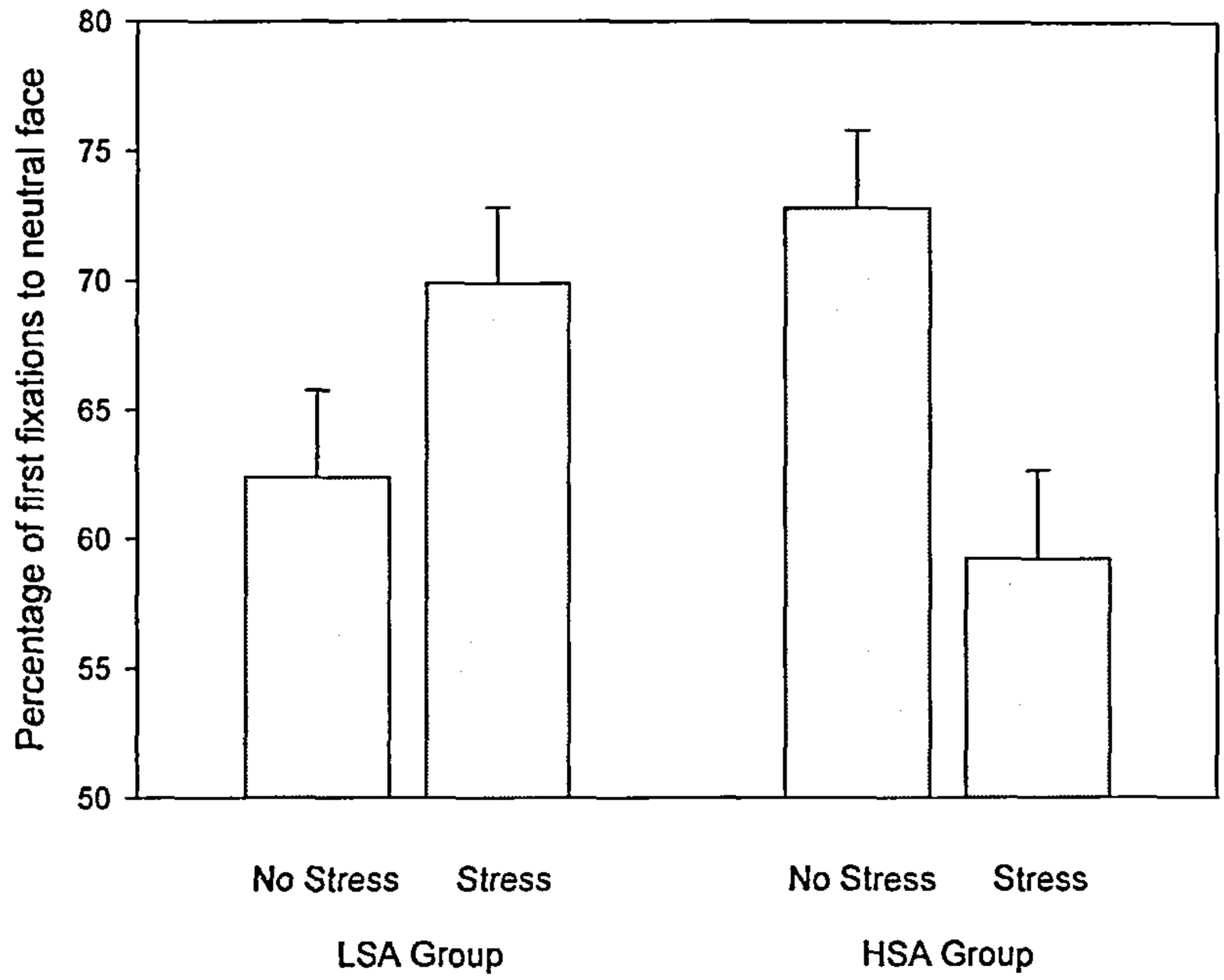

Figure A3. Mean percentage of initial fixations toward faces (relative to objects, in low social anxiety (LSA) and high social anxiety (HSA) groups tested under conditions of no stress and social-evaluative stress.

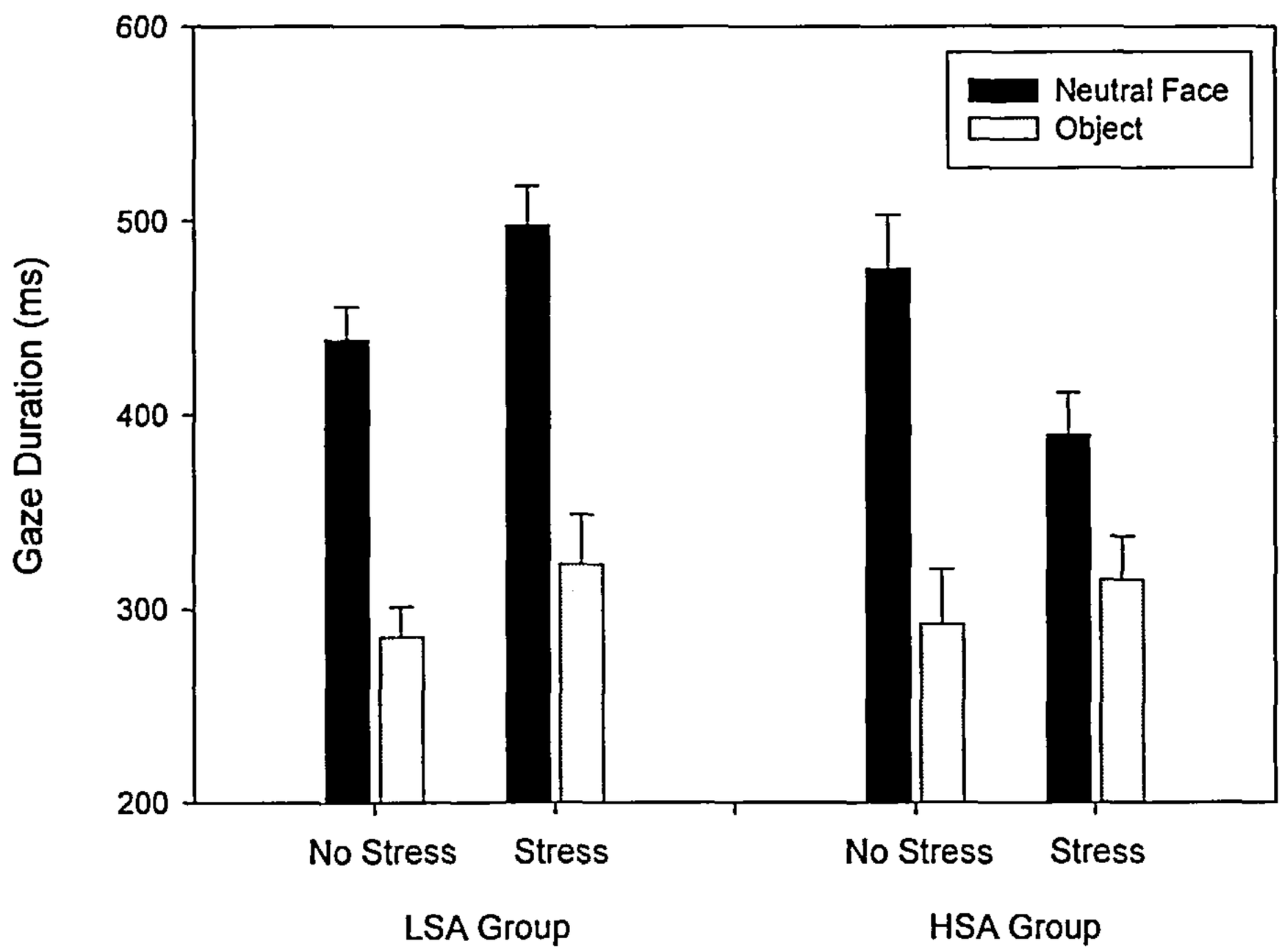

Figure A4. Mean gaze duration (ms) on initially-fixated picture on neutral face–object trials, in low social anxiety (LSA) and high social anxiety (HSA) groups tested under conditions of no stress and social-evaluative stress.

Appendix B (Experiment 3)

Table B1. Summary of Transformed Eye Movement Fixation Data for Each Group

Variables		Low social anxiety		High social anxiety	
		M	*SD*	*M*	*SD*
Pair type	Picture type				
Latency to initial fixations (values log10 transformed)					
Angry-object	Angry	2.55	.13	2.54	.14
	Object	2.53	.12	2.53	.23
Happy-object	Happy	2.55	.11	2.52	.12
	Object	2.55	.18	2.57	.20
Neutral-object	Neutral	2.57	.14	2.55	.16
	Object	2.54	.12	2.57	.21
Gaze duration on initially fixated pictures (values log10 transformed).					
Angry-object	Angry	2.77	.12	2.79	.15
	Object	2.53	.26	2.512	.20
Happy-object	Happy	2.76	.15	2.75	.14
	Object	2.55	.24	2.53	.20
Neutral-object	Neutral	2.7	.14	2.75	.13
	Object	2.57	.23	2.54	.23

Table B2. Mean Transformed Reaction Time (ms) and Percentage Errors on Target Stimulus Trials as a Function of Picture Type and Extrinsic Response Valence.

Variables		Low social anxiety		High social anxiety	
		M	*SD*	*M*	*SD*
Picture type	Response valence				
Reaction Time (ms) >3000=3000, <300=300 and values log10 transformed					
Angry	Positive	2.87	.10	2.84	.11
Angry	Negative	2.86	.10	2.86	.08
Happy	Positive	2.8	.10	2.83	.09
Happy	Negative	2.83	.08	2.84	.09
Neutral	Positive	2.86	.09	2.82	.10
Neutral	Negative	2.84	.09	2.84	.08
Object	Positive	2.91	.11	2.89	.11
Object	Negative	2.99	.18	2.95	.17

Appendix C (Experiment 4)

Table C1. Summary of Transformed Eye Movement Fixation Data for Each Group.

Variables		Low social anxiety		High social anxiety	
		M	*SD*	*M*	*SD*
Pair type	Picture type				
	Latency to initial fixations (values log10 transformed)				
Angry-object	Angry	2.5	0.1	2.5	0.2
	Object	2.7	0.2	2.7	0.4
Happy-object	Happy	2.5	0.1	2.5	0.1
	Object	2.6	0.2	2.7	0.4
Neutral-object	Neutral	2.5	0.1	2.6	0.3
	Object	2.7	0.3	2.7	0.1
	Gaze duration on initially fixated pictures (values log10 transformed).				
Angry-object	Angry	3.1	0.1	3.0	0.2
	Object	2.8	0.2	2.8	0.2
Happy-object	Happy	3.1	0.1	3.0	0.2
	Object	2.7	0.2	2.9	0.2
Neutral-object	Neutral	3.1	0.1	3.0	0.2
	Object	2.8	0.2	2.9	0.2

Table C2. Summary of Transformed Startle and Skin Conductance Responses for each Social Anxiety Group.

		Low social anxiety		High social anxiety	
Picture type	Startle SOA	*M*	*SD*	*M*	*SD*
	Startle Response Amplitude A-D Units (log 10 transformed)				
Angry	300	4.33	0.62	4.73	0.47
	3000	4.42	0.65	4.84	0.48
Happy	300	4.35	0.62	4.72	0.48
	3000	4.42	0.63	4.79	0.49
Neutral	300	4.33	0.62	4.73	0.48
	3000	4.39	0.62	4.73	0.51
Object	300	4.38	0.61	4.75	0.46
	3000	4.41	0.57	4.80	0.50
	Skin Conductance Response Amplitude (log[SCR + 1];μS)				
Angry		0.0075	0.0103	0.0083	0.0146
Happy		0.0072	0.0167	0.0062	0.0137
Neutral		0.0026	0.0093	0.0014	0.0127
Object		0.0067	0.0136	0.0136	0.0226

Table C3. Mean A Posteriori Estimates of Covariation and Summary Bias Measures.

	Low Social Anxiety				High Social Anxiety			
	Aversive noise		No noise		Aversive noise		No noise	
Picture	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Angry	52.7	18.6	45.4	17.3	52.5	23.1	44.3	22.1
Happy	39.4	12.6	61.8	14.0	38.8	17.6	60.4	18.5
Neutral	35.6	19.5	62.2	21.8	27.2	18.9	57.3	25.7
Object	27.4	18.0	72.4	18.9	38.8	21.8	58.4	20.6
Bias measure	38.7	38.9			31.9	46.9		

Note. Bias measure reflects tendency to selectively associate aversive noise outcomes with angry faces.

Table C4 Mean Base-Rate Percentage Estimates in Low and High Social Anxiety Groups.

	Low Social Anxiety		High Social Anxiety	
	M	*SD*	*M*	*SD*
Picture				
Angry	42.7	18.1	39.6	19.0
Happy	41.6	16.1	49.5	17.9
Neutral	25.1	12.5	20.1	15.0
Object	32.9	21.4	39.0	21.4
Outcome				
Aversive noise	46.4	15.5	43.9	16.8
No noise	55.5	16.6	59.0	18.6

Appendix D (Experiment 5)

Table D1. Mean Unadjusted A Posteriori Estimates of Covariation and Summary Bias Measures.

	Low social anxiety						High social anxiety					
	Angry		Happy		Neutral		Angry		Happy		Neutral	
Outcome	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Aversive	42.4	18.2	34.4	16.6	37.3	15.3	38.6	21.9	46.8	20.0	36.4	18.51
Pleasant	32.2	17.5	35.8	14.1	32.5	14.9	33.4	16.9	28.5	17.5	30.2	17.3
Neutral	27.8	16.2	30.6	15.9	29.7	18.1	27.0	15.9	26.4	17.1	26.7	17.6
Nothing	19.3	11.8	18.7	11.6	23.8	16.6	18.8	12.1	17.4	11.8	27.0	17.8
Bias measure	8.4	26.7	5.6	22.2	-1.5	24.9	-3.2	35.3	-4.2	28.6	-7.8	24.1

Note. Bias scores for angry and neutral faces relate to aversive outcome estimates whilst happy face bias scores relate to pleasant outcome estimates.

Table D2. Mean Unadjusted Base-Rate Percentage Estimates in Low and High Social Anxiety Groups.

	Low social anxiety		High social anxiety	
	M	*SD*	*M*	*SD*
Face Type				
Angry	35.7	12.0	41.3	14.8
Happy	36.8	9.4	31.2	10.8
Neutral	33.4	9.6	31.5	9.4
Outcome Type				
Aversive	36.8	16.9	34.7	16.9
Pleasant	29.8	11.0	23.5	8.9
Neutral	39.4	17.3	29.1	11.6
Nothing	23.5	10.3	23.4	13.2