The role of self-relevance, attention and online interpretation of social cues in social anxiety

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Doctor of Philosophy
2013

Author’s Declaration

I declare that this thesis contains the results of my own work and that it has been composed of by myself. All work belonging to other researchers has been fully acknowledged in accordance with academic conventions.

Signed ....

Date ......27.09.13……………………….

Indigo Gray Spes Non Fracta

Acknowledgements

My PhD journey has been a rollercoaster of emotions swinging pendulously from exhilaration to anxiety to determination to despondency and back to resiliency and hope. At the centre of all of that has been my family. My beautiful, tenacious and inspiring daughter Tuesday who has always managed to bring the smile back to my face even on the most difficult days, you really are my sunshine even though you think you're too old for me to call you that. My husband Gary was the glue that held everything together including me. You are the reason that I began this academic journey, having spotted potential in me that appeared to be quite elusive to all including me for many years. I thank you both for your love and patience. Juggling my PhD with motherhood, several jobs and various other projects along the way has been a challenge but one that I have learned so much from and I am thankful for it. I also thank my parents for continuing to believe in me and providing me with much needed respite when I have needed it.

Through all of this my supervisor Stephen Butler has shared all of my worries, hopes, plans and tears of frustration and joy! My second Supervisor Madeline Grealy has unfailingly provided the calm voice of reason and support. I thank you both for everything you have done to support me and I have been very lucky to have such keen minds and lovely people to guide me. I would also like to thank my panel member Sinead Rhodes for her advice and support. Another two very important people who deserve thanks for their technical input are Keith Edwards and Bruce McGregor. You are my tech superheroes although Bill Woodside was also always happy to help when possible. In addition, thanks to the departmental secretaries past and present who have always been on hand to ensure smooth administration and good cake and also to the Scottish Funding Council and the University for their Financial Support.

Thank you to the various postgrads and staff along the way who helped to throw a bit of fun into the journey as well as a shoulder to cry on at times. Not forgetting a huge thanks to all of my friends who have been patient in my absence from their life as I have had my head stuck in my thesis and a special thanks to Caroline Aitchison who had to put with a weekly account of the whole process! To all of the people who participated in my experiments I would say thank you for helping me to get to the end of my journey. It was a pleasure to meet you all.

Finally thank you to Aileen Gormley who was a very loyal friend during these last few years. Just as I started my postgraduate journey, you started a very different type of journey. How ironic that they should both end in the same week. I will never forget you.

Publication of Work Within This Thesis

From the results of Study 1, a poster titled, 'McKendrick M., Williams, L., Grealy, M. & Butler, S.H. (2010). Effect of context and facial features in emotional face processing' was presented at the International SCONET conference at The Unvirsity of Kent, Semptember 13th.

Based on the results of Study 3, a peer reviewed abstract of a poster presented at the the 16th European conference on eye-movements (ECEM), University of Provence, Marseilles, France, August 22nd, 2011 was published in the Journal of Eye Movements under the title, 'McKendrick M., Grealy, M. & Butler, S.H. (2011). Socio-cognitive load and social anxiety: processing efficiency and performance in an emotional antisaccade task'.

A poster based on the results of Study 5, a poster titled 'McKendrick, M. Grealy, M. & Butler, S. (2012). Performance related visual attention and awareness of social evaluative cues in social anxiety' was presented at the European Conference for Visual Perception Alghero, Italy, September 4th.

Table of contents

List of tables

Appendix I(i)

Pilot Study A

Appendix I(iii)

Pilot Study B

List of figures

Appendix I(iii)

Pilot Study B

Appendix V1

List of appendices

Appendix I: Pilot studies

Appendix II: Descriptive statistics tables

Appendix III: Supplementary statistics: non-parametric tests

Appendix IV Correlations

Abstract

Cognitive behavioural models of social anxiety (i.e. Clark & Wells, 1995; Rapee & Heimberg, 1997) conflict in their predictions regarding attention to facial expressions/gestures. Clark and Wells predict that anxiety is maintained in a social situation by decreased attention towards social cues, precipitated by increased self-focused attention. This results in missed opportunities for positive reinforcement from approving audience responses. Rapee and Heimberg argue that attention is split between imagining ones' own performance and scanning the audience for signs of social disapproval. Therefore, the aim of this thesis was to investigate the role of self-relevance and attention in emotional cue processing.

Studies 1-3 investigated cognitive processes in face perception using static face paradigms. The results of an eye tracking composite face task (Study 1) indicated that emotion categorisation occurred rapidly and independently of context. However the effect of viewing an emotional face on the observer involved higher cognitive processes such as prior expectations and self-relevance. In an online composite face categorisation task (Study 2) socially anxious individuals reported that they focused less on angry eyes when categorising a threatening face than less socially anxious participants. Furthermore, in an eye tracking antisaccade task (Study 3), socially anxious participants processed emotional faces with greater attentional control than neutral faces. Taken together these studies suggest that processing differences may account for attentional biases in socially anxious individuals but attention appears to be independent of context in static face paradigms.

In studies 4 and 5, processing efficiency was investigated using dynamic video clips. When the social threat was moderate in an emotion categorisation task

(Study 4), socially anxious individuals processed social cues more efficiently and interpreted ambiguous social cues more negatively than less anxious individuals, however, efficiency was slowed when the threat was heightened during a live speech eye tracking task (Study 5). Despite increased attention to emotional compared to neutral faces as the task progressed, no evidence was found for group differences in attention to social cues. However, there were group differences in awareness of social cues and socially anxious participants demonstrated lower self-confidence post-task. This suggests that biased interpretations of social cues in performance situations may not depend on biased attentional processes.

Chapter 1

An introduction to models of cognitive, informational and behavioural biases in social anxiety

Taking centre stage, you are immediately aware of the sea of faces before you. You know what to expect. You won't be able to live up to the audience's expectations. As you begin your speech, you gaze around the audience at the faces and yes, just as you thought, look at that man shaking his head. You start to feel hot and notice that your hand is trembling. You can feel yourself beginning to blush. You imagine how ridiculous you must look by now. The man on your left appears to be smiling, but why? He must be laughing at you.

This is the type of situation that a person who suffers from social anxiety or social phobia may regularly find himself or herself in whether they are giving a presentation or a public speech. However, even everyday simple social interactions can be the source of dread for many people. Social anxiety and social phobia share several similarities and are terms that tend to be used interchangeably but have their own definitions. Schenlenker and Leary (1982) defined social anxiety as a group of cognitive and affective responses elicited by the fear of negative social evaluation. The Diagnostic and Statistical Manual of Mental Disorders definition for social anxiety disorder is "clinically significant anxiety provoked by exposure to certain types of social or performance situations often leading to avoidance behaviour" (DSM-IV-TR, American Psychiatric Association, APA, 2000, p.429).

Social phobia is defined 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. The individual fears that he or she will act in a way (or show anxiety symptoms) that will be humiliating or embarrassing" (DSM-IV, American Psychiatric Association, APA, 1994, p.416-7). Hofmann and DiBartolo (2009) described social anxiety as a spectrum of related disorders. This may range from shyness to social anxiety disorder and may also include subtypes. For example, some socially anxious individuals may have comorbid avoidant personality disorder (Hofmann, Newman, Ehlers & Roth, 1995). This has been defined as “A pervasive pattern of social discomfort, fear of negative evaluation, and timidity” (American Psychiatric Association, 1987, p. 315).

Social anxiety can be induced by various social contexts including real or imagined performance situations, personal interactions or being observed in public (Schenlenker and Leary, 1982). However, public speaking including delivering a speech to an audience or giving a presentation to a group of people has been defined by Leary and Kowalski (1995) as being the most anxiety provoking social situation. While it can be situational in nature, social anxiety can also be dispositional (i.e. stable across different situations). Although social anxiety is thought to lie on a continuum (Rapee & Heimberg, 1997) it is the ‘marked and persistent fear of one of more social performance situations’ (American Psychiatric Association, APA, 1994, p.411) that differentiates dispositional from situational social anxiety. Therefore, an individual with dispositional social anxiety is likely to be faced with the stress of coping with debilitating anxiety every time they encounter the feared social situation. With the lifetime prevalence of social anxiety disorder estimated to be around 12% (Kessler, Berglund, Demler, Jin & Walters, 2005), this presents a significant difficulty for many individuals and may negatively impact on their social and professional life.

According to cognitive behavioural models of social anxiety, people use ‘cognitive schemas’ to organise information about the self, the world and the relationship between these in long term memory (Stein, 1995). Cognitive schemas are stable beliefs about one’s own abilities, value and attributes as a person and other’s evaluation of them. Socially anxious individuals tend to be biased towards negative schemas (Pinto-Gouveia, Castilho, Galhardo, & Cunha, 2006). Biased attention towards socially threatening cues such as negatively perceived facial expressions reflect and interact with schemas that are biased towards negative information such as one’s inability to perform well. These maladaptive cognitive schemas can underpin interpretative; memory and expectancy biases. In other words, negative information is accessed from memory and used to interpret events, leading to the expectation of a negative response and more attention being paid to negative responses that confirm these expectations. This culminates in a cycle of anxiety (Clark, 2001; Clark & Wells, 1995; Hirsch, Clark and Matthews; 2006; Rapee& Heimberg, 1997; Stravynski, Bond & Amado, 2004).

However, whilst attention clearly has a role to play in this process, the differential nature of the attentional mechanisms that underpin the foremost models, ‘a cognitive model of social phobia’ (Clark and Wells, 1995) and ‘a cognitive behavioural model of anxiety in social phobia’ (Rapee and Heimberg, 1997) is often neglected (i.e. Anderson, Goldin, Kurita & Gross, 2008; Beard & Amir, 2009). The former proposes that during a social performance or interaction, attention is diverted away from the external environment (i.e. the audience or conversant) inwardly towards the physiological feelings and an imagined self-image. In contrast, the latter model suggests that attention is divided equally between the audience and the self.

Clark and Well's (1995) model of social anxiety

According to the Clark & Wells (1995) model of social anxiety, an interaction between behavioural predispositions and prior experience facilitates an enhanced sensitivity to social threat. Clark (2001) elaborated by clarifying the assumptions that socially anxious individuals make when encountering a social situation as falling into three categories: extremely high social performance standards; beliefs about negative consequences that will follow a performance and global negative beliefs about the self. On encountering a social situation, the individual believes that the audience has high expectations of them but that they will behave in a socially unacceptable manner and thus be evaluated negatively by others.

The model was built upon the foundations of earlier models such as (Schlenker and Leary, 1982) in which the socially anxious individual constructs an ideal self who would achieve a very high standard of performance. When confronted with an anxiety producing situation, Schlenker and Leary (1982) suggested that the anxious individual shifts their mental and auditory attention towards the self in order to conceal their discomfort. In doing so they engage less in the communication, adopting instead a more passive style of listening and responding (smiling, nodding etc.). This provides a self-protective mechanism by drawing less attention to the anxious individual during a conversation or social performance. This in turn lowers the perceived expected standard thus narrowing the expectancy-outcome gap (i.e. the mismatch between what the anxious person expects will be the outcome and the actual outcome).

In addition to the cognitive and verbal shifts in attention towards the ‘self’ that Schlenker and Leary (1982) suggested are involved in social anxiety, the Clark and Well’s (1995) model incorporates a shift in visual attention into the model. Socially anxious individuals feel that that they are the centre of negative attention rather than basing this impression on more concrete evidence. Thus, their faulty assumptions are based primarily on proprioceptive information such as tension in the facial muscles. These sensations are then integrated into a distorted representation where the speaker imagines that they are substantially more red faced, shaky or tense looking than they are in reality. The socially anxious person will visualize themselves from a third person perspective, creating an ‘object’ which represents the self. It is this self-representation that is the central tenet in the model. Thereafter behaviours adopted to avoid social embarrassment can exacerbate a negative self-image. For example, practising a social response may lead to a stilted performance, in which the speaker is aware of their own tension and this feedback leads to increased self-monitoring culminating in a progressively more negative self-image (Clark, 2001).

During the situation, the socially anxious individual is then likely to ruminate on the negatively perceived evaluations and the distorted self-representation, leading to behavioural adjustments that may result in them looking uncomfortable or unsociable. However, rather than monitoring and evaluating external cues accurately to assess whether this is a true representation, attention is diverted from external sources towards the self-image which is focussed upon intensely, and evaluated negatively. This means that the socially anxious individual lacks the attentional resources available to accurately process external social cues and thus develops an unrealistic impression of the audience response.

Hirsch and Matthews (2000) distinguished between ‘online’ interpretation of social cues which involves processing of incoming information directly from the source (i.e. the audience) and ‘offline’ processing. The latter involves solely making an inference about social information based on pre-existing knowledge. According to the Clark and Well’s model, information on audience evaluation involves predominately offline processing of external social cues based on the negative biases inherent in the self-representation. This makes the model in effect a closed system with no significant direct input from the external environment.

This inwardly diverted attention results in the individual missing benign or positive cues that could disconfirm the negative impression that has been created by the focus on a negative self-representation. Although the model does acknowledge the potential for noticing some external cues (Clark, 2001), it largely suggests that this is due to expectations and interpretative biases driven by offline processing mechanisms. For example, an anxious individual may notice some social cues that they interpret negatively and those that they recall will be more likely to be negative cues. However, on the whole it is the reduction of attention to social cues that could disconfirm their negative assumptions that underpins the model. Stopa and Clark (2000) have suggested that this is the critical difference between social anxiety and shyness in that shy individuals do not shift attention from external to internal cues in the way that socially anxious people do. Thus, they are better prepared to accurately assess external social cues (Clark & Wells, 1995).

Rapee and Heimberg's model (1997) of social anxiety

Rapee & Heimberg (1997) presented a more open cognitive-behavioural model of social anxiety despite similarities to the Clark & Wells model by involving interdependence between internal processing of thoughts and sensations and external processing of social cues. The model begins in an essentially similar manner in that socially anxious individuals desire to make a good impression but assume that others will evaluate them negatively. The principal threat stimulus in this model is the evaluator (i.e. interaction partner or audience) while the principal threatening outcomes are the negative evaluation and the attached consequences. These may include social consequences such as being rejected from a group or professional consequences such as not being offered a promotion. The view endorsed by the model is that social anxiety operates on a continuum but that higher levels are associated with maladaptive assumptions, cognitions, attention, somatic and behavioural responses. Although any individual may be affected by situational stressors that may give rise to state anxiety, those with significantly higher levels of social anxiety are likely to exhibit greater responses to a social situation.

Like the preceding model, the Rapee and Heimberg (1997) model asserts that confronted with a social situation, a self-image including a physical and behavioural representation is generated about the perceived audience evaluation. However, attentional resources are directed towards the self-representation whilst also being directed towards external social evaluation. Rather than attentional resources being directed exclusively away from external towards internal cues, socially anxious individuals are likely to hyper scan their surroundings for cues, detect negative evaluation more rapidly and find it difficult to disengage from negative evaluative social cues. Thus, the model supports the existence of a negative attentional bias. Rapee and Heimberg (1997) include frowning or signs of boredom among these non-verbal negative external cues. Attention is split between external and internal online processing, depleting the proportion of attentional resources that can be directed towards each of them. Negative expectancies are then generated about the individual's performance and about audience evaluation of their performance, creating a cognitive negativity bias. This was a term coined by Baumeister, Bratslavsky, Finkenauer and Vohs (2001) which refers to the prioritisation given to negative information over positive information from the external environment.

The socially anxious individual predicts a high standard of expected performance based on the apparently negative external cues. For example if the audience looks bored, the individual feels that they must expect more of an entertaining or interesting performance and because the individual is partly attending to the negative self-image, the likelihood is that there will be a large gap between self-perception of performance and expectations of the audience evaluation. Thus, the individual expects that their performance will fall short of the audience evaluation. The resulting increased anxiety leads to physiological changes such as blushing, negative cognitions and behaviours such as rigidity or fidgeting, culminating in a cycle of anxiety.

Thereafter both internal and external cues feed into the representation of self that is compared to the audience evaluation (i.e. the audience's appraisal of the individual's performance), which is also likely to be misperceived by socially anxious people because of faulty cognitions and attentional processes. In this model it is the comparison between the self-representation and the audience evaluation that is a central component in the increase of anxiety. This combination of more weight given to negative attributions of events and attention to negative social cues that confirm their fears culminates in an online negativity bias by combining selectively attended negative information directly from the environment with negative attributions of the event. After the event, socially anxious individuals then evaluate their own performance more negatively than less socially anxious people. Similarities and differences between the Clark & Well's and the Rapee & Heimberg models of social anxiety are highlighted in Table 0.1

Table 0.1
Comparison between two cognitive-behavioural models of social anxiety

Clark and Wells (1995)	*Rapee and Heimberg (1997)*
Similarities	
Detection of audience activates assumption that others hold a high standard for performance	☑
Negative social cognitions: individual will be unable to meet expected standards	☑
Perceived social danger: audience as a whole processed as a source of social threat based on evaluative status.	☑
Somatic & cognitive symptoms: shakiness, sweating, blushing etc.	☑
Differences	
Attentional shift: individual shifts attention to internal processes such as proprioceptive information.	Attention split shifting between self-representation and external environment by way of a reciprocal relationship with attention to negative social cues (i.e. audience members frowning, shaking head etc.).
Processing of self as social object: third person perspective with distorted emphasis on visible indicators of anxiety from proprioceptive information (i.e. shakiness, sweating, blushing etc.)	Distorted self-image generated from proprioceptive 'internal cues' <u>and</u> from confirmation of fears based on attention to negative external social cues.
Internal processing: individual tries to control visible indicators of anxiety by engaging in safety behaviours (e.g. holding on to an object to hide shakiness) but efforts increase self-focussed attention.	External processing: increased self-focussed attention increases attention to the eternal environment as the socially anxious individual looks for evidence of negative social cues that will confirm their fears about their imagines image.
As a result of self-focused attention, attentional resources for the external environment are depleted. Reduced attention to external social cues such as nods and smiles that could provide positive affirmation about social performance.	Only partly reduced attention to positive self-affirming social cues caused by cyclical shifts in attention between internal self-representation (away from the audience) and negative external social cues at the direct expense of positive ones.
Implications	
Offline processing based on assumptions and memories of distorted self-image.	Online negativity bias based on direct attention to negative social cues.
Reduced attention to faces	Increased vigilance for negative faces

Cognitive biases

Before discussing the evidence to support the existence of an online interpretation bias and of attention to external social cues, evidence for cognitive biases at a more general level will be discussed since the Clark and Well's model in particular relies heavily on these. Offline cognitive biases include memory and expectancy biases. For example, an anxious person may be more likely to recall instances of being in a social situation when they felt that they had made a fool of themselves than a more positive social situation. Furthermore, prior to engaging in a subsequent social situation they may be more likely to expect to perform poorly again rather than expecting that they will achieve their goal.

According to the Clark and Well's (1995) model, cognitive biases are associated with internal processes such as oversensitivity of bodily sensations (proprioceptive biases) leading to a distorted self-image. For example, the anxious individual may remember that they felt that they were blushing the last time they spoke publically and imagine that they looked ridiculous. This can lead them to overestimate other's negative perceptions of their performance (Roth, Antony and Swinton, 2001). Following a social situation the socially anxious individual tends to ruminate on perceived failures (Clark, 2001). This rumination reinforces negative beliefs about their social performance and feeds into the anticipation of future social failures.

There has been evidence of socially anxious individuals having greater recall of negative information (i.e. Amir, Coles, Brigidi and Foa, 2001; Amir, Foa & Coles, 1998; Breck & Smith, 1983; Claeys, 1989; Heinrichs & Hofmann, 2001; Lundh & Ost, 1996 and 1997; Mansell & Clark, 1999; O'Banion & Arkowitz, 1977; Smith, Ingram & Brehm, 1983; Wild, Hackmann & Clark, 2008), although other studies have failed to support the existence of memory biases in social anxiety (Becker et al., 1999; Cloitre et al., 1995; Rapee et al., 1994). In a review of cognitive and attentional biases in social anxiety, Staugaard (2010) concluded that evidence for memory biases was inconclusive based on a lack of between group differences for memory or recognition of negative faces in several studies (i.e. Chen et al., 2002, D'Argembeau, Van der Linden, Etienne & Comblain, 2003; Hunter, Buckner & Schmidt, 2009; Mansell et al., 1999; Silvia, Allan, Beauchamp, Maschauer & Workman, 2006). However, the studies reviewed involved a variety of tasks and measures without a direct social threat on the most part.

Some studies have provided more compelling evidence of negative and self-referential memory biases in socially anxious individuals (e.g. Anderson et al, 2008; D'Argembeau, Van der Linden, d'Acremont, & Mayers, 2006). These biases are memories of perceived poor performances or failures on the part of the socially anxious person in a previous social situation. Stored negative self-referential memories are thought to underpin interpretation biases by generating maladaptive cognitive schemas when socially anxious individuals are confronted with a social situation (Rapee & Heimberg, 1997). During the social situation they would be directly interacting with facial expressions whilst processing these memories. However, many studies have focussed on using words rather than faces. If the assumptions of the Clark and Wells model are correct then reduced attention, whilst precipitated by negative expectations based on memories, would be associated with fewer memories of actual rather than imagined external social cues in tasks because of reduced attention.

Some evidence supports reduced explicit memory for faces, particularly happy or accepting faces compared to angry or critical (D'Argembeau et al., 2003; Lundh & Öst (1996) although it has been argued that this is actually due to low socially anxious individuals having enhanced recognition for accepting faces (Coles and Heimberg, 2005). This may support a deficit in positive processing and suggest that the conclusions of Staugaard (2010) may be oversimplified by focussing on memory in relation to threatening faces since this was one of the studies that was cited in the review cited as failing to support group differences. Non-socially anxious individuals are thought to demonstrate a benign or positive on-line inferential bias, which involves them pairing non-socially threatening or positive causal attributions with ambiguous social scenarios or facial expressions. However this is thought to be inhibited in socially anxious individuals (Amir, Prouvost and Kuckertz, 2012; Calvo, Eysenck, and Castillo, Calvo, Eysenck, and Estevez’s, 1994; 1997; Hirsch and Matthews, 2000, Leary, Kowalski and Campbell, 1988; Moser, Halcak, Huppert, Simmons andFoa , 2008). This may provide some support for the Clark and Wells (1995) model of social anxiety since if anxious individuals are not paying attention to external social cues as the model suggests then they may miss positive self-affirming cues such as nods or smiles.

However, these studies have investigated the benign/positivity bias in a non-visual form, using lexical decision sentence tasks with word probe (in which a socially threatening or no-threatening probe appears at critical points in a text and reaction time for acceptance of the probe is measured) or word sentence association paradigms (in which the participant must decide whether a socially threatening word or non-socially threatening word is related to an ambiguous sentence). This may not be representative of social cognitions during a real social performance or interaction. In face processing studies, socially anxious participants have been found to disengage faster from positive faces than negative faces (Chen, Clark, MacLeod and Gustella, 2012). Furthermore a recent study found that during event reappraisal, highly socially anxious individuals reported less positive social incidences and less positive emotions than low anxious individuals who exhibit the opposite pattern (Farmer and Kashdan, 2012).

This may suggest a diminished reward experienced by socially anxious individuals when viewing positive faces, which may be associated with a more general deficit in the positivity bias. Alternatively it could indicate a difficulty to disengage from a negative face relative to a positive one because of the implied social threat. The first interpretation may provide some support for a deficit in the positivity bias and as such also provide support for the Clark and Well's (1995) model. Yet the second interpretation would support the Rapee and Heimberg (1997) model which has postulated the occurrence of disengagement difficulties from negative faces in social anxiety. In that case it may be likely that an online negativity bias could ensue from the extra processing of the negative face.

Evidence from some studies suggest that counter to a deficit in positive processing, socially anxious individuals recall a higher percentage of faces than low socially anxious. Moreover, they have been found to recall negative faces more than positive faces (Foa, Gilboa-Schechtman, Amir and Freshman, 2000). In contrast, Perez-Lopez and Woody (2001) found that participants with social phobia had no advantage for identifying threat faces compared to the low anxious group, but recognised reassuring faces more than negative faces. This may be due to reduced attention for more threatening faces. The difference in the results in this study compared to those previously discussed may have been the increased social threat of the task in asking participants to imagine a real social situation. Moreover, they were asked to rate the faces in terms of reassurance or threat which is more self-relevant than simply identifying the emotion of the face.

These studies provide some support for the Rapee and Heimberg model of social anxiety in that they provide some indirect evidence of attention to external social cues (i.e. faces). Yet they also suggest on the whole that high social anxiety may be related to a deficit in positive social processing. What is less clear is whether this is due to reduced attention to positive faces or simply reduced processing of them. It is possible that even if the same amount of attention is paid to positive faces across groups, they may be interpreted differently and thus recalled as being less positive experiences by highly socially anxious individuals.

Support has been found for a negativity bias in interpreting ambiguous and neutral social scenarios (Amir et al. 1998; Amir et al., 2005; Beard & Amir, 2009; Constans, Penn, Ihen and Hope 1999; Helfinstein et al., 2008; Joormann & Gotlib, 2006; Murphy et al., 2007; Richards et al., 2002; Stopa & Clark, 2000). Social anxiety has also been associated with more negative evaluation of negative crowds (Gilboa-Shetman et al., 2005).

Further evidence suggests that negative scenarios as more likely to be interpreted as self-referential (Huppert, Foa, Furr, Filip & Mathews, 2003). Socially anxious individuals also tend to catastrophize the implications of their interpretations (Amir, Foa, & Coles, 1998; Brendle & Wenzel, 2004; Foa, Franklin, Perry, & Herbert, 1996). This cycle of interpretation and catastrophization may increase anxiety about the consequences of a negatively evaluated performance as well as increase expectations of further negative responses.

Negative interpretative biases and a deficit of the benign/positivity bias demonstrated in low socially anxious individuals may interact with other cognitive biases. Christensen, Stein, & Means-Christensen (2003) have suggested that memory biases could be the result of both negative internal and external interpretative biases. Indeed this has been supported by Huppert, Pasupelti, Roa and Mathews (2007) who found an apparent deficit in positive interpretations of social scenarios followed by a negativity bias in self-referential processing. This may suggest that when the social situation is first encountered socially anxious individuals may not engage in the type of positive interpretation of it that less anxious individuals do, then once they start to think about the personal relevance of the situation to them they may be begin to display a negativity bias.

Evidence suggests that expectancies of negative outcomes in social situations are associated with social anxiety (Amir, Foa and Coles, 1998; Wenzel, 2004). Automatically generated anxiety based schemas in social situations create an expectancy of a negative outcome, resulting in some cases in self-fulfilling prophecy. This may be reinforced or precipitated by a disproportionate lack of attention to positive social cues as the Clark and Wells model would predict or as Rapee and Heimberg's model predicts, an exaggerated allocation of attention to negative social stimuli, triggering a negative cycle of attentional, cognitive and behavioural effects that culminate in the maintenance of social anxiety (Stravynski et al, 2004).

Yet evidence for negative expectancies in relation to facial expressions is inconclusive. De Jong, Merckelbach, Bogels and Kindt (1998) found little evidence for biased expectancies of an aversive outcome associated with threat faces. However, a later study may shed more light on the nature of differences in expectancies. Garner, Mogg and Bradley (2006) conducted an illusory correlation task. HSA and LSA participants were asked to estimate the likelihood of a pleasant, unpleasant or neutral picture from the International Affective Picture System (IAPS) (Lang, 1999), or no picture at all being presented following an angry, happy or neutral face from the Ekman and Friesen (1976) face set. Expectancies of unpleasant pictures following angry faces decreased as the task progressed across anxiety groups. This suggests that an element of learning had occurred over the whole sample.

However whilst low anxious individuals consistently overestimated the likelihood of pleasant pictures following happy faces, this decreased over the course of the task in high anxious participants. This may indicate that a positivity bias superseded conditioning in the low anxious groups only. Moreover as the task progressed, high anxious participants increasingly expected an unpleasant picture to follow a happy face. This may provide evidence of a negativity bias in the high anxious group which may be due to the accumulation of angry faces. It is possible that less anxious individuals find it easier to treat each face as a discrete event whilst high anxious individuals may more aware of the increasing accumulation of negative faces as the task progressed.

This may indicate that a positivity bias superseded conditioning in the low anxious groups only. Moreover as the task progressed, high anxious participants increasingly expected an unpleasant picture to follow a happy face. This may provide evidence of a negativity bias in the high anxious group which may be due to the accumulation of angry faces. It is possible that less anxious individuals find it easier to treat each face as a discrete event whilst high anxious individuals may more aware of the increasing frequency of negative faces as the task progressed resulting in the number of faces being observed increasing over time.

In support of this, in post-task measures, high anxious participants overestimated the percentage of angry faces presented. Therefore changes in expectancies of negative external social cues across task time points may be an important factor that is overlooked in many studies. It may be the case that as a socially threatening situation progresses low anxious people relax more because they are more focused on positive expectations of public evaluation whilst high anxious people may become more anxious because of the mounting evidence of negative social feedback that they received by being more focussed on negative expectations.

It may be argued that negative expectancies reflect a higher degree of criticality in socially anxious individuals to other's performances as well as their own. However, Boschen and Curtis (2008) found no relationship between criticality of others and social anxiety. This suggests that fear of negative evaluation in socially anxious individuals is self-referential.

Overall, in terms of memory biases, the picture is generally somewhat inconclusive. There is some evidence of self-referential memory biases and some evidence for enhanced memories of negative social cues although this may be interpreted as reduced memory for approving social responses. However, it is not clear what the role of attention is in any memory biases. Evidence suggests that negative interpretation and a deficit in positive interpretations of ambiguous social responses may be present in socially anxious individuals. Similarly, negative expectations and a lack of positive expectations may also have a role in precipitating attention to faces but this may be mediated by the degree of self-relevance of the face and by changes across time.

Attentional biases

As well as cognitive biases, information processing biases such as increased or reduced attention to faces may have important implications for the developmental trajectory of social anxiety because as Mathews, & MacLeod, (2002; 2005) have suggested, they may contribute towards vulnerability for anxiety. Typically biases in attention as a function of social anxiety have been investigated in static face paradigms. However, such paradigms may neglect the relationship between expectations and attention. Leary, Kowalski and Campbell (1988) found that highly socially anxious participants adopted more negative expectations during an imagined social interaction whilst low socially anxious participants assumed that they would be evaluated more positively than others. Moreover, socially anxious individuals tended to draw negative interpretations from even the briefest glances in their direction.

Although Clark (2001) has suggested that a brief glance of a negative behaviour such as a frown can be perceived by a socially anxious individual during a social situation, he has suggested that this directly precipitates a shift in attention towards the internal environment (i.e. the self) rather than any on-going engagement with the external environment (i.e. the audience). This assertion has most notably been tested using the dot probe task. Typically an emotional face is presented alongside a neutral one, followed by a probe in the location of one of the faces at a presentation interval of 500ms. Faster probe identification indicates the location of the previously attended to face. Results at 500ms (i.e. Chen, Ehlers, Clark and Mansell, 2002) indicate that socially anxious participants demonstrate an attentional bias for objects (i.e. clocks; sofas; vacuum cleaners; telephones) compared to faces, have been taken to suggest avoidance of faces soon after awareness.

Yet this inference may be based on a dubious assumption since it may reflect an effortful avoidance of external cues rather than an automatic shift of attention towards internal processes. The avoidance of all facial expressions may reflect a cost/benefit goal directed strategy to avoid potential threat as soon as attention comes under conscious control. It could equally be argued that information elicited from a brief single glance during a social situation would feed an online negativity bias which may precipitate on-going engagement with the audience to monitor social cues. Equally, this could facilitate strategic avoidance of sustained eye-contact which is not wholly driven by attention to the self. Rather the individual could be ruminating on the perceived thoughts of the evaluator about their performance to a greater or equal amount than self-directed thoughts.

Crowe and Higgins (1997) have suggested that the ideal self is based on a promotion focussed approach (i.e., if you practice this then you will be evaluated more positively) whilst the ‘ought self’ is based on a prevention focussed approach (i.e., if you do not perform well, you will be evaluated negatively). Therefore, fear of negative evaluation may create a negative expectancy that relies on interaction with the external environment to maintain anxiety. This would require attention and online processing of the external environment.

Schultz and Heimberg (2008) suggested that there is evidence in socially anxious individuals for both internal and external attentional processing. Whilst some studies have provided evidence for enhanced attention to threat faces (Klumpp and Amir, 2009; Pishyar, Harris and Menzies, 2008; Mogg and Bradley, 2002; Mogg, Philippot, & Bradley, 2004; Sposari and Rapee, 2007), others have found that this is followed by avoidance (Amir, Elias, Klumpp, & Przeworski, 2003; Mogg& Bradley, 2002; Chen, Ehlers, Clark, & Mansell, 2002; Mansell, Clark, Ehlers, & Chen, 1999; Mogg, Philippot and Bradley, 2004; Stirling, Eley and Clark 2006). Yet other studies have failed to find any evidence of attentional biases in social anxiety (Clark, & Chen, 2002; Gamble and Rapee, 2009; Horenstein & Segui, 1997; Kanai, Nittono, Kubo, Sasaki-Aoki and Iwanaga, 2012; Mansell, Clark & Ehlers, 2003; Pineles and Mineka, 2005). Staugaard (2010) reviewed evidence of attentional biases to threatening faces in social anxiety and found limited support for early vigilant biases to threat faces, indicated by enhanced attention at 500ms in dot probe tasks and no evidence of maintenance biases, whereby an individual has difficulty in disengaging their attention from a threat face.

Evidence of vigilance-avoidance (i.e., early enhanced attention towards threat faces followed by subsequent avoidance of them) can be taken as support for the Clark and Wells model of anxiety. Yet this would only hold for avoidance from faces per se rather than avoidant biases to particular facial expressions that may signal a social threat, which would support the latter model because attention to particular faces in the audience would counter the motion of reduced attention to faces. Stirling, Eley and Clark (2006) found a general late avoidance of negative faces at 1000ms. Late avoidance biases may suggest that individuals are able to disengage attention from the face once attentional processing is fully under conscious control although they appear to extinguish at 1250ms (Mogg, Philippot and Bradley, 2004).

However, several criticisms have been made of dot probe tasks (Amir, Freshman, & Foa, 2002; Asmundson & Stein, 1994; Lee & Telch, 2008). For example whilst many studies have taken attention to negative faces at 500ms to be an indicator of vigilance and the lack of a negative bias at later time points to signal avoidance, critics suggest that vigilance actually occurs much earlier at around 100ms (i.e. Cooper & Langton, 2006; Miskovic & Schmidt, 2012). Thus, biases observed at 500ms actually indicate disengagement difficulties in anxious individuals. Indeed, evidence of avoidant biases at 500ms may represent an exaggeration of a general pattern of attention to threat faces.

On the other hand, evidence of enhanced attention in socially anxious individuals at 500ms compared to low anxious individuals may suggest a difficulty in disengaging from a threat face providing that it could be shown that they had attended to the face prior to this. This interpretation would be consistent with the Rapee and Heimberg model, which includes hyper-scanning of the environment for negative social cues as well as disengagement difficulties from them. If socially anxious individuals display very early vigilant biases then it is possible that enough information is being drawn from external sources to make interpretations at 500ms when more elaborative conscious processing is involved and this may result in threat monitoring behaviours at 500ms for some anxious individuals yet avoidance in others who are better able to regulate their attentional processes. Indeed Bogels and Mansell (2004) suggested that the relationship between attentional control (i.e., the way that individuals can control their attention towards a goal oriented stimuli and ignore an irrelevant stimuli) and attentional biases in social anxiety should be explored.

Dot probe tasks have unearthed a little evidence of high anxious participants paying more attention to internal information such as information about heart rate or to identifying a vibration from an electrode attached to the finger rather than face photos (Pineles and Mineka, 2005; Kanai et al., 2012). However, these and several other studies have found no evidence of increased or reduced attention to threat faces (e.g. Bradley, Mogg, Millar & Bonham-Carter, 1997; Gotlib, Kasch, Traill, Joormann, Arnow, & Johnson, 2004). Indeed problems with the dot probe task and other attention measures led Staugaard (2010) to conclude that eye-tracking is likely to yield more reliable evidence in measuring visual attention. This may be able to expose attentional biases at later presentation intervals. Whilst the dot probe paradigm can provide information about where a single location of attention at a single point in time, eye-tracking enables monitoring of multiple fixations in various locations across the entire time course of each trial (Armstrong & Olatunji, 2009). This means that different biases across 100-500ms or 500-1250ms for example, can be measured.

Gamble and Rapee (2009) used an eye-tracking paradigm with pairs of faces versus face/object pairs and found that that in contrast to the findings of Chen et al. (2002) all participants regardless of social anxiety attended more to faces than objects. Furthermore, there was evidence of vigilant biases for angry and happy faces (demonstrated by a higher proportion of fixations for these faces compared to neutral faces) in the social phobic group only up to 500ms, which were no longer apparent during later time courses. Conversely, in a recent eye-tracking dot probe study

(Schofield, Johnson, Inhoff & Coles, 2012), there was a significant correlation between social anxiety and the time spent fixating on angry faces across presentation times of 500ms, 1000ms and 1500ms.

Studies that have used social stressors have achieved yet more diverse results with regard to vigilance. Sposari and Rapee (2007) included a socio-evaluative speech task condition by telling participants prior to the dot probe task that they would be required to participant in a subsequent speech task during which they may be asked to detect negative responses from the audience. Participants in the social phobia group demonstrated higher vigilance for all faces regardless of emotion or social threat condition. Using eye-tracking Garner, Mogg and Bradley (2006) found that in a no stress condition, highly socially anxious participants demonstrated a higher attentional preference for neutral faces relative to objects compared to the low socially anxious group. However, in the stress condition the pattern reversed. Helfinstein, White, Bar-Haimand and Fox (2008) also found that the pattern of vigilance for threat cues associated with high social anxiety held when participants were primed with neutral words but not when primes involved threat words. This was interpreted as indicating that the shift in attention at 500ms may be due to participants having enough time to be able to process the meaning of the word prime in relation to the face.

Furthermore, low anxious participants, in line with literature suggesting that humans have a general disposition towards threat cues (i.e. Cooper & Langton, 1995), demonstrated a vigilant bias for angry faces indicated by enhanced attention to angry relative to neutral faces in the threat prime condition but not in the neutral one. The high anxiety group may have been generating faster automatic negative cognitive threat schemas than low anxious participants which could enable greater facilitation of threat words and congruent threat (angry) faces. This may have precipitated a withdrawal response from the threat face thereafter in the form of reduced attention.

However, as Staugaard (2010) has cautioned, there have been many inconsistencies in the ways in which dot probe studies such as these have been conducted including a mixture between clinical and non-clinical samples; different face sets and experimental conditions; considerable variations in group sizes and differences in relation to the presence of a threat condition. This makes it somewhat difficult to evaluate the empirical support for the existence or role of attentional biases in social anxiety. Evidence of attentional biases in social anxiety has been more conflicting in other static face paradigms. For example, Lee and Telch (2008) found evidence of vigilant biases to angry faces using a sustained inattentional blindness paradigm. Participants in a speech threat condition were more likely to detect the frowning face than the happy face regardless of anxiety. However, in the threat condition the high social anxiety group identified frowning faces significantly more than the low anxiety group.

Yet other tasks have failed to support attentional biases in social anxiety. For example, Lange, Heuer, Reinecke, Becker and Rinck (2008) found no effects using an inhibition of return task. Similarly, de Jong and Martens (2007) found no attentional differences across anxiety groups in an attentional blink task. Nor did Juth, Lundqvist, Karlsson and Öhman (2005) using a visual search task. This highlights the difficulties of interpreting attentional biases across different types of stimuli and tasks. Measures of social anxiety across tasks have included the Anxiety

Disorders Interview Schedule for DSM-IV (ADIS-IV; Brown, DiNardo & Barlow, 1994); FNE (Watson and Friend, 1969); (Leary, 1983); Liebowitz Social Anxiety Scale (Liebowitz, 1987); Social Phobia and Anxiety Inventory (Turner, Beidel & Dancu, 1996) Revised Cheek and Buss Shyness Scale (Cheek, 1983); Self-Consciousness Scale (Fenigstein, 1975); Social Phobia Inventory (Connor et al., 2000); Social Interaction Anxiety Scale (Mattick & Clark, 1998). It is possible that these scales measure different aspects of social anxiety with the result that attentional patterns associated with high scores on one scale may not be associated high scores on another scale.

Face sets have been varied including stimuli from databases such as Ekman & Friesen, 1976; Lundqvist, Flykt & Öhman, 1998; Martinez & Benavente, 1998; Matsumoto & Ekman,1988; Tottenham et al., 2009. This may be problematic as Adolph and Alpers (2010) reported higher arousal ratings for the Nim Stim faces set (Tottenham et al., 2009) than for the Karonlinska Directed Emotional faces set (Lundqvist, Flykt & Öhman, 1998). Therefore, attentional patterns may be influenced to some extent by the nature of the stimuli as some face sets may appear to be more socially threatening than others. Participant numbers have also varied greatly, ranging from 11 socially anxious participants in some studies to almost 40 per group in others. Furthermore, tasks that have found group differences in ERP data have often failed to find significant effects in behavioural data.

For example, Moser, Huppert, Duval and Simons (2008) conducted a modified flanker test where a reassuring (happy/surprised) face or threatening (anger/disgust) photo was flanked on either side by a photo of the same (congruent) face or different face (non-congruent) face. The task was to indicate the emotion of the central face and behavioural measures included reaction time and accuracy. ERP data suggested that low anxious participants had an early processing bias for positive faces, indicated by fronto-central activation. In contrast high anxious participants had a threat processing bias, indicated by occipito-temporal and parietal activation, during later elaborative processing stages when the meaning of the face is processed.

The authors posited that the overriding of positive activation by a posterior controlled negative bias is in line with attentional control theory (Eysenck, Derakshan, Santos & Calvo, 2007) in which a stimulus driven system (which makes socially anxious individuals sensitive to indicators of social threat) interferes with goal pursuit in attention. In other words, socially anxious people may be less able to inhibit a threatening face. In a social situation there is a possibility that this could result in a strain on processing efficiency, possibly resulting in less attention to the task. Yet no group differences emerged for the identification or reaction time, which casts doubt on this interpretation. A discrepancy between ERP data and behavioural measures was also found by Kolassa and Miltner (2006) whilst others have found no evidence of differences in either types of measure (Kolassa et al., 2007; Kolassa et al. 2009).

Therefore, the picture emerging from static face paradigms regarding attentional biases in social anxiety is largely inconsistent and at times conflicting. Moreover, the relationship between attention on static face paradigms and performance in social situations is tenuous. For example, evidence of vigilance-avoidance using a static face paradigm cannot capture the cycle of attentional shifts that may occur during a performance situation to a dynamic audience. Therefore brief vigilance followed by reduced attention to a negative face or to faces in general in a static face paradigm fits with the Clark and Well's (1995) model of social anxiety which suggests that brief attention to a negative social cue will precipitate a total shift in attention towards internal processes. However it cannot be assumed that a single shift in attention as captured by a task such as the dot probe task can represent the process during a social performance. None of the aforementioned tasks have investigated the effect of viewing emotional faces on the reported feelings of anxious participants towards themselves as a result of viewing them, nor how this is affected by context. It may be the case that the reason that there were discrepancies between the ERP data and behavioural measures in these studies was because the behavioural measures (i.e., reaction time or accuracy) were not socially relevant to the participant. Attributions or self-esteem measures may be important in relation to social anxiety alongside categorisation and speed or processing as they may more accurately indicate the cognitions during social cue processing.

In a review of the evidence supporting attentional biases, Schultz and Heimberg (2008) have suggested that although avoidance is a feature of many of the paradigms using static face photos, there is no evidence for this in more ecologically valid paradigms using real speech tasks. This suggests that attentional biases may not be an integral component of social processing in situ (i.e. during a performance to a live audience). Rather it appears that online interpretation biases in which seemingly negative social responses are perceived from audience faces or gestures may help to drive the cycle of social anxiety. Only a few studies have used more ecologically valid live speech tasks but attention has not been measured directly in these (e.g. Kanai, Sasagawa, Chen, Shimada & Sakano, 2010; Perowne & Mansell, 2002; Pozo, Carver, Wellens & Scheier, 1991; Veljaca & Rapee, 1998). Thus, whilst previous speech task studies have been highly instrumental in gaining knowledge of differences in interpretations and awareness of social audience responses across levels of social anxiety, without direct attention measures, the attentional processes must be inferred.

Yet it is possible that an online negativity bias could ensue from brief attention to audience faces and gestures that is relatively equal across anxiety groups. The crucial factor may the way in which the social cue is interpreted as it is encountered by the observer rather than how much attention is paid to it after the initial impression has been formed. Evidence of different attentional patterns across social anxiety groups using static face paradigms can indicate differences in processing styles across groups but shed little light on how these differences relate to the maintenance of anxiety in a social performance situation. Moreover, whilst many studies of emotional face processing have found conflicting evidence of attentional patterns, relatively little work has been conducted on the interplay between social context, anxiety, attention and awareness in social cue processing.

Indeed, there is evidence from gaze perception paradigms to suggest that awareness of social cues may differ across anxiety groups independently of attention. Gamer, Hecht, Seipp and Hiller (2011) asked participants to adjust the eyes of a virtual head to an area of perceived mutual gaze from one or two virtual observers. HSA individuals perceived that they were being looked at with a more liberal criterion of head direction than participants did, only when more than one observer was present.

More recently, Schulze, Lobmaier, Arnold and Renneberg, B. (2013) presented high and low socially anxious participants in a web based study with angry, fearful, happy and neutral facial expressions for 300ms, in which gaze was manipulated away from the participant in increments of 0°, 2°,4°,6° and 8°. Participants were then asked to indicate whether the face was looking directly at them or not. Results indicated that the more socially anxious participants were, the more they perceived gaze to be directed towards them in negative or neutral faces but not by positive faces. In addition, socially anxious participants were faster to respond to perceived direct gaze in the 0°, 2°, and 4° gaze conditions, which was indicative of the highest social threat.

Similar evidence of a wider cone of gaze in socially anxious individuals has also been provided by Harbort, Witthöft, Spiegel, Nick, & Hecht, (2013) and Young, Mareschalb, Cliffordb, & Daddsa (2013) although in the latter study this was only the case for male socially anxious participants. Differences in gaze perception may be underpinned by enhanced automatic processing in socially anxious individuals. Dumas et al. (2013) suggested that the amygdala is involved in emotional face processing at various temporal stages, with gaze direction (marked by activity between 190 and 350 ms) exhibiting greater activity for direct compared to averted gaze and gaze processing following the expression categorisation process.

Aims and structure of thesis

The aim of this thesis is to investigate the interplay between trait social anxiety, salience of emotional social cues, context and awareness in static and dynamic social cues. More specifically, the existence of online negativity bias and the relationship between this and attentional patterns is investigated. The role of attention and self-referential evaluative context and how each interacts with salience in face processing is first investigated in Chapter 2 before being considered in relation to attentional control in Chapter 4 using static face paradigms. The role of salience and awareness of social cues are investigated in a static face paradigm in Chapter 3 and with dynamic social cues in Chapter 6. Valence categorisation is also investigated first with static faces in Chapters 2 and 3 and then with dynamic social cues in Chapter 5 and 6. In Chapter 7, in the general discussion, a cohesive narrative is provided to link the studies together and consider the implications for the future of social anxiety research.

Chapter 2

Abstract

The role of self-relevance and expectations have been somewhat neglected in static face processing paradigms but may be important in terms of understanding how emotional faces may impact on attention and cognitions. The aim of Study 1 was to investigate the effect of self-relevant evaluative context on attention and cognitive responses to static faces. Sentence primes created an expectation of the emotion of the face before sad, happy, neutral or composite face photos were viewed. Eye movements were recorded and keypad responses were used to measure categorisation and cognitions about the face. Context had no influence on guiding attention but did affect the degree of perceived emotion on the face, internalisation and self-esteem. Self-relevant expectations about the emotion of a face and subsequent attention to a face that is congruent with these expectations appear to create a stronger effect at a cognitive level than when expectations and the perceived emotion on the face are incongruent.

An investigation of the relationship between expectations and salience in emotional face processing using an eye-tracking paradigm

The Rapee and Heimberg model of social anxiety (1997) postulates that attention to negative external social cues is integrated with negative self-focus. Thus, negative self-referential information such as memories and expectations of poor performance or self-perceived signs of anxiety should have a greater impact when it coincides with attention to a negatively perceived face. It is possible that scanning for such cues, as the model suggests could take place in the early stages of a social situation as a result of automatic processing. However, if the individual actively ruminates on the negative facial expression and on the cognitions of the evaluator rather than exclusively on their own self-image then it supports the Rapee and Heimberg model.

Eyes have been highlighted as having a particular role in social cognition (Itier & Batty, 1999) and may hold a special relevance for socially anxious individuals as a means of conveying the evaluative meaning behind the facial expression. Horley, Williams, Gonsalvez & Evian(2004) tracked the gaze of individuals with social phobia using free view eye-tracking and found that the Social Phobia group displayed wider scan paths and had fewer fixations to angry eyes than did controls. Scan paths are the trajectory of patterns between eye movements (saccades) and foveal fixations and they provide a direct measure of attention unlike tasks such as the stroop or the dot probe tasks (Horley et al. 2004). However, it is not clear whether this avoidance was because the eyes are used as a source of categorisation of the facial expression or as an attempt to read the cognitions underlying the apparent emotion. Alternatively, this differential pattern could simply indicate variation in automatic processing styles across social anxiety groups without any significant underlying cognition driving it.

Emotional face processing

Langner, Becker and Rinck (2009) have provided some evidence for differences in the way that socially anxious individuals use visual information to categorise facial expressions at a subconscious level. They used the ‘Bubbles’ paradigm (Gosselin & Schyns, 2001) in which Gaussian masks are used to restrict viewing conditions to a small circular image, which can convey different frequency bands in the image. Low spatial frequency (LSF) information involves simple configural information whilst high spatial frequency (HSF) information involves more complex information like contours. High social anxiety participants used both HSF and LSF information from eyes and LSF information from noses and mouths to categorise the emotion of the face. In contrast their low social anxiety counterparts used only HSF information from facial features. Yet there were no differences in categorisations of the face, suggesting that different visual information can be used by socially anxious individuals without categorisation being affected. Thus avoidance of eyes such as found by Horley et al. (2004) may be due to the ability of socially anxious people to obtain information from peripheral areas rather than direct observation of the feature. Moreover, the authors suggest that this tendency to use low LSF information may be directly linked to increased amygdala activity, which may precipitate scanning behaviour.

In support of a more configural processing style in socially anxious individuals, Gentilli et al. (2008) presented participants in an fMRI study with angry, disgusted, fearful, happy and neutral faces as well as scrambled pictures. Social phobics demonstrated greater activity in response to all faces compared to the scrambled picture in the left amygdala, insula and bilateral superior temporal sulci. These are areas that have been implicated in arousal, emotional face processing and interpersonal communication (Narumtoa, Okadab, Sadatob, Fukuia & Yonekurac, 2001; LoPresti, Shun, Tricarico, Swisher, Celone, & Stern, 2008). Decreased activity in Social Phobia participants compared to controls was found in the fusiform gyrus, left dorsolateral prefrontal cortex and bilateral intraparietal suclus, involved in contour processing (i.e. shapes of individuals facial features) (Heekeren, Marrett, Ruff, Bandettini & Underleider, 2006; Narumotoa et al., 2001).

This indicates that socially anxious individuals may rely more on processing the relationship between the features (configural processing) when discriminating facial expressions as Langner at al. (2009) suggested. Yet it is possible that higher cognitive processes also have a part to play in configural and feature processing in terms of willingness to engage with facial features that may appear to be socially threatening. Furthermore, not all studies have found evidence of different processing styles. For example, Furmark, Henningsson, Appel, Åhs, Linnman, Pissiota et al. (2009) found no group effects in amygdala activity through PET scanning measures in response to angry or neutral face photos. However the high social anxiety group reported higher levels of anxiety following all faces regardless of the expression. This may suggest that more elaborative higher order processes may have been involved when processing the faces resulting in higher anxiety rather than simple automatic processing differences as previously suggested.

Typically face identification is associated with increased fixations to the eye and mouth area in a triangular pattern (Groner, Walder & Groner., 1984; Henderson, Williams & Falk, 2005; Walker-Smith, Gale & Findlay, 1977, Yarbus, 1967). Itier and Batty (2009) suggest that the greater attention to the eye area generally is due to the degree of rich information that can be elicited from eyes. However, as discussed below, there is some debate regarding the nature of emotion categorisation in terms of the dominance of configural (relationship amongst the features) or featural (parts based) processing. This may be important in terms of how socially anxious individuals avoid negative features relatively to other emotional features since it may be due in part to how particular features are processed generally rather than simply a function of the anxiety.

Calder, Young, Keane and Dean (2000) split face photos into two different facial expressions on the top and bottom halves of the face. Face composites were either aligned to create the impression of a whole face or were misaligned. Whole faces were found to be processed more rapidly, suggesting a congruency effect with the top and bottom features being processed in accordance with each other. Taken separately, anger, fear and sadness appeared to be processed on the basis of the upper face whilst happiness and surprise were categorised on the basis of the bottom half. Schyns, Petro and Smith (2007) suggested that different emotions are routinely categorized in different parts of the face due to the salience of features (whites of eyes and size of mouth). However, both Calvo and Nummenmaa (2008) and Fox and Damjanovic (2006) argued that both feature based and configural processing play a part in detection of emotional faces.

Indeed Calvo and Nummenmaa (2008) concluded that configural processing was more important when processing fearful, angry and sad targets. In contrast happy, surprised and disgusted features were more associated with featural processing. This could help explain differences between socially anxious and non-socially anxious individuals in terms of the features that they may be likely to pick up on. High socially anxious individuals may be more inclined towards configural processing as Langner et al. (2009) have suggested and if Calvo and Nummenmaa (2008) are correct in their assertions that angry features are associated with configural processing, then highly socially anxious individuals may be more likely to be aware of angry faces. This may in turn give rise to a more negative impression of an audience. In contrast low anxious individuals are more inclined to feature based processing as Langner et al. (2009) have suggested then they may be more likely to notice happy features, which have been associated by Calvo and Nummenmaa (2008) with featural processing, thus a more positive impression of an audience may ensue. If socially anxious individuals have an advantage for configural processing then it is possible that they automatically avoid angry eyes due to superior ability to gain knowledge through more general scanning of the face rather than focussing on the contours of the features.

However, face processing may be also context dependent. Martin, Slessor, Allen, Phillips and Darling (2012) suggested that processing may be influenced by task demands. For example, in more difficult processing circumstances such as brief presentation intervals, local processing would be employed, whilst in a less demanding task and during automatic processing, a configural approach would be adopted. In further support for context effects, Malcolm, Lanyon, Fugard and Barton (2008) suggested that attention is not directly coupled with fixations which were argued to be guided by top down goal directed strategies as well as perceptual processes. Information encoded during shifts between fixations could influence the location of the subsequent fixation and this may be driven by tasks effects and contextual information.

An example of the influence of top down strategies may be the influence of expectations on attention. Cho and Telch (2005) found using structural equation modelling that negative self-referential statements were associated with social anxiety as was the absence of positive self-referential statements. It is possible that the effect of self-generated context in the form of expectations may prime the perception and potentially attentional processing of a face. Indeed evidence suggests that accurate face categorisation is enhanced when expectations are consistent with the emotion of the face observed (Barbalat, Bazargani & Blakemore, 2012) and that context can guide fixations (Aviezer et al., 2008). Thus if negative self-generated contextual information guides categorisations and fixations toward negative social cues, this may result in hyper-vigilance or avoidance of negative faces or facial features.

Furthermore, if context guides fixations and fixations are not coupled to attention as Malcolm et al. (2008) have suggested given the influence of context and information gained during shifts in attention, then avoidant biases in social anxiety may be the result of negative information deduced from relatively few fixations to negative stimuli. If so, a negative interpretation bias could be maintained directly from online processing rather than simply from memory or lack of affirmation from observing positive information. Evidence suggests that socially anxious individuals are no less accurate at identifying discrete facial expressions (Philippot & Douilliez, 2005). This may be because as Calvo and Nummenmaa (2008) found, emotional faces have rapid detection rates of 100ms after stimulus onset with emotion discrimination occurring at 200ms. Therefore, avoidance of faces after just one or two brief fixations would provide the socially anxious person with all of the social information that they need to successfully categorise a face.

However, if emotion is categorised in the mouth area as Malcolm et al. (2008) suggested then it seems counterintuitive for socially anxious individuals to be avoiding socially threatening eyes unless the eyes have a social function other than simple categorisation. Rather avoidance of negative eyes may be due to their role in being perceived to convey information about the cognition underlying the motion. If the cognition is assumed to be negative and self-referential then avoidance of sustained contact may predictably ensue.

In subsequent chapters, the relationship between fixations, attention and social anxiety will be more directly investigated. However, in the current study the focus was on measuring the effect of context and configuration of features on attention to emotional facial features and emotional interpretations in participants from a general population. By doing this it was reasoned that the effect of prior expectations on attention, interpretation of social cues and the effect on the individual could be investigated. In order to evaluate the effect of context at a cognitive level, the effect of positive, negative and neutral contextual information that was directed towards or away from the perceiver was investigated. This reasoning was grounded in the results from previous studies detailed below regarding the effect of context manipulation. Providing a narrative expectation may mimic the internal narrative about others' evaluation of their performance experienced by socially anxious individuals.

Manipulation of context and expectations

Context manipulation has been trialled with performance satisfaction and with social scenario interpretations. For example, Baldwin, Granzberg, Pippus and Pritchard (2003) found in a general population that visualization of an accepting face was associated with greater performance satisfaction than visualization of a critical face. Murphy, Hirsch, Matthews Smith and Clark (2007) found that manipulating written scenario endings to have a non-socially threatening meaning resulted in significantly less negative interpretations to ambiguous scenarios and significantly lower anticipated anxiety ratings than with neutral endings. Similarly, Sherwood, Shroeder, Abrami & Alden (1981) found in a mood induction study that positive and negative self-referential statements were related to elation and depressive mood respectively. However, only positive self-referent statements such as "I have much to look forward to" reduced anxiety compared to negative self-referent statements, e.g. "I have very little to look forward to"; positive non-self-referent statements, e.g. "The future looks promising if not downright exciting" and neutral primes, e.g. "Agricultural products comprised seventy percent of the income".

Study 1 An investigation of the effect of context and emotional features on eye movements and dimensional categorisation in emotional face processing.

The aim of the current study was to investigate the relationship between context (i.e. public evaluation) and processing of facial features to evaluate the role of cognitive processes in face processing. The focus was the relationship between congruent context and facial expressions in order to explore the link between expectations, attention to and interpretations of emotionally perceived faces. In order to investigate the effect of these factors on attention, categorisation and social cognition, several hypotheses were generated.

I. With regard to eye-movements, it was firstly hypothesised that in line with Groner et al. (1984) and Itier and Batty (2009) a higher proportion of fixations and dwell time would be made to the eyes in general. This hypothesis simply aimed to confirm established face processing patterns before going on to distinguish the effects of context and configurations on more subtle differences in attention.

II. In line with Malcolm et al. (2008), in incongruent composite faces (i.e. happy eyes and sad mouth or vice versa), context would combine with salience cues (i.e. eyes/ mouth shape) to guide fixations towards the feature congruent with the context (i.e. sad eyes when context is negative and happy mouths when context is positive). This hypothesis was aimed at investigating the possibility that prior expectations regarding the cause of the facial expression would guide participants' attention to features that were compatible with this expectation.

III. In the absence of context effects, whereby an explanation for the expression on the face is provided (e.g. with neutral primes), in line with the findings of Calder et al. (2000) attention and categorisation would be based on the salience of the feature. Specifically, happy mouths would be more salient than sad mouths and sad eyes would be more salient than happy eyes because sadness has been associated with processing from the eyes and happiness from the mouth area. This hypothesis aims to demonstrate the power of negative eyes to command attention in order to highlight that avoidance of negative eyes in socially anxious people is unlikely to be due to them being less salient than neutral or positive eyes. Moreover, differences in attention under context free conditions would serve to highlight the influence of context on guiding fixations.

IV. In accordance with Rapee and Heimberg (1997) (i) categorisation, (ii) internalisation of the emotion on the face (i.e. the degree to which the expression on the face has been caused by the viewer) and (iii) the impact on self-esteem would be intensified with congruent self-referential expectations that the expression on the face has been caused by the viewer. If this is the case then the act of paying attention to the face is important from a cognitive perspective, which would support the perspective of the Rapee and Heimberg (1997) model.

Method

Participants

19 participants (3 male; 16 female aged 18 to 54; mean age = 30) were recruited through the University of Strathclyde's virtual learning environment; posters displayed around the campus and local businesses; local classified ads and community websites. They were invited to take part in return for being entered into a draw for a digital MP3 player. Sample size for the experimental phase was based on other eye-tracking/attentional bias studies (i.e. Pflugshaupt et al., 2005; Rinck & Becker, 2006; Mogg, Millar & Bradely, 2000).

Ethical approaval was obtained from the School of Psychological Sciences and Health Ethics committee. Inclusion criteria included English speakers with normal or corrected-to-normal vision, free from visual deficits. Exclusion criteria included a history of substance abuse for past two years; a current or recent psychiatric disorder or neurological illness. Current levels of negative mood were controlled for by administering the self-report 21 item self-report Beck Depression Inventory II (Beck, Steer & Brown, 1996). The BDI-II has high reliability, coefficient alpha (.93) for undergraduate students and (.92) for clinically depressed participants. All participants scored below clinical levels of depression with scores ranging from 1 to 19 and a mean score 6.79 (SD = 5.39). Social anxiety was not tested for in this study because the aim was to investigate the general effect of context and salience of features on attention to and interpretations of faces.

Design

Eye movement data were analysed in two separate feature x prime x configuration (3 x 5 x 5) repeated measures ANOVAs for proportion of fixations and proportion of dwell time to features. The first repeated measures factor 'feature' included eyes, noses and mouths. Context was manipulated through the 'prime' factor with five types of prime including positive (self or non-self-referential); negative (self or non-self-referential) or neutral prime statements. The third factor 'face configuration' included five different face types comprised of happy eyes/happy mouth (happy); sad eyes/sad mouth (sad); happy eyes/sad mouth (happy/sad); sad eyes/happy mouth (sad/happy) and neutral. All emotional faces were composite with neutral noses. Manual responses to questions regarding categorisations, internalisation and self-esteem were analysed in a further series of prime x configuration (5 x 5) repeated measures ANOVAs. Likert scale face valence categorisation and self-esteem responses ranged from 1 (extremely positive) to 5 (extremely negative) and internalization responses where responses ranged from 1(definitely not) to 5(definitely).

Apparatus and Stimuli

250 prime statements were constructed to be positive, negative or neutral and self or non-self-referent with only the target words changed in valenced statements so that each was of equal length and structure. These prime statements were validated in Pilot Study A (Appendix I(i)). Examples of these are provided in Appendix I(ii). An example statement was 'Kate was convinced that with [you] or [them] the night would be a [disaster] or [success]'. Neutral primes included statements such as 'Kate opened the window'.

30 photo face stimuli: 5 male (models 21M; 22M; 23M; 24M; 28M) and 5 female models 01F; 02F; 3F; 05F; 06F) consisting of three emotional sad, happy and neutral expressions were selected from the NimStim Set of Facial Expressions (Tottenham et al., 2009). Several studies have used chimeric faces with different emotions being presented on each side of the face (i.e. Luzzi, Piccirilli & Provinciali, 2007; Kucharska-Pietura, David, Dropko, & Klimkowski, 2002) but in order to investigate the effects of the independent variables on attention to eyes or mouths, faces in this task were split horizontally to produce oppositely valenced expressions on the top and bottom half of the face (i.e. Calder et al., 2000). Areas of interest were standardised across faces of the same identity and expression.

Composite faces were constructed using Photoshop elements 5 by combining various arrangements of happy or sad upper face portions from the eye area (defined above the bridge of the nose); lower face portions from the mouth down (defined from the tip of the nose down) with neutral mid sections (including the nose). This gave rise to 5 valences for each model denoted by eye/mouth emotion: happy eyes and mouth (happy); happy eyes and sad mouth (happy/sad); sad eyes and happy mouth (sad/happy); sad eyes and mouth (sad) and neutral eyes and mouth (neutral). These are illustrated in Figure 1.1. Happy and sad open mouthed features were selected to test for salience because they both revealed salience cues such as whites of teeth and upward or downward curves in the mouths, but sadness is less likely to be associated with social or environmental threat so processing is not likely to be influenced by arousal in the same way that anger or fear faces might be although sad faces could signal social disappointment.

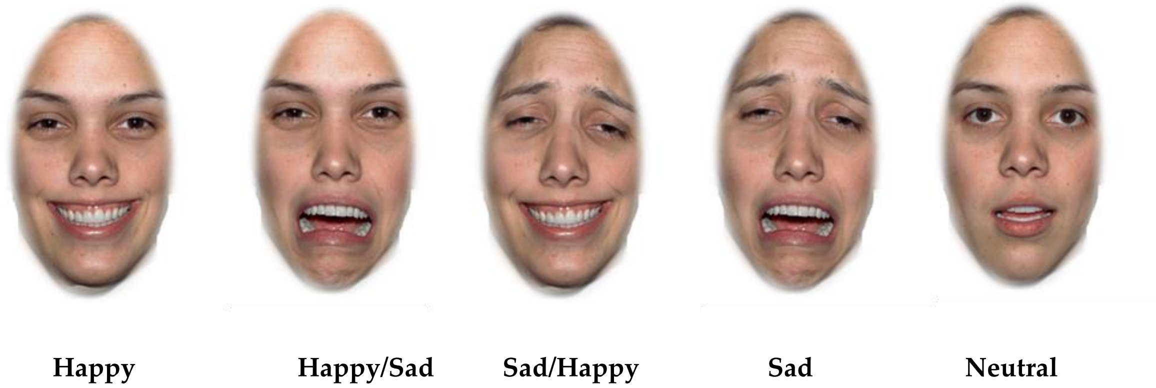

Figure 1.1 *Composite face types*

Face configurations were presented centrally on a ViewSonic G90ft 19 inch colour monitor attached to a Phillips personal computer controlled by SR Research Eyelink (SR Research Ltd., Mississauga, Ontario, Canada) software. The programme that controlled the software was specifically designed for the experiment using Experiment Builder software (SR Research, Canada). Each face was matched for skin colour and differences in hair and sizes were controlled for by framing the pictures with standardised ovals (height: 17.2 ˚ x width: 13.9˚). Each individual face was presented once with each prime type for a total of 250 trials so that there were 10 presentations of each face type for each prime type presented over five blocks.

Procedure

Each experimental trial consisted of the presentation of five sequential screens on a PC monitor. Prior to the experiment, the information sheet was presented and the consent form was signed. The BDI II (Beck et al., 1996) was also completed. Immediately prior to the experimental task, and prior to each of the five trial blocks participants completed a nine-point calibration sequence. This consisted of recording participants gaze while fixated on a central white fixation dot with a diameter of 0.5˚ presented on a black screen and then tracking their gaze as they followed the dot sequentially around the nine grid points on the screen. Successful calibration was followed by a repetition of the process during the validation stage.

At the beginning of each trial, the participant was presented with a prime for 2000 ms in the form of a statement about the person whose face was subsequently presented on the screen. After each prime, participants were presented a drift correction central fixation dot, followed by an on screen face for 1000ms. After each face disappeared from the screen, participants were asked to categorize the valence of the emotion of the face that they had just been looking at by looking on the screen towards a response from five keyboard options from 1-5, ranging including 'extremely positive'; 'slightly positive'; 'neutral'; 'slightly negative'; 'extremely negative'.

On the subsequent screen, participants were asked to rate the likelihood that if they were face-to-face with this person, they would think that the expression was due to them (i.e. I would think that this expression is definitely not because of something I have done; probably not because of something I have done; unsure; probably because of something that I have done; definitely because of something I have done). On the final screen, participants were asked to indicate how being confronted with this face made them feel about themselves by indicating a response from 'extremely positive'; 'slightly positive'; 'neutral'; 'slightly negative'; 'extremely negative'.

Eye movement data preparation

Saccades of <80ms were discarded as anticipatory and initial fixations which were >1° from the central fixation point were also excluded totalling 3.8% of trials. This led to an average of average of 9.5 trials per participant being excluded. Fixations and dwell time were analysed relative to the number of valid trials across each participant. Shapiro Wilk tests suggested that eye movement data for eyes and mouths were all normally distributed although fixations and dwell time for noses were skewed towards zero scores.

Statistical analysis

The general approach to statistical analysis throughout this thesis involves the use of ANOVA. This was deemed to be the most appropriate approach to take in consideration of the sample sizes in each of the studies and in light of the multiple variables analysed. Larson (2008) has advised that ANOVA is robust enough to analyse non-normal data with homogeneous variances in balanced designs. Other researchers have also suggested that ANOVA is often robust enough to cope with moderate deviations in normality (Glass et al. 1972, Harwell et al. 1992, Lix, Keselman & Keselman, 1996). Moreover, Lorenzen and Anderson (1993) recommend that transformations to correct non-normal data carry a high level of risk and should be avoided if the homogeneity of variance fails at the 0.05 α level, and generally if it falls between the 0.01 and 0.001 α level unless there is a theoretical reason to transform the data.

Thus, the adopted standard for the thesis was the following. Normality has first been checked using the Shapiro Wilk's test for sample sizes fewer than 50 and the Kolmogorov-Smirnov test for samples over 50 as recommended by Field (2009). Mauchly's and Levene's tests have then been checked for their significance level. Results have been reported in the first instance using ANOVAs given that all of the groups in each of the studies are of approximately equal size. If normality tests are failed for any variables and homogeneity tests also failed at the 0.001 α level, non-parametric analysis has been used to confirm results. Given the complex designs, extreme values have not routinely been removed. According to Field (2009), this should only be done if there has been a theoretical reason to support removal.

Results

Eye movement data were analysed as proportional data because it was the relative proportions of fixations and duration of attention across features that was of primary interest to the investigation. However, in order to convey the level of attention required to classify emotions and make cognitive decisions about the meaning of facial expressions, the mean number of fixations made towards and time spent looking at features across face configurations is illustrated in Figures 1.2 to 1.5.

Descriptive statistics for proportional eye movement data and manual response data are presented in Table 1.1 and Table 1.2 respectively.

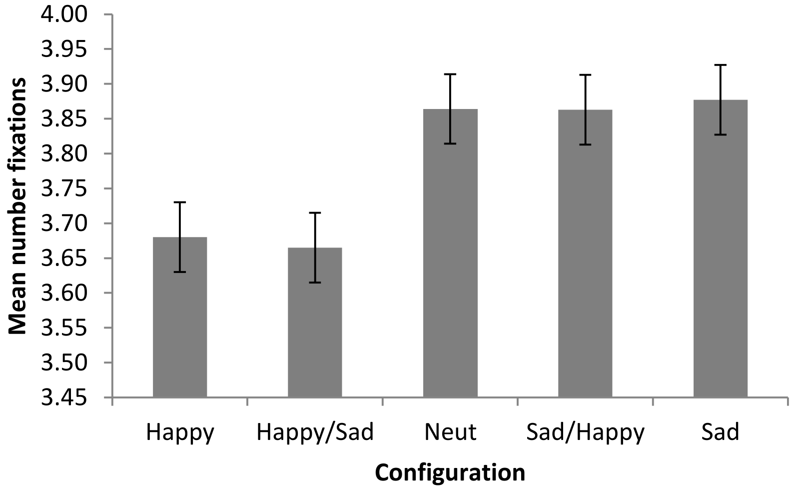

Figure 1.2 *Mean number of fixations per trial to eyes for each face configuration collapsed across prime type (bars denote standard errors)*

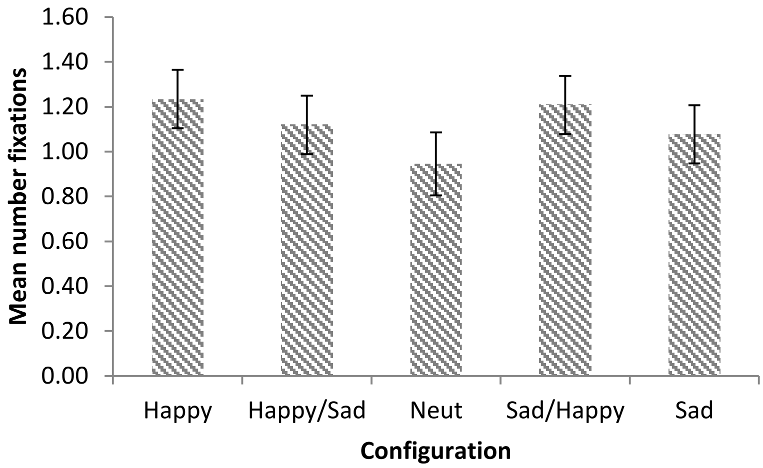

Figure 1.3 *Mean number of fixations per trial to mouths for each face configuration collapsed across prime type (bars denote standard errors)*

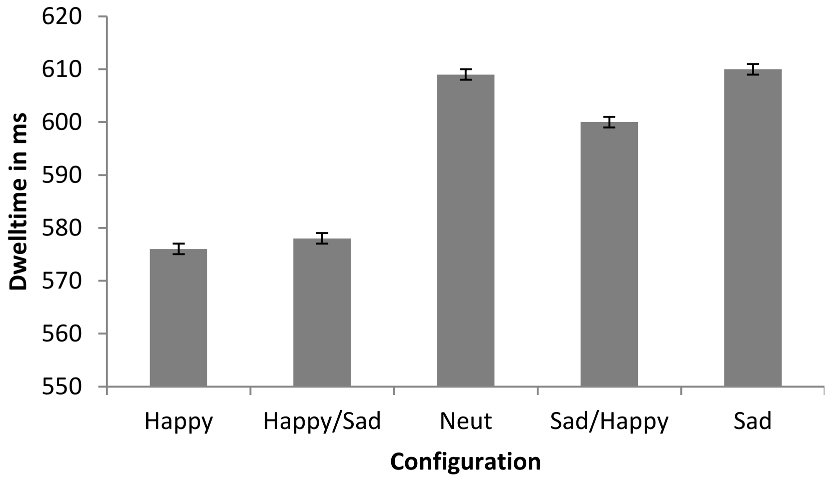

Figure 1.4 *Mean dwell time to eyes per trial for each face configuration collapsed across prime type (bars denote standard errors)*

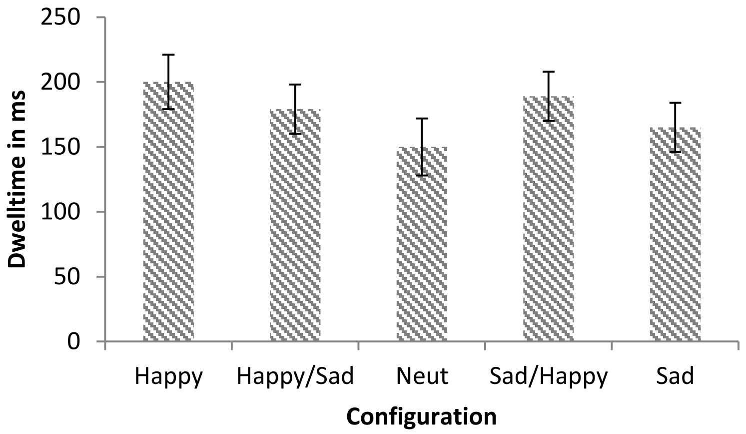

Figure 1.5 *Mean dwell time to mouths per trial for each face configuration collapsed across prime type (bars denote standard errors)*

Table 1.1

Mean proportions of fixations and dwell time

		Eyes				Mouth				Nose			
		Prop fix		Prop dwell		Prop fix		Prop dwell		Prop fix		Prop dwell	
Prime	Con	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Neg- Non-Self-Ref	Happy	0.56	0.17	0.57	0.18	0.19	0.09	0.2	0.11	0.16	0.13	0.15	0.12
	Happy/Sad	0.56	0.17	0.57	0.18	0.18	0.09	0.19	0.1	0.16	0.11	0.15	0.13
	Neutral	0.61	0.2	0.61	0.22	0.14	0.08	0.15	0.09	0.14	0.12	0.14	0.14
	Sad/Happy	0.58	0.16	0.59	0.16	0.18	0.09	0.19	0.08	0.16	0.11	0.14	0.12
	Sad	0.6	0.16	0.6	0.18	0.17	0.09	0.17	0.1	0.13	0.09	0.12	0.09
Neg- Self-Ref	Happy	0.57	0.16	0.58	0.17	0.19	0.08	0.21	0.09	0.16	0.11	0.15	0.12
	Happy/Sad	0.58	0.19	0.59	0.2	0.15	0.08	0.17	0.08	0.15	0.12	0.12	0.12
	Neutral	0.6	0.17	0.61	0.2	0.16	0.1	0.16	0.12	0.13	0.11	0.12	0.12
	Sad/Happy	0.6	0.17	0.61	0.17	0.18	0.1	0.19	0.1	0.13	0.11	0.12	0.11
	Sad	0.6	0.18	0.61	0.19	0.15	0.09	0.16	0.09	0.14	0.12	0.13	0.1
Neutral	Happy	0.57	0.18	0.57	0.17	0.19	0.09	0.22	0.11	0.14	0.12	0.13	0.12
	Happy/Sad	0.54	0.17	0.55	0.18	0.17	0.09	0.18	0.1	0.17	0.11	0.16	0.12
	Neutral	0.6	0.18	0.62	0.18	0.13	0.08	0.14	0.09	0.15	0.12	0.13	0.12
	Sad/Happy	0.58	0.15	0.58	0.15	0.19	0.08	0.21	0.09	0.14	0.11	0.12	0.1
	Sad	0.58	0.15	0.59	0.16	0.16	0.09	0.17	0.09	0.15	0.11	0.13	0.12
Pos- Non-Self-Ref	Happy	0.57	0.19	0.58	0.19	0.18	0.08	0.19	0.08	0.15	0.12	0.14	0.12
	Happy/Sad	0.57	0.16	0.58	0.15	0.17	0.08	0.18	0.09	0.13	0.11	0.12	0.1
	Neutral	0.6	0.18	0.59	0.2	0.14	0.09	0.15	0.11	0.15	0.11	0.14	0.12
	Sad/Happy	0.61	0.16	0.62	0.16	0.17	0.09	0.17	0.1	0.13	0.12	0.12	0.12
	Sad	0.58	0.17	0.61	0.17	0.16	0.08	0.16	0.09	0.13	0.09	0.12	0.08
Pos- Self-Ref	Happy	0.57	0.18	0.59	0.18	0.18	0.09	0.19	0.11	0.14	0.12	0.12	0.12
	Happy/Sad	0.58	0.16	0.6	0.17	0.16	0.09	0.17	0.09	0.12	0.09	0.1	0.07
	Neutral	0.61	0.18	0.61	0.2	0.14	0.1	0.15	0.1	0.14	0.13	0.13	0.14
	Sad/Happy	0.59	0.16	0.59	0.18	0.18	0.08	0.19	0.09	0.13	0.09	0.12	0.09
	Sad	0.63	0.15	0.63	0.16	0.16	0.08	0.17	0.08	0.12	0.09	0.1	0.09

Table 1.2.
Mean categorisation, internalisation and self-esteem data

Prime	Configuration	Categorisation		Internalisation		Self-esteem	
		M	SD	M	SD	M	SD
Neg-Non-Self-Ref	Happy	1.77	0.26	2.48	0.56	2.53	0.43
	Happy/Sad	4.09	0.23	2.41	0.55	3.40	0.33
	Neutral	3.31	0.30	2.27	0.37	3.14	0.22
	Sad/Happy	2.62	0.46	2.48	0.48	2.92	0.35
	Sad	4.21	0.22	2.29	0.49	3.34	0.37
Neg-Self-Ref	Happy	1.81	0.31	2.87	0.53	2.55	0.54
	Happy/Sad	4.10	0.15	3.46	0.51	3.64	0.43
	Neutral	3.38	0.38	3.06	0.43	3.36	0.40
	Sad/Happy	2.64	0.52	3.07	0.54	3.05	0.42
	Sad	4.18	0.28	3.48	0.59	3.76	0.45
Neutral	Happy	1.68	0.30	2.34	0.63	2.35	0.47
	Happy/Sad	4.04	0.21	2.36	0.68	3.31	0.38
	Neutral	3.15	0.25	2.13	0.55	3.01	0.14
	Sad/Happy	2.51	0.46	2.32	0.62	2.78	0.33
	Sad	4.13	0.21	2.24	0.53	3.31	0.34
Pos-Non-Self-Ref	Happy	1.58	0.22	2.57	0.52	2.32	0.43
	Happy/Sad	4.02	0.24	2.43	0.49	3.34	0.36
	Neutral	3.20	0.34	2.30	0.42	3.08	0.14
	Sad/Happy	2.45	0.40	2.42	0.57	2.74	0.35
	Sad	4.11	0.23	2.42	0.65	3.40	0.39
Pos-Self-Ref	Happy	1.64	0.31	3.62	0.50	2.09	0.37
	Happy/Sad	4.04	0.22	2.99	0.63	3.45	0.37
	Neutral	3.20	0.30	2.77	0.46	3.19	0.26
	Sad/Happy	2.34	0.38	3.35	0.42	2.66	0.36
	Sad	4.09	0.21	3.06	0.66	3.53	0.44

For eye movement behaviour, two separate feature x prime x configuration (3 x 5 x 5) repeated measures ANOVAs were conducted for proportion of fixations and proportion of dwell time.

Hypothesis I: Attention to eyes overall

The first hypothesis predicted a main effect of feature with a higher proportion of fixations and dwell time being made to the eyes regardless of configuration. This hypothesis serves simply to verify standard face processing patterns. Two 3 x 5 x 5 repeated measures ANOVAs for feature, prime and face configuration were conducted separately for the proportion of fixation and proportion of dwell time. The results for proportions of fixations revealed a highly significant main effect of feature, $F(2,36) = 57.01$, $MSE = 0.52$ $p < 0.001$, $\eta p^2 = 0.76$ *Power* = 1. Bonferroni pairwise contrasts indicated that eyes received a significantly higher proportion of fixations (M = 0.59, SE = 0.37) than mouths (M = 0.17, SE = 0.02, $p < 0.001$) or noses (M= 0.14, SE = 0.02, $p < 0.001$). This is illustrated in Figure 1.6.

Dwell time data essentially followed the same pattern as the fixation proportion data. Mauchly's test indicated that the assumption of sphericity can be assumed, ($\chi^2(2) = 5.25$, $p = 0.07$). There was a significant main effect of feature $F(2,36) = 57.1$, $MSE = 0.55$ $p < 0.001$, $\eta p^2 = 0.76$ *Power* = 1. Bonferroni pairwise contrasts indicated that eyes received a significantly higher proportion of dwell time (M = 0.6, SE = 0.38) than mouths (M = 0.18, SE = 0.02, $p < 0.001$) or noses (M = 0.13, SE = 0.24, $p < 0.001$). Therefore, as predicted and in line with standard face processing patterns, eyes received significantly more attention than any other feature.

Figure 1.6 *Heatmap: mean fixation pattern to composite faces (represented by green to illustrate the pattern of dwelltime, with red indicating a higher duration of dwell time across the eye area (ranging from 576ms to 610ms compared to mouths which ranged from 150ms to 200ms).*

Hypothesis II: Attention to eyes relative to mouths as a function of context and configuration

The second hypothesis predicted that in incongruent composite faces (i.e. happy eyes and sad mouth or vice versa), context would combine with salience cues to guide fixations towards the feature congruent with the context (i.e. sad eyes when context is negative and happy mouths when context is positive). This hypothesis investigates the possibility that context (specifically expectations induced by the primes) may guide attention to a congruent feature. This would require a significant prime x feature x configuration interaction. There was no main effect of prime for proportion of fixations, $F(4,72) = 1.38$, $MSE = 0.001$ $p = 0.25$, $\eta p^2 = 0.07$ *Power* = 0.41. The prime x feature x configuration interaction was also non-significant. Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2(35) = 56.33$, $p = 0.01$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.53$), $F(4.25, 76.43) = 5.87$, $MSE = 0.01$ $p = 0.4$, $\eta p^2 = 0.01$ *Power* = 0.06.

In tandem with the fixation proportion data, there was no significant main effect of prime for proportion of dwell time, $F(4,72) = 1.49$, $MSE = 0.001$ $p = 0.08$, $\eta p^2 = 0.07$ *Power* = 0.44, or significant prime x feature or prime x feature interaction. Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi 2(35) = 68.56$, $p = 0.001$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.51$), $F(10.09, 181.7) = 1.02$, $MSE = 0.01$, $p = 0.43$, $\eta p^2 = 0.05$ *Power* = 0.53. No other context relevant interactions were significant. Therefore, in contrast with the hypothesis, context did not guide fixations.

Hypothesis III: Attention to eyes relative to mouths as a function of salience only

The third hypothesis states that in the absence of context effects (i.e. with neutral primes), in line with the findings of Calder et al. (2000) attention and categorisation would be based on the salience of the feature. Specifically, happy mouths would be more salient than sad mouths and sad eyes would be more salient than happy eyes. This would specifically require a significant prime x feature x configuration interaction, which as it transpired from the paragraph above, was not the case. However, the hypothesis regarding salience in the absence of context effects was investigated by way of a feature x configuration interaction in order to demonstrate the effect of salience with a neutral prime, which was indeed found to be the case for the proportion of fixations.

Mauchly's test indicated that the assumption of sphericity had been violated ($\chi 2(35) = 56.81$, $p = 0.01$), therefore the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.53$), $F(4.28, 76.96) = 5.87$, $MSE =$

0.06 $p < 0.001$, $\eta_p^2 = 0.25$ *Power* = 0.98. There was also a significant feature x configuration interaction for dwell time. Again the assumption of sphericity was violated, ($\chi 2(35) = 68.36$, p = 0.001), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.51$), $F(4.07,73.18) = 4.86$, *MSE* = 0.02, $p < 0.001$, $\eta p^2 = 0.21$ *Power* = 0.95.

Bonferroni post-hoc analysis is reported in Tables 1.3 and 1.4 along with categorisation data for which a prime x configuration 5 x 5 repeated measures ANOVAs was conducted. Likert scale face categorisation responses ranged from 1(very positive) to 5 (very negative). There was a main effect of configuration. Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi 2(9) = 30.32$, $p < 0.001$). Transformations failed to normalise the data. Therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.7$) and analysis was followed up with non-parametric analysis to confirm the results (AppendixIII(i). The main effect of configuration was significant, $F(3,50) = 332.64$, *MSE* = 0.45 $p < 0.001$, $\eta p^2 = 0.95$ Power = 1.

Table 1.3

Emotional face categorisation based on attention to eyes

Faces with sad mouths	Sad		Happy/Sad			
	M	*SE*	*M*	*SE*	*P*	*Result*
Prop fixations to eyes	0.6	0.04	0.58	0.04	0.03	Higher proportion of fixations to sad than happy eyes
Prop dwell time to eyes	0.61	0.04	0.58	0.04	0.02	Higher proportion of dwell time to sad than happy eyes
Categorisation	4.14	0.04	4.06	0.04	<0.001	Faces with sad eyes were categorised more negatively than faces with happy eyes when mouths are sad.
Faces with happy mouths	Happy		Sad/Happy			
	M	*SE*	*M*	*SE*	*P*	*Result*
Prop fixations to eyes	0.56	0.04	0.59	0.04	0.3	No difference between attention to sad or happy eyes when mouths are happy
Prop dwell time to eyes	0.57	0.04	0.6	-.04	0.51	No difference between attention to sad or happy eyes when mouths are happy
Categorisation	0.7	0.05	2.5	.009	0.001	More negative categorisation for faces with sad compared to happy eyes in faces with happy mouths

Table 1.4

Emotional face categorisation based on attention to mouths

	M Happy	*SE*	*M* Happy/Sad	*SE*	*P*	*Result*
Prop fixations to mouths (when eyes are happy)	0.19	0.02	0.17	0.02	0.01	Higher proportion of fixations to happy than sad mouths
Prop dwell time to mouths (when eyes are happy)	0.2	0.02	0.18	0.02	0.02	Higher proportion of dwell time to happy than sad mouths
Categorisation (when eyes are happy)	1.7	0.05	4.06	0.04	<0.001	Faces with happy eyes categorised as negative when the mouth is sad and as positive when the mouth is happy
	Sad		Sad/Happy			
	M	*SE*	*M*	*SE*	*P*	*Result*
Prop fixations to mouths (when eyes are sad)	0.17	0.02	0.18	0.02	0.02	Higher proportion of fixations to happy than sad mouths
Prop dwell time to mouths (when eyes are sad)	0.17	0.02	0.19	0.02	0.01	Higher proportion of dwell time to happy than sad mouths
Categorisation (when eyes are sad)	4.14	0.04	2.5	0.09	<0.001	Faces with sad eyes are categorised as negative when the mouths is sad but positive when the mouth is happy

The results from Table 1.3 suggest that sad eyes were more salient than happy eyes when mouths are sad but not when mouths are happy. This is likely to be due to the influence of the more salient happy mouth which reduced to the attention drawn to the eye. Categorisation was made on the basis of the mouth but more salient negative eyes did contribute to the categorisation to some extent. Results from Table 1.4 indicate that happy mouths were more salient than sad mouths and categorisations were made on the basis of the mouth regardless of whether the eyes were happy or sad. Thus the hypothesis that in the absence of context effects, attention and categorisation would be based on the salience of the feature was supported. Furthermore, as predicted happy mouths were more salient than sad mouths and sad eyes were more salient than happy eyes. Therefore, if socially anxious individuals do avoid negative eyes compared to neutral or positive eyes then it is not because they are less salient.

Hypothesis IV(i): Effect of congruent self-referential context at a cognitive level in relation to interpretation of the emotion on the face

The final hypothesis predicted that categorisation; internalisation of the emotion on the face and the impact on self-esteem would be intensified with congruent self-referential expectations. A significant prime x configuration interaction would be expected in relation to each of these measures. For categorisation data it would be expected that a face that was categorised negatively preceded by negative self-referential prime would result in a more negative categorisation than other prime-face pairings. Similarly, it would be expected that a face that was categorised positively, preceded by positive self-referential information would be categorised more positively than other prime-face pairings.

Mauchly's test indicated that the assumption of sphericity could be assumed for prime, $\chi2(9)$ =6.2, , p = 0.72 and for the prime x configuration interaction, $\chi2(135)$ =152.03, p = 0.35. In terms of the power of self-reference to influence dimensional categorisations, there was a significant main effect of prime , $F(4,72)$ = 12.28, MSE = 0.43 $p < 0.001$, η_p^2 = 0.41 *Power* = 1. Faces were categorised significantly more negatively with negative self-referential primes (M = 3.22, SE = 0.04) than neutral (p = 0.01) or positive self-referential primes (M = 3.06, SE = 0.03, p = 0.003). Similarly, faces were categorised significantly more negatively with negative non-self-referential primes (M = 3.2, SE = 0.04) than neutral primes (M = 3.1, SE = 0.04, p = 0.004) or positive non-self-referential primes (M = 3.07, SE = 0.04, p = 0.002).

However, there were no significant differences between positive self-referential (M = 3.06, SE = 0.03,) positive non-self-referential (M = 3.07, SE = 0.04, p = 1) or neutral primes (M = 3.1, SE = 0.04, p = 1). Furthermore, there was no significant difference in categorisations of faces preceded by negative self-referential (M = 3.22, SE = 0.04) or negative non-self-referential primes (M = 3.2, SE = 0.04, p = 0.42).

The prime x configuration interaction was not significant, F (16, 288) = 1.37, MSE = 0.006, p =0.16, η_p^2 = 0.07 *Power* = 0.62. Therefore, only the valence of the primes influenced the intensity of categorisations of faces but the reference to the self or another cause of the emotion on the face had no effect on intensity ratings. Thus, the combination of prime and salience had no effect of the categorisation of emotional faces. Discrete categorisations were based solely on salience cues whilst dimensional categorisations were based on both salience information and context but these operated independently of each other. Categorisations were made on the basis of the feature that occupied the most attention relative to other faces. However, although context influenced the intensity of categorisation, there was, in contrast with the hypothesis, no influence of self-relevance on the intensity with which categorisations were made. Therefore, the hypothesis that categorisation would be intensified with congruent self-referential expectations was not supported.

Hypothesis IV(ii): Effect of congruent self-referential context at a cognitive level in relation to internalisation of the emotion on the face

To investigate the way in which self-referential and salience information interact to influence the likelihood of the perceived emotion of a face being internalised, a prime (5) x configuration (5) repeated measures ANOVA was conducted. Participants were asked to rate the likelihood that if they were face-to-face with this person, they would think that the expression was due to them. Responses ranged from 1(definitely not) to 5 (definitely). It was expected that a face that was categorised negatively preceded by negative self-referential prime would result in greater internalisations than other prime-face pairings such as a positive self-referential or negative non-self-referential prime. Similarly, it would be expected that a face that was categorised positively, preceded by positive self-referential information would be internalised significantly more than other prime-face pairings. Again a significant prime x configuration interaction would be anticipated.

There was a significant main effect of configuration. Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi2(9) = 27.56$, p = 0.02), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.62$), $F(2.48, 44.7) = 3.72$, $MSE = 0.46$ $p = 0.02$, $\eta^2 = 0.17$, *Power* = 0.72. The main effect for prime was significant. Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi2(9) = 54.51$, $p < 0.001$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.38$). $F(1.5, 27.07) = 48.02$, $MSE = 1.05$ $p < 0.001$, $\eta^2 = 0.73$ *Power* = 1.

As predicted, the configuration x prime interaction was also significant. Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi2(135) = 180.16$, $p = 0.02$) but ANOVA should be robust enough to cope with any slight deviations in normality indicated by a p value at this level (Lorenzo & Anderson, 1993; Howell, 2007). Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.29$), $F(4.58, 82.45) = 7.25$, $MSE = 0.35$ $p < 0.001$, $\eta p^2 = 0.29$ *Power* = 1. Pairwise comparisons are detailed below in Tables 1.5 and 1.6.

Results from Table 1.5 (which outlines significant p values, means and standard errors) indicate that there was significantly greater internalisation with a negative self-referential prime and face categorised as negative (i.e. face and prime congruent) than with a happy face (incongruent) or neutral face, as indicated by categorisation scores. However, there was no difference between internalisation of a congruent sad face or an incongruent face with sad eyes/happy mouth (categorised positively). This may be because the presence of even one negative feature that is consistent with the expectation of the emotion of the face may be enough to increase internalisation although not as much as when two features are present.

When preceded by a positive self-referential prime, participants were significantly more likely to internalise the emotion of the face when the face was happy than if it was perceived as negative or neutral but there were no differences in internalisation between faces categorised as positive. The exception to this was that there were no differences between faces with happy eyes/sad mouth (categorised negatively) and faces with sad eyes/happy mouth (categorised positively) (p = 0.71) so again just one happy feature is enough to initiate a congruency effect along with a positive prime because the presence of either happy eyes or a happy mouth appears to accord with the prime to result in greater internalisation of the emotion of the face. To measure how negative self-referential primes differed from non-self-referential and neutral primes in terms of internalisation of the face, pairwise contrasts were also examined across prime types for faces. The results are detailed in Table 1.6.

Only self-referential primes increased internalisation when paired with any of the face types as there were no significant differences in Likert scale scores across any other prime types (p > 0.18). As expected, where a negative self-referential prime preceding a face categorised as negative resulted in significantly greater internalisation than a negative non-self-referential prime or a neutral prime. However surprisingly, when preceding a sad (but not a happy/sad composite face) there were no differences between positive a negative self-referential primes in terms of how much they were internalised. At first glance it may be considered that this could be because the positive expectation followed by a sad face could indicate disappointment. However, a positive self-referential prime preceding a sad face was no more likely than any other face to be internalised ($p > 0.6$). Thus, it is difficult to determine until looking at the self-esteem data whether the face has been internalised positively or negatively.

When preceding a happy face, a congruent positive self-referential prime led to the emotion being significantly more internalised than a positive non-self-referential prime, a neutral prime or an incongruent negative self-referential prime. However, when preceding an ambiguous composite faces with sad eyes/ happy mouth, which was on average categorised as positive, an incongruent negative self-referential prime was equally likely as a congruent positive self-referential prime to result in the face being internalised. Again this may be because happy eyes or a happy mouth may be matched with the positive self-referential prime to increase internalisation of the expression of the face. This suggests that the internalisation of emotional cues is a two-fold process with the first stage involving expectations and the second involving a verification stage based on any salient information which is at hand regardless of how the face was initially categorised. Thus, the hypothesis was supported in respect of congruency effects with self-referential context although negative or positive eyes appeared to override the categorisation previously made on the basis of the mouth in this process.

Table 1.5

Combination of expectancy with emotional face categorisation

Prime		Face									
Neg-Self-Ref		Sad (neg)		Happy/Sad (neg)	*p*	Happy (pos)	*p*	Sad/Happy (pos)	*p*	Neutral (neut)	*p*
	M	**3.48**		3.46	*1*	2.87	*0.04*	3.07	*0.9*	3.06	0.02
	(SE)	**(0.14)**		(0.12)		(0.12)		(0.12)		(0.1)	
				*			*0.04*		*>0.05*		0.02
Pos-Self-Ref	M	3.07	*0.04*	3.00	0.02	**3.62**		3.35	0.07	2.78	<0.001
	(SE)	(0.15)		(0.14)		**(0.12)**		(0.1)		(0.11)	
					0.71			*			0.01

Higher scores indicate greater internalisation.
*P values relate to the comparison between the face highlighted in bold text (or *) and all other faces in the row.*
(neg/pos) denotes the valence that the face was categorised as.

Table 1.6

Combination of self and non-self-referential expectancy with emotional face categorisation

Prime		Neg-SR	*p*	Neg-NSR	*p*	Neutral	*P*	Pos SR	*p*	Pos NSR	*p*
Sad (neg)	*M*	**3.48**		2.29	*<0.001*	2.42	<0.001	3.06	*0.15*		
	SE	**(0.1)**		(0.11)		(0.12)		(0.15)			
Happy/Sad (neg)	*M*	**3.46**		*M* = 2.41	*<0.001*	2.36	<0.001	2.3	*0.03*		
	SE	**(0.12)**		(0.13)		(0.16)		(0.14)			
Happy (pos)	*M*	2.87			*0.02*	2.34	<0.001	**3.62**		2.57	*<0.001*
	SE	(0.12)				(0.14)		**(0.1)**		(0.19)	
Sad/Happy (pos)	*M*	3.07	*0.92*			2.32	<0.001	**3.5**		2.42	
	SE	(0.12)				(0.14)		**(0.1)**		(0.13)	*.001*

Higher scores indicate greater internalisation.
Vertical left hand column denotes face type and categorisation and top row denotes prime type
*P values relate to the comparison between the face highlighted in bold text (or *) and all other faces in the row.*
(neg/pos) denotes the valence that the face was categorised as.

Hypothesis IV(iii): Effect of congruent self-referential context at a cognitive level in relation to the impact of the face on the self-esteem of the viewer

For self-esteem ratings, participants were asked to indicate how being confronted with this face made them feel about themselves by indicating a response on a cedrus box with numbers 1 to 5 corresponding to labels 'extremely positive'; 'slightly positive'; 'neutral'; 'slightly negative'; 'extremely negative'. In order to investigate how emotional categorisation and context would be likely to affect how individuals feel about themselves, a prime (5) x configuration (5) repeated measures ANOVA was conducted for Likert scale self-esteem responses where responses ranged from 1(extremely positive) to 5 (extremely negative). It was expected that a face that was categorised negatively preceded by a negative self-referential prime would result in lower self-esteem than other prime-face pairings. Similarly, it was expected that a face that was categorised positively, preceded by positive self-referential information would result in higher self-esteem than other prime-face pairings. As with the previous analysis, a significant prime x configuration interaction would be anticipated, indicating that negative self-referential primes preceding negatively perceived faces would lower self-esteem most compared to other combinations such as a positive prime with a negatively perceived face.

There was a significant main effect of configuration. Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi2(9) = 77.79$, $p < 0.001$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.34$), $F(1.35, 24.34) = 39.04$, $MSE = 1.51$ $p< 0.001$, $\eta_p^2 = 0.68$ *Power* = 1. There was also a significant main effect of prime but as Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi2(9) = 41.91$, p <

0.001), degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.46$), $F(1.84, 33.09) = 17.88$, $MSE = 0.2$ $p < 0.001$, $\eta_p^2 = 0.5$ *Power* = 1.

Furthermore, the configuration x prime interaction was significant and Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi 2(135) = 190.45$, $p = 0.01$). Therefore, ANOVA should be robust enough to cope with any slight deviations in normality in the interaction (Lorenzo & Anderson, 1993; Howell, 2007). Degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.41$), $F(6.61, 118.94) = 6.22$, $MSE = 0.03$, $p < 0.001$, $\eta_p^2 = 0.26$ *Power* = 1. Bonferroni post hoc comparisons are detailed in tables 1.7 and 1.8.

As predicted negative self-referential primes preceding sad faces (congruent pairing) significantly increased negative self-esteem compared to neutral faces and faces that were categorised positively (incongruent). However there were no differences between sad faces and faces with happy eyes and sad mouths which were categorised on average as negative. Faces with happy eyes and sad mouths (congruent negative prime and negatively categorised face pairing) also led to significantly more negative self-esteem than neutral, or incongruent faces (i.e. faces with sad eyes and happy mouths or happy faces).

Positive self-referential primes led to increased positive self-esteem when preceding the most congruent happy face (i.e. when both eyes and mouths were happy and so congruent with the positive prime) than all other faces. It is noteworthy that faces with happy eyes and mouth led to a higher degree of positive self-esteem when in combination with positive prime than a face with negative eyes and a happy mouth. This suggests that the negative eyes are quite powerful in their own right in being able to reduce positive self-esteem even when they are out of context. A face with sad eyes/happy mouth preceded by a congruent positive self-referential prime also made participants feel better about themselves than a neutral face or incongruent faces with happy eyes/sad mouth or sad faces in terms of self-esteem Likert scale scores. To measure how negative self-referential primes differed from non-self-referential and neutral primes with regard to self-esteem, pairwise contrasts were also examined across prime types for faces.

Negative self-referential primes preceding sad faces or faces with happy eyes/sad mouth, both of which had been categorised as negative, led to lower self-esteem than negative non-self-referential, neutral or positive self-referential primes. Specifically, negative self-referential primes made participants feel more negative about themselves when preceding sad faces than neutral primes and the same was the case for faces happy eyes and sad mouths (categorised negatively) and faces with sad eyes and happy mouths (categorised positively) compared to neutral primes. This suggests that the presence of sad eyes or a sad mouth was sufficient to combine with a negative self-referential prime to lower self-esteem. Moreover when sad faces were preceded by negative self-referential primes, they were associated with significantly more negative self-oriented feelings than negative non-self-referential primes. Similarly when a face with happy eyes and a sad mouth (categorised negatively) was preceded by a congruent negative self-referential prime, it resulted in significantly lower self-esteem than when it was preceded by a congruent non-self-referential prime. Therefore, as predicted, a negative self-referential prime preceding a negatively perceived face based on the sad mouth increased negative self-esteem relative to other primes.

Positive self-referential primes led to significantly higher self-esteem when they preceded a happy face than positive, non-self-referential; neutral or incongruent negative self-referential primes. When preceding faces with sad eyes and happy mouths, which had also on average been categorised as positive; positive self-referential primes made participants feel significantly more positive about themselves than did when the face was preceded by an incongruent negative-self-referential primes. However there were no differences in self-esteem Likert scale scores in response to faces preceded by positive self-referential, positive non-self-referential or neutral primes. Therefore, faces perceived to be happy (due to the visual and emotional salience of the happy mouths) made participants feel better about themselves if preceded by a congruent positive prime. However positive self-referential primes in combination with obviously happy face increased self-esteem most as the presence of sad eyes significantly lowered positive self-esteem compared to when both the eyes and mouth was happy. Thus positive self-esteem in the context of face processing requires the individual to pay attention to a positive face before their positive expectations will make them feel good about themself. Yet a negative feature even when it is out of context has some influence in increasing negative self-esteem.

In summary of the self-esteem data, as predicted the combination of congruent context in the form of prime statements and perceived emotion from facial expressions intensified self-esteem although positive self and non-self-referential context was equal in influence on self-esteem when preceding a face with sad eyes which has been categorised as positive due to a happy mouth. In contrast negative self-referential context was more powerful in increasing negative self-esteem than non-self-referential negative context with faces that had been categorised as negative. Furthermore, obviously happy faces led to a higher degree of positive self-esteem when in combination with positive context than incongruent composites with negative eyes and happy mouths. Thus, negative eyes were influential in reducing positive self-esteem even when they challenge positive context.

Table 1.7

Combination of expectancy with emotional face categorisation

Prime		Face									
Neg-Self-Ref		Sad (neg)		Happy/Sad (neg)	*p*	Happy (pos)	*p*	Sad/Happy (pos)	*p*	Neutral (neut)	*p*
	M	**3.76**		3.64	*0.43*	2.55	*<0.001*	3.05	*<0.001*	3.36	*0.001*
	(SE)	**(0.1)**		(0.1)		(0.12)		(0.1)		(0.9)	
				*			*0.001*		*0.003*		*0.02*
Pos-Self-Ref	*M*	3.53	*<0.001*	3.45	*<0.001*	**2.09**		2.66	*<0.001*	3.19	*<0.001*
	(SE)	(0.1)		(0.1)		**(0.09)**		(0.08)		(0.06)	
			<0.001		*<0.001*			*			*0.001*

Higher scores indicate lower self-esteem.
*P values relate to the comparison between the face highlighted in bold text (or *) and all other faces in the row.*
(neg/pos) denotes the valence that the face was categorised as.

Table 1.8

Combination of self and non-self-referential expectancy with emotional face categorisation

Prime		Neg-Self-Ref	p	Neg-Non-Self-Ref	P	Neutral	P	Pos-Self-Ref	p	Pos-Non-Self-Ref	p
Sad (neg)	*M*	**3.76**		3.34	*<0.001*	3.31	*0.001*				
	SE	**(0.1)**		(0.1)		(0.08)					
Happy/Sad (neg)	*M*	**3.64**		*M* = 3.34	*0.03*	3.31	*<0.001*	*3.45*			
	SE	**(0.1)**		(0.08)		(0.08)		(0.1)			
Happy (pos)	*M*					2.35		**2.09**		2.55	*0.01*
	SE					(0.1)		**(0.09)**		(0.12)	
Sad/Happy (pos)	*M*	3.05	*0.047*			2.78	*0.95*	**2.66**		2.92	*0.14*
	SE	(0.1)				(0.08)		**(0.08)**		(0.08)	

Higher scores indicate lower self-esteem.
The vertical left hand column denotes face valence and categorisation and the top row denotes prime type
*P values relate to the comparison between the face highlighted in bold text (or *) and all other faces in the row.*
(neg/pos) denotes the valence that the face was categorised as.

Discussion

The primary aims of the study were to investigate potential mechanisms that might underpin the online negativity bias postulated by Rapee and Heimberg (1997) in terms of the effect of prior expectations regarding the emotion of the face and the relative importance of individual facial features. In line with Groner et al. (1984) and Itier and Batty (2009) higher proportions of fixations and dwell times were made to the eyes in general. However, in conflict with the suggestions of Malcolm et al. (2008), context in terms of prime statements about the emotion of the face model had no effect on guiding fixations which were solely guided by inherent characteristics of the features. Happy mouths appeared to be the most visually salient feature overall in terms of attracting attention and happy eyes the least salient. Context did not affect discrete categorisations, which were based on the mouth of incongruent composite faces (in line with Malcolm et al., 2008) despite minimal attention to mouths on the whole versus eyes.

It appears that categorisations were made on the basis of the feature that occupied the most attention relative to other configurations as indicated by Likert scale scores. Thus, facial features appear to be categorised automatically and efficiently and are based on the relative salience of facial features. These results suggests that avoidance of negative eyes would not have any impact on the categorisation of the face since this was made on the basis of the mouth with just one fixation on average. However, context did influence how positively or negatively faces were perceived. Furthermore, in line with Rapee and Heimberg (1997) and Philippot and Douilliez (2005), internalisation of the emotion on the face and its impact on self-esteem were intensified with a congruent self-referential context as shown by Likert scale scores.

It is possible that the overall preference for fixating on the eye region may represent an attempt for individuals to gauge the mental state or cognitions of another person in a social situation. Yet it could simply reflect the greater salience of two combined features. Indeed in composite faces with happy mouths, sad eyes being more salient than happy eyes did draw some attention away from happy mouths and categorisations were less positive relatively. Overwhelmingly, the eye movement data suggested that fixations were guided by salience alone as context had no influence on fixations or dwelltime. This does not support the assertions of Malcolm et al., (2008) that context guides fixations as if this were the case then fixations should have been guided towards the feature congruent with the prime in composite faces. It also provides no evidence to support the Rapee and Heimberg model that negative expectations guide attention towards negative social cues. Overall, despite eyes receiving more visual attention than mouths, categorisations of happy and sad emotional faces were predominately made on the basis of the salience of the mouth. Indeed, in agreement with the findings of Calvo and Nummenmaa (2008), they were made in just one fixation on average with an average fixation of less than 200ms.

This may explain why context had no effect on guiding fixations during the categorisation task. If emotional categorisation is made on the basis of the mouth then any attempt on the part of socially anxious individuals to avoid looking at the eye area may be unlikely to influence their categorisation of the face. Therefore, if they avoid eyes in order to evade the stress of having to evaluate the viewer's emotional state then this may be a counter-productive coping strategy because they will lack the opportunity to see the negative expression change to a less threatening one over time.

However, the results of the internalisation and self-esteem data shed more light on the role of features during social cognition. Self-focused expectancies in the form of self-referential prime statements increased the likelihood that the cause of the emotion on the face would be attributed to the actions of the viewer. In a negative self-referential context, faces perceived as negative, and therefore congruent with the expectation, were internalised significantly more according to higher Likert scale scores than other faces as Rapee and Heimberg (1997) posited. One sad feature was enough to increase internalisation and increase negative self-esteem when a negative self-referential facial expression is expected so avoidance of negative eyes would confer no benefit on an individual. Negatively perceived faces will not be likely to be internalised unless they are viewed in a self-referential context and this may partly account for some of the mixed results in the literature.

Furthermore the pairing between negative self-referential expectancies and negative eyes resulted in greater internalisation than when the prime and face were both positive. It appears that when a particular valence of expression is expected then any small piece of evidence that coincides with this expectation will be incorporated into the process of understanding the meaning of the facial expression. Moreover, negative eyes in a face categorised as positive appeared to reduce positive self-esteem somewhat. Thus, negative eyes appear to be particularly powerful in influencing the internalisation of the emotion on the face and negative self-esteem.

The Rapee and Heimberg (1997) model of social anxiety proposed that attention to negative external social cues is integrated in negative self-focussed preoccupied thoughts by exacerbating the distorted self-image. Confirmation of negative expectations may be likely to lead to more negative self-oriented feelings than disconfirmation. Although the sample used in the current study was drawn from a general population, the combination of negative expectations by engaging with a negatively perceived face did have the strongest effect overall compared to other prime/ face pairings. Furthermore, it seems that a lack of positive expectation leads to less internalisation of approving faces and reduced positive self-esteem than if a positive expectation is held. Given that the face was only presented for one second and would have to be held in mind whilst categorisation and social cognition decisions were made, the results of this study suggest that the greatest social threat occurs when negative expectations combine with attention to negative external social cues as the Rapee and Heimberg model (1997) predicted.

However, the results also have implications for studies such as Moser, Huppert, Duval and Simons (2008), which found differential ERP activity across groups with a high anxiety group demonstrating a bias for threat faces and a low anxiety group demonstrating a bias for positive faces, yet with no evidence of group differences for categorisation for face emotion. If discrete categorisation is made efficiently and automatically as the results of this study suggest, then categorisation and reaction time may not be the most appropriate behavioural measures to include in brain imaging studies. It may be more useful for future studies to include behavioural measures that tap into self-directed negative feelings and dimensional categorisations.

Conclusions from this study must be interpreted in light of some limitations. For example, the order of the questions following the eye-tracking task was not randomised although the response options were. This could potentially have resulted in an order effect where the social cognition responses were based on the valence of the categorisation rather than on the emotion of the face. However, this seems less likely give the results which indicated that although faces with sad eyes and happy mouths were categorised on average as positive, they were associated with less positive self-esteem when a negative expectation preceded them.

A further potential confound is that the noses used in the composite faces were all neutral and it is possible that a face split in half whereby the nose incorporated elements of each emotion would have resulted in different outcomes. However, unlike Calder et al. (2000), the faces were not misaligned but were designed to look as natural as possible. It would not have been possible to achieve this as effectively by this method. Alternatively, the corresponding emotion from the eyes could have been used, and separately for the mouth, but since the study already involved a lengthy eye-tracking experiment this was deemed to be impractical. This issue has been explored further in Chapter 3.

Finally, whilst the study provided some information on the effect of emotional features and context on face categorisation, without social anxiety measures, the relationship between negative context, self-relevance and social anxiety in face processing cannot be supported by the present results. The original intention was to replicate this study directly with a socially anxious sample, but in light of the eye-movement data in which emotional information was extracted in as little as one fixation, it was considered that it may be difficult in this particular task to elicit differences in visual attention. Moreover, given that context was not a contributory factor to eye-movements, it was decided that investigating the behavioural responses to composite faces in a socially anxious sample would be more useful and this was the focus for Chapter 3. In order to test the effect of referential statements on socially anxious participants, the effect of context in the form of the use of positive self-referential evaluative feedback and negative non-referential primes and feedback in various paradigms is explored throughout the remaining chapters.

Overall, the results suggest that categorisations of social cues can be made on just one or two brief fixations of less than 200ms on average. This suggests that people may be very accurate in categorising facial expressions under very restricted attention conditions which casts doubt on the assertion that missing social cues leads to a deficit in the positivity bias. It seems rather that context has a role to play in perceiving the intensity of the emotion possibly during more elaborative processing stages involving social cognition. From these results context appears to have no direct effect on attention. Rather, attention appears to be dependent on visual salience. Therefore, it is unlikely that the generation of negative social expectancies in socially anxious people would influence their visual attention in any automatic or rapid sense. If social anxiety is underpinned by maladaptive cognitive schemas then the results of this study suggest that this alone is unlikely to be the precipitator of attentional biases to emotional faces.

If socially anxious individuals assume that any negative social cues are more personally relevant to them than less anxious people do, then the generation of negative self-referential contextual schemas may cause them to perceive social cues as more intensely negative than less anxious individuals. This may lead to a greater internalisation of the negative cue and to lower self-esteem. If confronted by a positive face an anxious individual may be less likely to assume that is it self-referential. This in turn could result in the face seeming less positive and make them feel less confident than a less anxious person who has a more positive bias. If this interpretation holds for socially anxious people then a reduction in the positivity bias and an online enhanced negativity bias could ensue because of negative schemas about the cognitions of the face and in particular negative eyes, whilst processing a face with the bare minimum attention.

The remaining chapters in this thesis directly address attention and behavioural responses with socially anxious samples, but there are paradigms that are outside of its scope that may be fruitful for future researchers to pursue. For example, it may be useful to measure eye movements of socially anxious individuals in composite faces with different negative emotions with a variety of self-relevant behavioural measures. The behavioural measures used in this study were taken after the face had disappeared from the screen but it may also be useful to capture this information in real time whilst viewing the face in order to measure reaction time to decision making for more personally relevant measures. It may also be beneficial to pair self-relevant behavioural responses with EEG measures and eye-tracking. Finally, it would be informative to investigate the effect of negative expectations on initial orientation to features in congruent and incongruent face composites with a socially anxious sample.

In conclusion, facial features appear to be categorised automatically and efficiently and according to the current results, seem to be predominately made on the basis of the mouth. Context does not appear to influence eye movements or categorisations in the discrete sense although it may influence the valence intensity at which a face is perceived. The findings from the current study also suggest that eyes may play a special role in social cognition particularly with regard to negative self-relevant social information. Finally, it appears to be the case that expectations which are fulfilled by attention to a face that has a congruent expression will be processed more intensely in terms of self-directed cognitions than if the expectations are not fulfilled.

Chapter 3

Abstract

Social anxiety has been associated with self-focussed attention and reduced attention to faces (Clark & Well's, 1995) yet few face processing tasks include self-relevant measures. The aim of study 2 was to investigate self-reported attention to facial features during emotion categorisation and willingness to engage with faces as a function of anxiety. An online web task measured non-self-relevant categorisation and the feature focussed on to make this decision as well as self-relevant approach/avoidance desires when viewing composite faces with angry, happy and neutral features. Faces with angry eyes appeared to be generally threatening and were avoided but the low social anxiety group engaged more with angry eyes when categorising the face compared to the high anxious group. This is consistent with previous research suggesting that socially anxious people focus less on features, particularly negative eyes. This may be due to differences in processing styles or, at a more cognitive level, negative eyes may be too intimidating for socially anxious individuals to engage with.

An investigation of the role of salience and social anxiety in conscious emotional face processing using an online survey task.

The previous chapter provided some information regarding automatic processing of facial features and the effect of facial expressions in conjunction with expectations on the cognitions of the viewer in a general population. However, the main focus of this thesis was to investigate the relationship between attention to faces and cognitions as a function of social anxiety. In order to disentangle potential mechanisms for reduced attention to faces in socially anxious individuals, as suggested by the Clark and Well's (1995) model, it is necessary to investigate awareness of attention to social cues.

Visual attention is reportedly governed by a combination of top-down processing (i.e. prior knowledge, expectations and goals that are associated with conscious processing) and bottom-up processes (i.e. salience and motor responses associated with automatic processing) (Corbetta & Shulman, 2002). The results from Study 1 suggested that top-down processing does not influence attention to faces during the categorisation process. Context had no effect on fixations which were solely guided by salience as indicated by more attention to sad eyes and happy mouths compared to other eye and mouth emotions relatively regardless of context. Happy mouths appeared to be the most visually salient feature overall and happy eyes the least salient. Furthermore, context had no influence on discrete emotion categorisations of faces, which were based on the mouth of incongruent composite faces.

It is possible that these results may have been due to the nature of the task. Neumann, Spezio, Piven & Adolphs (2006) found using the 'Bubbles' paradigm (Gosselin & Schyns, 2001), that although the gaze behaviour and accuracy of emotion categorisation of an autism group were no different from controls for a whole upright face, they had a significantly higher proportion and duration of fixations to mouths compared to eyes in a restricted attention condition. There did not appear to be differences in how the groups used low level saliency information for eyes, as salient information indicated by high contrast and luminance elicited attention equally from both groups. However, when no salience information was present the preference for mouths in the autism group was attributed to top-down processing including learned associations and expectations. In the case of autism, the mouth may hold more relevance as a mode of communication than the eyes which may be more difficult to read. It is possible that social anxiety may function under a similar premise with respect to cognitions based on biased expectancies and memories of negative social situations, which may make the social meaning of the expressions of the eyes difficult or uncomfortable to interpret.

Social anxiety related differences in attention to faces have also emerged for viewing male faces compared to female faces, which a salience based account cannot entirely account for (Wieser, Pauli, Weyers, Alpers & Mühlberger 2009). Socially anxious participants made more first saccades towards angry male and happy female animated avatars in a freeview gaze task compared to low anxious participants. Moreover group differences in viewing durations changed with different time epochs. Socially anxious participants fixated angry and happy faces for longer than low anxious participants in the 0-1000ms time epoch but that this pattern was reversed in the 1000-1500 time epoch. No differences were found at later time epochs (i.e. after 1500ms). This suggests that any vigilance-avoidance patterns were fleeting. Angry faces were rated as being more negative and arousing overall with no between groups differences.

Thus, categorisation of the face may be likely to occur in the very early stages of processing whilst reduced attention to eyes or faces in a period following this could be caused by cognitive processes during which the meaning of the face in relation to the viewer is processed. Once this stage has been completed, attention may return to normal which would explain the vigilant-avoidant-normal attentional pattern over time. Early attention to emotional faces could result in reduced attention at a slightly later time point whilst the anxious individual consciously processes the self-relevance faces that have already automatically categorised. Once the individual has assigned some meaning to the face in relation to themselves, attention may return to a normal pattern which would account for the lack of differences at later time epochs.

Carver and Scheier (1988) proposed that anxiety strains working memory by placing cognitive load on it. The heightened awareness that the individual has about worrying over their poor ability to cope with the anxiety precipitates goal disengagement, resulting in attention being diverted inwards thereby hampering performance. A highly anxious individual will engage in task irrelevant thoughts for brief periods. This will then be followed by reengagement of attention to the task to re-evaluate the situation. Yet such a cycle may be likely to involve both automatic and conscious processes.

Evidence reviewed by Green and Phillips (2004) supports the idea that there is a dual role for automatic and conscious processing in avoidance of faces in face processing tasks. They proposed that crude discrimination of faces is governed by early automatic processing (i.e. under 200ms) but that finer details are processed during elaborative stages when attention is under conscious awareness and control. If this were the case then individuals should have some awareness of which features they are basing indicators of social threat on. Moreover, this review suggests that recognition takes place during automatic processing stages whilst evaluation of threat takes place during more elaborative stages.

This may explain a processing advantage for socially anxious individuals at early automatic stages of processing if they have a tendency towards configural processing (i.e. Langner et al., 2009) in which the face is processed more holistically than with more feature based processing. Whilst during elaborative stages when more detailed processing is required, low anxious individuals may be better equipped to deal with this if they have an advantage for contour processing in which the finer details are processed. Moreover, cognitive intrusions from memories and expectations may also interfere with processing facial expressions in socially anxious individuals at later stages of processing when the meaning of the expression is considered. The effect of social anxiety on working memory and inhibition is investigated in the next chapter but following this line of reasoning it would be likely that socially anxious individuals have no deficit in categorisation of facial expressions.

Categorisation in social anxiety: static whole face paradigms

Several studies have attempted to measure interpretation bias in terms of more positive or negative perceptions of emotional faces across levels of social anxiety. Results have been mixed but the weight of evidence does not support a deficit in socially anxious individuals with respect to discrete categorisation of emotional faces. Yoon, Joorman and Gotlib (2009) found that a high social anxiety group were significantly less likely than a control group to select happy faces as being more intense than negative faces, suggesting that happy faces may be less salient to this group or that negative faces are more salient. Hunter, Buckner, and Schmidt, (2009) found that high social anxiety participants exhibited greater accuracy in identifying happy, sad and fear faces than low social anxiety participants. However, paradoxically there were no differences with respect to angry faces. This may be due to angry faces being socially threatening generally.

However Phan, Fitzgerald, Nathan, and Tancer (2006) found that despite differential amygdala activity associated with social anxiety, there were no group differences in participants with social phobia and healthy controls in respect of accuracy or reaction times in categorising emotional facial expressions. Similarly, Nomura et al., (2004) discovered increased right amygdala activity in high social anxiety participants, which was correlated with activity in the prefrontal cortex and recognition of anger despite categorisations of the faces not differing. Thus, increased arousal to threat does not necessarily result in more negative interpretations of emotional faces. Rather more elaborate evaluating processing may be responsible for interpretation biases in socially anxious people.

Indeed, Straube, Kolassa, Glauer, Mentzel, and Miltner, (2004) found that social phobia participants demonstrated greater neural activity to angry compared to neutral faces in the insula (involved in threat processing and arousal), in both an explicit task (identify schematic or veridical face) and an implicit task (recognize emotion). Yet the amygdala, parahippocampal gyrus, fusiform gyrus (specialized for face detection), and superior temporal sulcus (implicated in evaluation of social relevance) were more active only in the implicit task. This suggests an automatic processing difference rather than a difference in cognitions. Furthermore, Mühlberger et al. (2009) failed to find any group differences in valence or arousal using face photos or artificial avatar expressions. Further studies have also failed to find evidence of difference in ratings of pleasantness or valence (Amir et al., 2005;

Campbell et al. 2009; Coles & Heimberg 2005; Heuer et al, 2007; Goldin et al, 2009; Merckelbach, van Hout, van den Hout & Mersh, 1989; Richards et al., 2002; Schofield, Coles & Gibb, 2007; Stein, Goldin, Sareen, Zorrilla, & Brown, 2002).

Interpretation of results has been limited in terms of the mixtures of stimuli and social anxiety measures. There has been a great deal of variation regarding the types of stimuli used in studies in terms of nationality of models, skin tones (i.e. DANVA2-AF and the DANVA2-AAAF Caucasian and African American face sets, (Nowicki, Glanville, & Demertzis, 1998) and the Matsumoto and Ekman, 1988 Japanese face set). The use of colour has varied with some sets using full colour faces (e.g. KDEF database (Lundqvist et al., 1998) and the NimStim Face Stimulus Set (Tottenham et al., 2009) whilst others used black and white photographs (e.g. Ekman and Friesen's (1976) face set; the Facial Expressions of Emotions series set (Young, Perret, Calder, Sprengelmeyer, & Ekman, 2002). Variations between stimuli could account in part for differences in interpretations of and behavioural responses to faces because some faces of the same emotion may appear to be more threatening because of inherent characteristics of the stimuli.

Social anxiety measures have also varied between clinical measures (e.g. The International Neuropsychiatric Interview (MINI), Lecrubier, Weiller, Bonora, Amorin, & Lépine (1994); Structured Clinical Interview for the DSM-IV Axis I Disorders (SCID), First, Spitzer, Gibbon, & Williams (1995) and questionnaires (e.g. Social Phobia Scale (SPS), Mattick & Clark (1998) and The Social Phobia Anxiety Inventory, Turner, Beidel, Dancu, & Stanley (1989)). Thus, it is somewhat difficult to generalise across studies. Sample sizes have also varied greatly with as little as nine participants per group in some studies (e.g. Mühlberger et al. 2009) and extremely large differences in group sizes in others (e.g. Yoon et al., 2009). However on the whole, they have not yielded reliable evidence of social anxiety related interpretation biases in response to static faces.

Yet closer inspections of some of these studies and additional ones reveal interesting insights into the nature of interpretation biases with regard to facial features and perceived relevance. For example, in a study by Coles, Heimberg and Schofield (2008), the high social anxiety group rated a schematic face with a negative brow shape (\ /) and a smiling mouth (upturned curve) more negatively than one with positive brows (/ \) and a frowning mouth (downturned curve). Yet there were no differences in the low social anxiety group, which suggests that high social anxiety participants may be sensitive to faces with angry eyes. Philippot and Douilliez (2005) suggested that rather than socially anxious individuals differing on interpretations of emotional faces per se, interpretation differences may be caused by the perceived relevance of the social threat to the anxious perceiver.

More self-relevant measures have also been found to yield anxiety related differences in behavioural measures. For example, despite no differences in intensity ratings, Schofield et al. (2007) did find that a high social anxiety group perceived that an interaction with the model would be more likely to be a negative experience than a low social anxiety group did. Stevens, Gerlach and Rista (2008) asked participants to rate face photos in the context of a conversation on scales of perceived friendliness and perceived rejection. Socially phobic participants rated both neutral and happy faces as less friendly than controls. Moreover, social anxiety was associated with higher perceived rejection ratings to angry faces.

Results from the study by Stevens et al. (2008) support the assumptions of Study 1 that negative social information may influence the intensity of self-relevant valence in emotional categorisations of faces. Rather than categorisation problems being an integral component of social anxiety, intensity ratings for information that is more personally relevant may be influenced by social anxiety. In support of this, Campbell et al. (2009) found that in spite of no difference in categorising emotional faces, high social anxiety participants found all faces to be less approachable than low social anxiety participants did. Furthermore, despite happy faces being rated as more approachable than angry or disgust faces, the high social anxiety group rated them significantly less approachable than the low social anxiety group. Approach/ avoidance measures may be a more relevant measure of a social threat than a categorisation task since it is inherently more relevant to the self.

Approach-avoidance

Gray's neuropsychological model (Gray & McNaughton, 2000), suggests that avoidance is associated with the behavioural inhibition system (BIS) which is related to signs of punishment, fear and novel stimuli. Heuer, Rinck and Becker (2007) randomly presented participants with angry, neutral or happy face photos or a picture of a puzzle on a PC monitor. The task involved participants being asked to push the image away or pull it towards them, with push and pull instructions for faces versus puzzle pictures being reversed over two blocks. The movement of the joystick caused the picture to increase in size as it was pulled towards the participant or decrease in size as it was pushed away. Following the experiment, participants were asked to rate the valence of all of the faces that had been presented during the task on a five point scale from ‘very unpleasant’ to ‘very pleasant’. Faster pull responses on the joystick suggests an approach tendency whilst faster push responses indicate avoidance. Overall, there was a marginally significant slowing in responses for the high social anxiety group compared to the low social anxiety group, which may indicate increased socio-evaluative processing. The high social anxiety group also pushed away angry and happy faces more quickly than they pulled them towards them whilst this difference was not evident in the low social anxiety group.

This suggests that the high social anxiety group had a stronger desire to avoid a socially threatening face. Despite no significant differences for valence ratings the high social anxiety group may have interpreted the happy face in a way that is negatively self-relevant if they associated it with being mocked. However, this type of task is considered to be indicative of automatic processing and Heuer et al. (2007) have suggested that the reason for the discrepancy between results on the approach-avoidance and the valence ratings reflects the differences between automatic and explicit conscious processing.

Seidel, Habel, Kirschner, Gur and Derntl (2010) tested automatic versus conscious approach-avoidance responses in a general population. Participants were required to pull or push a joystick in response to a series of emotional face photos to measure automatic responses. They were also asked to imagine standing opposite the face and rate their tendency to approach or avoid it. Happy faces were associated with approach tendencies both at automatic (faster pull response on joystick task) and explicit (higher rating for desire to approach) processing levels whilst angry faces were associated with avoidance tendencies (faster push responses on joystick task) at the automatic stage and at the explicit stage (higher rating for desire to avoid). Therefore at a general level both automatic and conscious processing appears to be involved with approach-avoidance responses. Evidence of conscious processing has also been found for socially anxious participants in approach-avoidance tasks. Campbell et al. (2009) found that happy faces were subjectively rated as less approachable by high anxious than low anxious participants. This suggests that approach-avoidance responses may reflect a measure of self-relevance. A face can be categorised independently of the self but a decision to approach or avoid the face cannot.

Roelofs et al. (2010) manipulated gaze direction in angry, happy and neutral faces to appear centralised or averted in an approach-avoidance task. To the viewer a centralised gaze would signal that the face was looking at them (and therefore any cognitions underlying the expression were likely to be relevant to the viewer). In the averted condition the gaze is directed somewhere else (therefore not relevant to the viewer). Angry faces were found to elicit an avoidance response in the high social anxiety group only in the direct gaze condition. There was also a difference which approached significance for happy faces such that the high social anxiety group appeared to avoid happy faces more than the low social anxiety group regardless of gaze direction. This suggests that negative social information that is self-relevant is associated with avoidance responses whilst negative information that is not self-relevant is not. This level of processing must occur beyond the automatic stages because it involves assessing cognitions. This reinforces the suggestions that both automatic and elaborative processes are involved with face processing in terms of approach/avoidance. The lack of gaze direction difference for happy faces but the elevated avoidance response may also be explained by the negative self-relevance of the happy face. If the face represents a person mocking the viewer then it is conceivable that the averted gaze could be communicating this mocking of the viewer to another person. This mimics the type of situation where a person is conscious in a social situation of a pair of individuals sniggering to each other about them.

To summarise, it seems that both automatic processing differences and strategic avoidance desires may be evident in social anxiety. Categorisation may be based on attention to different features when processing a whole face but the outcome may not differ between high social anxiety and groups unless the measure is directly self-relevant.

Study 2

Online categorisation of emotional faces as a function of social anxiety

From reviewing the literature at the beginning of this chapter it appears that both automatic processing differences resulting in reduced attention to salient features (Langner et al., 2004) and strategic avoidance desires (Campbell et al., 2009) may both have roles in how social anxiety influences face processing. There is some evidence that categorisation may be based on attention to different features in high and low social anxiety individuals (Coles et al, 2008). However, when processing a whole face, behavioural measures may not differ between high and low socially anxious groups unless the measure is self-relevant. The aim of Study 2 was to investigate the nature of conscious face processing across levels of social anxiety by using an online face processing task with ambiguous composite faces. In order to disentangle potential mechanisms for avoidance of facial features, it is necessary to investigate awareness of attention to social cues and behavioural responses. Gaining knowledge on the awareness of how features are used to categorise faces and how it would be likely to make individuals respond to an emotional face would potentially shed some light on the degree to which any apparent avoidance of negative salient features (e.g. Horley et al. 2004) is part of a strategic ploy to reduce anxiety.

Findings from Study 1 suggest that emotional categorisations tend to be made on the basis of salience information from the emotion of the mouth whilst there may be a role for negative eyes in social cognition. Sad eyes or a sad mouth in a face in the absence of other sad features were enough to increase internalisation and increase negative self-esteem when a negative self-referential facial expression is expected. Moreover, negative eyes in a face previously categorised as positive reduce positive self-esteem. Notwithstanding these conclusions, in the previous study, only happy and sad features were tested. The impact of negative features on social cognition may differ with expressions such as fear and anger which involve increased exposure of the whites of the eyes or increased brow muscle movement.

The specific aim of Study 2 was to investigate the awareness of feature selection for the categorisation processes and to measure the differences across social anxiety levels of non-self-relevant valence intensity ratings and self-relevant approach-avoidance tendencies. The study was conducted as an online image based computer task during which a composite face was presented. After viewing the face, participants were asked to indicate their conscious desires to approach and avoid each face before categorising the face and finally selecting the part of the face (upper or lower) that was used to base the categorisation on.

The following hypotheses were generated:

I. *Subjective approach-avoidance*: (i) Faces with negative eyes would be avoided more and approached significantly less than faces with negative mouths because of the social relevance of eyes. (ii) In addition, because there were no time restrictions on the responses, allowing time for the relevance of the face to the self to be processed, it was hypothesised that the high social anxiety group would be significantly more likely to indicate a desire to avoid faces overall but particularly more negatively perceived faces (i.e. those with angry eyes) than low social anxiety participants. On the other hand, it was predicted that low social anxiety participants would be significantly more likely to indicate a desire to approach a more positively perceived face that high social anxiety participants (i.e. Campbell et al., 2009).

II. *Face valence categorisations*: Overall faces with negative eyes would be rated more negatively than faces with negative mouths because of the social relevance of eyes. Group differences were not expected since it was expected that high social anxiety participants would not interpret faces as being more negative than low anxious participants because the face is not accompanied by self-referential information and the task is not socially threatening.

III. *Features*: high social anxiety individuals would identify the feature that they based their valence categorisations as a combination of information from the eyes and mouths (reflecting a more configural approach as Langner et al., 2004, suggested) but that low social anxiety individuals would indicate that they based their categorisations on the most salient feature in terms of a social threat. Awareness of the features that they based their categorisations on would reflect the effect of processing differences during elaborative stages of processing (i.e. Green & Phillips, 2004).

Method

Participants

129 participants partially completed the experiment but 71 participants had a substantial amount of missing data due to non-completion. Thus only the data from the 58 participants who completed the online study was analysed. This comprised 34 females and 24 males aged between 18 and 47 (M = 29.91, SD = 7.72) who were recruited through the University of Strathclyde's virtual learning environment; classified ads, community websites and forums. The study was given ethical approval by the University of Strathclyde School of Psychological sciences and Health Ethics Committee. Inclusion criteria included English speakers aged 17-60. Exclusion criteria included a history of substance abuse for past two years or; a current or recent psychiatric disorder.

Participants were split into high (20), moderate (18) and low (20) anxiety groups based the third percentile of scores (in accordance with Guastella, Carson, Dadds, Mitchell & Cox, 2009; Silvia et al2006) on the online 8-item Brief Fear of Negative Evaluation scale II (BFNE II; Carleton, Collimore & Asmundson, 2007). This scale has an internal consistency coefficient alpha of .97 with no differences in scores when administered in web format or paper format. Fear of negative evaluation is one of the pivotal predictors of social anxiety according to the Rapee and Heimberg (1997) model of social anxiety.

Participant demographics

In order to check that the high, medium and low social anxiety groups differed significantly on fear of negative evaluation and that gender and age was equivalent across groups to eliminate demographic confounds, Chi² and ANOVA analyses were conducted across gender, age and BFNE scores respectively. The assumptions for a 2 x3 Chi ² test for gender across groups were not met as 42% of cells had a count less than 5%. Therefore, three 2x2 Chi ² tests were conducted using Fisher's exact test to compare gender across high and low; high and moderate and moderate and low anxiety groups. Results revealed no significant differences across gender between the high and moderate group $\chi^2(5) = 0.38$, exact $p= 0.01$. There were also no significant differences between the low and the moderate group, $\chi^2(5) = 0.87$, exact $p= 0.51$ or between the high and low groups, $\chi^2(5) = 0.11$, exact $p= 0.74$. Two one-way ANOVAs confirmed that there were no significant differences for age across anxiety groups but that BFNE scores differed significantly across anxiety groups. Bonferroni post-hoc significance values are presented in table 2.1.

Table 2.1.
Participant characteristics

Anxiety	HSA		MSA		LSA		*F*	*P*	HSA LSA	HSA MSA	MSA LSA
	M	SD	M	SD	M	SD					
BFNE	30.25	0.78	19.61	0.82	13.55	0.78	116.62	< 0.001	< 0.001	< 0.001	< 0.001
Age	29	7	29	7	31	9	0.81	0.45			

BFNE, Brief Fear of Negative Evaluation Scale (8-item)

Design

Approach/avoidance in relation to positive and negative faces cannot be assumed to be on a bipolar scale since they are thought to be underpinned by two independent systems (i.e. the behavioural approach system and the behavioural inhibition system, Gray & McNaughton, 2000). Furthermore, social anxiety subtypes have associated with differential approach-avoidance responses (Hofmann, Newman, Ehlers & Roth, 1995; Kashdan and McKnight, 2010). Therefore, approach and avoidance were measured separately on two sliding bar percentage scales. Furthermore, having separate approach/avoidance scales reduces the chance of the approach/avoidance responses priming categorisation responses. Percentage data for each scale was analysed in a mixed ANOVA with anxiety group as a between groups factor (high/medium/low social anxiety) and two repeated measures factors; face configuration (angry eyes/happy mouth (angry/happy); angry eyes/neutral mouth (angry/neutral); happy eyes/angry mouth (happy/angry) and neutral eyes/angry mouth (neutral/angry)) and direction (approach; avoidance). Valence ratings were measured on a 7-point scale with response options ranging from 1 (very negative) to

7 (very positive). Ratings were analysed in a mixed 3x4 ANOVA with one between groups factor (anxiety group) and one repeated measure (face configuration).

The relative percentage weighting for how much the upper or lower face were focused on when making a categorisation was also measured by an entry box in which the participant entered how much weighting they gave to the lower face part of the face compared to the upper part when categorising the facial expression. An automatic calculation was computed for the lower face based on the entry for the upper face and vice versa. Percentages for weightings were analysed for the lower face only since the percentage of categorisation based on the upper face corresponded to this as a ratio. Data were analysed in a mixed 3x4 ANOVA with one between groups factor (anxiety group) and one repeated measure (face configuration).

Apparatus and stimuli

In Study 1 neutral noses only were used for all face composites but there is a possibility that the emotional shape of the nose could affect valence ratings. Notwithstanding this concern, including different combinations of configurations with emotional eyes, noses and mouths would lead to a task with a large number of trials rendering the experiment insurmountable. Therefore, it was decided that for an online task it would be more appropriate to select just one configuration, preferably neutral nose again in line with Study 1. It was reasoned that this would enable more direct comparisons to be drawn between the studies. However, in order to assess the contribution of the valence of the nose to the face categorisation, a pilot study (B) (Appendix I(iii)) was firstly conducted with one male (model 34) and one female face (model 1) selected from the NimStim Set of Facial Expressions (Tottenham et al., 2009).

30 photo face stimuli: 5 male (models 21M; 22M; 24M; 28M; 34M) and 5 female models 01F; 02F; 3F; 05F; 06F) consisting of three emotional expressions (angry, happy and neutral) were selected from the NimStim Set of Facial Expressions (Tottenham et al., 2009). 40 Chimeric faces were constructed using Photoshop elements 5 by combining various arrangements of emotional and neutral features into 4 ambiguous face types. These were comprised of faces with happy eyes/angry mouth; neutral eyes/angry mouth; angry eyes/ happy mouth and angry eyes/neutral mouth.

This gave rise to two configurations for each emotion combination i.e. angry/happy faces (angry eyes/happy mouth; happy eyes/ angry mouth) or angry/neutral (angry eyes/neutral mouth; neutral eyes/ angry mouth) over 10 identities. Based on the outcomes of the pilot data in Pilot Study B (Appendix I(iii)) all nose areas (set from the bridge of the nose just beneath the eyes to the tip of the nose and following the line of the end of the eyes) were neutral. This enabled conclusions to be drawn about the relative contribution of the eyes versus mouth to perception, categorisation and approach-avoidance desires. Examples of the composite face types are presented in Figure 2.1.

Happy-Angry Neutral-Angry Angry-Happy Angry-Neutral

Figure 2.1: *Example of composite face stimuli*

The Qualtrics questions for participants were as follows:

1. *"Please rate how inclined you would be to be to approach or avoid this face in a real situation by moving the slider along the percentage bar".*

   There were two separate percentage bars for approach and avoid responses.

2. *"Please rate the emotion of the face in terms of how positive or negative it appears to be from Very negative (-3) to very positive (3)".*

   Corresponding Likert scale tick boxes were presented under this question.

3. *"Please rate how much you think you focussed on the upper or lower face (from the midpoint of the nose) when making your decision".*

   Two entry boxes below this question accompanied the options of 'Upper %' and 'Lower %' respectively.

Procedure

Participants were asked to read the information sheet and indicate consent by ticking a box on the online consent form before being able to complete the experiment. They were asked to complete the BFNE II (Clareton et al., 2007) online scale via a Qualtrics survey link (Qualtrics Labs, Inc.) before being asked to view a series of composite faces. While the face was on the screen, they were asked to indicate how likely they would be to approach or avoid the face using a sliding scale for each of them from 0% to 100% before being asked to rate the valence of the face on a 7 point scale from 'very negative' to 'very positive'. They were then asked to rate the percentage that they focussed on the eyes and mouth relative to each other in making their valence categorisation. Face presentations were fully randomised across participants.

Results

The duration of time spent on each page in the online experiment was recorded as a crude estimate of the processing durations involved in responding to the questions. Inferential statistics were not conducted for this measure since it was not possible to control the durations and factors that may influence this outside of a lab environment. However the average time taken to submit a page was approximately 30 seconds. The minimum timing of the first response made by any participant to make the initial response (approach-avoidance) to the first question on the page was 560ms. This suggests that all responses were made once processing was under conscious control.

Approach-Avoidance

It was hypothesised that the high social anxiety group would be significantly more likely to wish to avoid all faces, particularly negatively perceived ones whilst low social anxiety participants would be significantly more likely to indicate a desire to approach a positively perceived face. Approach-avoidance responses were analysed using a mixed 2x3x4 ANOVA with one between groups factor: anxiety group (high; moderate; low) and two repeated measures factors: direction (approach; avoid) and configuration (Angry/Happy; Angry/Neutral; Happy/Angry; Neutral/Angry) for the percentage of likelihood of altering the distance between the participant and the face. Descriptive statistics for approach and avoidance desires illustrated in Table 2.2 suggest that overall ambiguous composite faces with one angry feature are associated more with avoidance than approach.

Table 2.2.
Mean approach-avoidance responses

		Approach%		Avoidance%	
		M	SD	M	SD
Angry/Happy	H	34.62	17.39	52.68	17.87
	L	25.59	14.69	54.36	19.96
	M	28.39	14.58	59.44	17.92
	Total Angry/happy	29.57	15.85	55.36	18.52
Angry/Neutral	H	30.14	18.39	60.49	18.48
	L	23.36	17.16	54.70	23.61
	M	25.78	11.27	62.74	16.19
	Total Angry/neutral	26.45	16.03	59.19	19.73
Happy/Angry	H	37.51	21.08	48.82	18.73
	L	32.82	15.49	46.69	19.99
	M	30.69	12.58	56.47	14.81
	Total Happy/Angry	33.77	16.84	50.46	18.25
Neutral/Angry	H	37.20	19.92	49.35	17.18
	L	31.13	17.28	46.18	19.07
	M	31.44	12.29	57.54	13.47
	Total Neutral/Angry	33.32	16.88	50.80	17.21

For approach responses, Kolmogorov-Smirnov normality test indicated that the data were not normally distributed on the Happy/Angry face for the high anxious group (p = 0.03) but Levene's test was non-significant at the 0.01 level, $F(2,55)$ = 1.63, p = 0.21) and all other Levene's tests were non-significant (p > 0.05). The avoidance data were not normally distributed for the high anxiety group for faces with angry eyes/neutral mouth (p = 0.004) or for the moderate group for faces with happy eyes/angry mouths (p = 0.02) but Levene's tests were non-significant for both of these faces respectively, $F(2,55)$ = 1.78, p = 0.18; $F(2,55)$ = 0.94, p = 0.4, as well as for the two other faces (p > 0.4). Furthermore, there were fairly equal numbers in each group so as Howell (2007) suggests, under these circumstances ANOVA should be robust enough to deal with small deviations in normality.

Hypothesis I(i): General subjective approach-avoidance

It was hypothesised that generally faces with negative eyes would be avoided more and approached significantly less than faces with negative mouths because of the social relevance of eyes. Thus a significant direction x configuration interaction would be expected. A 2x3x4 mixed ANOVA with anxiety as a between subjects factor and direction and configuration as repeated measures factors firstly revealed a significant main effect of direction, $F(1, 55)$ = 46.27, MSE = 1369.31, p< 0.001, η_p^2 = 0.46 *Power* =1. All of the faces elicited significantly higher avoidance desires (M = 54.12%, SE = 2.19) than approach desires (M = 30.72%, SE = 1.96).

In addition, the direction x configuration interaction was indeed significant as predicted. Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi2(5)$ = 15.78 , p = 0.01), degrees of freedom were corrected using Greenhouse Geisser epsilon (ε = 0.87), since Mauchly's W was < 0.75 (Field, 2009) , $F(2.62, 143.99)$ = 12.94, MSE = 144.71, p< 0.001, η_p^2 = 0.19 *Power* =1.

Bonferroni contrasts revealed that for approach desires, faces with happy eyes/angry mouth were significantly more likely to be approached (M = 33.67%, SE = 2.22) than faces with angry eyes/happy mouth (M = 29.53%, SE = 2.06). Similarly, faces with neutral eyes/angry mouth were significantly more likely to be approached (M = 33.26%, SE = 2.23) than faces with angry eyes/neutral mouth (M = 26.43%, SE = 2.11). Happy features had no attenuating effect on the rating of faces with angry features. Therefore, faces with angry eyes appear to be less approachable than faces with angry mouths. Furthermore, given the significant main effect of direction which indicated that there was a general desire to avoid all of the faces, the presence of either an angry mouth or angry eyes appears to be enough to signal a social threat regardless of the presence of a happy feature.

For avoidance desires, faces with angry eyes/happy mouths (M = 55.49%, SE = 2.45) were associated with desire to avoid significantly more than faces with happy eyes/angry mouths (M = 50.7%, SE = 2.38, $p = 0.03$). Faces with angry eyes/neutral mouth (M = 59.31%, SE = 2.6) were associated with a higher desire for avoidance than were faces with neutral eyes/angry mouths (M = 51.02%, SE = 2.21, $p < 0.001$). Again there were no significant differences between faces with happy eyes/angry mouth and faces with neutral eyes/angry mouth ($p = 1$) or with angry eyes/happy mouth and angry eyes/neutral mouth ($p = 0.25$). These contrasts were followed up with two Wilcoxon Signed Ranks tests which confirmed the significant differences between each pair reported (Appendix III(ii)). In support of the hypothesis, faces with angry eyes were associated with more conscious avoidance desires and less approach desires than faces with angry mouths, which suggests that angry eyes are more threatening. Happy features had no attenuating effect on approachability or avoidance ratings of faces with angry features.

Hypothesis I(ii): Subjective approach-avoidance as a function of social anxiety

It was further hypothesised that the high social anxiety group would be significantly more likely to indicate a desire to avoid faces overall, but particularly with more negatively perceived faces (i.e. those with angry eyes) than low social anxiety participants. In contrast, it was predicted that low social anxiety participants would be significantly more likely to indicate a desire to approach a more positively perceived face that high social anxiety participants. Therefore, a significant three-way interaction between anxiety, configuration and direction would be expected. To investigate this hypothesis fully, the results of the ratings data would be required to ascertain which face configurations were perceived positively or negatively.

However, this was rendered unnecessary because the results for approach/avoidance data revealed that the main effect for anxiety, $F(2, 55) = 1.75$, $MSE = 1109.62$, $p = 0.18$, $\eta p^2 = 0.06$ *Power* = 0.35 and anxiety group x direction interaction was non-significant, $F(2, 55) = 1.02$, $MSE = 1369.31$, $p = 0.37$, $\eta p^2 = 0.04$ *Power* = 0.23 as was the anxiety group x direction x configuration interaction $F(5.24, 143.99) = 0.68$, $MSE = 98.52$, $p = 0.65$, $\eta p^2 = 0.03$, *Power* = 0.25. Contrary to the prediction therefore, there were no group differences in subjective approach-avoidance desires. Participants indicated that they would wish to avoid all of the faces significantly more than approach them. Therefore the presence of just one angry feature is sufficient to signal a social threat.

Face valence ratings

Kolmogorov-Smirnov normality tests indicated that the avoidance data was not normally distributed for the high or low anxiety group on faces with angry eyes/happy mouth ($p = 0.02$; $p = 0.01$) or for the moderate group on faces with happy eyes/angry mouth ($p = 0.04$) but Levene's test was non-significant for faces with angry eyes/happy mouth $F(2,55) = 1.39$, $p = 0.26$ and faces with happy eyes/angry mouth, $F(2,55) = 0.26$, $p = 0.77$. Levene's tests on the other two faces were also non-significant ($p > 0.05$). Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi2(5) = 45.12$, $p < 0.001$), degrees of freedom were corrected using the Greenhouse Geisser epsilon ($\varepsilon = 0.68$), since Mauchly's test was < 0.75 (Field, 2009). Transformations failed to normalise the data. Therefore, results were followed up with non-parametric analysis. Descriptive statistics illustrated in Table 2.3 suggested that the faces were fairly ambiguous, although slightly more towards the negative end of the scale, with faces with angry eyes and a neutral mouth being rated a little more negatively than the others.

Table 2.3

Mean valence ratings from 1(very negative) to 7(very positive)

	Anx	M	SD
Angry/Happy	H	3.65	0.93
	M	3.50	0.79
	L	3.18	0.68
	Total Angry/Happy	3.44	0.82
Angry/Neutral	H	2.72	0.66
	M	2.74	0.33
	L	2.78	0.58
	Total Angry/Neutral	2.75	0.54
Happy/Angry	H	3.35	0.60
	M	3.33	0.49
	L	3.39	0.57
	Total Happy/Angry	3.36	0.55
Neutral/Angry	H	3.35	0.53
	M	3.20	0.49
	L	3.29	0.51
	Total Neutral/Angry	3.28	0.50

Hypothesis II: Face valence categorisations

It was hypothesised that across anxiety groups faces with negative eyes would be rated more negatively than faces with negative mouths because of the social relevance of eyes. Thus a significant main effect of configuration only would be anticipated indicating that faces with angry eyes were rated more negatively than faces with happy or neutral eyes. As expected, the main effect for anxiety group was non-significant, $F(2, 55) = 0.37$, $MSE = 0.26$, $p < 0.7$, $\eta_p^2 = 0.01$ *Power* =0.11 as was the anxiety group configuration interaction, $F(4.09, 112.59) = 1.28$, $MSE = 0.40$, $p = 0.28$, $\eta_p^2 = 0.28$ *Power* =0.39. Indeed as predicted, there was a significant main effect of configuration, $F(2.05, 112.59) = 20.58$, $MSE = 0.40$, $p < 0.001$, $\eta_p^2 = 0.27$

Power =1. However it must be noted that Bonferroni contrasts revealed that there were no significant differences in valence ratings between faces with angry eyes / happy mouths (M = 3.44, SE = 0.11) and faces with happy eyes/ angry mouths (M = 3.35, SE = 0.07, p = 1). This does not support the hypothesis that angry eyes are more salient than angry mouths. However, the results may be explained by the influence of happy mouths which were shown in Study 1 to be highly salient. If angry eyes were indeed more salient and more negatively rated than angry mouths, the effect of this may have been reduced by the happy mouth.

In support of this, faces with angry eyes and neutral mouths were rated significantly more negatively (M = 2.75, SE = 0.07) than faces with neutral eyes and angry mouths (M 3.28, SE = 0.07, p < 0.001). These results were confirmed by a Wilcoxon Signed Ranks test (Appendix III(ii)). This suggests that angry eyes may be the most salient features in terms of threat categorisation as predicted, yet the effect evident from analysis with angry and neutral feature pairings appeared to have been mitigated by the presence of a happy mouth in faces with angry eyes/happy mouths suggesting that angry eyes and happy mouths are equally high in salience.

Feature: subjective focus of attention for categorisation

It was predicted that high social anxiety individuals would base their valence categorisations on a combination of information from the eyes and mouths but that low social anxiety individuals would categorise the valence of the face based on the most salient feature in terms of the amount of attention that they focussed on the feature. Descriptive statistics for self-reported focus of attention on feature during the categorisation process are presented in Table 2.4. The means suggest that low anxious participants attended more to angry eyes when categorising faces than high or moderately anxious participants, which is consistent with the hypothesis.

Table 2.4

Mean % of self-report focus on lower face relative to upper face when categorising facial expression

	Anx	*M*	*SD*
Angry/Happy	H	45.32	8.89
	M	45.48	8.79
	L	35.92	7.30
	Total	42.13	9.37
Angry/Neutral	H	35.79	9.83
	M	34.85	9.37
	L	28.09	9.22
	Total	32.84	9.95
Happy/Angry	H	53.22	11.89
	M	56.59	6.98
	L	52.44	11.33
	Total	54.00	10.37
Neutral/Angry	H	55.78	11.90
	M	60.78	10.41
	L	55.05	10.86
	Total	57.08	11.19

Hypothesis III: Subjective focus of attention for categorisation as a function of social anxiety

If as predicted high social anxiety individuals base their valence categorisations on a combination of information from features, whilst low social anxiety individuals categorise the valence of the face based on the most salient feature, then a significant anxiety x configuration would be anticipated.

A 3 x 4 repeated measures ANOVA with anxiety as the between groups factor and face configuration as the repeated measures factor firstly revealed a significant main effect of configuration. A Kolmogorov-Smirnov test of normality revealed that the low anxiety group were not normally distributed for faces with angry eyes/happy mouth but the Levine's test was non-significant $F(2,55) = 0.82$, $p = 0.44$). However Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi2(5) = 55.92$, $p < 0.001$), degrees of freedom were corrected using the Greenhouse Geisser epsilon ($\varepsilon = 0.62$), since Mauchly's test was < 0.75 (Field, 2009) , $F(1.85, 101.52) = 93.43$, $MSE = 125.76$, $p< 0.001$, $\eta_p^2 = 0.63$ *Power* =1.

Bonferroni contrasts revealed that mouths were consciously focussed on significantly more on faces with neutral eyes/angry mouth (M = 57.2%, SE = 1.46) than faces with angry eyes/neutral mouth (M = 32.91%, SE = 1.25, $p<0.001$). This means that when paired with neutral features the categorisation was based on the angry feature regardless of whether it was the eyes (67.09%) or the mouth (57.2%). The same was found for angry paired with happy features. Faces with happy eyes/angry mouths were categorised on the basis of the mouth with a significantly higher percentage of scores for the mouth area (M = 57.2%, SE = 1.46) compared to faces with angry eyes/happy mouth (M = 42.24%, SE = 1.1, $p<0.01$) which were categorised more on the basis of the eyes (57.76%). However, faces with angry eyes/happy mouth (M = 42.24%, SE = 1.1) were categorised significantly more on the basis of the mouth than faces with angry eyes/neutral mouth (M = 32.91%, SE = 1.25, $p < 0.001$) and faces with neutral eyes/angry mouth were focussed on significantly more on the mouth area than those with happy eyes/angry mouth (M = 57.2%, SE = 1.46, $p = 0.04$). Again these differences were confirmed by Wilcoxon's Signed Ranks test (Appendix III(ii)). This suggests that anger is a more salient feature overall than happiness but that salience cues guide conscious feature based categorisation decisions.

There was also a significant main effect of anxiety, $F(2,55) = 5.53$, $MSE = 158.63$, $p = 0.01$, $\eta_p^2 = 0.17$ *Power* =0.83. Bonferroni post-hoc contrasts showed that the low anxious group focussed significantly less on the lower face relative to the upper face (M = 42.83%, SE = 1.41) than the moderate anxiety group (M = 49.43, SE = 1.35, p = 0.01) although the difference between the low and high anxiety group (M = 47.53, SE = 1.29) did not reach significance ($p = 0.07$). In apparent conflict with the hypothesis, the anxiety x configuration interaction was non-significant, $F(3.69, 101.52) = 1.44$, $MSE = 125.76$, $p = 0.23$, $\eta p^2 = 0.05$, *Power* =0.42.

However, although Levene's tests were all non-significant ($p > 0.15$), Mauchly's tests had been significant at the 0.001 α level. Therefore, since the results did not follow a normal distribution and transformations failed to normalise the data they were followed up using non-parametric Mann-Whitney tests corrected at the α 0.0167 level. These confirmed that with faces with angry eyes/ happy mouths, the low group (*Mdn* = 38) focussed significantly less on mouths relative to eyes than the high social anxiety group (*Mdn* = 48, $U = 89.5$, $z = -2.99$, $p = 0.002$) or the moderate anxiety group (*Mdn* = 44.5, $U = 72$, $z = -3.16$, $p = 0.001$). With faces with angry eyes/ neutral mouths, the low social anxiety group (*Mdn* = 26.5) focussed significantly less on mouths relative to eyes than the high social anxiety group (*Mdn* = 37, $U = 110.5$, $z = -2.42$, $p = 0.01$) or the moderate anxiety group (*Mdn* = 34.35, $U = 110.5$, $z = -2.03$, $p = 0.04$). This supports the hypothesis in showing that the high social anxiety group did make more use of both the eyes and mouth in faces with angry eyes whilst the low social anxiety group focussed more on the angry (socially threatening) eyes when categorising the emotion of the face than they did on the mouth.

Happy and neutral eyes are less socially threatening and indeed there were no significant differences between the low social anxiety (*Mdn* = 51) and high social anxiety group (*Mdn* = 52.4) for faces with happy eyes/angry mouths, in terms of which feature was focused on to categorise the face, $U = 194.5$, $z = -0.15$, $p = 0.88$ or between the low social anxiety and moderate anxiety groups (*Mdn* = 57, $U = 123.5$, $z = -1.65$, $p = 0.09$). With faces that had neutral eyes/angry mouths, there was also no significant difference between the low social anxiety group (*Mdn* = 54) the high social anxiety group (*Mdn* = 58, $U = 182.5$, $z = -0.47$, $p = 0.64$) or the moderate anxiety group (*Mdn* = 59.25), $U = 134$, $z = -1.35$, $p = 0.19$). These results coupled with the results for faces with angry eyes suggest that only in faces with socially threatening eyes, the low social anxiety group were significantly more likely to focus on the eye area compared to the high social anxiety or the moderate social anxiety groups.

Although overall angry features were on average reported to be the predominant basis for categorisation of facial emotion, high and moderately socially anxious participants used a combination of both features whilst low socially anxious participants used salient angry eyes more to categorise the emotion of the face. The parametric analysis only partially supported the hypothesis in showing that the high social anxiety group did use a combination of features to extrapolate information to base an emotion categorisation on. However, the non-parametric analysis, which is more robust to extreme non-normality supported the hypothesis by revealing that differences between high and low anxiety groups in terms of the former focussing less on eyes was only significantly different for faces with angry eyes. Therefore, the hypothesis was supported indicating that high social anxiety individuals base their valence categorisations on a combination of information from features, whilst low social anxiety individuals categorise the valence of the face based on the most salient feature.

In summary of the results, despite no significant difference in categorisations of the valence of emotional composite faces or in conscious desires to approach or avoid such faces, socially anxious individuals extrapolated information from faces in a different way than less socially anxious individuals as indicated by the features they indicated that they based their categorisations on. Overall, the presence of just one angry feature appeared to herald a social threat but there is some evidence that angry eyes are particularly threatening, and this in part accounts for differences in the way that high and low socially anxious participants focussed on them whilst judging the emotion of the face.

Discussion

The Clark and Wells (1995) model of anxiety suggests that avoidance of faces in social situations is precipitated by safety seeking behaviours. Yet Staugaard (2010) reviewed evidence of avoidance of faces in social anxiety and concluded that it was at an automatic rather than conscious level. However, others have found evidence of conscious decisions regarding approach and avoidance of faces (Campbell et al., 2009; Seidel et al., 2010). The aim of Study 2 was to investigate the way in which individuals across social anxiety groups would interact with emotional faces at a cognitive level when they had to decide whether the face was positive or negative and whether it was socially threatening or benign.

In ambiguous composite faces, just one angry feature (i.e. eyes or mouth) resulted in the face being perceived as socially threatening for all groups, who indicated that they would prefer to avoid such faces more than approach them. This was particularly the case for faces with angry eyes. There were no differences across anxiety groups for valence ratings although faces were rated slightly more towards the negative end of the scale. Angry eyes appeared to be the most salient feature but perception of valence intensity was mitigated by a happy mouth. This was indicated by a neutral valence rating when angry eyes and a happy mouth were presented together in the face and a negative valence rating when angry eyes were presented in a face with a neutral mouth.

This may suggest that angry eyes and happy mouths are both high in salience. However, despite no differences in valence ratings, when asked to indicate which features they had based their categorisations of the face on, high and moderately anxious participants based their valence categorisations on a combination of information from the eyes and mouths. In contrast, low anxious individuals indicated that they had based their categorisations of the valence of the face significantly more on eyes than mouths in faces that had angry eyes.

This appears to support the findings of Horley et al. (2004) and Langner et al. (2009) that low anxious individuals pay more attention to salient features than high anxious individual who use configural processing more. Horley et al. (2004) found that individuals with social phobia scanned around the features of the face more whilst non-socially phobic participants looked more at the features in the face.

Although this was at an automatic processing level, the data from the feature selection data in the current study suggests that an individual may have some awareness of their face processing styles in relation to how they use information to categorise emotion in the face. As Langner et al. (2009) suggests low level differences such as response to salience information (i.e. contours and contrast) may precipitate differences in attention across anxiety groups but once the processing has occurred, there may be some awareness on the part of the viewer with respect to being aware of extrapolating information from particular features.

These results may also support the assertions of Green and Phillips (2004) that conscious processing has a role in face discrimination with finer details being processed during elaborative stages. If low social anxiety individuals have a processing advantage for discriminating emotions based on information from highly detailed face features then it would explain why they focused more on the eye area. If this occurs during elaborative processing, it would explain why differences emerged in self-reports. Since this was an online study with four questions per trial and no timer on answering them, it implies a fairly long exposure to the face. Participants were asked to make this decision in the current study at the end of the trial which included four questions. The minimum score for page submission was approximately seven to eight seconds and the average page submission time was 30 seconds, which allows time for elaborative processing.

Differences revealed by the current study in relation to the features used to base categorisations on may exclusively be at the cognitive level rather than involving visual attention. For this reason it may be useful to replicate this study using eye-tracking methods. However the lack of differences for valence ratings may reflect the greater ability of individuals with higher social anxiety to obtain social information from peripheral areas as Langner et al. (2009) suggested. Alternatively, the self-reported focus on features could be based on several fixations given the lack of timing restrictions on the experiment web pages. Results from Study 1 suggest that categorisation is performed quickly on the basis of just one or two fixations so it may be that the awareness of the feature used to categorise the face also encompasses self-relevant cognitions. Participants had already been asked about their desires to approach or avoid the face and had categorised it.

Although categorisation alone contains no elements of self-reference, making a decision on one's willingness to engage with a face or not is relevant to the self in that approaching a face may place the individual in a more vulnerable position than avoiding it. Socially anxious participants may have combined a preference to avoid a seemingly threatening face with a negative valence rating and as a result they may have consciously avoided dwelling on the emotional content of angry eyes.

The contribution of a happy mouth to valence categorisations is discordant with the lack of attenuation of happy features on approach-avoidance desires. In other words, whilst the presence of a happy mouth influenced categorisations in a positive way, there was still a tendency to avoid rather than approach faces even when they contained a happy mouth. This may be due to the difference in self-relevance between the two measures. Valence categorisations appear to have been based on the most salient feature (i.e. angry eyes and happy mouth), which is in agreement with the results from Study 1.

The finding that happy features had no attenuating effect on approachability or avoidance responses suggests that angry eyes are more personally socially salient than happy mouths. This may be because subjective approach-avoidance measures represent a cognition regarding a potential interaction with an interlocutor or audience member. Again this reinforces the findings in Study 1 regarding negative eyes having a special role in more socially relevant cognitions.

The results of approach-avoidant desires differ from those of Campbell et al., 2009) in not revealing group differences whilst the previous study indicated that high socially anxious individuals rated all faces and particularly negative ones as less approachable. This may be because the faces used in this study were all ambiguous composite faces rather than whole faces. Thus, one feature may not be enough to elicit a specific social anxiety induced response on approach-avoidance desires. If social anxiety operates on a continuum as Rapee and Heimberg (1997) have suggested then the general social threat elicited by one angry feature may need to be enhanced by a more holistic angry social cue offered by a whole face condition in order to see differences emerge for socially anxious individuals.

Support for this explanation is offered by evidence of a general approach-avoidance response for happy and angry faces. Van Peer, Rotteveel, Spinhoven, Tollenaar and Roelofs (2010) found that happy faces were categorised more accurately if they moved towards the participant whilst angry faces were rated more negatively if they moved in the other direction. Therefore, specific approach-avoidance patterns found in socially anxious samples may represent an extension of this general pattern. If that is the case then the level of social anxiety in the current sub-clinical sample may be simply too low for any differences on this measure to emerge.

Campbell et al. (2009) sampled participants with clinical social phobia compared to non-anxious controls. The clinical sample may have been more sensitive to approach measures than the sample measured in the current study. Moreover, the small sample of 12 social phobia participants also had comorbid disorders. Furthermore, the face set used (Matsumoto & Ekman, 1988) also differed from that used in the current study, and faces had been presented to participants around 5-6 times before the approach-avoidance measures were taken. In addition, participants were first required to label the faces with discrete emotions (i.e. happy, disgust or angry) before being asked to rate their approach desires.

In contrast participants in the current study were asked to rate their approach and avoidance desires after seeing the first presentation of each face and were asked to make this decision before categorising the face in terms of valence only. The remoteness of an online task may also have reduced the situational anxiety compared to a lab based experiment and this could have attenuated any potential differences across anxiety groups.

The findings of this study reflect those of Coles et al. (2008) in finding that angry eyes are more threatening than angry mouths. The lack of group differences in this study may also be due to the use of veridical rather than schematic faces. Veridical faces may be more threatening generally as they are more realistic so the high social anxiety group may have reached a ceiling level which reduced any differences. An alternative explanation is that the schematic faces may have elicited a response based on the extremity of the angles of the brows compared to those used in the current study.

The study was not without its limitations. For example, the self-reported focus on features could be based on several fixations. However, it was not possible without direct attention measures in this study to ascertain whether there were any differences across features in initial fixations and how many of these were required to categorise the face. Furthermore, although the faces were randomized, the approach-avoidance questions were asked before the categorisation questions in a bid to avoid the responses being led by the categorisations as they may have been in the Campbell et al. (2009) study. It may have been useful to randomize the order of these questions.

Finally, only one measure of social anxiety was used for this study and no screening of current depression or general anxiety was included. This decision was taken due to the length of the task and the online nature of the experiment. As it was, less than half of the respondents who started the experiment completed it, and it was anticipated that this would be the case during the data collection stage of the pilot study. It was decided therefore that to add additional questionnaire items would not be appropriate in the interests of gaining a large enough sample to split social anxiety groups.

It would be useful for future researchers to replicate the study using eye-tracking in a more controlled environment. Direct eye-movement measures in conjunction with extended presentation intervals and self-report measures could ascertain the exact feature that the participant was looking at when the decision was made and at what point the decision occurred. Conducting the study in a lab setting would allow more control over the length of the experiment by inserting breaks. This would provide an opportunity to increase the social anxiety and screening measures used.

From the findings of the current study coupled with those of study 1, it is important to address the issue of categorisations of facial expressions in a dynamic context with and without a social stressor. These issues are discussed further in Chapters 5 and 6 but it is also prudent to investigate the assertions of Carver and Scheier (1998) regarding working memory and social anxiety and this is the focus of the next chapter. To sum up the findings of the current study, it appears that angry eyes are particularly threatening but that despite no group differences in identifying the threat, less socially anxious individuals appear to be more willing than more socially anxious people to engage with a social threat. This may be taken as evidence to support a reduction in attention to social threat cues as the Clark and Wells (1995) model assumes but the mechanism underpinning this reduction is not likely to involve self-focused attention given that the task did not involve a social threat.

Chapter 4

Abstract

Preliminary evidence suggests that social anxiety may lead to difficulties inhibiting faces (Wieser et al., 2009). The aim of study 3 was to investigate the effect of social anxiety, emotional salience and socio-cognitive load on the performance in an antisaccade task with emotional faces preceded by valenced sentence primes. Despite no group differences, latencies were significantly longer for happy than angry faces. Furthermore, high anxious participants made more erroneous antisaccades to neutral than angry and happy faces. Results are consistent with a general approach-avoidance response for positive and threatening social information. However increased socio cognitive load may alter attentional control with high anxious individuals avoiding emotional faces, but finding it more difficult to inhibit ambiguous faces.

Socio-cognitive load and social anxiety: Performance in an emotional antisaccade task.

As well as the contribution of context and self-relevance to processing of emotional faces, which has been the focus of the previous two chapters, attentional biases in social anxiety may be influenced by attentional control as Bogels and Mansell (2004) suggested. Individuals may differ in respect of the degree to which they are able to control their attention by choice or to ignore irrelevant stimuli. This may result in the attention of some socially anxious individuals being easily captured by an emotional face that they might be aware of whilst others with greater ability to control their attention may be able to strategically avoid engaging with the face.

Carver and Scheier (1988) proposed that anxiety places cognitive load (i.e. an information overload) on the working memory system and that the expectancy of being unable to cope with the anxiety elicited by a particular situation is the catalyst to further anxiety in individuals with social anxiety. This is then thought to precipitate goal disengagement. In the case of public speaking an anxious individual may expect to perform poorly and by engaging in worrying thoughts about this they start to take their mind of the task resulting in a loss of control of their performance. Thoughts could revolve around the distorted self-image as the Clark and Wells model suggests. Yet is equally likely that a face that is perceived negatively could occupy attentional resources, thus interfere with the anxious individual's ability to deliver a confident performance.

Inhibition deficits have been investigated more often with general anxiety than with social anxiety and several conflicting theories have been proposed on the effect of anxiety on cognitive efficiency and performance. For example, Cognitive Interference Theory (Sarason, 1988) holds that anxiety leads to task irrelevant cognitions during a task which impedes task performance by restricting the attentional resources available. This may result in a performance deficit. In contrast, according to Processing Efficiency Theory (Eysenck & Calvo, 1992) it is the cognitive processing involving functions such as working memory that is compromised by worry and pre-occupation with the self rather than performance necessarily being compromised. In this account there is no direct relationship between performance quality and the anxiety that occurs for the individual during the delivery of the performance.

Similarly, Attentional Control Theory holds that anxiety interferes with the balance between top-down and bottom-up process in visual perception (i.e. expectations and attention to salient facial features) by inflating the relevance of attention to salient stimuli, such as negative faces. However, this may not necessarily result in goal driven performance deficits if compensatory strategies are implemented (Eysenck et al. 2007). This is thought to result in an attentional bias for threat related stimuli because of a disruption in processing efficiency but that the quality of performance may not be affected. Put simply, negative expectations could make a face appear more negative and whilst this may result in extra processing to understand the relevance of the face to the anxious individual's performance, they may be able to stay on course with the task if they find a way to stay focussed. Whilst performance may not necessarily be affected by anxiety, the resources utilized during the task may have an exacerbating effect on the anxiety because of the additional focus on threatening social cues. This may result in the experience being perceived and remembered as being more negative, leading to negative expectations of future social performance situations.

Antisaccade task

Saccade tasks measure attention and inhibition by requiring participants to direct their attention to a given location or ignore an irrelevant stimulus (thereby suppressing a reflexive response) as they make a volitional saccade in the opposite direction. Because the task directly measures the ability to control attention, it is more reliable than a self-report attentional control questionnaire whereby a participant describes their ability to control attention (Derakshan and Eysenck, 2009; Reinholdt-Dunne, Mogg and Bradley, 2009). Saccade tasks involves a fixation point being presented with a peripheral target being randomly presented to either the left or right of the fixation point. Participants are then instructed to look towards (prosaccade) or away (antisaccade) from the target to the mirror location on the screen (Munoz & Everling, 2004). In the prosaccade condition, a reflexive saccade (stimulus driven) is unlikely to be controlled by executive function but in the antisaccade condition, participants are required to inhibit a reflexive saccade with a volitional cue (goal driven). In other words, they must suppress the urge to be drawn to a target/image which would naturally elicit automatic attention and instead control their attention to deliberately direct it away from this.

Antisaccade tasks have more commonly been used in samples with generalised anxiety disorder (GAD) rather than social anxiety. In one such study with GAD participants, Derakshan, Ansari, Shoker, Hansard & Eysenck (2009) conducted an antisaccade task in which participants were instructed to look away from angry, happy and neutral faces, to the opposite side of the screen. Results indicated that in the high compared to low anxious group there were longer latencies (i.e. the time between the onset of the face and the saccade towards it or away from the face) to the first correct saccade when the face was angry relative to happy or neutral faces. However, there were no differences in error rates (i.e. saccades made to the face rather than to the opposite side of the screen). This suggests that increased anxiety leads to processing inefficiency to threat because of difficulties inhibiting the threat stimulus but that it does not impact on performance. Rather, trait anxious individuals are likely to compensate by making more effort to employ strategies to control performance (Gray and Braver, 2002). This is in line with Attentional Control Theory which allows for the possibility that processing inefficiencies may not result in goal driven performance deficits if compensatory strategies are implemented (Eysenck et al. 2007).

With regard to social anxiety there is mixed evidence on performance deficits on the antisaccade task. Wieser, Pauli and Muhlberger (2009) tested attentional control in an eye-tracking study using an antisaccade task involving computer generated avatars with angry, sad, fearful, happy and neutral facial expressions. Sixty three undergraduates were split into high and low socially anxious groups (top and bottom 20% of scores on the Brief Negative Evaluation scale (BFNE; Leary, 1983) and a moderate anxiety group (scores within 40-60% range). Socially anxious participants made significantly more errors for all facial expressions than moderately anxious participants but not in comparison to low anxious participants, although there were no significant differences between the low and moderately anxious groups. The authors concluded that there was evidence for weak attentional control in this group, possibly due to executive function deficits. This suggests on one hand that performance rather than processing efficiency is affected by social anxiety since it was the error rate that was affected rather than simply the latencies as was found in the study by Derakshan et al. (2009) with participants with Generalised Anxiety Disorder.

In light of this it could be reasoned that processing efficiency costs without performance impairments are evident in generalised anxiety, which is in line with Processing Efficiency Theory (Eysenck & Calvo, 1992) or attentional control theory assuming that a compensatory strategy has been employed by the sample. However social anxiety may be more susceptibleHowever, there were no significant differences between the low and high anxiety group in the study by Wser et al. (2009). Behavioural data revealed that across all facial expressions all highly socially anxious participants rated faces more negatively than low anxious participants did. There were no group differences between ratings for individual facial expressions. This may be because without contextual information, socially anxious participants tend to interpret all facial expression as negative since they may be guided more by schema than salience cues. If cognitive schemas regarding their likely performance and other's evaluations of it interfere with how faces are interpreted in socially anxious individuals, then the social intent behind emotional faces may appear ambiguous and require additional evaluative processing. This may lead to an increased error rate in the high anxious group but it is possible that the low anxious group may be less inclined to inhibit a face if their sociability makes faces more attractive to them as stimuli to engage with.

Socially anxious individuals have also been found to exhibit greater neural activity relative to controls in the right amygdala in response to anger and disgust faces than to neutral faces and also to neutral faces than ovals compared to more left amygdala activity in controls (Straube et al., 2004; Amir et al., 2005; Phan, Fitzgerald, Nathan & Tancer, 2006). Whilst the left amygdala is thought to be more specialised for salient driven fear processing, local fine grained and dynamic processing, the right amygdala is implicated in emotional evaluation, global processing and processing of ambiguous stimuli (Hardee, Thompson and Puce, 2008; Baas, Aleman & Kahn, 2004; Glascher and Adolphs, 2003 and Wright and Liu, 2006). Thus whilst Derakshan and Eysenck (2009) found that salience driven vigilance but not performance was modulated by trait anxiety, the higher error rates found in the Wieser et al. (2009) study may reflect the greater cognitive load associated with social evaluation in social anxiety, which may result in faces appearing to be more ambiguous for this group. Furthermore, it is possible that the low anxious group also had some difficulty inhibiting faces if they were more sociable as their enhanced sociability could feasibly result in an inhibition difficulty similar to the high anxious group but on a reward based rather than aversive basis, since low social anxiety participants rated all faces more positively than high social anxiety participants did.

An additional reason for the lack of group differences in Wieser et al.'s sample could be individual differences within groups. The standard deviations for errors rates were up to four times larger than group means for some of the facial expressions in the study. Unsworth and Engle (2007) have suggested that individual difference in working memory capacity may be responsible for goal oriented performance with those lower in working memory finding it more difficult to inhibit distractions. Indeed evidence suggests that social anxiety subtypes can be associated differentially with approach-avoidance responses (Hofmann, Newman, Ehlers & Roth, 1995; Kashdan and McKnight, 2010). A subtype of social anxiety has been associated with more aggressive approach responses to social threat than avoidance (Kashdan and McKnight, 2010). In contrast, some socially anxious individuals also have comorbid avoidant personality disorder (Hofmann, Newman, Ehlers & Roth, 1995). Thus individual differences in socially anxious subtypes may result in differential behaviours within a high socially anxious group.

Indeed, in an ERP study, Batagllia et al (2005) found that shy children who were at risk of developing social phobia with the short allele serotonin transporter gene had had reduced cortical activity in response to angry and neutral faces than those with the long allele. Furthermore, those with two copies of the short allele of the serotonin transporter gene had significantly smaller N400 amplitudes than those with one copy in response to angry faces. Koizumi et al. (2010) found using an emotional face-word stroop task that negative words interfered with stroop performance for categorisation of positive faces in those with two copies of the short allele, whilst positive words interfered with categorisation for those with one or two long alleles.

Gray and Braver (2002) have suggested that individual differences in working memory may be underpinned by differences in behavioural approach sensitivity (BAS), linked to extraversion, approach tendencies and left frontal lobe activity and behavioural inhibition sensitivity (BIS), linked to social anxiety, withdrawal and right frontal lobe activity. Using fMRI to measure neural activity whilst participants performed a working memory task, they found that higher BAS was associated with greater working memory performance and lower working memory activity in the anterior cingulate cortex. Right frontal cortical areas have also been associated with a prevention focus (i.e. preventing an aversive outcome through strategic avoidance) whilst left frontal areas have been associated with a promotion regulatory focus (i.e. pursuit of a desired outcome) (Amodio, Shah, Sigleman, Brazy & Harmon-Jones, 2004). Linking this evidence together suggests that social anxiety which has been linked to poor working memory (associated with inhibition difficulties) and avoidance responses, may suggest that socially anxious individuals may not exhibit performance deficits if they have been able to overcome them by employing compensatory strategies to avoid the undesired social stimulus (i.e. emotional face). However this extra cognitive effort is likely to result in processing inefficiencies. Thus if compensatory strategies are employed to maintain performance, one would expect that high anxious, relative to low anxious participants would be faster to saccade away from emotional faces with fewer errors compared to neutral faces although this is in contrast with the findings of Wieser et al. (2009). This may suggest variability in the ability to employ compensatory strategies.

However it is possible that an avoidant pattern may emerge when the social threat is increased either directly or by increasing the socio-cognitive load. Increased threat could result in the vigilance patterns that emerged in the study by Wiesser et al. (2009) study manifesting as avoidance patterns. Certainly this shift from vigilance to avoidance with a higher social threat has been observed in other static face paradigms (e.g. Garner et al., 2006; Helfinstein et al., 2008). If this were to occur then high socially anxious participants may in fact make less errors and exhibit faster latencies on antisaccade trials with threat faces compared to less anxious individuals.

Furthermore, it is possible that it may be a challenge for socially anxious individuals to inhibit a neutral face in an antisaccade task or during a performance task because the emotional ambiguity may require increased socio-evaluative processing. This kind of processing necessitates a verbal internal narrative in terms of processing the meaning of the facial expression in relation to the self. There is some evidence that socially anxious individuals process emotional words differently than neutral stimuli. For example, Amir and Bomyea (2011) found that individuals with social phobia had greater working memory capacity for emotional than neutral words but the pattern was reversed in non-phobic individuals. This was thought to be due to increased anxiety and rumination during the task, which in line with attentional control theory, constrain cognitive resources resulting in performance deficits for neutral social stimuli. In summary, socially anxious individuals may have inhibition deficits for emotional faces but in some cases may be able to employ compensatory strategies to counter this. If the social threat is high enough, they may be more likely to avoid emotional faces, thereby becoming less likely to look at the face in error. However what may appear to be avoidance of an emotional face may in fact be a reduced ability to inhibit a neutral face because of the ambiguity of the meaning of the expression and the strain that the socio evaluative processing may then place on the working memory system.

Furthermore, context may also have a role to play in inhibition since in a social situation; the individual would have to match their prior expectations to the face that was encountered. The relative congruency between the expectation and outcome may then have a direct bearing on the individuals processing efficiency of the face. For example in a real performance situation, if an individual expects an audience face to be negative, this will automatically prime a neural response that is consistent with this expectation. If the face is indeed negative in line with the expectation then the process will continue uninterrupted but if a face that is not consistent with expectations (i.e. positive or ambiguous) it may have a small processing cost whilst the expression is re-evaluated. By increasing socio-cognitive load by introducing contextual factors, it may be possible to emulate more closely inhibition responses in a more naturalistic situation than many of the static face photo paradigms provide because the self-relevance of the facial expression is increased.

Study 3 Attentional control in social anxiety: An antisaccade task with emotional faces primed by valenced self and non-self-referential sentence primes.

The aim of Study 3 was to investigate the relationship between attentional control and social anxiety under conditions of increased socio-cognitive load. In order to manipulate socio-cognitive load, it was first necessary to conduct a pilot study (C) (Appendix I(iv)) to validate a series of contextual prime sentences that were designed to increase the social salience of the faces in the saccade tasks (Appendix I(v)). Unlike in Study 1, where positive and negative sentences were used in both self and other referential format, only positive self-referential and negative non-self-referential sentence primes were selected for the final selection. This is because these types of primes would not pose a direct social threat.

A positive self-referential prime should lead a participant to expect that a non-socially threatening face would appear afterwards in the context of an antisaccade task. Similarly a negative non-socially threatening prime, whilst negative should not signal a social threat because it directs the negative response away from the participant to another cause. This means that what is being investigated is simply the effect of socio-cognitive load where increased socio evaluative processing may occur rather than a threat prime where threat specific processing is likely to occur. It was expected that socially anxious individuals were likely to self-generate negative self-referential thoughts in response to a neutral prime where a direct reason for the expression on the face has not been provided.

The present study evaluated attentional control with emotional and neutral faces across social anxiety levels under conditions of increased socio-cognitive load. It improved on Derryberry and Reed (2002) by measuring both direct and indirect measures of attentional control using the antisaccade task and the Attentional Control scale (Derryberry & Reed, 2002). Furthermore, some of the weaknesses of the Wieser et al (2009) study were addressed by using face photos rather than avatars to increase ecological validity.

Unlike Wieser et al. (2009), a control stimulus (inverted neutral face) was also included. Inverted faces have been shown to be less susceptible to configural processing in particular than upright faces (Leder & Bruce, 2000; Rhodes, Brake & Atkinson., 1993). Brown, Huey and Findlay (1997) found that in a study investigating the visual ‘pop put’ effect that in peripheral vision, upright faces were processed more efficiently than inverted faces. Furthermore, Gilchrist and Proske (2006) showed that an upright face was subject to a higher error rate in the antisaccade task than an inverted face due to its high level properties.

Indeed, Olk and Garay-Vado (2011) found that an upright face distractor was more difficult to ignore than an inverted face regardless of cognitive load (i.e. identifying the face from a list of names or a previously viewed face). If socially anxious individuals are as Langner et al. (2009) have suggested more susceptible to configural processing then this effect should be more pronounced than with the low anxiety group who are thought to have a more featural processing style. Therefore one would expect that in an antisaccade task with a high social threat, socially anxious individuals would make less error to emotional faces due to an avoidance effect but that this would be more pronounced for upright faces. The most popular measures that are generally used in the antisaccade task are latencies, peak velocity and accuracy (Jazbec, Mcclure, Hardin, Pine and Ernst, 2005). Whist latencies and peak velocity measure processing efficiency, error rates provide a measure of performance accuracy. Given the previous findings with latencies and errors in anxiety samples, these are the measures that were focused on for the current study.

It was predicted that

I. Overall, latencies would be shorter for the pro than anti saccade task because of the relative ease of making a reflexive response rather than suppressing it.

II. Based on the subjective avoidance responses in Study 2 (which revealed a general avoidance of the most negatively perceived face) angry upright faces would overall be associated with faster latencies in the antisaccade task and longer ones in the prosaccade task than other face types because of their social threat status.

III. This effect would be exaggerated by social anxiety where faces were preceded by a neutral prime (allowing an opportunity for the anxious individual to generate negative self-referential expectations) but would be attenuated by a non-threat prime (i.e. positive self-referential or negative non-self-referential).

IV. Overall, there would be fewer errors made in the pro than anti saccade task because of the relative ease of making a reflexive response rather than suppressing it.

V. There would be lower errors to angry upright faces in the high compared to the low anxiety group in the antisaccade task which again would be attenuated by a non-social threat prime. Evidence of reduced errors to socially threatening faces in the high anxiety group may be taken as evidence to support the Clark and Well's (1995) model of social anxiety as far as can be inferred by a static face paradigm.

Method

Participants

136 participants were recruited through the University of Strathclyde's virtual learning environment; posters displayed around the campus and local businesses; local classified ads and community websites. Participants were invited to participate in return for being entered into a draw for a £50 prize. Inclusion/exclusion criteria and ethical approvals were based on the same protocol as the previous eye tracking study (Study 1).

From the original survey respondents 76 participants who were naive to the purpose of the study completed the experiment but two participants were withdrawn as they has clinical levels of depression and revealed after the experiment that they were receiving medication to treat this. Another two participants were withdrawn as their level of English was deemed too poor to have understood the task instructions. Thus data from 72 participants was analysed. Participants were split into high (24), moderate (24) and low (24) anxiety groups based the third percentile of scores (i.e. Guastella et al,2009; Silvia, Allan, Beauchamp, Maschauer & Workman, 2006) on the online 8-item Brief Fear of Negative Evaluation scale II (BFNE II; Clareton et al., 2007) which has an internal consistency coefficient alpha of .97. Sample size for the experimental phase was based on other eye-tracking and social anxiety studies (e.g. Derryberry & Reid, 2002; Wieser et al, 2009).

Social anxiety was also measured using the The Social Phobia Inventory (SPIN (Connor et al., 2006) which measures five aspects of social phobia including social inadequacy (i.e. fear and avoidance of social situations); self-esteem (i.e. fear and avoidance of criticism; physiological symptoms (i.e. fear of loss of bodily control); social inferiority (i.e. fear and avoidance of authority) and performance anxiety (i.e. fear of public attention). The scale has generally been found to have very good psychometric properties (Antony, Coons, McCabe, Ashbaugh and Swinson, 2006) and is highly correlated with the SPS (Mattick & Clarke, 1998) and moderately correlated with the SIAS (Mattick & Clarke, 1998) with coefficients of (.71) and (.60) respectively (Antony, Coons, McCabe, Ashbaugh & Swinson, 2006).

Participants completed the 20-item Attentional Control scale (ACS) (Derryberry & Reed, 2002), which has a high internal consistency with a coefficient alpha of .88. The ACS is a self-report questionnaire which measures focused attention including inhibition and task shifting, with items such as “When I need to concentrate and solve a problem, I have trouble focusing my attention” and “It is easy for me to alternate between two different tasks”. Responses on a four point Likert scale range from, 1(almost never) to 4 (always). Scores can range from 20 to 80 with higher scores indicating stronger attentional control.

Current negative mood and anxiety were measured by administering the self-report 21 item self-report Beck Depression Inventory II (Beck et al., 1996) and Beck Anxiety scale (Beck, Epstein, Brown & steer, 1988) respectively. The BDI-II has high reliability, coefficient alpha (.93) for undergraduate students and (.92) for clinically depressed participants and the BAI has also been demonstrated to have high internal consistency with a coefficient alpha of (.91).

Participant demographics

24 high social anxiety, 24 moderate social anxiety and 24 low social anxiety (low social anxiety) participants completed the experiment. The sample was comprised of 51 female and 21 male participants but a 2x3 Chi ^{2} test showed that the gender was equally distributed across the three groups, χ^2 (2) = 2.82 , p = 0.24. Participant's ages ranged from 18 to 57 and years of education ranged from 11 to 24. A series of one way ANOVAs were conducted for age, education, BFNE, SPIN, BDI, BAI and ACS scores. Main effects and Bonferroni post hoc significance values are presented in table 3.1.

Table 3.1

Participant characteristics

Anxiety	HSA		MSA		LSA		*F*	*p*	HAS LSA	HSA MSA	LSA MSA
	M	SD	M	SD	M	SD					
BFNE	31.5	2.9	22	2.4	14.6	2.6	242.74	<0.001	<0.001	<0.001	<0.001
SPIN	31	12.9	20.6	8.6	12	7.2	22.56	<0.001	<0.001	0.001	0.01
ACS	48.4	8.7	51.6	6.1	53.7	7.3	3.07	0.05	0.05	0.42	1
BDI-II	11.8	7.8	10.1	6.6	6.7	6	3.49	0.04	0.001	1	0.26
BAI	13	8.2	10.6	8.1	6.4	7.2	0.31	0.02	0.02	0.71	0.29
Age	26	8.1	31	11.8	31	11.1	2.7	0.08			
Education	16.3	2.7	16.9	3	16.4	3	0.1	0.65			

BFNE, Brief Fear of Negative Evaluation Scale (8-item); SPIN, Social Phobia Inventory, ACS, Attentional Control Scale, BDI-II, Beck Depression Inventory-II, BAI, Beck Anxiety Inventory. SPIN scores in the HFNE group range from above 19 on the SPIN which Connor et al. (2000) have suggested is a reliable cut off point to differentiate high and low social anxiety.

Participants in each of the groups were not different in terms of gender, age or education across the three groups but were reliably differentiated on social anxiety measures. However, the higher scores for the high anxiety group relative to the low anxiety group for both depression and general anxiety suggest that these factors must be taken into account when interpreting the data. It is also notable that whilst some researchers have included such measures as covariates, Field (2007) asserts that there should not be group differences on the covariate. The borderline significantly lower ACS scores for the high relative to the low anxiety group may suggest that the highly socially anxious participants had less confidence in their ability to control their attention than their less anxious counterparts.

Design

In order to measure the effect of the task, eye movement data were initially analysed in a series of mixed four way ANOVAs with one between groups factor: anxiety group (high/medium/low) and three within group factors: condition (prosaccade/antisaccade); prime (positive self-referential; negative non-self-referential) and face type (angry; neutral; happy; inverted neutral face). The dependent variables were the latency from the central fixation point to the target on prosaccade trials and away from the target on antisaccade trials for correct saccades and error rates were defined as the percentage of erroneous saccades in the antisaccade task. To simplify the analysis following the investigation of a task effect, a series of mixed three way ANOVAs were then computed for the prosaccade and antisaccade tasks separately.

Apparatus and stimuli

A series of 120 positive self-referential and negative non-self-referential primes (i.e. non-threatening) as well as neutral primes were constructed and validated in Pilot study C (Appendix I(iv)). Primes were considered to be non-socially threatening by directing the source of negative information away from the individual and directing positive self-affirming information towards them. An example of a positive self-referential prime was ‘Sara is impressed by your speech’ while a negative non-self-referential prime was, ‘Sara is annoyed with her boss’ and a neutral prime example was, ‘Sara takes the train to work’.

30 photo face stimuli: 5 male (models 21M; 24M; 28M; 33M; 34M) and 5 female models 03F; 05F; 06F; 08F; 09F) consisting of angry, happy and neutral expressions were selected from the NimStim Set of Facial Expressions (Tottenham et al., 2009). A control inverted neutral face stimulus was also included. All of the faces used in the tasks were Caucasian to control for salience differences in contrast between skin tone and white from teeth and eyes. Each identity was presented twice with the same prime and valence (i.e. 20 presentations of each prime type for each valence in each condition) for a total of 240 trials. This was split into two blocks of 120 prosaccade and 120 antisaccade trials and the presentation order of blocks was counterbalanced amongst participants. Stimuli presentation order was also randomised across participants.

Faces with each prime type were equally presented to the right or left of the screen at a visual angle of 10.1^{o} from the centre. They were presented on a black background at a screen resolution of 1240 x 1024 pixels at a visual angle of 15.2^{o} in height and 11.3º in width. Dimensions replicated those used by Wieser et al. (2009). Face configurations were presented on a ViewSonic G90ft 19 inch colour monitor attached to a Phillips personal computer controlled by Eyelink (SR Research Ltd.) software. The programs that controlled the software were designed in-house. Each face was matched on all skin colour and differences in hair and sizes were controlled for by framing the pictures with standardised ovals.

Procedure

Prior to commencing the eye-tracking task, participants were asked to read the participant information sheet and sign the consent form. The BFNE II (Carleton et al., 2007) was completed online and consent was obtained by clicking on a consent box before the participant was able to proceed to the next stage of the experiment. Participants were then asked to attend the University to complete the experimental phase of the study. Before commencing the task, participants were asked to complete the Social Phobia Inventory (SPIN) (Connor, Davidson, Churchill, Sherwood, Foa & Weisler, 2000); Attentional Control Scale (Derryberry & Reed, 2002); Beck Depression Inventory II (Beck et al., 1961); Beck Anxiety Inventory. Questionnaires were administered prior to the task because of the potential effect of the task priming procedure on responses.

They were then seated 57cm from the monitor and wore a lightweight headset comprising a head camera and two eye cameras placed just below the eyes. Eye-movements were recorded using the SR Research Ltd. Eyelink II system (Canada) using pupil centre at 500Hz. The experimental task was preceded by 12 practice trials where participants were offered an opportunity to ask for clarity on the task instructions and indicate that they had time to process and understand the meaning of the sentences.

Immediately prior to the experimental task, and prior to each trial block participants completed a nine-point calibration sequence. This consisted of recording participants gaze while fixated on a central white fixation dot with a diameter of 0.5˚ presented on a black screen and then tracking their gaze as they followed the dot sequentially around the nine grid points on the screen. Successful calibration was followed by a repetition of the process during the validation stage. Between each presentation of the prime and the face the fixation dot was presented again to correct for drift caused by head movements.

At the start of each trial, participants were presented with a prime statement for 2000ms that they were asked to read. They were then presented with a drift correction where they were asked to fixate a dot before being presented with a face to either the left or right of the screen for 1000ms. On the prosaccade block they were asked to look towards the face and in the antisaccade block they were asked to look to the opposite side of the screen to where the face appeared. The task is illustrated in Figure 3.1

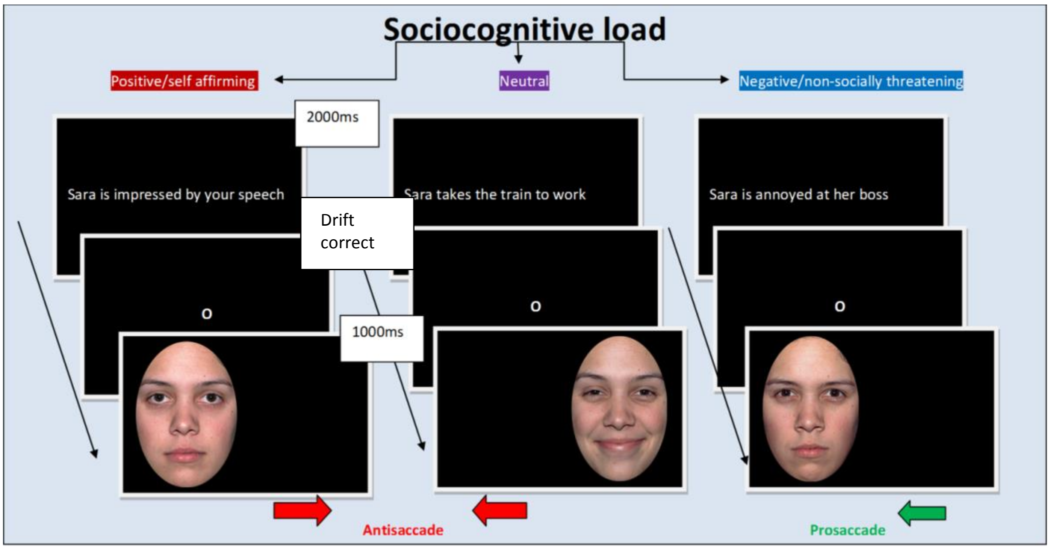

Figure 3.1 *Schematic of modified emotional face saccade task*

Eye movement data preparation

Data was analysed using SR Research Ltd. Data Viewer 1.9.1. The first saccade after onset of the face was taken as a saccadic measure. Latencies were calculated from the target onset to the onset of the first correct saccade and latencies of <80ms were discarded as anticipatory saccades. Initial fixations which were >1° from the central fixation point were also excluded as were saccadic amplitudes under 2°. Saccades with a velocity and acceleration rate of between 30°/s to 8,000°/s² were included for analysis. This led to an average of 2.9% of trials for each participants being excluded. Percentages of antisaccades and prosaccades were analysed relative to the number of valid trials across each participant.

Results

Boxplots suggested a degree of variability, which is likely to reflect skew in the data and indeed some of the variables failed the Shapiro Wilk's normality tests; particularly the error data which was skewed towards 0 scores. Because of the variability of scores over various measures it was considered to be impractical to remove all participants who had extreme scores on the bases of their eye-movements to particular stimuli. As Field (2009) suggests, extreme scores should not automatically be considered to be outliers without a concrete reason to suspect that they are not representative of the population. Thus, whilst participants with extreme scores were not removed from the analysis, any violations of assumptions of ANOVA were corrected with the appropriate methods.

As recommended by Field (2009) where Mauchly's test was significant at below 0.75, the Greenhouse Geisser correction was applied, and where it was significant with a value of above 0.75, the Huynh-Feldt epsilon. There were an exactly equal number in each group so ANOVA should be robust enough to cope with deviations from normality (i.e. Howell, 2007). Descriptive statistics for saccadic latencies are presented in table 3.2 (Appendix II(i)). Self-report attentional control was not significantly correlated with error scores (Appendix IV(i) so does not seem to be a reliable method of assessing attentional control. Therefore, attentional control was measured on the basis of the antisaccade task only.

Hypothesis I: Latencies as a function of task

It was predicted that overall, latencies would be shorter in the pro than antisaccade task. A 2x3x4 ANOVA with three repeated measures factors: task (anti/

pro); prime type (negative/ neutral/ positive) and face type (angry/ happy/ inverted/ neutral) revealed a significant main effect of task**.** There was a significant main effect of task for saccadic reaction time, $F(1,71) = 410.23$, $MSE = 360.32$, $p < 0.001$, *partial* $\eta^2 = 0.85$, *Power* =1. Latencies were significantly shorter for prosaccades (M =181.36ms, SE=2.2) than for antisaccades (M=265.49ms, SE= 5.05). Thus, the hypothesis that latencies would be shorter in the pro than antisaccade task was supported.

Hypothesis II: Latencies as a function of face type

Antisaccade

It was predicted that angry upright faces would be associated with faster latencies in the antisaccade task than other face types. Levene's test was non-significant for all latency variables ($p > 0.05$) so the assumption of homogeneity can also be assumed. An anxiety group (3) x prime (3) x face (4) ANOVA for the antisaccade task revealed a significant main effect of face; Mauchly's test indicated that the assumption of sphericity had been met, ($\chi^2(5) = 6.5$, $p = 0.26$), $F(3,207) = 4.09$, $MSE = 539.61$, $p = 0.01$, *partial* $\eta^2 = 0.06$, *Power* =0.84. Bonferroni corrected post-hoc comparisons revealed that there were significantly shorter mean latencies before saccading away from angry (M = 261.27 ms, SE=5.08) compared to happy faces (M = 268.98 ms, SE=5.42), $p<0.01$. Therefore, the hypothesis that angry upright faces would be associated with faster latencies in the antisaccade task compared to other face types was partially supported since this was only the case in relation to happy faces. The means and standard errors for saccadic latency for faces are illustrated Figure 3.2.

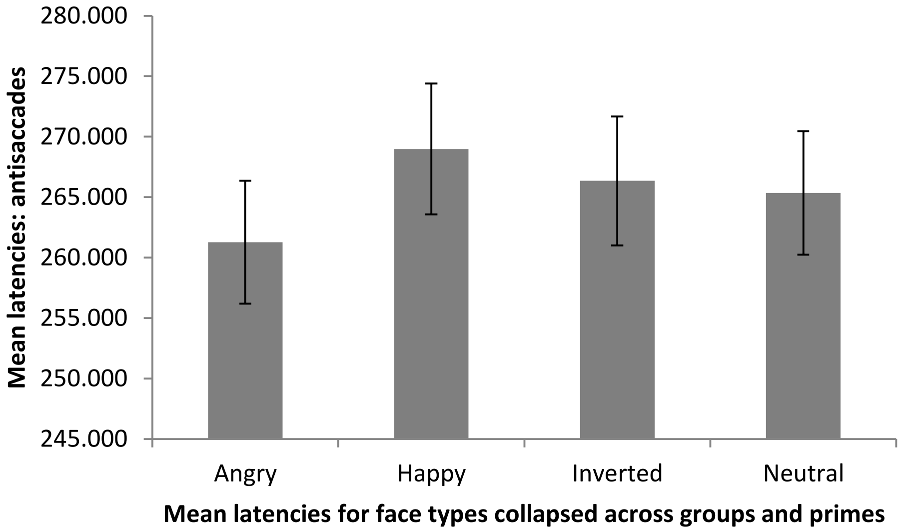

Figure 3.2 *Mean saccadic latency for faces in the antisaccade task (bars denote standard errors)*

Prosaccade

It was also predicted that angry upright faces would be associated with longer latencies in the prosaccade task than other face types. Levene's tests were non-significant at the 0.01 α level. In contrast to the prediction, there was no main effect of face for latencies on the prosaccade task when an anxiety group (3) x prime (3) x face (4) ANOVA was conducted, $F(52.67, 184.48) = 0.2$, $MSE = 95.37$, $p = 0.88$, *partial* $\eta^2 = 0.003$, *Power* =0.08.

Hypothesis III: Latencies as a function of face type combined with anxiety group and prime

Antisaccade

It was further predicted that faster latencies away from angry faces would be exaggerated by social anxiety when faces were preceded by a neutral prime (allowing an opportunity for the anxious individual to generate negative self-referential expectations) but would be attenuated by a non-threat prime (i.e. positive self-referential or negative non-self-referential). Thus, a significant three way interaction for anxiety group x face x prime would have been expected.

There was no significant main effect of anxiety on saccade latency for antisaccades, $F(2,69)= 0.42$, $MSE = 22047.53$, $p= 0.66$, *partial* $\eta^2 = 0.01$, *Power* =0.12. Mauchly's test indicated that the assumption of sphericity for prime had been violated, ($\chi^2(2) = 6.97$, $p = 0.03$), therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = 0.96$). There was no main effect of prime, $F(1.92, 132.72)= 0.03$, $MSE = 546.63$, $p= 0.97$, *partial* $\eta^2 = 0.00$, *Power* =0.06. There was also no significant anxiety group x prime interaction, $F(3.85, 132.78)= 1.58$, $MSE = 545.47$, $p= 0.19$, *partial* $\eta^2 = 0.04$, *Power* =0.47, or anxiety group x face interaction, $F(6, 207)=0.65$, $MSE = 539.59$, $p = 0.69$, *partial* $\eta^2 = 0.02$, *Power* =0.26. The prime x face interaction $F(3.87,267.09) = 1.94$, $MSE = 1363.96$, $p= 0.12$, *partial* $\eta^2 = 0.03$.

Crucially, the anxiety group x prime x face interaction was also non-significant, $F(7.74, 267.07)= 1.52$, $MSE = 1364.8$, $p= 0.15$, *partial* $\eta^2 = 0.04$, *Power* =0.6. Therefore, the hypothesis that angry upright faces would overall be associated with faster latencies in the antisaccade task when compared to other face types was partially supported for happy faces. However, the prediction that this effect would be exaggerated by social anxiety, but attenuated by a non-threat prime, was not supported since there were no significant effects of anxiety or context.

Prosaccade

It was also predicted that longer latencies in the prosaccade task for angry faces compared to other face types would be exaggerated by social anxiety but attenuated by a non-threat prime. Levene's tests were all non-significant at the 0.01 α level. However, there was no main effect for anxiety for latencies on the prosaccade task when an anxiety group (3) x prime (3) x face (4) ANOVA was conducted, $F(2,69)= 0.75$, $MSE = 333.31$, $p= 0.48$, *partial* $\eta^2 = 0.02$, *Power* =0.19. Mauchly's test indicated that the assumption of sphericity for face had been violated, ($\chi^2(5) = 0.71$, $p < 0.001$), therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = 0.89$).

Sphericity was also violated for prime ($\chi^2(2) = 12.39$, p = 0.001), and degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = 0.9$). There was no significant main effect of prime, $F(1.81, 124.54)= 0.03$, $MSE = 105.31$, $p= 0.97$, *partial* $\eta^2 = 0.05$, *Power* =0.05, and no significant group x face interaction, $F(5.35, 184.48)= 0.73$, $MSE = 95.37$, $p = 0.61$, *partial* $\eta^2 = 0.02$, *Power* =0.27 or significant group x prime interaction $F(3.61, 124.54)= 0.33$, $MSE = 105.31$, $p= 0.83$, *partial* $\eta^2 = 0.01$, *Power* =0.12, or group x prime x face interaction $F(6.09, 209.94)= 0.57$, $MSE = 210$, $p= 0.76$, *partial* $\eta^2 = 0.02$, *Power* =0.23. The prime x face interaction was also non-significant, $F(2.91, 124.54, 6.58)= 0.29$, $MSE = 194.14$, $p= 0.77$, *partial* $\eta^2 = 0.02$, *Power* =0.24. Since Mauchly's tests had been significant at the 0.001 level the results were verified using a Kruskal-Wallace test (Appendix III(iv)). Therefore, neither of the hypotheses regarding latencies in the prosaccade task were supported.

Hypothesis IV: Accuracy as a function of task

It was predicted that overall, fewer errors would be made in the pro- than antisaccade task. The descriptive statistics (Table 3.3: Appendix II(ii)) illustrate the high degree of variability in the data and extremely large standard deviations suggest that there are considerable individual differences in antisaccade performance. A three-way repeated measures ANOVA with condition (pro/anti); prime (negative/ neutral/ positive) and valence (angry/ happy/ inverted/ neutral) found that the main effect of task for error rates was significant $F(1,71)=86.13$, $MSE=0.01$, $p< 0.001$, *partial* $\eta^2 = 0.55$, *Power* =1. Bonferroni pairwise contrasts revealed that error rates were significantly higher for antisaccades (M = 17%, SE=0.01) than for prosaccades (M =0.01%, SE=0.01). Therefore the hypothesis was supported.

Hypothesis V: Accuracy as a function of anxiety group and prime

Only antisaccade errors were analysed with respect to anxiety since prosaccade errors were negligible. It was predicted that there would be lower errors to angry upright faces in the high compared to the low anxiety group in the antisaccade task, which again would be attenuated by a non-social threat prime. Therefore, a significant anxiety group x face x prime interaction was expected.

Kolmogorov-Smirnov tests suggested that the data failed the assumption of normality ($p<0.001$) for several variables and transformations failed to normalise the data since it was multivariate proportional data with a skew towards 0 scores. However, Levene's test was not significant at $\alpha = 0.001$ level and as Lorenzen (1993) suggests this is the most appropriate benchmark for deciding whether to assume non-normality.

A 3 x 3 x 4 (anxiety x prime x face) ANOVA for errors on the antisaccade task failed to reveal a significant main effect for anxiety group $F(2,69) = 0.84$, $MSE = 0.02$, $p = 0.44$, *partial* $\eta^2 = 0.02$, *Power* =0.19. Mauchly's test for the factor of prime indicated that the assumption of sphericity could be assumed ($\chi 2(2) = 2.3$, $p = 0.32$. The main effect of prime was not significant $F(2, 138) = 2.3$, $MSE = 0.02$, $p = 0.74$, *partial* $\eta^2 = 0.04$, *Power* =0.1. Nor was the main effect of face type. Mauchly's test indicated that the assumption of sphericity for face type had been violated, ($\chi^2(5) = 12.39$, $p = 0.03$) and degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = 0.96$), $F(2.89, 5.78)=0.97$, $MSE = 0.02$, $p = 0.41$, *partial* $\eta^2 = 0.09$, *Power* =0.61.

Mauchly's test for the prime x face interaction indicated that the assumption of sphericity could be assumed ($\chi^2(20) = 18.7$, $p = 0.54$), but in contrast to the hypothesis, the anxiety x prime x face interaction was non-significant, $F(12, 144) = 1.12$, $MSE = 0.01$, $p = 0.07$, *partial* $\eta^2 = 0.34$, *Power* =0.65, as was the potential interaction for anxiety x prime $F(4,38) = 0.45$, $MSE = 0.01$, $p = 0.77$, *partial* $\eta^2 = 0.01$, *Power* =0.15.

Although there were no group differences as predicted, there was a significant anxiety x face interaction, $F(5.78, 199.44)=3.35$, $MSE = 0.05$, $p = 0.004$, *partial* $\eta^2 = 0.09$, *Power* =0.98. Bonferroni corrected post-hoc comparisons revealed that error rates were significantly higher in the high anxiety group only for neutral faces (M = 21.4%, SE=3.3) than for angry faces (M = 13.6%, SE=3.3, $p = 0.002$) and happy faces (M = 16.4%, SE=3.2, $p = 0.03$). Because the significant effect was in the high anxiety group only and the Levene's had been significant between the 0.001 and

0.01 level, the results were reanalysed separately in a series of 3 x 4 mixed ANOVAS for each group.

This revealed that Mauchly's tests were non-significant for the high social anxiety group (p > 0.17) and the low social anxiety group (p > 0.16), and the significant results in the high social anxiety group and opposite pattern in the low social anxiety group were confirmed. Error rates were significantly higher in the high anxiety group only for neutral faces. Furthermore, because depression and general anxiety scores had been significantly higher in the high anxiety group than the low anxiety group, correlations were conducted for depression and generalised anxiety, with errors across each face emotion and prime type. No significant correlations were found between depression or general trait anxiety and error rates for any of the facial expressions (Appendix IV(ii)). The differences across groups and facial expressions are illustrated in Figure 3.3.

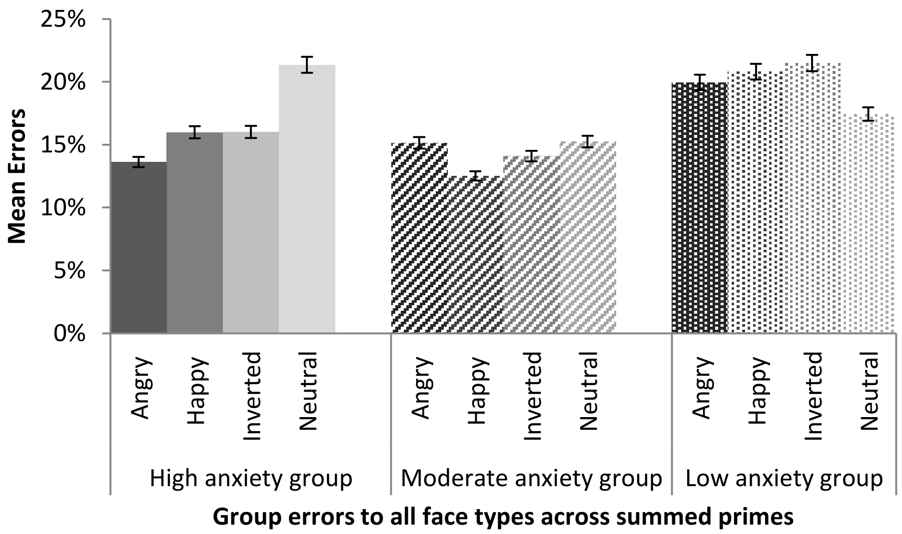

Figure 3.3 *Mean antisaccade errors across anxiety groups and face types (bars denote standard errors)*

In summary of the error data, it was predicted that there would be a significantly higher error rate in the antisaccade compared to the prosaccade task and the results supported this hypothesis. It was further predicted that there would be fewer errors to angry faces in the high compared to the low anxiety group in the antisaccade task, but that this would be attenuated by non-socially threatening context. In partial support for the hypothesis, regardless of context, the high anxiety group made significantly more errors to neutral upright faces compared to angry or happy faces. The opposite (though non-significant) pattern was observed in the low anxious group.

Discussion

Saccadic latencies were shorter and fewer errors were made in the prosaccade than antisaccade task. There were also significantly shorter latencies before saccades were made away from an angry faces compared to happy faces in the antisaccade task, but there was no significant difference in latencies between angry and neutral faces. This may indicate general approach-avoidance for happy and angry faces respectively as Van Peer, et al. (2009) suggested. However, there were no group differences for latencies or error data. In the antisaccade task, the high anxiety group made significantly more errors to neutral upright faces compared to angry and happy faces whilst the opposite (though non-significant) pattern was observed in the low anxious group. This provides some evidence of avoidance of emotional faces in high anxious participants, but conflicts with the findings of Wieser et al. (2009) who found that high anxious relative to moderately anxious participants had a higher error rate for all faces.

One explanation for these results is that the high social anxiety group may have had more indecision around neutral faces making it more difficult to inhibit them. This may have been due to the emotional ambiguity of the face. The moderate group had similar error rates for all faces but neutral whilst the low social anxiety group demonstrated the opposite pattern to the high social anxiety group suggesting that both of the more extreme groups may respond differently to emotional versus neutral faces for different reasons. For example, the low social anxiety group may be more sensitive to emotional faces because of their enhanced salience processing abilities (Langner et al. 2009) whilst the high social anxiety group may be more sensitive to neutral faces because of the increased socio-evaluative processing required for faces where less salience information is available.

The higher error rate for neutral faces in the high social anxiety group may have been consistent to some extent with the assertion of Carver and Scheier (1988) regarding the effect of cognitive load and anxiety in placing strain on the working memory system and precipitating goal disengagement. The results also support Amir and Bomyea (2011) who found that individuals with social phobia had greater working memory performance for emotional than neutral words, but that the reverse pattern was observed in non-phobic individuals. This is consistent with the results in the current study since the opposite error pattern was also found in low socially anxious participants, albeit without significant differences. This may suggest that the high social anxiety group engaged in increased evaluative processing of neutral faces, which may represent more ambiguous social cues.

The lower errors made with emotional faces may have been due to avoidance of them relative to neutral faces. This may have been due to more realistic faces than those used in the Wieser et al. (2009) study in which high socially anxious participants had a higher mean error rate to all faces compared to moderately anxious participants. This may be a more compelling explanation given that the error rate for neutral faces in the current study was similar to the error rate for all faces in the high anxiety group observed in the Wieser et al. (2009) study.

This explanation is consistent with the findings of Helfinstein et al. (2008) that under neutral conditions a vigilant pattern towards threatening faces may emerge with a socially anxious sample but when the social threat is increased the pattern shifts towards avoidance. The stimuli used in the current study may have been perceived as being more socially threatening that the avatars used in the Wieser et al. (2009) study because (i) they were more realistic looking photographic images of facial emotion and (ii) because they were preceded by socio-evaluative primes which may have inflated the social relevance of the face. This may have led to a pattern that is more consistent with avoidance rather than vigilance to the threat stimuli. In contrast, Helfinstein et al. (2008) found that in a no threat condition low anxious individuals appear to avoid threat faces but start to be more vigilant towards them under a direct social threat. This again is supported by the non-significant pattern in the low anxious group in the current study who had a somewhat higher error rate for emotional faces compared to neutral faces in direct contrast to the high anxiety group. Overall, the error rate was a little lower than in the study by Wieser et al. (2009). This may reflect the separate block design for the pro and antisaccade tasks in the current study whereas Wieser et al. (2009) used a word to direct participants to make a pro or antisaccade.

Despite the significance of the results, in which the high social anxiety group made significantly more errors to neutral than emotional faces, the extremely high standard deviations in the current study for error rates are consistent with those found in the Wieser et al. (2009) study. This is also consistent with the assertions of Kashdan and McKnight (2010) and Hofmann et al. (1995) regarding subtypes of social anxiety. That said, the level of variability was similar across groups. This suggests that varying degrees of attentional control are exhibited regardless of anxiety although it is possible that socially anxious individuals have more ability on average to direct their attention away from a socially threatening face. Individual differences across groups in levels of attentional control make it difficult to interpret the results of antisaccade tasks to some extent, and the sample must also be considered as a potential reason for the differences between the results of the current study and those of Wieser et al. Even taking this into account, there appear to be some similar patterns across these two sets of results.

As well as the similarity between the error rate for neutral faces in the current study and all face types in the Wieser et al. study (which did not employ a socio-cognitive load), the pattern for the latency data was analogous. Wieser et al. (2009) had a similar, although non-significant pattern with angry faces having shorter latencies in the antisaccade task than happy faces. The current results may have been more extreme because the faces are preceded by social information which may enhance the salience of the social threat of an angry face resulting in an avoidant response. This suggests that on some level avoidance of socially threatening faces may not be exclusive to high social anxiety. However if, as Rapee and Heimberg (1997) have suggested, social anxiety operates on a continuum then avoidance may manifest itself more in particular tasks and situations such as when in a directly socially threating situation. Under conditions of direct social threat the gap between avoidant behaviours in high social anxiety and low social anxiety groups may widen resulting in more group differences.

Despite no significant relationship between self-report attentional control and performance, the borderline significantly lower self-report Attentional Control Scale scores for the high relative to the low anxiety group suggests that high anxious participants were less confident in being able to control their attention. This may be due to the scale measuring general attention rather than visual attention. In the case of social anxiety, it is feasible that visual attention could be enhanced in order to monitor the environment for threat and to engage an avoidance response if necessary. Yet mental or auditory attention may be compromised in terms of a social situation where they have to concentrate on speech performance.

There were some limitations with the study. For example, the control face was not effective in showing that upright facial expressions had any differential effect generally on saccades. Confidence intervals were wider with inverted faces, so although there were not significant differences, the mean error score was similar to a happy face. The control face may not have acted as a control because of the increased socio-cognitive processing which may have given it more social relevance even when inverted as it was still obvious that it was a face. In addition, results may have been more pronounced with faces with open mouths rather than closed mouths. However, these were selected in order to enhance ecological validity in a social context since a critical social response to a performance or general social interaction would be unlikely to elicit an open mouthed angry facial expression.

The lack of group differences despite the opposing patterns on errors rates may also reflect the nature of the sample. Firstly, there may not be a large enough split between groups in terms of social anxiety scores resulting in effects not being as strong as they may have been with a clinical sample. The effect of individual differences on antisaccade performance and subsequent attentional patterns during a social stress situation had been investigated in Chapter 6.

Another important factor to consider when interpreting the results is the fact that depression and anxiety scores were significantly higher in the high anxious group than the low anxious group. Although the concurrence of depression and anxiety is a prevalent feature of social anxiety, this may have some influence on the results, although the pattern of results obtained was not consistent with those for generalised anxiety in previous studies (i.e. Derakshan et al., 2009). Depression and generalised anxiety scores also did not meet clinical levels so the influence of these factors if any may have been relatively small.

D'Argembeau et al. (2006) have discussed the issue of comorbidity of depression, anxiety and social anxiety scores at some length and concurred with Field (2009) that ANCOVA is not an appropriate method for controlling a factor that differs between groups. Furthermore, in light of the significant comorbidity between social anxiety and depression (e.g., Kessler, Stang, Wittchen, Stein, & Walters, 1999; Stein, Fuetsch, Muller, Hofler, Lieb, & Wittchen, 2001), it would be unrealistic and artificial to try to isolate the effect of depression or anxiety.

It is suggested that rather than attempting to control for these, researchers may be wise to increase the sample sizes so that they can sample socially anxious participants with varying levels of depression and/or generalised anxiety. This approach would also enable researchers to control the influence of individual differences in tasks such as the antisaccade task to some extent. However, in the current study there was no significant correlation between either depression or general trait anxiety and error rates for any of the facial expressions. Therefore, there is no evidence to suggest that depression or anxiety have influenced the difference in error rates across facial expressions in the high social anxiety group.

Given the apparent effect of the socio-cognitive load in increasing the social salience of the emotional faces in this task compared to the Weisser et al. (2009) study in which there was no social information to process before being presented with faces, it may be useful for researchers to manipulate different types of cognitive load in a replication of this study in order to assess the relative contribution of social context to the current results. Although there were no differences in latencies or errors as a result of prime types, the additional processing of social information may have increased the social relevance of the faces. However to be sure that was the social content that contributed to any effects, it would be useful to replicate the study with perhaps a mathematical load to measure the effect of processing non-social information on inhibition of faces. It may also be useful in light of the apparent failure of the inverted face to act as a suitable control face, for researchers to include a non-face control in future studies. An oval matched to size and skin colour may be one possibility.

In conclusion, when faces in a static face paradigm are made more socially salient, angry faces appear to be indicative of a social threat. This is associated with a general avoidance responses indicated by more efficient processing before making an eye movement away from it compared to a more desirable socially affirming face. In addition, there appears to be an exaggerated strategic avoidance response for emotional faces in more socially anxious individuals. Yet the ambiguity of a neutral face may be more difficult to inhibit for this group, possibly due to the increased social-evaluative processing required for this task. Again like Study 2, an apparent avoidance of a potential social threat in the form of an emotional face could be taken as evidence to support the Clark and Well’s (1995) model of social anxiety but in the absence of a direct socio evaluative threat, it is more feasible that this is underpinned by a difference in automatic face processing styles rather than a shift in attention towards internal processing. This is particularly highlighted by the lack of effect of primes on attention suggesting that the threat content made no difference to attentional control.

Chapter 5

Abstract

Social anxiety has been associated with more efficient processing of emotionally threatening faces and reduced processing of positive social cues. Much of the research has been conducted with static face paradigms or morphed videos where the expression changes sequentially but in a real social situation micro expressions may be constantly fluctuating. The aim of study 4 was to investigate processing efficiency of dynamic social cues in a video based categorisation task with models displaying positive, negative or neutral expressions. The high social anxiety group processed social cues more rapidly than low anxious participants, although overall neutral faces were processed more slowly than emotional expressions. However the high anxious group also rated neutral expressions more negatively than low anxious participants. This may be due to socially anxious individuals treating a neutral ‘ambiguous’ dynamic cue as a source of potential social threat.

Dimensional valence categorisation and speed of processing of emotional faces in social anxiety

The previous three chapters and much of the evidence to support or refute the claims of the Clark and Well’s (1995) or Rapee and Heimberg (1997) models of social anxiety have been based on static face paradigms. With dynamic social cues, there may be subtle attentional biases such as early vigilance or delayed engagement for social threat cues which are not apparent over the course of a speech because of a constant cycle of engagement, disengagement and re-engagement. If each expression in a dynamic display was attended to briefly and processed more rapidly in a high anxious group, then this may result in more processing time for self-relevant social cognitions.

In support of increased processing efficiency in socially anxious individuals, Brühl et al. (2011) found that socially anxious participants had heightened amygdala and upper midbrain activity in anticipation of negative and ambiguous pictures. The authors cite these areas as being involved in processing of emotional valence and modulation between top-down and bottom-up processing. Increased activity was also found in occipital and thalamic regions, which the authors suggest are involved in perceptual and attentional processes whilst increased activity in prefrontal cortical areas including the ventrolateral cortex (VLPFC), medial prefrontal cortex (MPFC) and dorsolateral prefrontal cortex (DLPFC), which were thought to represent cognitive emotional integration. The authors suggest that these areas are related to anticipation of negative stimuli, self-focussed cognitions and control of emotions based on previous research (i.e. Herwig et al., 2007a; Herwig et al., 2007b; Bogels & Mansell, 2004 and John & Gross, 2004) respectively. If the authors are correct in their interpretation of evidence to support these linkages from neural activity to processing, then it may suggest that anticipation of social threat may precipitate a preparedness of the visual and cognitive systems to process threat cues, which may result in more efficient processing of emotionally threatening information.

Processing efficiency in static face paradigms

Further evidence of processing efficiency for negative information in socially anxiety has been provided by several static face studies (e.g. Gilboa-Schechtman, Presburger, Marom & Hermesh, 2005; Kolassa & Miltner, 2006; Moser et al., 2008;

Mueller et al., 2009; Yoon & Zinbarg, 2007). In contrast, other studies have found evidence for inefficiency for processing negative information (e.g. Heuer, Lange, Isaac, Rinck & Becker, 2010; Mullins & Duke, 2004; Montagne et al., 2006) or for positive information (e.g. Silvia et al, 2006). However, these studies have been open to different interpretations.

For example, Gilboa-Schechtman et al. (2005) found that participants with social phobia rated moderately negative crowds (i.e. with more negative than positive or neutral faces) more negatively than controls in a face in the crowd task. They were also faster in identifying emotional faces in negative compared to balanced crowds (i.e. with more of an even distribution of negative, positive and neutral faces). In an earlier study, Gilboa-Schechtman, Foa and Amir (1999) also found that participants with social phobia were relatively faster at identifying angry compared to happy faces. More rapid processing of negative information by itself would be unlikely to result in a negativity bias, but if the individual were hypersensitive to negatively perceived faces which matched their negative expectations and ruminated on the self-relevance of these then an online negativity bias could ensue, in line with the predictions of the Rapee and Heimberg (1997) model. However, Staugaard (2010) cautioned that the social phobic group in the study by Gilboa-Schechtman et al. (1999) was in fact slower at identifying happy faces but not any faster at recognising angry faces compared to controls.

This was reinforced by Silvia et al. (2006) who suggested that the inconsistency between socially anxious individuals' negative expectations of social evaluation followed by a positive face decreases categorisation processing speed compared to less anxious individuals. This was demonstrated in the study in which happy or sad face photos were followed by a blank screen and participants were asked to indicate correct categorisation of the face by means of a yes/no response. Overall, happy faces were recognised faster than sad faces but the gap between recognition speeds was significantly higher for the high social anxiety group. This effect appeared to be due to a slower response to categorise a happy face rather than any between group differences in processing speeds for happy faces.

A subsequent experiment (Silvia et al., 2006) replicated the design with angry faces replacing the sad faces used in the previous study. However, the same pattern was observed with an apparent processing deficit for speed of processing happy faces relative to angry ones in the high anxious group. If socially anxious people do process positive faces more slowly then it could account in part for a deficit in the positivity bias as their slow processing of positive social cues may impact on their cognitions. Alternatively, a slower processing time for positive social cues could lead to gestures such as nods or smiles being missed if another social cue such as a frown catches their attention in a dynamic situation. On the other hand, a slowed response to categorising positive social cues and a heightened processing for negative social cues may reflect prior expectations.

Context effects in processing efficiency

Yoon and Zinbarg (2007) found using a face priming task that latencies between cues and target faces were faster when the cue and target face were congruent (i.e. both positive or both negative) and social anxiety was significantly correlated with negative interpretations of neutral faces. However, happy faces were processed faster in the high social anxiety group when preceded by disgust faces, which may suggest that happy faces are associated with a negative interpretation such as sneering or mocking by socially anxious individuals.

The study involved a priming task in which participants were presented with a probe followed by a target face (angry, happy or disgust). Probes included a string of three question marks, or a face (angry disgust, happy or neutral). Half of the participants were told to prepare a 5 minute speech (threat condition) whilst the other half were simply asked to write an essay (non-threat condition). The task involved identifying the emotion of the target cue face by keyboard response. Following the target picture presentations a message appeared to indicate that the participant should generate a story which would link the cue and target faces. Alternatively a ‘no story’ message was displayed. For question mark cues, only the target face was to be included in the story. Participants cued the start and end of the picture presentations by a key press and the latency between these points was recorded as the reaction time measure.

Latencies between cues and target faces were faster when the cue and target face was congruent (i.e. both positive or both negative) and social anxiety was significantly correlated with negative interpretations of neutral faces. Angry faces that followed neutral ones were processed faster in the high social anxiety group compared to the low social anxiety group suggesting that the neutral faces were interpreted more negatively by this group. Furthermore, happy faces were processed faster in the high social anxiety group when preceded by disgust faces, which may suggest that happy faces are associated with a negative interpretation such as sneering or mocking. Therefore, reaction times revealed differences that the self-report measures failed to.

Carrera-Levillain and Ferandez-Dols (1994) also found evidence of context effects for processing. Whilst neutral faces were rated towards the negative side of neutral on a dimensional categorisation task with a scale from negative to positive, they were still closer to a neutral scale point than negative or positive faces were. However, when they were paired with positive or negative descriptions of unusual situations they were treated as categorical positive or negative expressions depending on which were congruent with the context.

State anxiety as a mediator of processing efficiency

In addition to context effects, state anxiety appears to influence processing speeds for emotion categorisation of faces in combination with trait social anxiety. For example, Mullins and Duke (2004) presented high and low socially anxious individuals with face photos of happy, sad, angry and fearful expressions. Each face was presented in a high intensity and low intensity expression. Accuracy and reaction time were recorded and participants completed the experiment alone (no threat condition); in the presence of the experimenter (slight threat condition); alone with threat of having to deliver an evaluated speech (moderate threat condition) and with the experimenter as observer and a speech threat (high threat condition). Self-report post-test state anxiety measures revealed that anxiety was significantly higher for participants in the moderate and high social threat conditions. This suggests that the threat of a speech task significantly increases state anxiety regardless of dispositional social anxiety. Furthermore, there were no group differences found for categorisations of facial expressions.

In the no threat condition, when viewing low intensity angry or sad faces, high social anxiety participants took longer to categorise the emotion of the face. This may because negative facial expressions are more difficult to distinguish from each other when the expression is weak, and this may present a particular difficulty for socially anxious people as the meaning of the facial expression must be evaluated for its social threat significance. Conversely, in the moderate threat condition the same faces were identified more rapidly by the high social anxiety group but no differences were evident in the high threat condition.

Thus, attention may depend on the interplay between social anxiety and situational anxiety. With high intensity facial expressions, anger and fear faces were categorised faster by both groups in the moderate threat condition compared to the low or high threat conditions. This may suggest that when state anxiety is very low or very high people have more difficulty in distinguishing negative facial expressions. This is possibly because in low social threat conditions there is a lack of social relevance to the viewer of the face, yet in very high social threat conditions, state anxiety may slow processing speeds for social cues because it could cause uncertainty. In summary, it seems that there is mixed evidence from static face paradigms regarding efficiency for processing negative faces or inefficiencies in processing positive faces in socially anxious individuals. This may be mediated to some extent by context and state anxiety.

Static versus dynamic paradigms

As well as the difficulties of comparing results across studies due to the variety in stimuli and social anxiety measures, a more significant difficulty may arise from the two dimensional nature of static faces. Photographs may appear to socially anxious individuals to be less socially threatening than more realistic three dimensional dynamic faces which are more similar to the type of faces that one would find in an audience.

Indeed, Biele and Grabowska (2006) found that angry dynamic facial expressions were rated more intensely than angry static faces. Moreover, in a static face paradigm, the expression is by its nature constant. In more realistic situations facial expressions will be constantly fluctuating and may go through several shifts in appearance and valence over the space of just a few seconds. This may change the nature of visual attention to the face, interpretation of it and processing durations.

A recent study of participants from a general population (Trautmann-Lengsfeld, Domínguez-Borràs, Escera, Herrmann & Fehr, 2013) found that despite no differences in categorisations or arousal to emotional dynamic compared to static faces, EEG measures indicated that the late posterior positivity (LPP) was more extensive and temporally expanded for dynamic compared to static disgust and happy faces. This has been linked to processing of positive and negative facial expressions (e.g. Vuilleumier & Pourtois, 2007) and fMRI data showed that various posterior and anterior regions were activated and deactivated in a repeated pattern (Trautmann-Lengsfeld et al., 2013). This suggests that it may be more ecologically valid to investigate processing efficiency across social anxiety groups in dynamic rather than static face paradigms.

Processing speeds in dynamic morphed face paradigms

Several attempts have been made to study dynamic processing using morphed face photos. The morphed face paradigm was originally trialled by Niedenthal, Halberstadt, Margolin and Innes-Ker (2000) who presented 100-frame movies in which an emotional face was initially presented. The facial expression then gradually became neutral over the course of the movie. Participants in the original study indicated the frame at which the initial expression was no longer present on the face. A series of studies have since utilised a similar method in relation to social anxiety.

For example, Montagne, Schutters, Westenberg, van Honk, Kesselsand and deHaan (2006) rapidly presented participants with a series of face photo morphs to form video sequences with clips of 0.5 seconds and 2 seconds which increased in neutral-emotion ratios in increments from 0% to 100% for emotional faces including anger, disgust, fear, happiness, sadness, and surprise. Socially anxious participants who were asked to indicate which emotions they detected under no time restrictions, had more difficulty in recognising negative emotions compared to controls, but there was no group difference for positive emotions. However, the forced choice task used did not include a neutral option which may have influenced the results. Moreover, the apparent recognition difficulties in the high social anxiety group may not represent a categorisation deficit. Rather the lack of a time limit may have resulted in an opportunity for rumination on negatively perceived faces based on information from memory.

This limitation on processing faces with long decision intervals was noted by Edwards (1998) who found a reduction in accuracy of categorising negative emotional expressions with a general population as time allocated to complete the task increased, presumably enabling participants to engage in more elaborative processing. All negative emotions were more prone to error with the longer time frame (3 minutes: 13 frames) than with the shorter time frame (38 seconds: 3 frames), but there was no difference in task lengths for happy faces. This may be because there are more categories of negative emotion to be distinguished than happy emotions.

Hoffman, Traue, Bachmayer and Kessler (2006) morphed face photos in incremental 200 steps to produce videos of dynamic faces ranging from neutral to emotional with durations of 2-3 seconds. Fear and surprise were rated as realistic with velocities of around 550-700m whilst happiness took a little longer at 826ms followed by, disgust and anger at 907ms and 939ms respectively (which were the only ones not to be significantly different from each other). Sadness was rated realistic at above 1198ms. The relatively longer processing times for anger and disgust which may be more socially threatening for socially anxious individuals compared happiness in a general population appear to be in contrast with the patterns evident from static face processing paradigms for socially anxious individuals who appeared to exhibit faster processing for socially threatening compared to non-threatening expressions.

Although fear and surprise were associated with the shortest processing times in the above study, the authors did not offer an explanation for this, but it could be due to their relationship with the environment from a sociobiological perspective. Fear may feasibly signal an environmental threat and surprise may signal a novel event that may have to be responded to quickly. Whalen (1998) has suggested that both of these expressions depict vigilant expressions denoted by the whites of the eyes and therefore signal an important event.

The relatively easy processing of positive faces for non-socially anxious individuals may be underpinned by there being fewer categories of positive emotions than negative emotions. Unkelback, Fiedler, Bayer, Stegmuller, and Danner (2008) suggested that positive words are processed faster than negative words because positive information is more compactly assembled in neural networks (the Density Hypothesis) since there are more differential categories of negative information compared to positive information.

Although this has been tested with words, and is likely to be underpinned by different neural processes, the principle may be similar for emotional faces which have more negative emotions including anger, fear, sadness and disgust compared to positive expressions such as happiness and surprise. It may be the case that at short presentation intervals automatic processing of salient features would result in faster processing of emotional information. At longer presentations intervals, more elaborative cognitive processing is involved, with the result that negative faces may be more difficult to interpret because of the increased categories of negative emotion available in the neural network. However, if the happy face is interpreted as negative by socially anxious people then this effect may differ across groups.

Notwithstanding the insight that sequential morphing studies have provided on dynamic face processing, morphing images to create dynamic faces may in themselves may not be entirely ecologically valid. In real social situations, facial expressions involve a series of micro-expressions which may change in a non-serial manner from neutral to emotion or vice versa. Heuer, Lange, Isaac, Rinck and

Becker (2010) attempted to counter this by allowing participants to scroll back and forward through a video of morphed faces. In experiment 1, the time was limited to the 100 seconds of the video from viewing the first frame to the last in sequence but in the free view condition, participants could scroll back and forward on the video and take as long as required to categorise the face. In the limited (start to finish) viewing condition, happy faces were identified more accurately than angry faces whilst disgust faces were least accurately identified. In the unrestricted condition whilst happy faces were still identified most accurately than anger or disgust faces, disgust faces were processed faster than angry faces. This suggests that with increased time the way in which people categorise negative expressions may alter.

In both conditions, accuracy was not influenced by social anxiety. However, in the limited time condition, there was a non-significant trend in favour of slower reaction times for emotional identification in the high social anxiety group, which was not present in the freeview condition. However, the study was limited by the forced choice nature of the identification process as well as having all female participants rating faces of both genders. Moreover, whilst participants did not have to follow a sequential order in identifying the emotions in the free view condition, this and the previously described morphing studies still essentially used static face photos to produce an unrealistic dynamic display.

Furthermore, the aim of these tasks was generally to distinguish discrete emotions, and this is not something that is likely to happen in a social performance situation where the main fear of socially anxious people will be signs of disapproval. In such a situation differentiating whether the emotion on the face indicates anger, disgust, distain or disappointment may be much less important than the more general signal of negative evaluation. It may, therefore, be more appropriate to measure processing times in dimensional valence categorisations rather than for identification of specific emotions.

Study 4 *Processing speeds and valence categorisation in social anxiety with videoed social cues*

Three dimensional dynamic faces such as those found in an audience may change the nature of attentional biases compared to those demonstrated in static and morphed face paradigms because of the fluctuating nature of facial expressions as they move in real time. The aim of Study 4 was to measure social anxiety related differences in processing times for dimensional categorisations in a relatively naturalistic paradigm using real video clips rather than morphed static images. The task consisted of a series of pre-rated short video clips contained positive, negative or neutral social cues in the form of facial expressions and gestures. Measures included an emotional valence rating and speed of processing of the social cues exhibited in the video clips.

It was hypothesised that:

I. Because dynamic social cues involve a series of discrete expressions which may seem ambiguous at points, neutral dynamic clips would be rated significantly more negatively than neutral (still) filler clips.

II. Given the evidence of negative expressions being more difficult to decipher generally, the high social anxiety group would rate behaviours more negatively on average than the low social anxiety group because they will apply greater self-relevance to the somewhat ambiguous social cue. A relationship between the perceived self-relevance and attention to negative social cues would provide some support for the Rapee and Heimberg (1997) model of social anxiety.

III. Because dynamic social cues involve a series of discrete expressions which may seem ambiguous at points, neutral dynamic clips would take longer to recognise than positive or negative dynamic clips.

IV. In light of the findings of Mullins and Duke (2004) in a moderate threat condition such as the current task, high social anxiety participants would categorise all clips significantly more rapidly than low social anxiety participants.

Method

Participants

59 participants were recruited through posters displayed around local businesses; local classified ads and community websites. Participants were invited to participate in return for being entered into a draw for a £50 prize. Inclusion/exclusion criteria and ethics approvals replicated the previous non-eye tracking study (Study 2).

Participants were split into groups of 20 high, 21 moderate and 18 low anxiety participants based the third percentile of scores (i.e. Guastella et al., 2009; Silvia et al, 2006) on the 8-item Brief Fear of Negative Evaluation scale II (BFNE II; Clareton et al., 2007). General social anxiety was measured on the 17-item Social Phobia Inventory (SPIN) (Connor, Davidson, Churchill, Sherwood, Foa & Weisler, 2000). Current negative mood and anxiety were measured by administering the self-report 21 item self-report Beck Depression Inventory II (Beck et al., 1996) and Beck Anxiety scale (Beck, Epstein, Brown & Steer, 1988) respectively.

Participant demographics

20 high social anxiety (HSA), 21 moderate social anxiety (MSA) and 18 low social anxiety (LSA) participants completed the experiment. The sample comprised 40 females and 19 males participants but a 2x3 Chi² test showed that the gender was equally distributed across the three groups, χ^2 (2) = 1.28, p = 0.54. Participant's ages ranged from 17 to 53 and years of education ranged from 12 to 28 years. A series of one way ANOVAs were conducted for age, education, BFNE, SPIN, BDI, and BAI. Main effects and Bonferroni post-hoc significance values are presented in Table 4.1.

Table 4.1

Participant characteristics

Anxiety	HSA		MSA		LSA		*F*	*p*	HSA LSA	HSA MSA	MSA LSA
	M	SD	M	SD	M	SD					
BFNE	31.85	3.71	19.9	4.2	11.06	1.76	256.4	<0.001	<0.001	<0.001	<0.001
SPIN	35.35	11.93	19.76	12.81	6.11	5.79	2.56	<0.001	<0.001	<0.001	<0.001
BDI-II	19.45	18.01	10.05	6.23	5.83	8.23	6.48	0.01	0.01	0.05	0.84
BAI	16.5	6.92	10.09	5.79	5.22	6.17	15.35	<0.001	<0.001	0.01	0.06
Age	23	4.85	25	7	27	9.05	1.64	0.2			
Education	16.55	3.65	15.42	2.5	17.61	4.3	1.87	0.16			

BFNE, Brief Fear of Negative Evaluation Scale (8-item); SPIN, Social Phobia Inventory, ACS, Attentional Control Scale, BDI-II, Beck Depression Inventory-II, BAI, Beck Anxiety Inventory. Welch tests were used for BFNE and SPIN scores as Levene's tests were significant.

Participants in each of the groups were not significantly different in terms of gender, age or education across the three groups but were reliably differentiated on social anxiety measures. However, the higher scores for the high anxiety group relative to the low anxiety group for both depression and general anxiety suggest that these factors must be taken into account when interpreting the data, as discussed in Chapter 4.

Design

Differences in ratings and reaction times were assessed with two-way mixed ANOVAs with one between subjects factor: anxiety group (high; moderate; low) and one repeated measures factor: clip valence (neutral still; negative dynamic; neutral dynamic; positive dynamic).

Materials and apparatus

Clips of actors displaying social cues (i.e. gestures and accompanying facial expressions) were presented on an ISUS G707 laptop with a screen resolution of 1440 x 900 pixels using Experiment Builder software (SR Research Ltd). Video clips (e.g., Figure 4.1) were 424 x 236 pixels in size and participants were seated approximately 50cm from the monitor. The experiment was built with a looping sequence for missing responses so that if a clip timed out it would be randomly re-presented at a later point in the experiment.

Positive and negative behaviours replicated those used by Perowne and Mansell (2002). Negative behaviours included 1) yawning; 2) looking at watch; 3) look of disbelief; 4) shaking head; 5) talking to neighbour and a 6) long look around the room. Positive behaviours included, 1) leaning forward; 2) smiling; 3) nodding in agreement; 4) making notes 5) pointing in agreement and 6) nodding in acknowledgement. These were accompanied by the appropriate facial expressions, such as frowning, looking dismissive, disinterested and bored to accompany negative gestures and smiling/looking interested for positive gestures. Neutral behaviours included: 1) ‘scratching head’; 2) ‘adjusting seat’; 3) ‘playing with pen’; 4) squinting’; 5) ‘briefly looking around room’ and 6) ‘rubbing eyes’.

Two examples of each behaviour type across each valence and actor were edited into four second clips and 18 separate neutral filler clips were selected for each actor. The reason for this was to provide filler clips (neutral still poses) for Study 5 (Chapter 6) in which each trial would consist of one actor performing a valenced behaviour along with 5 additional static, neutral actors. It was intended that one of each type of behaviour would be selected for each actor and nine filler clips (to be presented 10 times). This yielded a total of 648 different clips. An example neutral clip is illustrated in Figure 4.1.

Figure 4.1 *Example video stimuli*

Procedure

Participants were asked to read the information sheet and sign the consent form before completing the Brief Fear of Negative Evaluation scale II (BFNE II; Clareton et al., 2007); Social Phobia Inventory (SPIN) (Connor, Davidson, Churchill, Sherwood, Foa & Weisler, 2000), Beck Depression Inventory II (Beck et al., 1961) and Beck Anxiety scale (Beck, Epstein, Brown & Steer, 1988).

They were then seated in front of a computer screen and asked to imagine that they were giving a speech or an interview and that the people who they would subsequently see in the video clips were evaluating their performance. They were then presented with a video clip displayed on the centre of the screen that would over the course of four seconds change from a still neutral pose to an emotional or neutral dynamic pose, returning afterwards to a neutral pose. They were asked to rate the valence of the social cue during the clip in the context of the imagined social performance situation as quickly as possible on scale ranging from -3(negative), through 0 (neutral) to 3 (positive) (similar to Perowne & Mansell, 2002) by pressing a key on a cedrus response keypad with 8 key press options. Responses were only registered if they occurred within the four second epoch and once each clip finished another one would immediately start.

Because they were instructed to respond as quickly as possible once they detected the behaviour, the four second slot provided sufficient time for the responses to be registered within the desired time. However, participants were first given 24 practice trials based on a different model where they were asked to practice making a decision within the desired timing. The experimenter was then able to check the result file to ensure that the decisions were made within the allocated time slot in the majority of cases. However, in order to reduce missing responses, any clips that a response was not made to were represented at random points during the experiment. Two neutral keys, which were equal in denoting a zero score for valence rating, were placed at the bottom of the keypad and negative or positive responses were allocated to the left or right side of the keypad in a counterbalanced manner across participants in order to control for handedness.

Results

Hypothesis I: Valence ratings of neutral dynamic versus neutral filler clips

It was hypothesised that neutral dynamic clips would be rated significantly more negatively than neutral (still) filler clips. Descriptive statistics for valence ratings (Table 4.2) suggested that the high anxiety group made more negative ratings than the low or moderate anxiety groups for all clip types. Furthermore, neutral dynamic clips appeared to be more negatively rated overall than did neutral filler clips. Negative clips appeared to be rated more negatively than others overall and positive clips seemed to be the most positively rated compared to all other clips types. Kolmogorov-Smirnov tests indicated that the assumption of normality had been violated across several variables but group numbers were fairly equal.

Table 4.2

Mean valence ratings of clip types across anxiety groups

	Anx	*M*	*SD*
Fill	High	-0.35	0.52
	Mod	-0.17	0.28
	Low	-0.07	0.19
	Total	-0.20	0.37
Neg	High	-1.85	0.49
	Mod	-1.77	0.41
	Low	-1.43	0.94
	Total	-1.69	0.66
Neut	High	-0.88	0.50
	Mod	-0.57	0.35
	Low	-0.47	0.45
	Total	-0.65	0.46
Pos	High	1.14	0.57
	Mod	1.52	0.43
	Low	1.43	0.66
	Total	1.37	0.57

A two-way 3 x 4 mixed ANOVA for anxiety group x clip type revealed as expected a main effect of clip type. However, whilst Levene's test was non-significant for all variables (p>0.07), Mauchly's test indicated that the assumption of sphericity had been violated, (χ^2 (5) = 159.91, p< 0.001), therefore the degrees of freedom were corrected using the Greenhouse Geisser estimates of sphericity (ε = 0.41). F(1.22, 68.11) = 460.89, *MSE* = 0.51, p<0.001, *partial* η^2= 0.89, *Power* = 1.

Bonferroni corrected post-hoc contrasts revealed that positive clips were rated significantly more positively (M = 1.37, SE = 0.07) than negative (M = -1.68, SE = 0.08, p<0.001), neutral dynamic (M = -0.64, SE = 0.06, p<0.001) or neutral filler clips (M = -0.19, SE = 0.05, p<0.001). Negative clips were rated significantly more negatively than neutral dynamic or neutral filler clips (p<0.001) but neutral dynamic clips were also rated significantly more negatively than neutral filler clips (p<0.001).

As Figure 4.2 illustrates, neutral dynamic clips were rated more negatively overall than neutral filler clips. Therefore the experimental hypothesis was supported.

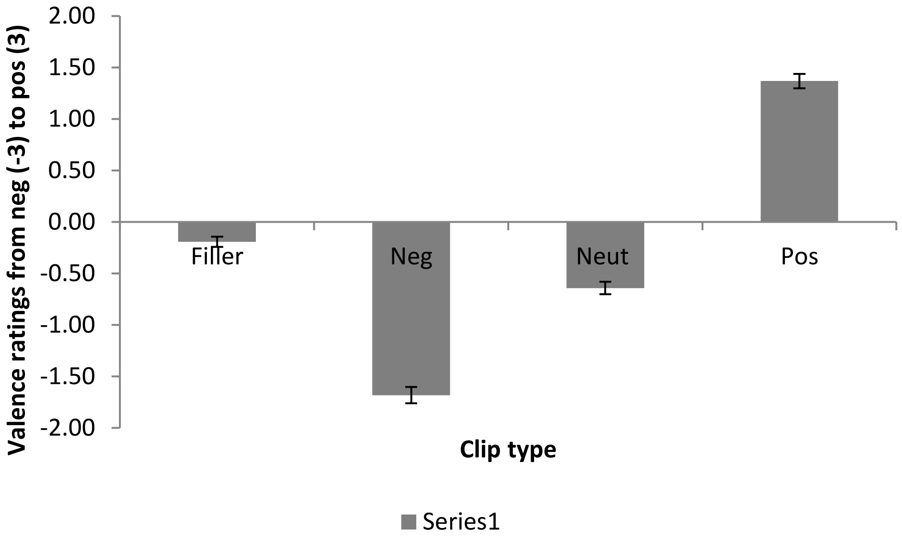

Figure 4.2 *Mean valence ratings across clip types (bars denote standard errors)*

Hypothesis II: Ratings of social cues as a function of social anxiety

It was further hypothesised that the high social anxiety group would rate behaviours more negatively on average than the low social anxiety group. The main effect of anxiety was significant as expected, $F(2,56) = 5.6$, $MSE = 0.43$, $p=0.01$, *partial* $\eta^2 = 0.17$, *Power* = 0.84. Bonferroni corrected contrasts revealed that the high social anxiety group rated social gestures in the video clips significantly more negatively (M = -0.48, SE = 0.07) than the low social anxiety group (M = -0.14, SE = 0.08, $p = 0.01$). There was no significant difference between the moderate social anxiety group (M = -0.25, SE = 0.08) and the high social anxiety group ($p = 0.08$), or low social anxiety group ($p = 0.91$). The anxiety group x clip valence interaction was non-significant, $F(2.43, 68.11) = 0.87$, $MSE = 0.51$, $p=0.44$, *partial* $\eta^2 = 0.03$, *Power* = 0.21., which suggested that this effect was constant across all social cue types.

However because the data was not normally distributed according to the normality tests, the Mauchly's was significant at the 0.001 α level and transformations had failed to normalise the data, the results were followed up with non-parametric analysis. The main effect of clip valence was confirmed using Wilcoxon tests for comparisons with α set at 0.0167 (Appendix III(v)). All comparisons were significantly different (p<0.001).

The main effect of anxiety group, which indicated that the high social anxiety group rated social gestures in the video clips significantly more negatively than the low social anxiety group was followed up with a Mann-Whitney test, which failed to reach significance for emotional clips. Negative clips (U = 141, z = -1.14, p = 0.26) were not rated significantly more negative by the high social anxiety group (*Mdn* = -1.69) than the low social anxiety group (*Mdn* = -1.63). Similarly positive clips were not found to be rated more negatively U = 121, z = -1.72, p = 0.09) by the high social anxiety group (*Mdn* = 1.22) than the low social anxiety group (*Mdn* = 1.49).

The effect for neutral dynamic clips held (U = 103, z = -2.23, p = 0.02) such that the high social anxiety group (*Mdn* = -0.74) rated the clips significantly more negative than the low social anxiety group did (*Mdn* = -0.57). Similarly, the effect remained significant for neutral filler clips (U = 102, z = -2.28, p = 0.02) with the high social anxiety group (*Mdn* = -0.15) rating clips significantly more negatively than the low social anxiety group (*Mdn* = -0.12). From this it can be only be concluded that high social anxiety participants made more negative interpretations of neutral social cues than low social anxiety participants did.

Since the high anxiety group had been significantly higher in both depression and general trait anxiety scores, correlations were conducted between BDI II and the

BAI scores respectively and emotional valence ratings. In light of the non-normal distribution of the data Spearman's correlations were conducted (Appendix IV(iii)) and revealed that despite no significant correlations between depression scores and ratings, general trait anxiety was negatively correlated with ratings of neutral filler clips (r = - 0.31, p = 0.02, r^2 = 0. 096) and neutral dynamic clips (r = - 0.32, p = 0.004, r^2 = 0.1) but no other clips types. This could indicate that generalised trait anxiety contributed to the more negative ratings of neutral filler and dynamic clips.

To further investigate the effect of general trait anxiety alone on ratings of neutral social gestures, a 2 x 3 mixed ANOVA with one within group factor (clip valence : neutral filler or neutral dynamic) and one between groups factor: anxiety (high/ moderate/ low) was conducted on BAI scores split by third percentiles. Levene's tests were non-significant for neutral fillers, $F(2,55) = 1.22$, $p = 0.31$ and neutral dynamic clips, $F(2,55) = 1.11$, $p = 0.34$ so homogeneity could be assumed. There was no significant main effect of general trait anxiety $F(2,55) = 2.84$, MSE =0.3, p = 0.07, partial η^2= 0.09, *Power* = 0.53 and no significant anxiety x clip type interaction, $F(2,55) = 0.54$, MSE =0.04, p = 0.58, partial η^2= 0.02, *Power* = 0.14.

Therefore it can be assumed that the more negative ratings of neutral social stimuli observed for the high social anxiety group compared to the low social anxiety group are independent of depression and general trait anxiety at least in terms of acting on their own. It is, however, possible that the combination of high social and generalised trait anxiety is responsible for the effect. Therefore, the hypothesis that the high social anxiety group would rate behaviours more negatively on average than the low social anxiety group has been partially supported in relation to neutral dynamic cues compared to neutral still social cues.

Hypothesis III: Reaction times to categorise neutral dynamic versus neutral filler clips

It was hypothesised that neutral dynamic clips would take longer to recognise than positive or negative dynamic clips. Descriptive statistics for reaction time, presented in Table 4.2, suggested that overall neutral dynamic clips took longer to process.

Table 4.3
Mean reaction time in ms

	Anx	*M*	*SD*
Fill	High	2169.97	489.05
	Mod	2362.82	278.59
	Low	2434.48	325.41
	Total	2319.31	385.54
Neg	High	2095.48	489.66
	Mod	2414.63	294.42
	Low	2542.36	293.49
	Total	2345.41	411.09
Neut	High	2333.57	514.75
	Mod	2655.59	280.50
	Low	2710.85	252.32
	Total	2563.29	400.79
Pos	High	2154.25	435.62
	Mod	2391.95	259.57
	Low	2463.98	206.68
	Total	2333.35	339.88

Levene's tests were significant at the 0.05 level but not at the 0.01 level for negative clips $F(2,56) = 4.17$, $p = 0.02$; neutral clips $F(2,56) = 3.76$, $p = 0.03$ and positive clips $F(2,56) = 4.72$, $p = 0.01$. Although groups were fairly equal and so should be fairly robust to moderate deviations from normality the results of the ANOVA have been reported but also followed this up with non-parametric analysis. A two-way mixed ANOVA with one repeated measure factor of clip valence (neutral filler or neutral dynamic) and one between groups factor of anxiety (high/ moderate/ low) revealed a main effect of clip type.

Mauchly's test indicated that the assumption of sphericity had been violated, (χ^2 (5) = 31.3, p< 0.001) therefore degrees of freedom were corrected using the Greenhouse Geisser estimates of sphericity (ε = 0.71). F(2.13, 119.43) = 38.75, MSE = 28500.49, p<0.001, *partial* η^2= 0.41, *Power* = 1. Bonferroni corrected contrasts revealed that neutral dynamic clips took significantly longer overall to rate (M = 2566.67ms, SE = 48.35) than neutral fillers (M = 2322.42, SE = 49); negative (M = 2350.82, SE = 43.54, p<0.001) or positive clips (M = 2336.73, SE = 41.55, p<0.001). Therefore the experimental hypothesis was supported, and this is illustrated in Figure 4.3.

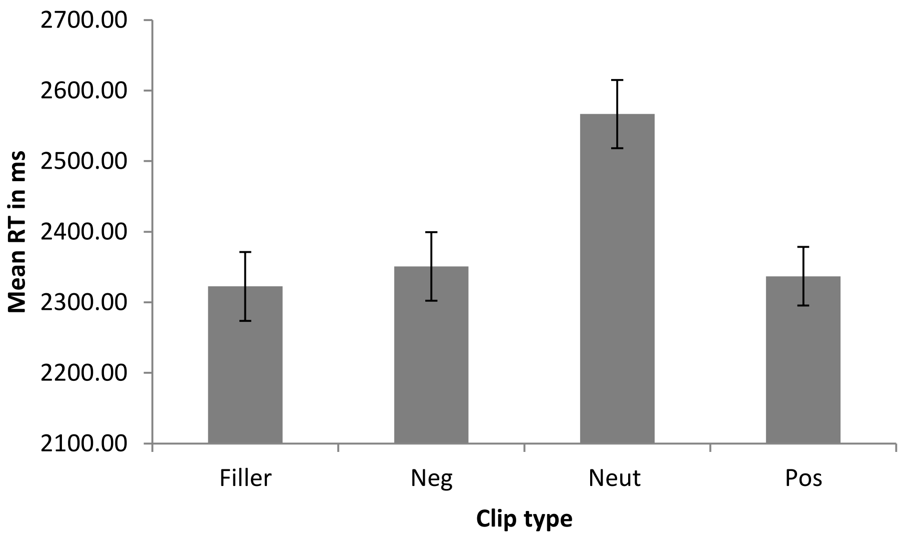

Figure 4.3 *Mean reaction time for categorisation of social cue (bars denote standard errors)*

Hypothesis IV: Reaction times to categorise social cues as a function of social anxiety

It was further hypothesised that high social anxiety participants would categorise all social cues contained within the video clips significantly more rapidly than low social anxiety participants. The main effect of anxiety group was significant $F(2,56) = 5.68$, $MSE = 457427.86$, $p=0.01$, *partial* $\eta^2 = 0.17$, *Power* = 0.85.

Bonferroni post hoc contrasts revealed that the high social anxiety group rated all cues significantly faster (M = 2188.32, SE = 75.62) overall than low social anxiety participants (M = 2537.92, SE = 79.71, $p = 0.01$) and moderate social anxiety participants (M = 2456.25, SE = 79.71, $p = 0.04$). There was no significant difference between the moderate social anxiety and low social anxiety group for reaction times ($p = 1$). This is illustrated in Figure 4.5. The anxiety group x clip valence interaction was non-significant, $F(2.23, 119.43) = 38.75$, $MSE = 28500.49$, $p=0.12$, partial $\eta^2 = 0.06$, Power = 0.56. Therefore, as predicted, the high social anxiety group processed all clips significantly faster than the other groups.

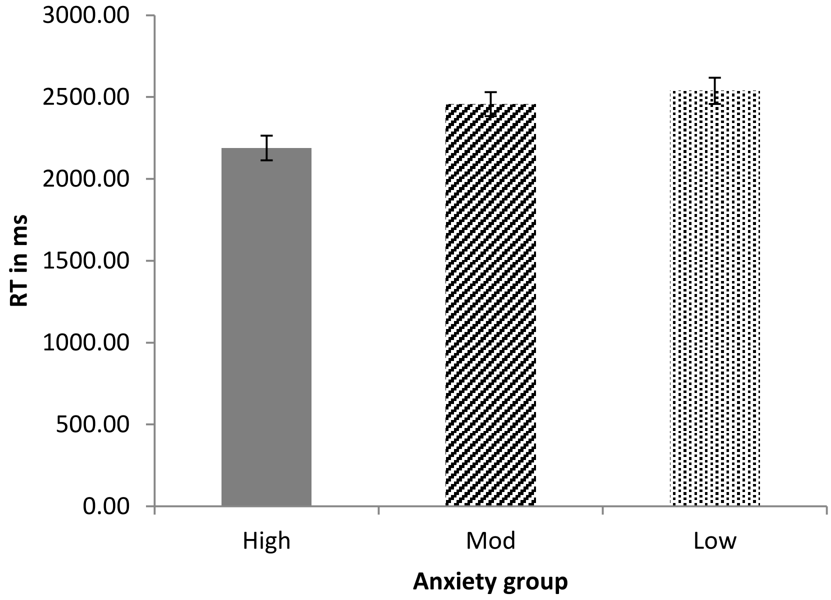

Figure 4.4 *Mean reaction time to categorise social cue across social anxiety groups (bars denote standard errors)*

Again because the data was not normally distributed according to the normality tests, the Mauchly's was significant at the 0.001 α level and transformations had failed to normalise the data, the results were followed up with non-parametric analysis for both main effects.

The main effect of clip type, which found that neutral dynamic clips took longer to recognise than positive or negative dynamic clips was confirmed using Wilcoxon tests for three comparisons (i.e. each clip type compared to neutral dynamic clips) with α set at 0.0167 (Appendix III(vi)).

The main effect of anxiety, which was followed up with a Mann-Whitney test adjusted α level 0.0125 failed to reach significance for filler ratings (U = 120, z = -1.75, p = 0.08), meaning that the high social anxiety group (*Mdn* = 2248.94), did not significantly differ in time to categorise filler clips than the low social anxiety group (*Mdn* = -2465.45). However, it remained significant for reaction times for dynamic neutral ratings ($U = 92$, $z = -2.57$, $p = 0.009$) with the high social anxiety group (*Mdn* = 2353.72) rating neutral clips significantly faster than the low social anxiety group (*Mdn* = 2703.3).

It also remained significant for negative ratings ($U = 85$, $z = -2.78$, $p = 0.005$) with the high social anxiety group (*Mdn* = 2101.07) rating negative clips significantly faster than the low social anxiety group (*Mdn*= 2467.69), and likewise for positive clip ratings ($U = 94$, $z = -2.51$, $p = 0.011$) with the high social anxiety group rating positive clips (*Mdn* = 2230.07), significantly faster than the low social anxiety group (*Mdn* = 2426.51). Therefore, when processing dynamic clips, overall neutral dynamic clips took longer to categorise on dimensional valence than other clips types but high social anxiety participants categorised all dynamic clips significantly more rapidly than did low social anxiety participants.

Again, because the high anxiety group had been significantly higher in both depression and general trait anxiety scores, correlations were conducted between BDI II and the BAI scores respectively and reaction times for dynamic clips only, as only these were significantly different across groups according to parametric analysis. Spearman's correlations revealed that depression scores were negatively correlated with reaction time for neutral dynamic clips ($r = -0.31$, $p = 0.02$, $r^2 = 0.096$) as were general trait anxiety scores ($r = -0.36$, $p = 0.01$, $r^2 = 0.13$). Reaction times for negative clips was also significantly negatively correlated with general trait anxiety scores ($r = -0.28$, $p = 0.03$, $r^2 = 0.08$).

To further investigate the effect of depression alone on ratings of neutral dynamic social gestures, a one-way ANOVA was conducted for BDI II scores based on a third percentile split. The Levene's test was non-significant at the 0.01 α level, *F*(2,55) = 3.85, *p* = 0.03, so it was considered that ANOVA should be robust enough to proceed with. Results indicated that there was no significant main effect of depression *F*(2,55) = 2.84, *MSE* =0.154413.44, p = 0.09, partial η^2= 0.08, *Power* = 0.48. Therefore, it can assumed that depression alone would not be responsible for the effect although it is possible that the combination between depression and social anxiety could have been a contributory factor in the more rapid processing of neutral and negative dynamic clips in the high social anxiety group.

To further investigate the effect of general trait anxiety alone on reaction time of processing neutral and negative dynamic clips, a 2 x 3 mixed ANOVA with one within group factor (clip valence: neutral dynamic or negative dynamic) and one between groups factor: anxiety group (high/ moderate/ low) was conducted on BAI scores split by third percentiles. Levene's tests were non-significant for neutral dynamic clips, *F*(2,55) = 0.79, *p* = 0.46 and for negative clips, *F*(2,55) = 1.73, *p* = 0.19, so homogeneity could be assumed. Again there was no significant main effect of general trait anxiety group *F*(2,55) = 2.88, *MSE* = 845337.31, p = 0.06, partial η^2= 0.1, *Power* = 0.54, and no significant anxiety x clip valence interaction, *F*(2,55) = 0.27, *MSE* = 13268. 32, p = 0.76, partial η^2= 0.01, *Power* = 0.09. Therefore, it can be assumed that depression and general trait anxiety have not independently significantly contributed to the faster reaction times on deciding the valence of social clips although the combination of depression and/or trait generalised anxiety with social anxiety may have influenced the results to some degree.

In summary of the results, it was hypothesised that neutral dynamic clips would be rated significantly more negatively than neutral (still) filler clips but they would take longer to recognise than positive or negative dynamic clips. Both of these hypotheses were supported by the statistical analyses. It was further hypothesised that the high social anxiety group would rate behaviours more negatively on average than the low social anxiety group because they would apply greater self-relevance to the somewhat ambiguous social cue. This was found to be the case but only the neutral dynamic clips were conclusively found to be rated significantly more negatively than neutral still clips in the high social anxiety compared to the low social anxiety group so the hypothesis was partially supported. Finally it was predicted that the high social anxiety participants would categorise all clips significantly more rapidly than low social anxiety participants and this hypothesis was supported for all dynamic clips.

Discussion

The aim of the study was to investigate valence based categorisation and processing times of dynamic social cues in relation to social anxiety. The results indicated that high anxious participants rated neutral dynamic and filler clips more negatively than low anxious participants rated them. They also categorised dynamic clips significantly more rapidly than less anxious participants did. The lack of difference between processing speeds for categorising emotional compared to neutral clips in the high social anxiety group may reflect their more negative ratings of neutral dynamic clips, which in effect may mean that they have been treated as emotional social cues. This would be consistent with the conclusions of Carrera-Levillain and Ferandez-Dols (1994) and Yoon and Zinbarg (2007) if the socially anxious participant's self-relevant negative expectations acted as a prime for the neutral social cues.

Overall, neutral dynamic clips were rated significantly more negatively than neutral (still) filler clips, whilst positive clips were rated most positively and negative clips most negatively. Neutral dynamic clips also took longer to categorise for dimensional valence than other clips types, which may reflect the relative lack of salience information available. Carrera-Levillain and Ferandez-Dols (1994) found that whilst neutral expressions were rated more negatively than positively in a dimensional categorisation task, they were still closer to a neutral scale point. This is consistent with the valence rating results in the current study.

The results of the current study may have differed from those found by Silvia et al. (2006) and Gilboa-Schechtman at al. (1999; 2005) because the video task was more personally relevant to the participants who had been asked to imagine that the facial expressions and gestures that they were viewing were in response to their performance on the speech task. However, if the dynamic faces were all interpreted as a social threat by the high social anxiety group in the current study then it would explain why the reaction times were faster overall for this group.

This interpretation is in line with the results found by Yoon and Zinbarg (2007). In the aforementioned study, angry faces that followed neutral faces were processed faster in the high social anxiety group compared to the low social anxiety group and happy faces were processed faster when preceded by disgust faces for the high social anxiety group. This suggests that when faces are interpreted negatively because they have been primed by negative expectations, it speeds reaction times in the high social anxiety group. In the same way, in the current study, because participants were asked to imagine themselves in social performance situations, they may have formed an expectation of the way in which the audience would be likely to evaluate them and this may have acted as a similar type of prime.

The faster processing speeds for the high anxiety group may reflect differential neural activity during the anticipatory stages of the task, which could culminate in a more efficient processing style. This interpretation is consistent with Brühl et al. (in press) who found that socially anxious participants had heightened neural activity in areas associated with arousal, threat processing and visual attention. If socially anxious individuals can categorise emotional faces more rapidly it could explain increased scanning behaviour, whereby an individual makes a series of brief fixations around the face in a distributed pattern (i.e. Horley et al., 2004). In being able to extrapolate emotional information rapidly they may require only very brief fixations to gain the emotional content from facial features that they need to make a response to the face. This may also be why Veljaca and Rapee (1998) found that socially anxious participants discriminated negative behaviours more efficiently than less anxious participants. The advantage for rapid processing may as Langner et al. (2009) suggested be due to an advantage for configural processing (discussed in Chapter 2). The inference that socially anxious individuals could efficiently scan an audience for negative social cues is consistent with the Rapee and Heimberg (1997) model of social anxiety.

Yet studies such as Langner et al. (2009) and Horley et al. (2004) infer that faster processing of faces in socially anxious individuals is at an automatic level. This would presume that there would not be time to assign a cognitive meaning to the face. Yet the high social anxiety group in the present study processed neutral social cues faster than the low social anxiety group in addition to the emotional social cues, without the emotion markers of angry eyes or happy mouths etc. This is not consistent with a salience based pattern of attention and may suggest that socio-evaluative processing has a role in processing dynamic faces. The dynamic nature of these stimuli may have altered the process by which the social cues in this study were categorised compared to studies using static face photos. Micro expressions are constantly fluctuating in realistic dynamic faces and this may mean that elaborative processes necessarily play a part in assessing the changing micro expressions over a given period of time, thereby lengthening the categorisation process.

Although Hoffmann et al. (2006) found that dynamic facial expressions were identified with considerably faster reactions times than those in the current study, reaction times in these studies are indeed indicative of elaborative rather than automatic processing times. In the former study, emotions were considered to be realistic at exposure times of between 550ms and 1198ms depending on the emotion type. Yet in the current study, participants took even longer with processing speeds of 2000ms to 2700ms on average to identify the valence of the emotion.

There are several possible reasons for this discrepancy. The videos in the study by Hoffman et al. (2006) were graded incrementally for increasing emotion in a linear fashion whereas in the current study, facial expressions may have fluctuated considerable more since they were less controlled and non-linear. This may have resulted in extra processing time as the faces and gestures were monitored over a period of time in order for participants to gain a stable impression of their valence. The fact that gestures were also included in the video clips may also have added time to the decision making process since comprehension of these would require to be integrated with the facial expressions. However, the stimuli used in the current study are more ecologically valid than those used in morphing studies and as such may represent a more realistic response.

Another possible reason for the extra processing time of social cues in the current study may have been that participants were told that the clips would last for four seconds before timing out. This gave participants an opportunity to wait until they were more confident about their decision before indicating the valence of the video clip. This type of delay may only occur when the categorisation task is a primary task but in a real performance situation, categorisations of social cues are secondary to the primary performance task. This aspect is investigated in Chapter 6.

Yet in the current study the high anxious group were significantly faster to categorise the valence of social behaviours even at these long reaction time intervals than the moderate and low anxiety groups. It may be the case that each of the dynamic segments in the video clips are processed independently in a series of micro processing steps which cumulatively result in faster processing even at long intervals. If socially anxious individuals are able to observe more of these micro changes because of faster automatic processing times, it may help to explain why they had a more negative impression of the video clips, particularly of neutral clips.

Furthermore, although the non-parametric analysis suggested that the difference between groups for valence ratings of positive clips did not reach significance, the mean ratings are consistent with slightly more negative interpretations of all faces in the high anxious group compared to the low anxious group. Therefore, the faster reaction times in the current study may conflict with the relatively slower reaction times for identifying happy faces in the Silvia et al. (2006)

study because some of the micro social cues included in the positive clips may have appeared to be negative to the high social anxiety group.

This effect of speeded processing of dynamic facial expressions in high social anxiety individuals may in part depend upon concurrent state anxiety. Mullins and Duke (2004) found that when state anxiety was moderately elevated by the threat of a speech task, processing times for identifying facial emotions increased in participants with greater social anxiety. Yet when state anxiety was low or particularly high rather than moderately high, identification was slowed for the high anxiety group. The conditions of the current study may have produced a somewhat elevated level of state anxiety as well because participants were asked to imagine themselves in a social situation and because the videos (albeit pre-recoded) looked more realistic than a still photo or sequential morphed image video. However, in the absence of a measure of state anxiety this theory cannot be substantiated and as such the omission of a state anxiety measure is a limitation of the study.

Other limitations include the combination of social gestures with facial expressions. Although this provided realistic social cues, it was not possible to distinguish which elements (i.e. facial expression or gesture) were primarily driving the response. Therefore, it may be useful for researchers to conduct subsequent studies of each of these elements separately. Furthermore, the fixed timing of the clips at 4 seconds for just one categorisation task per clip may have created an unnatural situation which does not wholly represent the categorisation process. In a real social performance situation, a speaker is faced with several concurrent tasks including paying attention to the goal of their performance, monitoring the audience and their ability to meet expectations. Therefore, the available time and processing resources are likely to be considerably more constrained in a more realistic situation. This aspect has been investigated further in the next chapter.

In summary, results from the current study suggest that socially anxious individuals process dynamic social cues more efficiently than less anxious individuals. This may be due to the effect of moderate social threat present in the task which may have increased the self-relevance of the facial expressions and gestures. Furthermore, the results indicate that high socially anxious individuals interpret ambiguous social cues more negatively than less socially anxious individuals. This may be underpinned to some extent by the fluctuating micro-expression contained in dynamic faces and gestures as opposed to the constancy of the expression in a static face photo.

Chapter 6

Abstract

Without direct measures in ecologically valid paradigms, limited knowledge of attentional focus can be ascertained. The aim of Study 5 was to measure attention and online interpretation of social cues in a speech paradigm. Eye-movements were tracked during a task in which participants were told that a 'live web linked panel' was evaluating their social performance. Despite no differences in visual attention early in the task, social anxiety appeared to increase awareness whilst slowing processing of social cues. As the task progressed, more visual attention was paid to emotional social cues across groups. However, the low anxiety group were aware of more negative cues, whereas the high anxious group were equally aware of all social cues. Post task private and public evaluation ratings were more negative for high anxious participants than for the low anxious group. Situational anxiety in the early performance stages may disrupt allocation of attention to emotional faces but heighten awareness of social cues. However over the course of a speech task, social anxiety may inhibit the discrimination of genuine emotional threats.

Investigation of attentional and online interpretative biases across social anxiety during a speech task

Although in the most recent update to the Rapee and Heimberg model of social anxiety (Morrison, & Heimberg, 2013). The role of biased attention is included as an integral feature in the maintenance of social anxiety, an earlier update (Heimberg, Brozovich and Rapee, 2010) included the possibility that an online negativity bias may occur in the absence of attentional biases, even though it allows for the possibility of attentional biases. Encoding of a perceived negative facial expression can prime increased negative expectations about subsequent social cues.

Negative expectations are also thought to prime neural activity that may result in socially anxious individuals being in a different state of preparation as they encounter audience faces compared to less anxious individuals (Brühl et al. 2011). As facial expressions and gestures are being encoded they may be automatically compared to the individual's expectations and social cues that are congruent with negative expectations and may be more readily integrated in the negative self-construct and perception of the audience evaluation. This may be the pivotal stage that determines the occurrence of an online negativity bias yet it does not rely on an attentional bias. In a social performance situation, this may culminate in increased self-focussed attention and alternately, rumination on the perceived social cues. A decision making process may then be initiated resulting in enhanced vigilance or avoidance of negatively perceived social cues.

Evidence from static face or dynamic paradigms may shed some light on the potential mechanisms that may underpin attentional and interpretative biases in socially anxious individuals. However, Schultz and Heimberg (2008) have suggested that a speech paradigm, in which participants must deliver a social performance in front of an audience, is perhaps the more ecologically valid means of testing attentional biases to threatening social cues such as negative facial expressions. During speech tasks, socially anxious participants appear to view themselves significantly more negatively than their less anxious counterparts (Christensen et al., 2003). They have also been found to report higher levels of subjective anxiety, fearful thoughts and experience greater arousal during speech tasks (Eckman & Shean, 1997; Hofmann, Newman, Ehlers & Roth, 1995). Furthermore, they reportedly have more negative self-evaluations and less positive cognitions than low anxious participants in post task ratings (Eckman & Shean, 1997). However, it is not clear whether these effects are linked to differences in attention across social anxiety groups.

Attention to faces in ecologically valid speech paradigms

The Rapee and Heimberg (1997) model asserts that when confronted by a socially threatening situation, the socially anxious individual will scan their surroundings for cues, detect negative evaluation more rapidly and find it difficult to disengage from negative evaluative social cues such as frowning or signs of boredom. This creates negative expectancies about the individual's performance and about audience evaluation of their performance, culminating in a negativity bias. A number of studies have made inferences on attention as a factor in a negativity bias. For example, Daly, Vangelisti and Lawrence (1989) asked participants to participate in a speech task whilst three audience members rated their performance. Ratings of participants' gaze suggested that the high social anxiety group maintained less eye-contact with the audience and looked significantly more at their notes than their less anxious counterparts, which may suggest a reduction in attention.

Subsequently, Pozo et al. (1991) measured participant's interpretations of the facial expressions of a confederate who interviewed them via a videotaped recording. Confederates were trained to display positive, negative or neutral facial expressions. The task involved participants answering a series of nine questions posed to them by an opposite sex interaction partner via a close-circuit TV link. The task was split into three blocks with three questions asked in each. There were also three conditions. In condition ‘A’ participants were presented with a confederate acting in a neutral manner across the three blocks. In condition ‘B’ the confederate was negative in block 1, neutral in block 2 and positive in block 3. In condition ‘C’, the confederate was positive, then neutral, and finally negative in the third block.

Participants were unaware that the interaction partner had been pre-recorded in a series of neutral, disapproving or approving facial expressions presented with one emotion type per block. After each block, participants were asked to interpret how they expected the interaction partner to evaluate the participant and how likely they thought it was that the interaction partner would want to get to know them better but since these two items were very highly correlated a combined score was calculated. Videos were scored for direct attention if the participant looked ahead directly at the interaction partner when the partner was also looking at them (indicating direct eye contact). High social anxiety participants gave significantly lower ratings for the degree to which they believed that the interaction partner approved of them than low social anxiety participants did. However, video recordings revealed no differences in the direction of the participant’s face when looking at the interaction partner, although eye movements could have occurred in the absence of head movements.

Video based methods of inferring attention were also used by Farabee, Holcom, Ramsey and Cole (1993) who asked participants to deliver a speech to two prerecorded confederates. High social anxiety participants were reported by two independent observers to have gazed towards confederates for shorter durations but not with less frequency than low social anxiety participants. However, when confederates disagreed with the participant's point of view, high social anxiety individuals looked less frequently and for less time towards them. Again this method was crude in terms of measuring visual attention because it relied on the subjective observations of two observers. Furthermore, whilst these studies used different facial expressions as stimuli, this may provide limited information regarding how socially anxious people interact with an audience because facial expressions do not occur in isolation. Rather, they may at times be accompanied by gestures that may also indicate social approval or disapproval.

Attention and online interpretation biases with audience gestures.

Gesture processing has been associated with cortical areas associated with functions other than face processing, such as object perception and social cognition (Flaisch, Schupp, Renner & Junghöfer, 2009). Therefore, it may operate independently from face processing. This means that in a real social performance or interaction situation gestures may attract attention in socially anxious individuals in a way that static face paradigms cannot capture. Veljaca and Rapee (1998) included gestures in a study in which they asked participants to deliver a five minute speech to the experimenter and two confederates. Confederates were each trained to exhibit positive and negative behaviours, which had been independently rated for intensity. During the speech, participants were asked to indicate by way of a two manual button-press devices when they noticed a positive or negative behaviour.

High social anxiety participants were significantly better at detecting negative behaviours whilst low social anxiety participants were better at detecting positive behaviours. Veljaca and Rapee (1998) concluded that this was due to socially anxious participants allocating more attention to negative external cues. However, the high social anxiety group was more liberal in the criteria that they accepted to constitute a negative response since they interpreted more types of behaviour as being negative than did low social anxiety participants. Therefore, it is difficult to draw any firm conclusions regarding their allocation of attention because in the absence of direct measures of attention, it could be argued that socially anxious participants may have simply been more likely to perceive the social cue as negative rather than attending more towards negative gestures or facial expressions. If a socially anxious individual perceives a facial expression to be more socially threatening then they may experience a keener awareness of the facial expression than an individual who is paying equally as much attention to it but is less threatened by the meaning of the expression, or who reads less into the meaning of it.

Therefore, the reported observations of audience negative and positive social behaviours in the Veljaca and Rapee speech study may have indicated higher awareness of the social cue because of a more liberal interpretation of what constitutes an evaluative response rather than because of increased visual attention to the cue. It is possible that high social anxiety participants were more aware of negative social cues because they expected to see them.

Perowne and Mansell (2002) combined the methods from Veljaca and Rapee (1998) and Pozo et al. (1991). Participants were asked to perform a three minute speech in front of a panel presented on a video screen. They were told that the screen facilitated a live link to a judging panel in a different room while they were being filmed. They were also told that they would have an opportunity to meet the panel afterwards to further discuss their performance. Confederates were assigned a specific behaviour which was evenly distributed across the audience. Participants were asked to perform their speech and told that their social and public speaking skills would be evaluated. Post-task, participants were shown a neutral identity photo of each confederate and asked to rate on an 8 point Likert scale how much they thought that each had enjoyed the speech. They also completed a forced choice task for the most observed valence of behaviours for each confederate.

Six confederates who were featured in the videos (half male; half female) were allocated a set of negative, positive or neutral behaviours with each confederate behaving consistently only in a positive, negative or neutral manner. Confederates who displayed negative behaviours included actions such as, ‘yawning’ and ‘looking at watch’, indicating boredom as well as a ‘look of disbelief’ and ‘shaking head’ indicating disapproval in addition to ‘attempting to talk to neighbour’ and a ‘long look around the room’ indicating boredom and distractibility. Positive behaviours for selected confederates included, ‘leaning forward’ and ‘making notes’, which may indicate interest in the content of the speech. Other positive behaviours included ‘smiling’, ‘nodding in agreement’, ‘nodding in acknowledgement’ and ‘pointing in agreement’, all of which indicate social approval. Neutral behaviours included, ‘scratching head’ and ‘adjusting seating position’ as well as ‘playing with a pen’, ‘squinting’, ‘looking briefly around the room’ and finally, ‘rubbing eyes briefly’.

Results indicated that high social anxiety participants interpreted the audience more negatively on the whole. Moreover, the high social anxiety group selectively identified audience members who displayed negative behaviours while the low social anxiety group identified the panel members who had acted positively. There were no significant group differences in number of behaviours across valences, although both positive and negative behaviours were recalled overall more than neutral behaviours. These results conflict with the findings of Veljaca and Rapee (1998) whereby high anxious participants had discriminated more negative behaviours while low anxious ones discriminated against positive ones. This may be because whilst Veljaca and Rapee (1998) measured online biases, Perowne and Mansell (2002) measured memory dependent offline biases since ratings were taken after the performance rather than during it. Participant numbers in each group were also low in this study with only 10 in each group, which means that individual differences in the sample may have influenced the results. However, the greater identification of negative confederates in the high social anxiety group lends some support to the Rapee and Heimberg model (1997).

More recently, Kanai et al. (2009) measured interpretations in a four minute speech task with high and low anxious participants. Speeches were performed to an opposite sex senior student confederate who displayed standardised behaviours every ten seconds for five seconds with each being repeated five times. These included 'scratching head', 'running fingers through hair' and 'clearing throat'. Participants were videoed during the task and state anxiety measures were taken at the beginning of the session, after being informed that they would be giving a speech, after a three minute preparation period and after the speech task. They were asked to rate how much from 0-100 they had consciously observed behaviours and to record interpretations in closed and open questions. They were asked to record their interpretations of the social cues in writing and rate them for emotionality and threat of behaviours on a 7 point Likert scale. Open responses were coded as negative, neutral or unclassifiable and coders were also asked to rate them for threat content.

State anxiety was elevated for both groups during the speech task, however, there were no differences in subjective observations of behaviours but high social anxiety participants interpreted social cues more negatively than those from the low social anxiety group. It is important to note though that this was in relation to the degree of valence negativity rather than in the number of negative interpretations. Furthermore, low anxious participants made significantly more neutral interpretations than high anxious participants in open ended questions. As described in the introduction, non-socially anxious individuals are thought to demonstrate a benign or positive on-line inferential bias, in which they pair non-socially threatening or positive causal attributions with ambiguous social information resulting in a positive appraisal of the situation. Results from Kanai et al (2009) described above suggests the presence of a cognitive negativity bias and a deficit in the benign bias in the high anxiety group, since despite no apparent differences in attention, the high social anxiety group inferred a more negative interpretation of the social cues and also recalled less neutral information than their less anxious counterparts. However, the latter effect was no longer significant after controlling for depression. Since these decisions were made post task (i.e. offline) it is not clear whether a negative interpretation bias was constructed online or offline and no measures of attention were taken during the task.

van Gaal and Fahrenfort (2008) reviewed literature on the relationship between visual attention and awareness and suggested that different neural processes may underpin each of these. Certainly evidence from change blindness experiments in which a viewer attends to a location but is unaware of a visual change occurring highlights the difference between these processes (Lamme, 2003). In such cases attention may be evident at a neural level but conscious experience may not be reported. Conversely, neural activity related to awareness has been found to occur at an onset of around 100ms prior to visual attention (Wyart & Tallon-Baudry, 2008). This could potentially lead to a higher awareness of the significance of a facial expression or gesture if it is perceived to be self-relevant even during the briefest period of attention to it. Thus, reduced attention may not indicate reduced awareness of a social cue.

In summary, the Rapee and Heimberg (1997) model of social anxiety asserts that when confronted by a socially threatening situation, socially anxious individuals pay attention to the external environment. This takes the form of detecting signs of social threat from facial expressions and/or gestures as well as diverting some attention towards imagining their performance in a negative way. However, Heimberg, Brozovich and Rapee (2010) argue that attentional patterns depend upon the expectations of the socially anxious performer who may adopt a vigilant or avoidant attentional pattern depending on their prior expectations of the social threat. Yet differences in attention to signs of social threat across social anxiety groups have predominately been conducted using static face paradigms.

Schultz and Heimberg (2008) suggested that a speech paradigm, in which participants must deliver a social performance in front of an audience, may be a more ecologically valid means of testing attentional biases to threatening social cues because it represents a closer simulation of the feared situation for socially anxious individuals. A number of speech paradigms have been conducted but all without any direct measures of attention. Results from these studies suggest that socially anxious individuals interpret audience evaluation of their performance in a more negative light than less anxious individuals but whilst some inferences have been made about the reason for this, including differences in attention to the audience, no firm conclusions can be made regarding the assumptions of the Rapee and Heimberg (1997) model in respect of vigilant attention to social threat cues without direct attention measures.

Therefore, in social performance situations there is currently no clear evidence to make the claim that interpretative biases are associated with attentional biases to social threat cues such as negative facial expressions and/or negative audience gestures. Furthermore, it is not clear whether any emergent attentional biases would be influenced by the degree of social threat elicited by the situation as Heimberg and Schultz (2008) suggested that negative biases should be reduced by a less critical audience.

Study 5 Performance related visual attention and awareness of social evaluative cues in social anxiety

The aim of the current study was to test whether there was any evidence of attentional biases in an ecologically valid paradigm by measuring visual attention to a videoed audience during a speech task. The study improved upon previous studies by employing a direct measure of attention through the use of eye-tracking. The study also addressed whether this operates independently of online interpretative biases that were measured by asking participants to note by a keypad response each time they noticed a positive or negative audience response to their performance.

Further to these aims, the study was designed to address the question of the way in which the perceived level of social threat may impact on attentional and/or interpretative biases in social anxiety by including a positive feedback condition aimed at decreasing the level of social threat in comparison to a neutral feedback condition. A final aim of the study was to assess the prevalence of a negative offline interpretative bias (i.e. after the performance) in a high social anxiety group.

In order to test attentional and interpretative processes in social anxiety using an ecologically valid paradigm the current study has been based on previous speech studies with several modifications. Participants underwent a mock job interview with 18 questions posed by the experimenter over two blocks. Between blocks participants were given a break where they were given either positive or neutral audience feedback (i.e. told that the audience were impressed with their performance and that any seemingly negative responses were not due to the performance) or that an audience member had to step out and would return shortly. This feedback was intended to be used to prime responses in the second testing block by lowering the social threat for one half of the participants (i.e. those who received positive/non-threatening feedback on their performance).

Participants directed each of their responses to an audience panel presented remotely on a screen. The panel, which participants were told would be evaluating their performance, comprised six confederates displayed in a matrix of boxes (representing separate booths where confederates were filmed). In each box a video clip was presented with a single panel member displaying either a positive, negative or neutral social cue each four seconds whilst all other panel members remained virtually static with a neutral facial expression. Each of these video clips comprised one experimental trial.

Attention of participants to each of the boxes containing a panel member was measured during the performance by tracking eye movements to each of the boxes containing an individual panel member. In order to measure awareness of social cues and thus assess the existence of an online negative interpretative bias in the high social anxiety group, participants were asked to note by a keypad response each time they noticed a seemingly positive or negative response from an audience member to their performance. The key pressed and response times for key presses were measured.

Heimberg and Schultz (2008) suggested that negative biases should be reduced by a less critical audience and Heimberg, Brozovich and Rapee (2010) found that positive self-images improved self-esteem in contrast to negative self-images which decreased self-esteem in socially anxious individuals. Therefore, the study was conducted over two blocks with positive feedback being provided to one half of the participants prior to block 2 and neutral feedback being provided to the other half. The blocks were then analysed as two separate tasks. It was reasoned that with neutral feedback the social threat would be high because of self-generated negative expectations regarding the audience evaluation and the participant’s future performance in the high social anxiety group but with positive feedback, the social threat would be low because participants would know that the audience had evaluated their performance positively (i.e. less critically) in the first block.

A reflective component was also included in the paradigm to measure offline interpretations of social cues. Post-task interpretations of their own performance and of their expectation of the audience evaluation were taken in order to gauge whether online interpretation of social cues (i.e., during the task) matched offline interpretations (i.e., after the task). This was achieved by asking participants to rate how good the quality of the performance was and how much they thought that the panel had rated their performance by a key press response.

Rationale for the procedural aspects of the study were based on the strengths and weaknesses of previous studies. For example, in the interests of using standardised stimuli as Pozo et al. (1991) did, participants were told that they would be performing to a live panel via a web link but in fact the panel was pre-recorded and each positive, negative or neutral behaviour was pre-rated for valence. Similarly to Veljaca and Rapee (1998) interpretations of social cues were made online (during the task) rather than after the task (i.e. Pozo et al., 1991; Perowne & Mansell, 2002). There are drawbacks and benefits to taking this approach. Perowne and Mansell legitimately criticised the approach taken by Veljaca and Rapee (1998) on the grounds that asking participants to detect positive and negative behaviours during the task may interfere with their natural attention.

However, although it is acknowledged that the attentional patterns to social cues may in fact be influenced to some degree by this requirement, it was decided that given that one of the primary aims of the study was to investigate the relationship between attentional and cognitive biases to negative social cues, the benefit of gaining a real time measure of interpretation warranted a similar approach to that taken by Veljaca and Rapee (1998). However, in an attempt to mitigate some of the potentially confounding effects of recording subjective observations of audience evaluation on attention, participants were instructed to only note signs of positive and negative evaluation from the panel that happened to catch their attention rather than to look for these explicitly.

Several hypotheses were generated in respect of attention; awareness and reflection. In spite of the predictions of Rapee and Heimberg (1997) model of social anxiety which suggest that socially anxious individuals selectively scan for signs of social disapproval, Daly et al. (1989) found that audience confederates observed high social anxiety individuals as maintaining less eye-contact with the audience during a speech task. Furthermore, Farabee et al. (1993) found that when audience members disagreed with participants on their point of view during a speech task, high social anxiety individuals were observed to look less frequently at confederates and for less time towards them. It is possible that this pattern could represent a vigilant-avoidant pattern of attention since other speech studies (i.e. Veljaca & Rapee, 1998; Perowne & Mansell, 2002) found that socially anxious groups detected negative behaviours more than less anxious groups. However, at this stage this is speculative and since Daly et al. (1989) and Farabee et al. (1993) are the only speech tasks identified that have attempted to measure attention, albeit subjectively, the hypotheses for attention have been based on an avoidant pattern of attention. Thus, it was hypothesised that:

I. *Attention to social cues*:

   i. In block 1, the high social anxiety group compared to the low social anxiety group would display fewer fixations to all boxes containing a panel member displaying a social cue, but more so for those displaying negative social cues. In contrast, it was predicted that boxes displaying positive social cues would elicit more fixations from the low social anxiety group relative to the high social anxiety group. Reduced fixations to all social cues would provide support for the Clark and Well's (1995) model but reduced fixations to negative social cues only would provide support for the Rapee and Heimberg (1997) model since on-going engagement with negative social cues in a repeated pattern would be required to precipitate a vigilant-avoidant pattern of attention,

ii. In block 2 when feedback had been given these differences for the proportion of fixations to boxes containing a social cue would only be apparent between the high social anxiety and low social anxiety groups who received neutral feedback (high social threat) about their performance in block 1. However, there would be no differences in proportion of fixations to boxes containing a social cue between the high social anxiety and low social anxiety groups where participants received positive feedback (low social threat) in line with predictions of the Rapee and Heimberg model.

iii. In block 1, the high social anxiety compared to the low social anxiety group would have decreased dwell time to all boxes containing a panel member displaying a social cue, but more so for those displaying negative social cues. In contrast, it was predicted that boxes displaying positive social cues would be fixated for longer by the low social anxiety group relative to the high social anxiety group. Again reduced dwelltime to all social cues would provide support for the Clark and Well's (1995) model but reduced dwelltime to negative social cues only would provide support for the Rapee and Heimberg (1997) model.

iv. In block 2 differences in the proportion of dwell time to boxes containing a social cue would only be apparent between the high social anxiety and low social anxiety groups who received neutral feedback (high social threat) about their performance in block 1 before completing block 2. However, there would be no differences proportion of dwell time to boxes containing a social cue between high social anxiety and low social anxiety groups where participants received positive feedback (low social threat) in line with predictions of the Rapee and Heimberg model..

II. *Online perception and interpretation of social cues*: In light of the results of Veljaca and Rapee (1998) that high social anxiety individuals have an enhanced awareness of negative social cues, it was predicted that:

i. In block 1 the high social anxiety group would be more aware of social gestures, particularly negative social cues such as a panel member frowning or shaking their head, than the low anxiety group. This would support the Rapee and Heimberg (1997) model of social anxiety.

ii. In block 2 these differences would only be apparent for the high social anxiety group who received neutral feedback compared to the low social anxiety group who also received neutral feedback whilst there would be no differences between anxiety groups where participants received positive feedback.

III. *Reaction time to categorise social cues:* Furthermore, in line with the findings of Mullins and Duke (2004) that a very high socially threatening situation can slow processing speeds in socially anxious individuals, it was predicted that:

   i. The high social anxiety group would process threatening social cues more slowly in the first block. This would be indicated by a longer delay before indicating that a negative behaviour had been observed in each trial that a negative key press was made.

   ii. This effect would be attenuated by the positive feedback condition (low social threat).

IV. *Offline interpretation of social cues*: Based on the findings of Perowne and Mansell (2002), Kanai et al. (2009) that high social anxiety participants have negative offline interpretations of the audience response to their performance, it was predicted that the high social anxiety group would have post-task:

   i. Lower-self evaluative ratings than the low social anxiety group in block 1.

   ii. Lower ratings for perceived audience evaluation in block 1.

   iii. Self-evaluative ratings would be mediated in block 2 by feedback type such that positive feedback (low social threat) would reduce any differences between social anxiety groups in respect of how they evaluated their own performance.

iv. Furthermore, ratings for perceived audience evaluation would be similarly mediated in block 2 by feedback type.

These predictions would be in line with predictions of the Clark and Well's (1995) and Rapee and Heimberg (1997) models.

Method

Participants

170 Participants were recruited to complete the online survey but of these only 92 were willing to complete the experimental stage. One participant was withdrawn because it transpired that she was being treated for clinical depression. Another was withdrawn because she had a diagnosis of Asperger's syndrome. One more participant was withdrawn because of an equipment failure during the experiment. Therefore data from 89 participants were analysed. Participants were recruited through the University of Strathclyde's virtual learning environment; posters displayed around the campus and local businesses; local classified ads and community websites.

Participants were initially invited to participate in return for being entered into a draw for a £50 prize, a £5 Amazon voucher or a credit (for undergraduate students). The sample size for the experimental phase was based on other eye-tracking and social anxiety studies (e.g. Derryberry & Reid, 2002; Wieser et al., 2009). Inclusion/exclusion criteria and ethical approval was based on the same protocol as the previous eye tracking studies.

Participants were split into high (32), moderate (27) and low (30) anxiety groups based the third percentile of scores (i.e. Guastella, Carson, Dadds, Mitchell & Cox, 2009; Silvia et al, 2007). The moderate social anxiety group was added to act as a control group. The 17 item Social Phobia inventory (SPIN) (Connor, Davidson, Churchill, Sherwood, Foa & Weisler, 2000) was added as an additional measure of social anxiety. Current negative mood and anxiety were measured by administering the self-report 21 item self-report Beck Depression Inventory II (Beck et al., 1961) and Beck Anxiety scale (Beck, Epstein, Brown & Steer, 1988) respectively. To include a measure of self-focused attention, which as Heimberg, Brozovich & Rapee (2010) suggested is increased in socially anxious participants during a social performance situation, the Private & Public Body Consciousness Scale (Miller, Murphy & Buss, 1981) scale was also included.

The sample was comprised of 51 females and 38 males participants but a 2x3 Chi² test showed that the gender was equally distributed across the three groups, χ^2 (2) = 2.83 , p = 0.24. Participant's ages ranged from 17 to 60 and years of education ranged from 12 to 24 years. A series of one way ANOVAs were conducted for age, education, BFNE, SPIN, BDI, and BAI scores. Main effects and Bonferroni post-hoc significance values are presented in Table 5.1.

Table 5.1

Participant characteristics

Variable		HSA		MSA		LSA		*F*	*p*	HSA LSA	HSA MSA	MSA LSA
		M	SD	M	SD	M	SD					
BFNE	*M*	30.94	3.06	23.52	1.7	16.16	3.27	167.21	<0.001	<0.001	<0.001	<0.001
SPIN	*M*	28.56	10.72	20.52	10.32	11.47	8.0	23.77	<0.001	<0.001	0.01	0.01
BCS	*M*	33.5	10.1	31.85	10.54	30.03	12.06	0.78	0.46			
BDI-II	*M*	12.13	8.81	8.96	5.21	6.67	7.5	4.23	0.02	0.02	0.32	0.74
BAI	*M*	12.47	9.47	9.22	7.83	6.23	6.32	4.69	0.02	0.01	0.38	0.49
Age	*M*	24	2	30	2	28	2	3.6	0.04	0.32	0.09	1
Education	*M*	16.66	2.63	16.51	3.27	16.57	2.81	0.02	0.98			

BFNE, Brief Fear of Negative Evaluation Scale (short form); SPIN, Social Phobia Inventory, BCS, Private & Public Body Consciousness Scale, BDI-II, Beck Depression Inventory-II, BAI, Beck Anxiety Inventory. Welch tests were used for Age and BFNE scores as Levene's tests were significant.

Participants in each of the groups were no different in terms of gender, age, education or body consciousness across the three groups but were reliably differentiated on social anxiety measures. The lack of group differences for body consciousness suggests that the high social anxiety group were no higher in self-focused attention than the low social anxiety group. However, again as found in the previous two chapters, the high social anxiety group also had higher scores than the low social anxiety group for both depression and general anxiety.

Design

A series of mixed ANOVAs were conducted separately for each block. Block 1 was analysed using a series of 2 x 3 ANOVAs with anxiety as the between subjects variable (high; moderate; low) and clip valence (positive; negative; neutral) as the repeated measures factor. Block 2 was analysed using a series of 2 x 3 x 3 mixed ANOVAs with 2 between groups factors: Group (HSA; MSA; LSA) and prime (positive self-affirming prime or neutral prime) and 1 repeated measures factor: clip valence (positive; negative; neutral). These were conducted for each dependent variable; (i) Proportion of fixations to each box containing a panel member who is displaying a dynamic behaviour (positive, negative or neutral) relative to boxes containing a panel member who was displaying a still neutral behaviour; (ii) Proportion of dwell time to each box containing a panel member who is displaying a dynamic behaviour relative to boxes containing a panel member who was displaying a still neutral behaviour; (iii) Proportion of observed behaviours to each box containing a panel member who is displaying a dynamic behaviour relative to boxes containing a panel member who was displaying a still neutral behaviour (indicated by a positive or negative key press response). (iv) Reaction time to indicate that a positive or negative behaviour had been observed.

Materials, apparatus and stimuli

Interview schedule

The study deviated from previous speech studies discussed by asking participants to talk about themselves rather than a general topic. The purpose of this was to heighten self-consciousness. Rather than using a speech task on a random topic a job interview was used as the format for the social performance. Job interviews are more personally relevant than speaking about a general topic. They also entail more personal evaluation by the interviewer. In addition, job interview tasks have been found to induce situational stress (Henning, Netter & Voigt, 2001). Furthermore, by splitting the task into a series of questions and short answers, there was more likelihood that participants would be able to keep talking over the duration of the whole task than if they were simply asked to talk about a topic for ten minutes. Participants were given only approximately 30 seconds to answer each question. This meant that the duration of speech could be controlled at regular intervals, which enhanced the likelihood of participants being able to maintain a response to each question over a period of six trials before pausing before the next question so that a drift correct could be performed. The interview consisted of 36 questions which had been collated from five different job sites (Appendix V).

Video images

Video clips prepared for Study 4, described in Chapter 5, were used to form montages of six video clips presented together for each experimental trial. Data from the first 27 participants who completed Study 4 were used to validate the clips to be used in Study 5. This constituted approximately a third of the sample. Details of the construction and validation of the video stimuli are provided in Appendix VI, which shows that each clip valence (i.e. positive, negative and neutral) was reliably rated according to the intended valence that it was designed to convey.

Video montages were presented on a ViewSonic G90ft 19 inch colour monitor attached to a Phillips personal computer controlled by SR Research Ltd. Eyelink software. The program that controlled the software was designed in-house. A web camera was mounted on top of the monitor so that it was highly visible to participants. The on screen panel who participants were told would be evaluating their performance was comprised of six confederates displayed in a matrix of boxes containing six individual video clips measuring 424 x 236 pixels each (Figure 5.1).

Figure 5.1 *Example video configuration of interview panel (in this case all displaying neutral social cues).*

During each four second trial for a total of 108 trials in each experimental block, a single panel member displayed a positive, negative or neutral social cue whilst all other panel members remained virtually static with a neutral facial expression. Social cues and presentation times were replicated from Perowne and Mansell (2002) and were based on the stimuli prepared from Study 4 (Appendix VI)

Behaviours and presentation times were replicated from Perowne and Mansell (2002). The negative behaviours were: 1) yawning; 2) looking at watch; 3) look of disbelief; 4) shaking head; 5) talking to neighbour and a 6) long look around the room. Positive behaviours comprised: 1) leaning forward; 2) smiling; 3) nodding in agreement; 4) making notes; 5) pointing in agreement and 6) nodding in acknowledgement. These were accompanied by the appropriate facial expressions, such as frowning, looking dismissive, disinterested, and bored to accompany negative gestures and smiling/looking interested for positive gestures. The neutral behaviours included were: 1) scratching head; 2) adjusting seat; 3) playing with pen; 4) squinting; 5) briefly looking around room and 6) rubbing eyes. Rather than actors being assigned with positive or negative behaviours, behaviours were randomised across the entire panel and the location of the panel members was also randomised. This minimised any preferential attention based on salient characteristics of particular actors (i.e. hair colour, age, etc.) or screen location.

Each actor displayed a different type of behaviour once for 18 trials, meaning that each actor appeared displaying either a positive, negative or neutral behaviour at each location on the screen. A neutral filler clip appeared in 90 trials (with each filler appearing 15 times across locations not occupied by the dynamic clip in each trial).

A Latin square design was used to ensure that for each valence, each of the six actors and six behaviour types appeared once in every location. This yielded 108 trials for each block. The pattern was stable across valance types in order to provide optimal standardization across valence measures. Areas of interest were built into the experiment by drawing a rectangular resource round each video clip box and then standardising the size and location of each to fit perfectly around the boxes which measured 424 x 236 pixels each.

Procedure

Prior to commencing the experiment, participants were asked to read the participant information sheet and sign the consent form before completing the questionnaires. The BFNE II (Carleton et al., 2007) was completed online, delivered via Qualtrics survey provider, and consent was obtained by clicking on a consent box before the participant was able to proceed to the next stage of the experiment. Participants were then asked to attend the University to complete the experimental phase of the study.

Before commencing the experimental task, participants were asked to complete the Social Phobia inventory (SPIN); Beck Depression Inventory II; Beck Anxiety Inventory and the Body Consciousness Scale. Questionnaires were administered prior to the task because of the potential effect of the task priming responses. Following questionnaire completion, participants were told that they would be asked to participate in an interview in front of a live panel who would be evaluating their performance. Participants were given the opportunity to prepare for the interview by having a look at the interview schedule for a period of five minutes.

This preparation period was added in order to increase the likelihood that participants would be able to fill the 30 second time slot available to deliver their answer to the panel.

Participants were then seated 57cm from the monitor and wore a lightweight headset comprising a head camera and two eye cameras placed just below the eyes. Eye-movements were recorded using the SR Research Ltd. Eyelink II system using pupil centre at 500Hz. Prior to the task commencing, the experimenter switched on the web camera, which unknown to the participant did not actually connect to the web. The participant was shown their own image in the web camera briefly in order that they would believe that there was a live video connection to the panel.

Following this, a nine-point calibration sequence was conducted by recording participants' gaze while they fixated on a black central point in a white fixation dot with a diameter of 0.5˚ presented on a black screen and by thereafter tracking their gaze as they followed the dot sequentially around the nine grid points on the screen. Successful calibration was followed by a repetition of the process during the validation stage.

It was originally intended that a drift correct screen would be presented before the video clips on each trial. However, at the testing stage it become apparent that the demands of speaking whilst monitoring the panel for positive and negative behaviours and being distracted by the onscreen behaviours resulted in difficulties for participants in being able to accurately fixate on the drift correct central fixation point every four seconds between trials. As a result, a drift correct was scheduled after every six trials for a total of 18 over the course of each of the speech tasks. These intervals provided an opportunity to have the participant focus more on the fixation point as the experimenter paused to ask a question from the interview schedule. This also enabled the participant to have regular prompts to help them generate speech for the task.

During the speech task participants were asked to wear a rubber swim cap under the EyeLink II headset. The purpose of this was to minimise slippage of the headband as they were talking in order to maximize the quality of the eye movement data. Participants were asked to imagine that they were taking part in a real job interview and that their performance would be visually and verbally recorded by a webcam and sound recording equipment via a live web link to a judging panel of six performance evaluators. In order to guard against detected differences in seating or lighting positions and to retain the feel of 'real' judges, it was explained to participants that each of the judges would be seated in a separate booth in the building and that another experimenter was looking after them.

Furthermore, it was explained that the images of each judge would be displayed at a particular location for a few seconds before there would be a screen change with the locations of each identity being randomly reallocated a new location. In addition, participants were told that there was a time lag on the video link so that the visible responses from the judges may not match the participant's performance and that this may mean at times that judge's visible responses were still visible even once the participant had ceased their verbal response. After completing each block, participants were asked to rate how good the quality of the performance was and how much they thought that the panel had rated their performance by Likert scale key press responses ranging from 1(very poor) to 8 (very good).

Eye movement data preparation

Data were analysed using SR Research Ltd. Data Viewer 1.9.1. Analysis was conducted separately for each block of the experiment. Eye movements were analysed in a series of mixed ANOVAs with two between group factors in block 1 including one between groups anxiety factor with three levels (high; moderate; low) and one repeated measures factor with three levels : valence (positive; negative; neutral). In block 2, two between groups factors included feedback type with two levels (positive/neutral) and anxiety with three levels (high/moderate/low). Clip valence (positive; negative; neutral) was again the repeated measured factor with three levels.

Dependent variables for eye-movements were the proportion of fixations and proportion of dwell time to each defined area of interest (AOI) where a dynamic social cue had occurred, relative to fixations elsewhere on the screen. Proportions of fixations and dwell time used rather than fixation counts (i.e. total number of fixations to AOI) or dwell count (i.e. total amount of time spend on AOI) because the number of fixations in each AOI relative to fixations in non-AOIs areas changed between trials, so using a proportion measure provided a more standardised measure.

It was considered to be important to measure attention over the entire trial as measuring initial orienting to clips types cannot reliably assess differences between social gestures. This is because whilst latency data or peak velocity of saccade towards a static object is controlled, it was not possible to distinguish which part of the social gesture attracted initial orienting of attention. Manual responses for observed positive and negative social cues were calculated as a percentage of trials that a key press was registered where a dynamic clip had been attended to. Self-evaluation of performance and expected audience evaluation of performance was measured post task by key press response.

Results

Hypothesis I(i): Visual attention to social cues in Block 1 for proportion of fixations

It was hypothesised that high social anxiety compared to low social anxiety participants would have fewer fixations to all boxes in which a panel member was displaying a social cue but more so for those displaying negative social cues. In contrast, it was predicted that positive faces would be fixated to more by the low social anxiety group relative to the high social anxiety group. Therefore, a significant main effect of anxiety group and a significant anxiety group x clip valence interaction would be anticipated.

Descriptive statistics (Table 5.2) suggested that overall a slightly higher proportion of fixations were made to emotional compared to neutral clips and that the high social anxiety group had a slightly higher proportion of fixations towards negative and neutral clips and slightly lower proportion of fixations towards positive clips compared to the low social anxiety group.

Table 5.2

Mean proportion of fixations across clip valence and anxiety: block 1

Clip	Anx	*M*	*SD*
Neg	High	0.32	0.06
	Mod	0.31	0.07
	Low	0.30	0.08
	Total	0.31	0.07
Neut	High	0.31	0.07
	Mod	0.30	0.06
	Low	0.30	0.09
	Total	0.30	0.07
Pos	High	0.31	0.06
	Mod	0.32	0.06
	Low	0.32	0.10
	Total	0.31	0.07

Kolmogorov-Smirnov tests suggested that the data was not normally distributed for the low social anxiety group for neutral clips *k-s* (30) = 0.17, $p = 0.04$ and positive clips *k-s* (30) = 0.18, $p = 0.01$ and for the high social anxiety group for positive clips *k-s* (32) = 0.17, p = 0.02. However, Mauchly's test indicated that the assumption of sphericity could be assumed (χ^2 (2) = 0.14, $p = 0.93$) and Levene's tests were all non-significant ($p > 0.52$). Thus, homogeneity of variance was assumed and there were approximately equal numbers in each group.

A 3 x 3 mixed ANOVA with one between group factor: anxiety (high; moderate; low) and one between group factor: clip valence (negative; neutral; positive) failed to reveal a significant main effect of clip valence, $F(2,172) = 2.29$, $MSE = 0.01$, $p = 0.1$, $\eta_p^2 = 0.03$ *Power* = 0.46. More importantly in terms of the hypothesis, there was no significant main effect of anxiety group, $F(2,86) = 0.1$, $MSE = 0.01$, $p = 0.91$, $\eta_p^2 = 0.02$ *Power* = 0.06 or a significant anxiety x clip valence interaction, $F(4, 172) = 1.94$, $MSE = 0.01$, $p = 0.11$, $\eta_p^2 = 0.04$ *Power* = 0.58.

Therefore, the hypothesis for avoidant attentional biases in the high social anxiety group was not supported.

Hypothesis I(ii): Visual attention to social cues in Block 2 for proportion of fixations

It was predicted that in block 2, fewer fixations would only be apparent for the high social anxiety group who received neutral feedback (high social threat) whilst there would be no differences between groups where participants received positive feedback (low social threat). Therefore, a significant feedback x anxiety group interaction and feedback x anxiety group x clip valence interaction was expected.

Descriptive statistics for block 2 (Table 5.3) suggest that overall there was a higher proportion of fixations made to emotional clips compared to neutral clips. The high anxiety group appeared to have a slightly higher proportion of fixations towards all dynamic social cues but there did not appear to be a clear pattern regarding the effect of feedback across each of the groups.

Table 5.3

Mean proportion of fixations across clip valence, anxiety and feedback : Block 2

Clip	Anx	Feedback	*M*	*SD*
Neg	High	Pos	0.33	0.07
		Neut	0.33	0.07
		Total	0.33	0.07
	Mod	Pos	0.34	0.10
		Neut	0.32	0.07
		Total	0.33	0.08
	Low	Pos	0.31	0.13
		Neut	0.33	0.08
		Total	0.32	0.11
	Total	Pos	0.33	0.10
		Neut	0.33	0.07
		Total	0.33	0.09
Neut	High	Pos	0.30	0.10
		Neut	0.33	0.07
		Total	0.32	0.09
	Mod	Pos	0.32	0.10
		Neut	0.29	0.08
		Total	0.30	0.09
	Low	Pos	0.29	0.11
		Neut	0.32	0.07
		Total	0.31	0.09
	Total	Pos	0.30	0.10
		Neut	0.32	0.07
		Total	0.31	0.09
Pos	High	Pos	0.33	0.06
		Neut	0.34	0.06
		Total	0.34	0.06
	Mod	Pos	0.32	0.08
		Neut	0.32	0.08
		Total	0.32	0.08
	Low	Pos	0.32	0.13
		Neut	0.34	0.07
		Total	0.33	0.10
	Total	Pos	0.32	0.09
		Neut	0.33	0.07
		Total	0.33	0.08

Kolmogorov-Smirnov tests suggested that the data was not normally distributed for the moderate anxiety group for neutral trials *k-s* (27) = 0.19, $p = 0.01$. However, Mauchly's test indicated that the assumption of sphericity could be assumed (χ^2 (2) = 2.37, $p = 0.31$) and Levene's tests were all non-significant ($p >$ 0.64) suggesting that sphericity and homogeneity of variance could be assumed.

A 2x3x3 mixed ANOVA with two between group factors: Feedback (positive; neutral) and anxiety group (high/moderate/low) and one between group factor: Clip valence (negative/neutral/positive) revealed no significant main effects of anxiety, $F(2,83) = 0.85$, $MSE = 0.02$, $p = 0.85$, $\eta_p^2 = 0.01$ *Power* = 0.07 or feedback $F(1,83) = 0.19$, $MSE = 0.02$, $p = 0.19$, $\eta_p^2 = 0.01$, *Power* = 0.07. The anxiety group x clip valence was non-significant, $F(2,166) = 0.71$, $MSE = 0.01$, $p =$ 0.59, $\eta_p^2 = 0.02$, *Power* = 0.23 as was the anxiety group x feedback interaction, $F(2,83) = 0.49$, $MSE = 0.01$, $p = 0.61$, $\eta_p^2 = 0.01$, *Power* = 0.13 and the clip valence x feedback interaction, $F(2,166) = 0.8$, $MSE = 0.01$, $p = 0.45$, $\eta_p^2 = 0.01$, *Power* = 0.19. The anxiety group x clip valence x feedback interaction was also non-significant, $F(4,166) = 0.65$, $MSE = 0.01$, $p = 0.63$, $\eta_p^2 = 0.02$, *Power* = 0.21, which means that the hypothesis was again not supported.

However, there was an unexpected significant main effect of clip valence, $F(2,166) = 7.08$, $MSE = 0.01$, $p = 0.01$, $\eta_p^2 = 0.08$ *Power* = 0.93. Bonferroni pairwise comparisons revealed a significant emotion effect with negative clips (M = 0.33, SE = 0.01, $p = 0.01$) and positive clips (M = 0.31, SE = 0.01, $p = 0.01$) receiving a significantly higher proportion of fixations than neutral dynamic clips (M = 0.33, SE = 0.01) but no significant differences between these (p=1). This is illustrated in Figure 5.2 alongside the non-significant main effect of clip valence for block 1. This was likely to be due to the salience of the emotional social cues capturing more attention as participants start to get more used to the task as the pattern in the first block was similar but less pronounced.

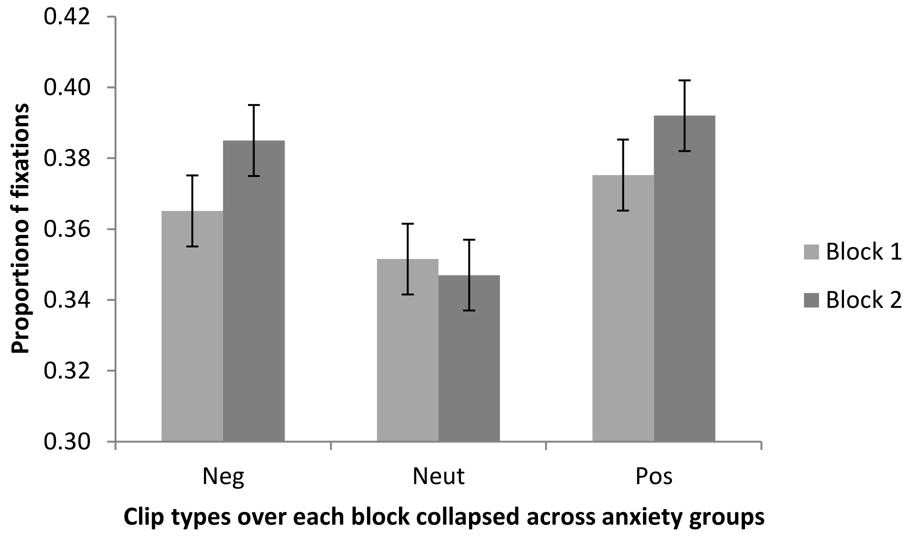

Figure 5.2 *Mean proportion of fixations to boxes displaying active social cues (bars denote standard errors)*

Hypothesis I(iii): Visual attention to social cues in Block 1 for proportion of dwell time

It was hypothesised that high social anxiety compared to low social anxiety participants would have decreased dwell time to all boxes in which a panel member was displaying a social cue, but more so for those displaying negative social cues. In contrast, it was predicted that positive faces would be fixated for longer by the low social anxiety group relative to the high social anxiety group. Therefore, a significant main effect of anxiety group and a significant anxiety group x clip valence interaction would be anticipated.

Descriptive statistics (Table 5.4) suggested that the high social anxiety group fixated for longer towards negative and neutral clips and less towards positive clips compared to the low social anxiety group.

Table 5.4

Mean proportion of dwell time across clip valence and anxiety: Block 1

	Anx	*M*	*SD*
Neg	High	0.38	0.07
	Mod	0.35	0.05
	Low	0.36	0.08
	Total	0.37	0.07
Neut	High	0.36	0.08
	Mod	0.35	0.07
	Low	0.34	0.06
	Total	0.35	0.07
Pos	High	0.36	0.08
	Mod	0.38	0.05
	Low	0.39	0.07
	Total	0.37	0.07

Kolmogorov-Smirnov tests suggested that the data was normally distributed and Mauchly's test indicated that the assumption of sphericity could be assumed (χ^2 (2) = 0.14, p = 0.93). Levene's tests were also all non-significant (p > 0.52). A 3 x 3 mixed ANOVA with one between group factor: anxiety (high/moderate/low) and one between group factor: clip valence (negative/neutral/positive) revealed a main effect of clip valence that approached significance, $F(2,72) = 2.79$, $MSE = 0.01$, $p = 0.06$, $\eta_p^2 = 0.03$ *Power* = 0.54.

Bonferroni post-hoc contrasts suggested that positive clips were fixated on for significantly longer (M = 0.38, SE = 0.01) than neutral clips (M = 0.35, SE = 0.01, p = 0.03) but not for longer than negative clips (p=1). There was no difference between negative and neutral clips (p=0.54) and again, crucially no significant main effect of anxiety, $F(2,86) = 0.001$, $MSE = 0.01$, $p = 1$, $\eta_p^2 = 0.001$ *Power* = 0.05 or significant anxiety x valence interaction, $F(4, 172) = 1.76$, $MSE = 0.01$, $p = 0.14$, $\eta_p^2 = 0.04$ *Power* = 0.53 was observed. This mimicked the proportion of fixation data from block 1 and again does not support the hypothesis for a reduction in attention to faces in the high social anxiety group.

Hypothesis I(iv): Visual attention to social cues in Block 2 for proportion of dwell time

It was predicted that in block 2, decreased dwell time would only be apparent for the high social anxiety group who received neutral feedback (high social threat) whilst there would be no differences between groups where participants received positive feedback (low social threat). Therefore a significant feedback x anxiety group interaction and feedback x anxiety group x clip valence interaction was expected.

Descriptive statistics for block 2 (Table 5.5) suggest that overall there was a higher proportion of dwell time to emotional compared to neutral clips and this appeared to have been slightly higher in the high anxiety group for neutral and positive clips although there appears to be no difference in attention to negative clips. Positive feedback appears to have increased the time spent attending to negative clips for the high social anxiety and moderate social anxiety groups but lowered proportion of dwell time to neutral and positive faces in the moderate social anxiety and low social anxiety groups.

Table 5.5

Mean proportion of dwell time across anxiety, clip valence and feedback: Block 2

Clip	Anx	Feedback	*M*	*SD*
Neg	High	Pos	0.40	0.06
		Neut	0.37	0.07
		Total	0.38	0.06
	Mod	Pos	0.42	0.08
		Neut	0.38	0.08
		Total	0.40	0.08
	Low	Pos	0.37	0.08
		Neut	0.38	0.08
		Total	0.37	0.08
	Total	Pos	0.40	0.07
		Neut	0.37	0.07
		Total	0.38	0.07
Neut	High	Pos	0.35	0.07
		Neut	0.33	0.08
		Total	0.34	0.07
	Mod	Pos	0.34	0.08
		Neut	0.37	0.05
		Total	0.36	0.06
	Low	Pos	0.32	0.06
		Neut	0.38	0.06
		Total	0.35	0.07
	Total	Pos	0.33	0.07
		Neut	0.36	0.07
		Total	0.35	0.07
Pos	High	Pos	0.39	0.07
		Neut	0.39	0.08
		Total	0.39	0.07
	Mod	Pos	0.39	0.07
		Neut	0.40	0.09
		Total	0.40	0.08
	Low	Pos	0.38	0.08
		Neut	0.39	0.06
		Total	0.39	0.07
	Total	Pos	0.39	0.07
		Neut	0.40	0.08
		Total	0.39	0.07

Kolmogorov-Smirnov tests suggested that the data was normally distributed and Mauchly's test indicated that the assumption of sphericity could be assumed (χ^2 (2) = 0.88, p = 0.65). Levene's tests were also all non-significant (p > 0.53). A 2 x 3 x 3 mixed ANOVA with two between group factors: Feedback (positive; neutral) and anxiety (high/ moderate/ low) and one between group factor: Clip valence (negative/ neutral/ positive) revealed no significant main effects of anxiety, $F(2,83) = 0.51$, $MSE = 0.01$, $p = 0.6$, $\eta_p^2 = 0.01$ *Power* = 0.13 or feedback $F(1,83) = 0.13$, MSE = 0.01, $p = 0.72$, $\eta_p^2 = 0.01$, *Power* = 0.07.

However, there was a significant main effect of clip valence $F(2,166)$ = 11.77, $MSE = 0.01$, $p < 0.001$, $\eta_p^2 = 0.12$, *Power* = 0.99. Bonferroni contrasts revealed that similarly to the proportion of fixation data, positive (M = 0.39, SE = 0.01, $p < 0.001$) and negative clips (M = 0.39, SE = 0.01, $p < 0.001$) received a significantly higher proportion of dwell time than neutral clips (M = 0.35, SE = 0.01). In contrast to the hypothesis, the anxiety group x clip type x feedback interaction was non-significant, $F(4,166) = 0.7$, MSE=0.01, $p = 0.59$, $\eta_p^2=0.02$, *Power = 2.81.* The anxiety group x clip type was also non-significant, $F(4,166)$ = 0.27, MSE=0.01, $p = 0.9$, $\eta_p^2=0.01$, *Power = 0.1,* as was the anxiety group x feedback, $F(2,83) = 1.62$, MSE=0.01, $p = 0.2$, $\eta_p^2=0.04$, *Power = 0.33.* However, there was a marginally significant clip valence x feedback interaction, $F(2,66)$ = 3.07, $MSE = 0.01$, $p = 0.05$, $\eta_p^2 = 0.04$ *Power* = 0.59.

Bonferroni post-hoc contrasts revealed that there was a significantly higher proportion of dwell time across groups to negative clips (M = 0.40, SE = 0.01, p < 0.001) and positive clips (M = 0.39, SE = 0.01 $p < 0.001$) than to neutral clips (M = 0.34, SE = 0.01) when positive feedback had been received but with neutral feedback there was a higher proportion of dwell time to positive faces only (M = 0.40, SE = 0.11) compared to neutral clips (M = 0.36, SE = 0.01, $p = 0.02$), but that there was no difference between neutral and negative clips (M = 0.37, SE = 0.01, $p = 1$) when the feedback was neutral. Therefore, feedback did appear to have a small marginally significant effect on attention but not in relation to social anxiety groups as was predicted.

In summary of the eye movement data, it was hypothesised that in the first half of the task, high social anxiety compared to low social anxiety participants would have fewer fixations and decreased dwell time to all faces but that in the high social anxiety group only, these biases would be significantly greater for negative compared to neutral or positive faces. Furthermore, it was predicted that positive faces would be fixated to more and for longer by the low social anxiety group. These hypotheses were not supported since there were no significant differences in eye movements across groups.

It was further hypothesised that in the second half of the task group differences would only be apparent for the group who received neutral feedback whilst there would be no differences between groups where participants received positive feedback. Again this hypothesis was not supported since there were no group differences and no significant main effect of feedback or interaction between feedback and anxiety.

Emotional social cues were associated with more visual attention overall with both positive and negative clips capturing a higher proportion of fixations than neutral clips. Furthermore, there is some weak evidence (only marginally significant) to suggest that with neutral feedback, the duration of attention mirrored the pattern in the first block of the task where positive faces were looked at for longer on average (although this was significant for the second block only). Yet with positive feedback, both positive and negative faces were fixated for longer period, probably due the incongruence between positive feedback and the presentation of a seemingly negative social cue. Therefore, there is no evidence from these results to support a reduction in visual attention to social cues in socially anxious individuals during a performance.

Hypothesis II(i): Online perception and interpretation of social cues in block 1.

Awareness of social cues during the task was measured by asking participants to indicate when they noticed a positive or negative audience response by pressing a cedrus keypad labelled ‘negative’ or ‘positive’. It was predicted that the high social anxiety group would be more aware of social gestures, particularly negative cues (indicated by pressing a higher percentage of negative keys than positive across trials) than the low anxiety group. Therefore, a significant main effect of anxiety and a significant anxiety group x clip valence interaction would be anticipated.

Self-reported observations of positive and negative behaviours were measured for trials where at least one fixation had been directed towards the dynamic clips in the matrix as these were the target clips that contained social cues. Trials where an observation of a social cue was indicated by a key press when the participant had not made any fixations to a positive, negative or neutral dynamic clip were discarded but this only accounted for 2% of trials. A positive or negative key press was registered on approximately 30% of trials where a box containing dynamic social cue was fixated to (with 32% for negative clips, 31% for positive clips and

26% for neutral clips). Descriptive statistics (Table 5.6) suggest that the high social anxiety group may have been slightly more aware of social cues than the other groups.

Table 5.6
Mean self-report observations of positive and negative behaviours (indicated by pressing negative or positively labelled key) when fixations have been directed towards a dynamic negative, neutral or positive clip: block 1

Key	Clip valence	Anx	*M*	*SD*
Negative	Negative	High	0.26	0.19
		Mod	0.18	0.18
		Low	0.24	0.24
		Total	0.23	0.20
Negative	Neutral	High	0.21	0.15
		Mod	0.11	0.09
		Low	0.21	0.18
		Total	0.18	0.15
Negative	Positive	High	0.18	0.13
		Mod	0.12	0.11
		Low	0.14	0.13
		Total	0.15	0.13
Positive	Negative	High	0.12	0.09
		Mod	0.07	0.08
		Low	0.09	0.09
		Total	0.09	0.09
Positive	Neutral	High	0.10	0.08
		Mod	0.06	0.07
		Low	0.08	0.07
		Total	0.08	0.07
Positive	Positive	High	0.17	0.13
		Mod	0.14	0.19
		Low	0.16	0.24
		Total	0.16	0.19

Kolmogorov-Smirnov tests revealed that several variables were not normally distributed but Levene's test was non-significant for all of the variables ($p > 0.06$) so it can be assumed that homogeneity of variance is fairly equal across groups and the group sizes were approximately equal. A 2x3x3 mixed ANOVA with one between groups factor: anxiety (high; moderate; low) and two repeated measured factors: key (positive; negative) and dynamic clip valence (positive; negative; neutral) revealed a borderline significant main effect of anxiety group, $F(2, 86) = 3.03$, $MSE = 0.05$, $p = 0.05$, $\eta_p^2 = 0.07$ *Power* = 0.57. Bonferroni contrasts revealed that the high anxiety group indicated that they had observed significantly more social cues overall (M = 17%, SE = 0.02) than the moderate anxiety group (M = 11%, SE = 2, p = 0.05) but there were no significant differences between the high social anxiety and low social anxiety group (M = 15%, SE = 2, p = 1) as expected. This does not support the hypothesis that the high social anxiety group would indicate that they had observed more social cues (illustrating higher awareness of social cues) than the low social anxiety group by making more cedrus box key responses. Rather it seems that both of these extreme ends of the social anxiety groups were relatively equally aware of social cues.

This result may have been due to an overall negative perception of panel member's responses to participant's performances. This is illustrated by the overall negative relative to positive key presses. Firstly, the main effects of key, $F(1,86) = 59.03$, $MSE = 0.01$, $p < 0.001$, $\eta_p^2 = 0.41$ *Power* = 1 and clip valence were significant. Mauchly's test indicated that the assumption of sphericity for clip valence had been violated ($\chi^2(2) = 18.69$, $p < 0.001$), therefore since Mauchly's W was > 0.75, degrees of freedom were corrected using the Hugh Feldt estimates of sphericity ($\varepsilon = 0.87$), $F(1.74, 149.57) = 5.96$, $MSE = 0.01$, $p < 0.01$, $\eta_p^2 = 0.07$ *Power* = 0.83.

For the clip valence x key interaction, Mauchly's test indicated that the assumption of sphericity had been violated ($\chi2(2) = 82.34$, $p < 0.001$), therefore since Mauchly's W was < 0.75, degrees of freedom were corrected using the Greenhouse Geisser estimates of sphericity ($\varepsilon = 0.87$) to reveal a significant clip valence x key interaction, $F(1.23, 106.15) = 9.79$, $MSE = 0.04$, $p < 0.001$, $\eta_p^2 = 0.1$ *Power* = 0.92. Bonferroni post-hoc contrasts revealed that as one may expect, there was a significantly higher proportion of negative keys pressed indicating that more negative social cues had been perceived when a negative clip was present (M = 23%, SE = 2, $p < 0.001$) than a positive clip (M = 9%, SE = 1).

However, when a neutral dynamic clip was displayed, there was also a significantly higher proportion of negative keys pressed indicating that more negative social cues had been perceived (M = 18%, SE = 2, $p < 0.001$) than when a positive clip was present (M = 9%, SE = 1). There were no other significant interactions (p>0.51). The anxiety group x clip, $F(1.73, 149.14) = 0.8$, $MSE = 0.01$, $p = 0.51$, $\eta_p^2 = 0.02$ *Power* = 0.27 and anxiety group x key interactions $F(1,86) = 1.82$, $MSE = 0.01$, $p = 0.17$, $\eta_p^2 = 0.04$ *Power* = 0.37 were non-significant. This means that there was a general negative perception of both neutral and negative social cues. The significant interaction is illustrated in Figure 5.11.

Because Mauchly's test was significant at the 0.001 α level for both key and clip valence, the results were followed up with non-parametric analysis. The main effect of key across clips types was followed up using three Wilcoxon Signed ranks tests adjusted at the 0.0167 α level (Appendix III(v)). This confirmed that negative keys were pressed significantly more than positive keys when negative and neutral dynamic clip types were observed but the effect was not significant for positive clips types.

Hypothesis II(ii): Online perception and interpretation of social cues in Block 2

It was predicted that higher awareness of social cues (indicated by a higher percentage of key presses across trials), particularly negative cues in the high social anxiety group relative to the low social anxiety group would only be apparent for the group who received neutral feedback, whilst there would be no differences between groups where participants received positive feedback. Therefore, a significant feedback x anxiety group interaction would be expected in addition to a significant feedback x anxiety group x clip valence interaction. Descriptive statistics (Table 5.6: Appendix II(iii)) suggests that positive feedback appeared to lower perceptions of negative social cues in the high anxiety group relative to other groups.

To investigate this further, a 2x2x3x3 ANOVA with two between group factors, anxiety (high; moderate; low) feedback (positive/neutral); and two within group factors: clip valence (negative; neutral; positive) and key (positive; negative) was conducted for trials where fixations were made to clips containing dynamic social cues. The Levene's test was non-significant at the 0.01 level so it can be assumed that homogeneity of variance is fairly equal across groups. Mauchly's test indicated that the assumption of sphericity could be assumed for clip valence (χ^2 (2) = 1.34, p = 0.51).

There was a significant main effect of key, $F(1,83) = 22.78$, $MSE = 0.01$, $p < 0.001$, $\eta_p^2 = 0.22$ *Power* = 1. Similarly to block 1, Bonferroni contrasts revealed a significantly higher proportion of clips that were rated negatively (M= 0.17, SE=

0.01) than positively (M = 0.13, SE = 0.01). There was no significant main effects of anxiety $F(1,83) = 0.71$, $MSE = 0.06$, $p = 0.31$, $\eta_p^2 = 0.03$, $power = 0.25$, clip valence, $F(2,166) = 0.82$, $MSE = 0.01$, $p = 0.44$, $\eta_p^2 = 0.01$, $power = 1.37$ or feedback, $F(1,83) = 0.18$, $MSE = 0.06$, $p = 0.68$, $\eta_p^2 = 0.03$, $power = 0.07$.

The anxiety group x feedback interaction was non-significant, $F(2,83) = 1.18$, $MSE = 0.06$, $p = 0.31$, $\eta_p^2 = 0.03$, $power = 0.25$ as was the anxiety group x clip valence x feedback, $F(4,166) = 1.6$, $MSE = 0.01$, $p = 0.18$, $\eta_p^2 = 0.04$, $power = 0.49$; anxiety group x key interaction, , $F(2,83) = 0.3$, $MSE = 0.01$, $p = 0.97$, $\eta_p^2 = 0.01$, $power = 0.05$ and anxiety group x clip valence x feedback x key, $F(4,166) = 1.04$, $MSE = 0.01$, $p = 0.39$, $\eta_p^2 = 0.03$, $power = 0.32$ as was the anxiety group x key x clip valence, $F(4, 166) = 0.51$, $MSE = 0.01$, $p = 0.73$, $\eta_p^2 = 0.01$, $Power = 0.17$. However there was an unexpected significant anxiety group x clip valence, $F(4, 166) = 2.56$, $MSE = 0.01$, $p = 0.04$, $\eta_p^2 = 0.06$ $Power = 0.71$. However, this was not in the direction that would have been anticipated (i.e. with regard to the high social anxiety group). Rather, Bonferroni contrasts revealed that there were significantly more positive and negative social cues perceived in the low anxiety group only when a negative dynamic clip was present (M = 0.16, SE = 0.02) than a positive (M = 0.12, SE = 0.01, $p = 0.03$) or a neutral dynamic clip (M = 0.13, SE = 0.01, $p = 0.02$). This suggests that the low social anxiety group were more aware of negative clips than others but that the high social anxiety and moderate social anxiety groups were equally aware of positive, negative and neutral social cues.

Therefore, the hypothesis that the high social anxiety group would be more aware of negative behaviours only in the neutral feedback condition was not supported. The difference across anxiety groups in awareness of social cues in illustrated in Figure 5.3. As visual attention increased to emotional social cues in block 2, awareness became more even across the groups.

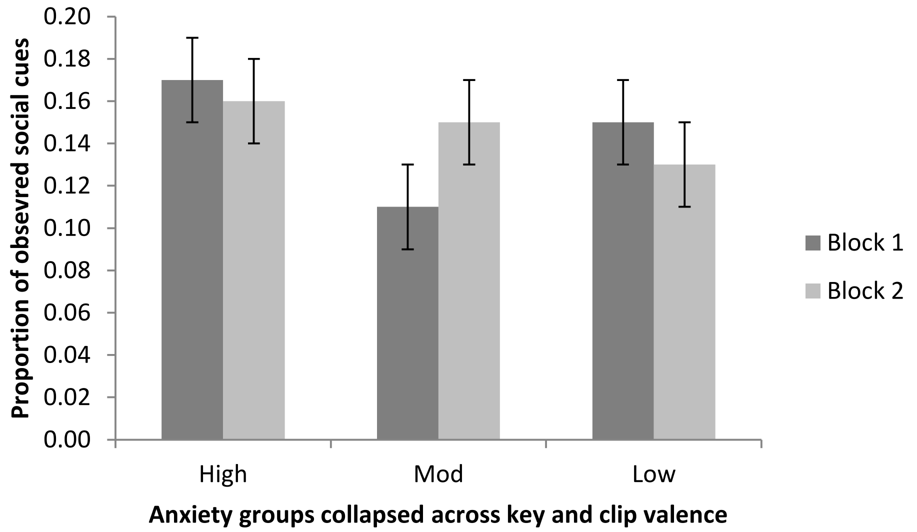

Figure 5.3 *Mean awareness of social cue across anxiety groups indicated by key press (bars denote standard errors)*

The clip valence x key valence interaction was non-significant, $F(2, 166) = 0.09$, $MSE = 0.01$, $p = 0.91$, $\eta_p^2 = 0.01$ *Power* = 0.06, as was the key x feedback, $F(1\ 83) = 0.01$, $MSE = 0.01$, $p = 0.44$, $\eta_p^2 = 0.51$ *Power* = 0.1 and key x clip valence x feedback interaction, $F(2, 166) = 0.49$, $MSE = 0.01$, $p = 0.61$, $\eta_p^2 = 0.01$ *Power* = 0.13. The clip valence x feedback interaction was also non-significant, $F(2, 166) = 1.39$, $MSE = 0.01$, $p = 0.25$, $\eta_p^2 = 0.02$, *Power* = 0.3.

In summary of Hypothesis II, it was predicted that the high anxiety group would be more aware of social gestures (particularly negative social cues) than the low anxious group. This hypothesis was not supported since although the high social anxiety group was significantly more aware of social behaviours than the moderate social anxiety group, their awareness did not significantly differ from the low social anxiety group when attention to clips was equal across clips types and anxiety group. Furthermore, there were no group differences between negative interpretations when negative social clips were present.

As attention increased to positive and negative social cues in the second block, there were no longer any between groups differences apparent for awareness of social cues and no differences in reaction times. The decrease in group differences for awareness of social cues appears to reflect a later increase in awareness in the moderately anxious group which resulted in a more even distribution of awareness across groups. Furthermore, there was a slight drop in awareness in the high and low anxiety groups as attention increased to emotional cues so this may represent a conflict of demands on resources.

Hypothesis III(i): Reaction time to categorise social cues in block 1

It was predicted that the high social anxiety group would process threatening social cues more slowly. This would be demonstrated by a longer delay before making a key press during the trials where a positive or negative key was pressed to indicate that a social cue had been perceived. Reaction time for the time taken to press a positive or negative key was evaluated in a 3 x 3 mixed ANOVA in block 1 with one between subjects factor: anxiety group (high; moderate; low) and one repeated measures factors: clip valence (negative; neutral; positive). A significant anxiety group x clip valence was anticipated. Descriptive statistics (Table 5.7) suggest that the high social anxiety group took longer than other groups to indicate that they had observed positive or negative social cues on trials where an observation was indicated.

Table 5.7

Mean reaction time to deciding on valence of observed behaviour (Block 1)

Clip val	Anx	*M*	*SD*
Neg	High	934.65	515.42
	Mod	649.54	435.33
	Low	770.16	538.42
	Total	792.71	508.82
Neut	High	762.68	470.31
	Mod	434.57	315.23
	Low	688.98	490.68
	Total	638.30	453.72
Pos	High	854.11	381.87
	Mod	632.99	461.96
	Low	694.27	597.05
	Total	733.15	490.72

Levene's tests were all non-significant ($p > 0.07$) although Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2(2) = 13.18$, $p = 0.01$), therefore degrees of freedom were corrected using the Hugh Feldt estimates of sphericity ($\varepsilon = 0.91$) since Mauchly's W was > 0.75 (Field, 2009). There was a significant main effect of clip valence, $F(1.82, 156.83) = 7.26$, $MSE = 83289.93$, $p = 0.01$, $P\eta^2 = 0.08$, *power* =0.92. Bonferroni post-hoc contrasts showed that overall, decisions took longer to make when a negative clip was present (M = 784.78ms, SE = 53.22) than a neutral dynamic clip (M = 628. 74ms, SE = 46.44), although there were no significant differences in speed of processing a positive clip (M = 727.12, SE = 51.76) relative to a neutral clip ($p = 0.09$) or negative one ($p = 0.24$).

There was also a significant main effect of anxiety, $F(2, 86) = 3.23$, $MSE = 527164.69$, $p = 0.045$, $P\eta^2 = 0.07$, *power* =0.6 with the high social anxiety group (M= 850.48ms, *SE*= 74.1) being significantly slower than the moderate group (M = 572. 37ms, SE = 80.67) in making a decision about the valence of a social cue. There were no significant differences in processing time between the low social anxiety group (M = 717.80, SE = 76.53) and the high social anxiety group (*p* = 0.65) or between the low and moderate social anxiety groups (*p* = 0.58). The anxiety group x clip valence interaction was non-significant, $F(1.82, 156.83) = 0.96$, $MSE = 79740.59$, $p = 0.43$, $P\eta^2 = 0.02$, *power* =0.29.This does not support the hypothesis since the high social anxiety group was only slower than the moderate social anxiety group (but not the low social anxiety group) to process all social cues rather than simply threatening ones. The pattern of reaction times for observing social cues across anxiety groups (illustrated in Figure 5.4) reflects the pattern observed in the awareness date for block 1.

Hypothesis III(ii): Reaction time to categorise social cues in Block 2

Reaction times for block 2 were analysed in a 2x3x3 mixed ANOVA with the addition of feedback (positive; neutral) as an additional between subjects factor. It was predicted that the slower reaction time for the high social anxiety group predicted for the first block would be evident in the neutral feedback condition only. Descriptive statistics for block 2 (Table 5.8) suggests that overall there were no group differences for processing time.

Table 5.8

Mean reaction time for valence rating (Block 2)

Clip	Anx	Feedback	*M*	*SD*
Neg	High	Pos	682.38	629.19
		Neut	882.46	490.90
		Total	782.42	564.35
	Mod	Pos	673.06	433.46
		Neut	656.07	356.00
		Total	664.25	387.51
	Low	Pos	869.80	522.95
		Neut	653.73	305.59
		Total	761.77	434.95
	Total	Pos	743.52	536.68
		Neut	735.79	401.81
		Total	739.61	470.62
Neut	High	Pos	763.05	593.82
		Neut	847.75	390.13
		Total	805.40	496.10
	Mod	Pos	801.42	601.42
		Neut	618.31	472.25
		Total	706.47	535.86
	Low	Pos	723.03	534.86
		Neut	524.03	441.35
		Total	623.53	492.33
	Total	Pos	760.74	563.99
		Neut	668.46	446.50
		Total	714.08	507.21
Pos	High	Pos	588.19	542.61
		Neut	918.62	458.18
		Total	753.40	521.74
	Mod	Pos	799.32	665.59
		Neut	663.10	429.16
		Total	728.69	548.97
	Low	Pos	680.83	563.78
		Neut	566.45	347.21
		Total	623.64	463.71
	Total	Pos	682.15	580.74
		Neut	721.73	433.30
		Total	702.16	508.99

There was no significant main effect of anxiety, $F(2, 83) = 0.49$, $MSE = 0.02$, $p = 0.06$, $P\eta^2 = 0.06$, *power* =0.54; feedback $F(1, 83) = 0.09$, $MSE = 614655.03$, $p = 0.77$, $P\eta^2 = 0.01$, *power* =0.06, clip valence, $F(2, 166) = 0.41$, $MSE = 63447.75$, $p = 0.66$, $P\eta^2 = 0.01$, *power* =0.13 in block 2 and no other main effects of interaction were significant ($p>0.16$). Specifically, the anxiety x clip valence interaction was non-significant, $F(4, 166) = 1.68$, $MSE = 63447.75$, $p = 0.16$, $P\eta^2 = 0.01$, *power* =0.12 as was the anxiety x feedback interaction, $F(2, 83) = 0.21$, $MSE = 614655.02$, $p = 0.21$, $P\eta^2 = 0.04$, *power* =0.33 and the clip valence x feedback interaction, $F(2, 166) = 1.45$, $MSE = 63447.75$, $p = 0.24$, $P\eta^2 = 0.02$, *power* =0.31. The anxiety group x clip valence x feedback interaction was also non-significant, $F(4, 166) = 0.74$, $MSE = 63447.75$, $p = 0.57$, $P\eta^2 = 0.02$, *power* =0.24.

Therefore the hypothesis was not supported for block 2. This may have been due to the cost incurred to indicating an observed response in block 2 as more visual attention was paid to social cues. However, it is interesting to note from the means that whilst positive feedback appears to have speeded decision making across all clips valences for the high social anxiety group relative to neutral feedback. The opposite effect is observed in the moderate social anxiety and low social anxiety groups who took longer to indicate that they had observed a positive or negative social cue with positive feedback relative to neutral feedback.

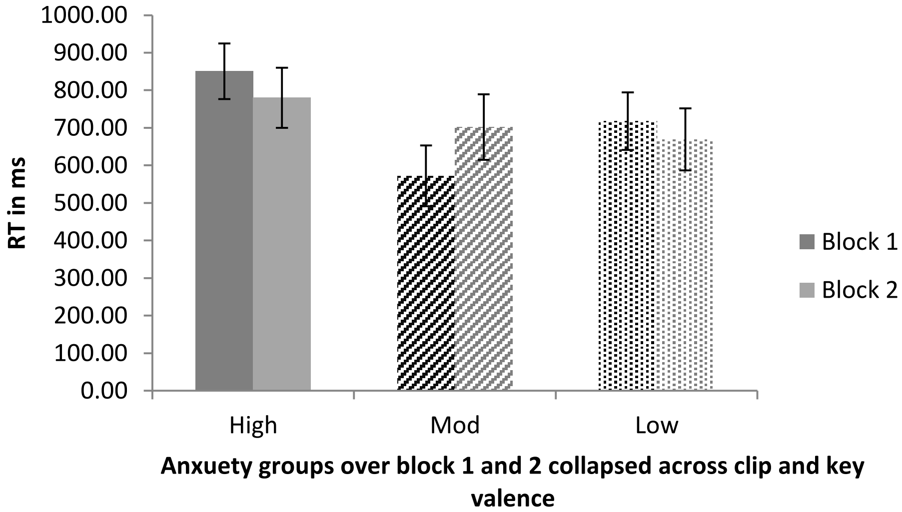

Figure 5.4: *Mean reaction time to note observed social cue (bars denote standard errors)*

In summary of the reaction time data, in block 1 (where there had been no evidence of differences in attention across groups or clip valences), negative clips took longer to process than neutral clips and the high social anxiety group took longer to note an observed social cue than the moderate social anxiety group, with the low social anxiety group nestled between these. However, as attention to positive and negative cues increased in block 2 as evidenced by a higher proportion of fixations and dwell time to boxes containing clips of panel members displaying positive or negative social cues, differences in processing times to decide whether an observed social cue were positive or negative were no longer evident. Because any significant differences between anxiety groups were only observed between the high and moderately anxious groups, it is unlikely that these were influenced by general trait anxiety or depression since these did not significantly differ between these groups.

The reaction times for observing a social cue indicated by the timing of positive or negative key press, reflect the pattern observed in the awareness data. In block 1 in the high social anxiety group were more aware of social cues than the moderate social anxiety group, but not the low social anxiety group. Similarly the high social anxiety group took significantly longer to decide the meaning of the cue than the moderate anxiety group but not than the low anxiety group. Moreover, the lack of replication of the effects seen in block 1 as attention increased to emotional social cues in block 2, as indicated by a higher proportion of fixations and dwell time to positive and negative clips, suggests that processing time and conscious awareness of social cues may be disrupted by visual attention and vice versa. Paradoxically this reduction in attention as awareness increases may suggest that reduced attention is conducive to an online negativity bias whereby the meaning of the social cue can be reflected on in the absence of further attention to a facial expression or gesture.

Offline interpretation: Post task ratings

After completing each block, participants were asked to rate how good the quality of the performance was and how much they thought that the panel had rated their performance. A series of one way between subjects ANOVAs with three levels of anxiety (high, moderate and low) were conducted for block 1 post-test rating of self-evaluation of performance and for perceptions of audience evaluations of performance. For block 2, the analysis was repeated with feedback (positive/neutral) as an additional between subjects factor. Dependent variables were ratings on a Likert scale key press responses ranging from 1(very poor) to 8 (very good). It was predicted that the high social anxiety group would have lower self-evaluative ratings than the low social anxiety group and also that they would have lower ratings for perceived audience evaluation. It was further predicted that both of these would be mediated in the second half of the task by feedback type such that positive feedback would reduce any differences.

Hypothesis IV(i) Self-confidence in performance for block 1

The descriptive statistics for self-evaluations (Table 5.9) suggested that there was an inverse relationship between social anxiety and self-confidence in performance.

Table 5.9

Mean post task ratings for self-evaluation: Block 1

ANX	*M*	*SD*
High	3.31	1.23
Mod	3.96	1.29
Low	4.83	1.21
Total	4.02	1.38

Levene's test was not significant for self or other evaluation (p > 0.3) so the assumption of homogeneity can be maintained for all analysis. A one-way ANOVA with three levels (high, moderate and low anxiety group) revealed a significant main effect of anxiety for self-evaluation, $F(2, 86) = 11.71$, $MSE = 1.54$, $p < 0.001$, $P\eta^2 = 0.21$, *power* = 0.99. Bonferroni contrasts revealed that the high social anxiety group had significantly lower self-evaluation ratings (M = 3.31, SE = 0.22) than the low social anxiety group (M = 4.83, SE = 0.23, $p < 0.001$). The moderate social anxiety group also had significantly lower self-evaluation ratings (M = 4.04, SE = 0.23, $p = 0.03$) than the low anxiety group but there was no significant difference between the high social anxiety and moderate social anxiety groups. Thus the hypothesis was supported.

Hypothesis IV(ii) Self-confidence in performance for Block 2

The descriptive statistics for block 2 (Table 5.10) suggested that overall there has been a slight increase in self-confidence across all groups but similarly to block 1 that there was an inverse relationship between social anxiety and self-confidence in performance.

Table 5.10

Mean post task ratings for self-evaluation: Block2

ANX	Feedback	*M*	*SD*
High	N	4.56	1.15
	P	4.25	1.00
	Total	4.41	1.07
Mod	N	4.29	1.54
	P	5.15	1.34
	Total	4.70	1.49
Low	N	5.33	1.59
	P	5.73	0.96
	Total	5.53	1.31
Total	N	4.73	1.47
	P	5.02	1.25
	Total	4.88	1.36

Levene's test was not significant for all self or other evaluations ($p > 0.05$) so the assumption of homogeneity can be maintained. A two-way between groups ANOVA with anxiety group (high, moderate and low) and feedback (positive, neutral) as factors revealed a significant main effect of anxiety for self-evaluation, $F(2, 83) = 6.32$, $MSE = 1.64$, $p = 0.01$, $P\eta^2 = 0.13$, *power* =0.89. Bonferroni contrasts revealed that the high anxiety group has significantly lower self-evaluation ratings (M = 4.41, SE = 0.23) than the low anxiety group (M = 5.53, SE = 0.23, $p = 0.01$). There were no significant differences between the high social anxiety and the moderate social anxiety group (M = 4.72, SE = 0.25, p =1) but the difference between the low social anxiety and moderate social anxiety group approached significance (*p*=0.056) with the low social anxiety group having slightly more confidence in their performance than the high social anxiety group. The main effect for feedback was not significant *F*(1, 83) = 1.37, *MSE* = 1.64, *p* = 0.25, $P\eta^2$ = 0.02, *power* =0.21. The anxiety x feedback interaction was also non-significant, *F*(2, 83) = 1.6, *MSE* = 1.64, *p* = 0.21, $P\eta^2$ = 0.04, *power* =0.33. Therefore, the hypothesis has only been partially supported since regardless of feedback, the high social anxiety group had significantly lower self-evaluation than the low social anxiety group.

Hypothesis IV(iii) Perceived audience evaluation for Block 1

Descriptive statistics (Table 5.11) for perception of audience evaluation suggest that social anxiety is inversely related to confidence in other's evaluation of social performance.

Table 5.11
Mean post task audience evaluation post task ratings: Block 1

ANX	*M*	*SD*
High	3.25	1.14
Mod	3.78	1.45
Low	4.33	1.4
Total	3.78	1.39

A one-way ANOVA with three levels (high, moderate and low anxiety group) a significant main effect of anxiety for audience evaluation, *F*(2, 86) = 5.16, *MSE* = 1.76, *p* = 0.01 $P\eta^2$ = 0.11, *power* = 0.81. Bonferroni corrected contrasts revealed that the high social anxiety group has significantly lower perceived audience-evaluation ratings (M = 3.25, SE = 0.2) than the low social anxiety group (M = 4.33, SE = 0.26, *p* = 0.01), but there were no significant differences between the moderate social anxiety group (M = 3.78, SE – 0.28) and high anxiety groups (*p*

= 0.4) or the moderate social anxiety and low social anxiety groups (p = 0.35). Thus the hypothesis that the high social anxiety group would have lower perceived audience evaluations of their performance compared to the low social anxiety group was supported.

Hypothesis IV(iv) Perceived audience evaluation for Block 2

The descriptive statistics for block 2 (Table 5.12) similarly to self-evaluations suggest that there has been a slight increase in confidence overall regarding the perception of audience evaluation of performance. However again, similarly to the patterns for self-evaluations, positive feedback appears to have increased social confidence in the moderate social anxiety and low social anxiety groups only but paradoxically decreased social confidence in the high social anxiety group.

Table 5.12

Mean post task audience evaluation: Block 2

ANX	Feedback	*M*	*SD*
High	N	4.44	1.15
	P	3.63	1.31
	Total	4.03	1.28
Mod	N	4.00	1.41
	P	5.15	1.21
	Total	4.56	1.42
Low	N	4.33	1.72
	P	5.47	0.92
	Total	4.90	1.47
Total	N	4.27	1.42
	P	4.70	1.41
	Total	4.48	1.42

Levene's test was non-significant, $F(5,83) = 1.86$, $p = 0.11$) so the assumption of homogeneity was satisfied. A 2 x 3 between subjects ANOVA with anxiety and feedback results for audience evaluation revealed a significant main effect of anxiety for audience-evaluation, $F(2, 83) = 3.49$, $MSE = 1.72$, $p = 0.04$, $P\eta^2 = 0.08$, *power* =0.64. Bonferroni pairwise comparisons revealed that the high anxiety group had significantly lower self-evaluation ratings (M = 4.03, SE = 0.23) than the low anxiety group (M = 4.9, SE = 0.24, $p = 0.03$). The main effect for feedback was not significant $F(1, 83) = 3.12$, $MSE = 1.72$, $p = 0.08$, $P\eta^2 = 0.04$, *power* =0.42.

However the anxiety x feedback interaction was significant, $F(2, 83) = 5.7$, $MSE = 1.72$, $p = 0.01$, $P\eta^2 = 0.12$, *power* =0.85. Bonferroni contrasts revealed that in the moderate social anxiety group those who had received positive evaluative feedback had significantly higher ratings for perceived audience evaluation of their performance (M = 5.15, SE = 0.36) than those who had received neutral feedback (M = 4, SE = 0.35, $p = 0.03$). The same pattern was found in the low social anxiety group although this did not reach significance because they had higher ratings in the neutral condition so the gap was less extreme.

However, positive feedback actually lowered the high anxiety group's perception of audience evaluation although the difference between positive feedback (M = 3.63, SE = 0.33) and neutral feedback (M = 4.44, SE = 0.33) was not significantly different ($p = 0.08$). Furthermore, in the positive feedback condition only, the high social anxiety group had significantly lower confidence in audience approval than the moderate social anxiety group ($p = 0.01$) or the low social anxiety group ($p = 0.001$). Therefore, paradoxically, positive feedback has a debilitating effect on high social anxiety perceptions of audience evaluation.

Since depression and general trait anxiety were significantly higher in the high compared to the low social anxiety group, correlations were conducted between scores on the BDI II and the BAI scales and post task evaluations (Appendix IV(iii)).

These indicated that there was a weak negative correlation between self-evaluation and depression (r = - 0.23, p = 0.03, r^2 = 0.05) and self-evaluation and general trait anxiety (r = - 0.22, p = 0.04, r^2 = 0.05) in the second block only. Therefore, depression and general trait anxiety may have contributed a little to the self-ratings of performance in post-task reflection but since the correlations were weak (contributing to only 5% of the variance) and only evident for block 2, depression and anxiety do not appear to have played a particularly influential role in impressions of participants' performance.

In summary of the post task rating data, for both evaluations of own performance and the perceptions of audience evaluations, the means suggested a very slight increase in social confidence over the two halves of the speech task. However, on the whole the high social anxiety group demonstrated a significantly lower degree of confidence in their own performance and in their perceptions of the audience evaluation of it. This pattern was clear in the first block (where there were no group differences in visual attention to social cues), but the effect in the second half appeared to be primarily driven by feedback. Whilst positive feedback appeared to lower the social threat for the moderate social anxiety and low social anxiety groups, leading to increased confidence, it appeared to reduce social confidence in the audience approval for the high social anxiety group. Looking at the means in the neutral condition for block 2 (where attention had increased towards positive and negative social cues), there do not appear to be any real differences in perception of audience evaluations. Indeed the high social anxiety group appear to rate evaluations very slightly more positively than the other groups.

Discussion

The aim of the current study was to test attentional and interpretative processes in social anxiety using an ecologically valid paradigm using a speech task. Results indicated that visual attention was equal across groups and social cues in block 1 as indicated by the lack of significant differences across anxiety groups or clip valence for proportion of fixations and dwell time to boxes containing a panel member displaying an active social cue. However, as the task progressed on to block 2, more attention was paid to emotional clips, evidenced by a significantly higher proportion of fixations and dwell time to positive and negative clips than to neutral clips. The lack of group differences in attention does not support the Clark and Well's or the Rapee and Heimberg models of social anxiety. Despite the lack of group differences in attention, high social anxiety participants were more aware of social behaviours and took longer to process them in the early task stage than the moderate social anxiety group. This could be interpreted as support for the Rapee and Heimberg model as cognitive attention in the high social anxiety group has been directed towards the audience rather than towards the self exclusively. However, they did not significantly differ from the low social anxiety group. As the task progressed, the low social anxiety group were more aware of negative cues than positive or neutral ones whilst the high social anxiety group were equally aware of all social cues. Post-task, high social anxiety participants had less confidence in their own performance and in the audience evaluation of their performance.

Overall, fixations and duration of attention increased in the second block towards positive and negative social cues. This may reflect a general attentional bias towards emotional compared to neutral stimuli. Indeed, Nummenma, Hyona and

Calvo (2006) found that participants asked to rate photos from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) for valence similarity, oriented initial fixations towards emotional pictures more than neutral images. They also had longer gaze duration and a higher number of fixations towards emotional pictures than neutral photos. Images had been corrected for luminance, colour saturation, contrast and complexity, suggesting that higher order affective properties of the emotional pictures rather than low level salient properties that were responsible for this effect.

It may be argued that the increase in attention to emotional social cues during the second block reflected better task performance having had some task practice on the task. However, increased duration of attention to emotional social cues was mediated by feedback. With neutral feedback, only positive social cues gained more attention than neutral cues but with positive feedback, positive and negative social cues attracted more attention than neutral cues did. This may reflect a natural tendency to seek reassurance in the form of social approval. Bodie (2010) investigated public speaking anxiety and suggested that state anxiety is highest during the expectation of and early parts of the speech but that over time this diminishes.

This may explain the differences over time in attentional and interpretative patterns evident over the two experimental blocks, whereby despite no significant differences in attention, there was evidence of higher awareness of social cues in the high social anxiety group in block 1 relative to the moderate social anxiety group with the low social anxiety group nestled between these. Yet these differences were not apparent in block 2 as differences in attention started to emerge with more attention being paid to clips displaying emotional social cues than neutral ones. As participants relaxed into the task they may have been more drawn towards confederates displaying signs of social approval. More attention may have been paid at this stage to negative behaviours by those who had received positive performance feedback because the negative social cue was incongruent with their positive expectation. However, the lack of group differences in attention may have been due to the nature of the stimuli. Dynamic social cues in the videos changed fairly rapidly in both location and valence, which may have rendered the capture of attentional biases difficult due to the distraction caused by a new movement on screen.

The lack of group differences were constructive in demonstrating that attentional biases are not required for increased awareness of social cues across different levels of social anxiety. Yet, it must be noted that the current paradigm may not represent the way in which individuals allocate attention in a more naturalistic setting since they were asked to respond when they were aware of positive or negative social cues. This may have led their behaviour, particularly in the second half of the task when fixations towards positive and negative clips increased. Indeed Hunt, Cooper, Hungr and Kingstone (2007) found that in a visual search task using schematic angry, happy and neutral faces, happy and angry face distractors only elicited speeded saccades when emotions were the focus of the search task.

The awareness data from the current study casts doubt on this explanation since the low socially anxious group appeared to distinguish a genuine social threat in the form of being aware of more negative clips relative to positive or neutral ones in the second block of the task. Therefore, if they directed eye-movements towards positive and negative clips simply because of the task instruction to indicate when these had been observed then one would expect that reported awareness would have increased similarly across all groups. Moreover, the task instruction was not to search for positive or negative social cues, but rather to simply note if they observed these occurring at any particular point in time. Nonetheless, it would be useful for researchers to modify this paradigm by removing the observed social cue response.

The generally negative perception of neutral social cues was similar to the effect found by Pozo et al. (1991). However whilst high social anxiety participants remained particularly aware of all social cues, low social anxiety participants appeared to be better able to regulate their awareness to focus more on a genuine social threat cues as the task progressed. This may be due to high social anxiety participants having more liberal criteria for what constitutes a negative social cue as Veljaca and Rapee (1998) found.

Although changes in perception across the span of a task are more likely to occur in a live speech task with an audience, differences in perceptions across the time course of the task have also been noted in static face processing tasks. For example, Garner, Mogg and Bradley (2006) found that expectancies of unpleasant pictures following angry faces generally decreased as the task progressed. Low anxious individuals consistently overestimated the likelihood of pleasant pictures following happy faces, but this decreased over the course of the task in high anxious participants. In contrast, they increasingly expected an unpleasant picture to follow a happy face. Furthermore, post-task measures indicated that high anxious participants overestimated the percentage of angry faces presented. Similarly if the high social anxiety group in the current study recalled seeing more negatively perceived faces, then this may help to explain the lower perceived audience evaluation ratings in the high social anxiety group.

Higher self-reported observations for emotional evaluative responses in the high social anxiety group compared to the moderate social anxiety group may be because high social anxiety participants may be more inclined to think about social cues in relation to their dispositional anxiety. In contrast, the low social anxiety group, whose scores fell between the other two groups, may have been unprepared for the situational anxiety elicited by the task. This interpretation is supported by the reaction times for noting a positive or negative cue, which followed a similar pattern to the interpretation data. The high social anxiety group took significantly longer to process social cues than the moderate anxiety group, with reaction times for the low anxious group again falling between the other two groups. This may suggest that reaction times are slowed and awareness increased in a socially stressful situation by the combination of dispositional and situational social anxiety.

Although situational anxiety was not directly measured, some inferences about the cause of the u-shaped curve between social anxiety and awareness of social cues may be made by looking beyond the literature on social anxiety. For example, there is evidence from the sports psychology field that those with higher dispositional self-consciousness display less choking behaviours than those with lower self-consciousness presumably because they have had to develop resilience to performing under high self- focussed attention (Baumeister, 1984; Lewis and Linder, 1997). Thus, the inclusion of a moderate anxiety group in this study has important implications for the design of ecologically valid experimental paradigms.

The evening out of awareness as the task progressed over the second half as demonstrated by the lack of significant group differences for observed social cues indicated by key presses, may reflect a slower build-up of awareness of social cues in the moderate social anxiety group at the same time as a slight decrease in awareness in the high and low groups, coinciding with greater attention to emotional clips. This trade-off may represent a conflict in processing demands between visual and cognitive attention. Although the current results are not strong enough in this respect to draw any firm conclusions regarding this, it is possible that reduced attention may be precipitated by cognitions regarding audience social cues because of the cognitive demands of task irrelevant thoughts. This is an issue that researchers may benefit from investigating further.

Post-task ratings demonstrated that the high social anxiety group had less confidence in their social performance and also perceived the audience to evaluate them more negatively than low social anxiety participants did. Thus although behaviours were interpreted more negatively overall, low anxious participants may have been less threatened by this. The results of the post-task self-evaluations are similar to the findings of Christiansen et al. (2003), Perowne and Mansell (2002), Kanai et al. (2009) and Makkar and Grisham (2011). They are also in line with predictions of both the Clark and Well's (1995) and Rapee and Heimberg (1995) models regarding post task processing.

This may have reflected the relative difficulty that high anxious participants had in learning to distinguish a genuine social threat over the course of the task. Whilst the low social anxiety group over the course of the task became relatively more aware of the negative behaviours (which constituted an actual threat) compared to neutral and positive behaviours, the high social anxiety group remained equally aware of all social cues. This may reflect the findings of Eckman and Shean (1997) that over the course of three speeches, self-reported and physical nervousness and arousal decreased significantly more for low anxious participants relative to the high anxious group. Similarly, the high anxiety group also had poorer negative self-evaluation ratings than the low anxious group at post task ratings. Makkar and Grisham (2011) found that following a speech task, negative beliefs and assumptions were greater predictors of post task processing than self-focused attention. It may have been the case that high social anxiety participants in the current study continued to hold the belief that all social cues were potentially a source of threat. This reduced ability to regulate their awareness of a threat cue may have fed directly into the post task negative interpretative bias. This does not provide support for either the Clark and wells or Rapee and Heimberg models of social anxiety but does off a new insight into the nature of attention toward and interpretation of social cues during a social performance.

Furthermore, high social anxiety participants paradoxically responded negatively to receiving positive feedback. Although the difference in ratings was not significantly different between positive and neutral feedback for the high social anxiety group, the relationship between positive and neutral ratings was inverse compared to the other two groups for both self-ratings and perceived audience evaluation ratings. Only the moderate group rated perceived audience evaluation significantly higher with positive compared to neutral feedback but this was largely because the low anxious group had relatively high ratings for perceived audience evaluation with neutral and positive feedback. The detrimental effect of positive feedback in the high anxious group may reflect the findings of Wallace and Alden (1997), that positive social cues were perceived as expectations upon them regarding future actions rather than as a positive evaluation of them. Alternatively they may have felt that the positive feedback was disingenuous.

Heimberg and Schultz (2008) originally suggested that negative biases should be reduced by a less critical audience and this led to the hypothesis that biases would emerge only in the neutral condition. However Weeks and Heimberg (2012) have recently hypothesised that fear of positive evaluation may have equal importance in the maintenance of social anxiety as fear of negative evaluation. Indeed this has been supported by Chen, Clarke, McLeod and Gustellla (2012) who found that reduced attention to positive faces was associated with increased state anxiety in high social anxiety participants. In addition Lange et al. (2012) found that positive priming failed to reduce negative interpretations of high social anxiety participants. Moreover, Weeks and Howell (2012) found that fear of positive evaluation was associated with reduced acceptance of positive social outcomes and increased negative thoughts in socially anxious individuals who received positive evaluation. Furthermore, the effect of fear of positive evaluation has been a recent update to the Rapee and Heimberg model (Morrison & Heimberg, 2013).

These studies along with the results of the current study suggest that the inherent negativity involved in social anxiety is unlikely to be mediated by simple positive appraisal. Therefore, the level of perceived audience criticality appears to operate much more at a cognitive level than from veridical perception of audience cues in the sense that whilst attention to social cues may be instrumental in forming an impression, the meaning of what is being attended to may be distorted.

Limitations

As expected with the complex nature of this study, there were some limitations and one of these may have been the trial presentation times. Any evidence of an early bias to the negative clips or a lag in engaging with positive clips may have been lost over the course of the 4 second trials. Therefore, a limitation of the current study was that the video clips were not controlled enough to ascertain whether positive or negative behaviours captured attention any faster or slower across groups. This was due to the variety of behaviours within clips.

Furthermore since the speed, frequency and magnitude of motion between hand gestures and head turns was not measured precisely, it would be difficult to isolate the cause of any saccadic reaction times to the valence of the social cue rather than to another artefact of the behaviour. In subsequent studies researchers may wish to research initial orientation to faces and social gestures in a social speech task using tightly controlled dynamic stimuli and it may be easier to do this through computer generated avatars which can be designed to control for each of the factors. In addition, the standardisation of behaviours and locations through randomised presentations may have been achieved at the cost of the panel appearing natural. The lack of attentional differences in the first block across clip types may have been due to the rapid dynamic changes rather than situational anxiety. Therefore, it may be useful for researchers to replicate the study using the original arrangement that Perowne and Mansell (2002) used.

A further limitation of the study was the lack of inclusion of a measure of state anxiety, particularly given the assumptions made regarding situational anxiety.

However, in the Mullins and Duke (2004) study, self-report post-test state anxiety measures revealed that anxiety was significantly higher for participants in the moderate (alone with threat of having to deliver an evaluated speech) and high (experimenter as observer and a speech threat social threat conditions) compared to the low anxiety condition (experimenter as observer) or no threat condition. Therefore, since the current study was conducted with the experimenter as an observer and with a threat of social evaluation in situ, it is reasonable to assume that state anxiety was high. Moreover, administering a state anxiety questionnaire may fail to capture an accurate measure of anxiety across the time course of a speech task. In future studies it would be useful to include a measure of state anxiety both before the task and also a measure of physiological arousal during the task. This would enable any changes in attention of awareness to be mapped directly to the situational anxiety elicited by the task.

Furthermore, whilst in the current study there were no significant differences in attention between groups, the mean proportions of fixations and dwell time for block 1 indicated that the high social anxiety group directed slightly more attention towards negative and neutral clips and slightly less towards positive clips compared to the low social anxiety group. The pattern, although weak, is consistent with biased attention towards negatively perceived social cues and a reduction in attention towards positive social cues.

If in future researchers were able to replicate the study with more of a group split between social anxiety scores across groups, then any significant effects found that were consistent with this pattern may be associated with a negativity bias and a deficit in the positivity bias in high social anxiety individuals. However, the pattern appears to have been further weakened in the second block as both groups looked more towards emotional clips than neutral dynamic clips. Although no firm conclusions can be drawn from these results regarding group differences in attentional biases during social performance, the patterns found in block 1 of the experiment provide the basis for further studies of this nature.

In conclusion, there was no evidence of group differences in attention in the current study but this may in part be due to the type of paradigm used. It is possible that with a more naturalistic paradigm group differences for early and sustained attention may emerge. Notwithstanding this possibility, the results suggest that avoidance or vigilant biases may be less crucial in the cycle of anxiety as has previously been suggested by models such as the Clark and Wells (1995) and Rapee and Heimberg (1997) models of social anxiety. Rather, any brief attention to an external social cue may be sufficient to exacerbate the perception of predominately negative facial expressions or gestures. Evidence of positive evaluation may also result in reduced social confidence leading to difficulties distinguishing a genuine social threat in more socially anxious individuals.

Chapter 7

General Discussion

The aim of this thesis was to investigate the existence of an online negativity bias in social anxiety in which negative information taken directly from the environment, in this case negative social cues from an audience, are given more weighting than positive or benign social information (Baumeister, 2001, Hirsch and Matthews, 2000). Furthermore, the studies herein were designed as an attempt to understand the underpinning mechanisms of a negative interpretation bias in socially anxious individuals by measuring direct attention using eye tracking methodology. Two models of social anxiety have dominated the literature regarding the processes involved in the maintenance of anxiety in social situations. The Clark and Wells (1995) model asserts that during a social performance or interaction, attention is directed away from the external environment (audience or social threat) inwardly towards internal processes driven by a preoccupation with self-focused attention. The assumed reduction in attention towards external social cues means that any negativity bias must operate offline (i.e. not through direct input from the environment) but rather, through faulty assumptions and memories. In contrast, the Rapee and Heimberg (1997) model counters that attention is split between the audience and the self, with a negativity bias being formed directly through the perceptions of negative social cues emitted from the audience.

Static face paradigm as a tool to investigate a negative attentional bias

Static face processing paradigms have provided mixed evidence for either model. Some studies have provided evidence for enhanced attention to threat faces as the Rapee and Heimberg model suggests (Klumpp & Amir, 2009; Mogg & Bradley, 2002; Mogg, Philippot, & Bradley, 2004; Pishyar, Harris & Menzies, 2008; Sposari & Rapee, 2007), others have found that this is followed by avoidance (Amir, Elias, Klumpp, & Przeworski, 2003; Chen, Ehlers, Clark, & Mansell, 2002; Mansell, Clark, Ehlers, & Chen, 1999; Mogg & Bradley, 2002; Mogg, Philippot & Bradley, 2004; Stirling, Eley & Clark 2006). Yet other studies have failed to find any evidence of attentional biases in social anxiety (Clark, & Chen, 2002; Gamble & Rapee, 2009; Horenstein & Segui, 1997; Kanai, Nittono, Mansell, Ehlers, Pineles & Mineka, 2005; Kubo, Sasaki-Aoki & Wanaga, 2012). Such conflicting results should be viewed in the context of the diverse paradigms, stimuli, sample sizes and social anxiety measures with which they have been investigated.

A considerable amount of research using static face paradigms has done so without the anxiety evoking component of having to make a speech, which Schultz and Heimberg (2008) suggest more closely resembles an anxiety provoking situation for socially anxious individuals because they have real social cues to perform to. Whilst facial expressions in static face paradigms are constant, dynamic three dimensional facial expressions fluctuate across a series of micro-expressions. This may change the nature of visual attention to the face. Thus, the static face paradigm with constant expressions and no threat cue does not adequately represent a social situation, so evidence of attentional patterns of socially anxious people are limited in what they can convey about the effect of engagement with an audience in a social context.

In this line of reasoning, patterns that suggest avoidance of faces, which may be taken to support the Clark and Wells (1995) model do not really make sense in the context of a static face paradigm. Since the model suggests that reduced attention to external faces is due to increased attention to the self-image then it seems unlikely that this would happen when the socially anxious individual was in a lab setting viewing faces and not actually giving a speech.

Even static face paradigms that have included a social speech threat may not really tap into the processes involved in actually being confronted with a live audience. The increased anxiety caused by the prospect of being in an anxiety provoking situation may precipitate amygdala activity. Indeed increased amygdala and occipital activity has been found for high social anxiety individuals in anticipation of negative and ambiguous face pictures (Brühl et al., 2011) which could affect processing styles since these areas are thought to be involved with arousal, perception and attention. Langner et al. (2011) have suggested that increased scanning behaviour in socially anxious individuals may be linked to amygdala activity and the tendency to adopt a more configural processing style when categorising face photos.

This is quite distinct from the effect of the face itself in real time in a social situation as there is likely to be rapid changes across stimuli and the act of viewing an audience is secondary to goal maintenance in terms of delivering a performance. What static face paradigms can tell us is that there may be differences in socially anxious people in their general processing styles and as such these studies are not redundant but may need to be interpreted independently of the arguments to support or refute cognitive behavioural models of social anxiety. Studies 1-3 of this thesis investigated cognitive processes in face perception using static face paradigms.

Categorisation of facial expressions

The Clark and Wells (1995) model infers that positive social cues such as smiling or nodding are missed as a result of a reduction in attention to the audience in high social anxiety individuals. The majority of research into a deficit in the positivity bias has been conducted using word probes and ambiguous sentence paradigms (Amir et al., 2012; Calvo et al., 1994; 1997, Hirsch et al., 2006, Hirsch & Matthews, 2000, Moser et al., 2008). However Chen et al. (2012) found evidence to suggest that socially anxious individuals disengaged more rapidly from positive faces than negative faces compared to less anxious participants, but it is difficult to draw conclusions from this as it could support a diminished reward from a socially affirming cue, or enhanced vigilance of a social threat. Either account would assume that on some level the face had been categorised prior to a behavioural response.

The role of context in attention to and categorisation of facial expressions

The aim of the Study 1 was to investigate the relationship between context (i.e. public evaluation) and the processing of facial features to evaluate the role of cognitive processes during and after face categorisation. The paradigm was an eye tracking composite face categorisation task with context based sentence primes. Results suggested that categorisations of social cues can be made on just one or two brief fixations of less than 200ms on average. Therefore, categorisation of social cues may be efficient under very restricted attention conditions, which casts doubt on the premise of a deficit in the positivity bias being underpinned by missing positive social cues since even in the briefest of glances, information can be encoded about the valence of the face. Any evidence of a reduction in attention to positive face thereafter may simply reflect a behavioural response.

Furthermore, the results indicated that emotion categorisation occurred independently of context. However, the effect of viewing an emotional face on the observer involved higher cognitive processes such as prior expectations and self-relevance. From these results it seems rather that context has a role to play in perceiving the intensity of the emotion possibly during more elaborative processing stages involving social cognition when meaning is attached to the face.

In support of Rapee and Heimberg (1997), categorisation and internalisation of the emotion on the face as well as the impact on self-esteem were intensified with congruent self-referential context. Specifically, a face categorised as negative which was preceded by a negative self-referential statement about the cognitions underlying the facial expression was rated as more intensely negative, internalised more (i.e. rated as the expression being caused by the participant more) and was associated with greater negative self-esteem ratings. Positive context/face parings also intensified the positive valence rating, increased internalisation and increased positive self-esteem but negative pairings were more powerful for composite faces.

Yet context appeared to have no direct effect on attention in terms of how individuals categorise a face. Rather, attention appears to be dependent on visual salience. Context in the form of sentence primes presented prior to the presentation of a face photo had no effect on fixations which were solely guided by salience. Happy mouths appeared to be the most visually salient feature overall, as they received a higher proportion of fixations and dwell time and happy eyes the least salient. Furthermore, context did not affect discrete categorisation of faces which was made on the basis of the feature that occupied the most attention relative to other configurations. Whilst Study 1 was based on a sample from the general population, it may be the case that the categorisation process occurs more efficiently for socially anxious individuals because they have an inherently different processing style, which then combines with negative expectations.

Conscious processing of faces in social anxiety

It has been suggested (Langner et al., 2010) that socially anxious individuals process facial expressions in a more configural than feature based style. This may be due to differential amygdala activity in socially anxious individuals because they are more susceptible to low spatial frequency processing and the amygdala has been found to be more sensitive to this (Vuilleumier & Pourtois, 2007). However, there is also evidence that despite no differences in categorising emotional faces, high social anxiety individuals rate faces to be less approachable than low social anxiety individuals, which infers a role for conscious processing (Campbell et al., 2009). The aim of Study 2 was to investigate the nature of conscious face processing across levels of social anxiety by using an online face processing task with ambiguous composite faces.

The results suggested that angry eyes are generally threatening across anxiety groups since faces with angry eyes received the most negative valence ratings, were least likely to be approached and more likely to be avoided. This general response may reflect the lower anxiety scores in the study compared to those in the study by Campbell et al. (2009) but it suggests that such responses to threat are likely to operate on a continuum as Rapee and Heimberg (1997) suggested. However, the results also appeared to support a configural processing account since high social anxiety participants reported that they based their categorisations of facial emotions more evenly across the eyes and mouth region for faces with socially threatening eyes whilst less anxious participants extracted more information from the eye region to base their decision on.

Therefore, whilst there appears to be a general conscious protective behavioural response to threat faces, what may be specific to socially anxious individuals is the way in which they extract information from faces. This could potentially result in apparent avoidant biases in static face paradigms being misperceived by researchers as being indicative of evidence to support reduced attention during social situations as predicted by Clark and Wells (1995). In fact it may simply reflect a different processing style which does not result in a reduction in the social information being received by the socially anxious individual. In summary, the results from Studies 1 and 2 suggest that attentional patterns when processing faces, both at an automatic and conscious level are not related to differences in cognitions across anxiety groups.

Attentional control as a function of social anxiety

Bogels and Mansell (2004) suggested that differences in attentional biases may be related to individual differences in attentional control. Individual differences in the way that individuals can control their attention towards a goal oriented stimuli and ignore an irrelevant stimuli may influence the ability of some socially anxious individuals to control their attention towards audience faces that they perceive as being critical. An efficient processing system leading to initial vigilance of a social threat cue such as a critical looking face may give rise to subsequent avoidance for some individuals who are able to divert their attention away from the anxiety provoking stimulus, whilst others with weaker attentional control may find it more difficult to inhibit a socially threatening face. Yet there has been little research reported on with respect to social anxiety and attentional control. Wieser et al. (2009) provided some mixed evidence of poor attentional control to angry faces in a static face antisaccade task but this was only in comparison to a mid-anxiety group with no differences emerging between the high and low anxiety group.

The aim of Study 3 was to investigate the relationship between attentional control and social anxiety under conditions of increased socio-cognitive load which would emulate the types of expectations of an audience member's thought processes as the speaker delivers a performance. In this way, although a static face paradigm was used, the addition of context increased the sociocognitive load in a way that may be more representative of a real performance situation.

The results of this study indicated that socially anxious individuals struggled under conditions of increased social cognitive load to inhibit more ambiguous facial expressions, indicated by a higher error rate in the antisaccade task. This may reflect the conclusions of Carver and Scheier (1988) that anxiety coupled with cognitive load places a strain on the working memory system but as Amir and Bomyea (2011) demonstrated, socially anxious individuals have greater working memory for emotional as opposed to neutral information. A greater working memory for emotional information could lead emotional faces to be processed more readily than neutral faces.

Summary findings from static face paradigms

In summary, the investigations using static face paradigms conducted in this thesis demonstrate that attentional patterns when processing faces do not appear to be related to differences in cognitions across anxiety groups. Some static face paradigms may therefore be limited in the knowledge that they can convey about how socially anxious individuals are likely to behave in a social performance situation, and more importantly, why any differences occur. However, the antisaccade task accompanied with a sociocognitive load may provide more transferable information. The additional processing required when sociocognitive load is added to the task appears to affect the way in which those with higher social anxiety inhibit emotional compared to neutral information.

Whilst increasing the social relevance of faces in a static face antisaccade paradigm was associated with increased avoidance of emotional faces, neutral faces may have been more difficult to inhibit if socially anxious individuals are more sensitive to emotional faces which may be associated with being an indicator of social evaluation. It is possible that this process could also be demonstrated in a real performance situation which could potentially lead a socially anxious individual to ruminating on the meaning of a neutral face, whilst they may be faster in making assumptions about an emotional face, particularly negative faces which affirm their pre-existing negative expectations. This requires further research using a more ecologically valid paradigm and would be a useful area to be considered for further research. However, such a paradigm would require a great deal of control over the stimuli used. As the ultimate aim of this thesis was to investigate the existence of an online negativity bias in social anxiety and the role of attention in this, more naturalistic dynamic stimuli were used for studies 4 and 5.

Dynamic face paradigms

It cannot be assumed that similar processing will occur across static and dynamic stimuli. For example, Biele and Grabowska (2006) found that angry dynamic facial expressions were rated more intensely than angry static faces. This may be because the situation feels more socially threatening as it resembles a closer representation of reality. The cyclical pattern of attention and interpretation that may occur during a real performance situation in front of real audience faces which may be accompanied by gestures cannot be adequately represented by static face processing paradigms. However, there has been a dearth of ecologically valid studies which have measured attention directly to investigate this.

The aim of Study 4 was to measure social anxiety related differences in processing times for dimensional categorisations in a relatively naturalist paradigm using real video clips rather than morphed static images. Results suggested that socially anxious participants categorised dynamic social cues (i.e. facial expressions and gestures) more rapidly than low anxious participants did. Socially anxious participants also interpreted neutral facial expressions significantly more negatively than low anxious participants did and there was a trend for more negative interpretations across facial expressions generally in the high anxious group.

This may have been partly caused by an accumulation of attention and interpretation cycles across the trial which contained moment to moment subtle changes in expressions and movements. This could potentially result in parts of the clips looking more negative or ambiguous to socially anxious participants as the micro-expressions altered from across the clip. It is possible that for each of these micro expressions a comparative process rapidly occurs to compare the expression with the expectations of the socially anxious participants.

If repeated cycles of this comparative process accumulatively increase the perceived negative valence of facial expressions as the expectation is repeatedly confirmed by a seemingly negative response then it may lead to a more negative impression overall of audience evaluation. This may be more pronounced with dynamic neutral and positive clips than it is with static images because of the fluctuating nature of the images. Rather than staying constantly neutral or positive, they may lapse into more ambiguous or negative looking micro expressions over the course of the social cue. If socially anxious individuals can process social cues more efficiently then it is not surprising that they may be more receptive to these subtle changes.

The results from Study 4 demonstrate that an online negativity bias could potentially be the product of faster processing times in response to dynamic faces and more negative interpretations in socially anxious individuals rather than being dependent on attentional processes. Furthermore, socially anxious individuals appear to have more liberal criteria for social threat, evidenced by their more negative interpretation of neutral cues than their less socially anxious counterparts. It is possible that socially anxious individuals may categorise dynamic neutral faces as more socially threatening than they do static neutral faces which again may call into question the relationship between attentional biases on static face paradigms and cognitive behavioural models of social anxiety.

Attention, awareness and discernment of social cues across social anxiety groups in an ecologically valid speech task with dynamic social cues

Schultz and Heimberg (2008) advocated the use of a speech paradigm as a more ecologically valid means of testing attentional biases to threatening social cues because it mimics, socially, an anxiety provoking situation. Several speech paradigms have been conducted but all without any direct measures of attention. Results from these studies suggest that socially anxious individuals interpret audience evaluation of their performance in a more negative light than less anxious individuals. However, Veljaca and Rapee (1998) found using an audience based speech task that high social anxiety participants included more types of social cue as being indicative of a social threat than low social anxiety participants did. Furthermore Kanai et al. (2009) found that high anxiety participants rated negative social cues more intensely in a speech paradigm.

Thus, in order to bring the previous findings together by investigating valence categorisation of social cues with processing times and attention, an ecologically valid speech task was conducted in Study 5, which involved participants delivering a social performance to an onscreen ‘live panel’ comprising pre-rated video clips of dynamic positive, negative and neutral social cues. Results for the first half of the task indicated that visual attention was equal across groups, indicated by a lack of any significant differences in proportions of fixations or dwell time across groups or valence of trials. Yet the high social anxiety group reported being more aware during the task of social cues than the moderate social anxiety group with the low social anxiety group nestled between the other groups. This was indicated by a higher proportion of keys pressed in response to having noticed a positive or negative audience response. Therefore, in social performance situations there is no clear evidence thus far to be able to claim that interpretative biases are associated with attentional biases to social threat cues such as negative facial expressions and/or negative audience gestures.

Yet the pattern of means were consistent with slightly enhanced attention to negative and neutral cues in the socially anxious group and slightly reduced attention to positive social cues. It is possible that using a more clinical sample with wider between group differences in social anxiety levels could have resulted in significant differences in attention across groups. If this reflected the pattern of means in the current study then this would support both the Rapee and Heimberg model, in indicating enhanced attention to negatively perceived social cues and the Clark and Well's model by endorsing a reduction in attention to positive cues, thereby limiting positive affirmation.

However, individual differences in attentional control may influence the ability of some socially anxious individuals to control their behavioural response. An efficient processing system leading to initial vigilance may give rise to subsequent avoidance for some individual who are able to divert their attention away from the anxiety provoking stimulus, whilst others with weaker attentional control may find it more difficult to inhibit a socially threatening face. Pairing performance on a dynamic attentional control task with attention to social cues on a speech would be a paradigm worthy of further research to investigate this theory.

Another potential source of individual difference could be in relation to the perception of social cues since Young Jun et al.(2013) found that males but not females had a wider cone of gaze perception. However in the current study there were no significant between group differences for gender distribution so any effects of awareness of social cues is unlikely to have been confounded by gender differences.

Even in the absence of apparent attentional differences across groups there can still be differences in awareness of social cues. The pattern is somewhat surprising in terms of the lack of significant differences between the high social anxiety and low social anxiety groups but this may reflect over-confidence on the part of the low social anxiety group that was somewhat undermined when they found themselves having to deliver a performance in front of an actual panel.

Yet as the task progressed to the second half, more attention was paid to emotional clips across groups, evidenced by a higher proportion of fixations and dwell time to positive and negative dynamic clips in the matrix than neutral dynamic clips. The low social anxiety group were more aware of negative social cues than positive or neutral ones whilst the high social anxiety group were equally aware of all social cues. Post-task, high social anxiety participants had less confidence in their own performance and in the audience evaluation of their performance. This suggests that rather than there being attentional differences as a function of social anxiety in response to dynamic social cues during a speech task, socially anxious individuals may find it difficult to discern a genuine social threat as they may be more likely to interpret more types of social cues as being threatening than less anxious individuals. Paradoxically positive evaluation lowered their perception of a positive audience evaluation which again suggests that they have difficulty discerning genuine threat or positive appraisal.

Processing efficiency as a function of level of social threat

Conclusions from Study 4 suggested that an online negativity bias in socially anxious individuals could potentially be the product of faster processing times in response to dynamic faces, and more negative interpretations in socially anxious individuals rather than being dependent on attentional processes. However, in Study 5, for the high social anxiety group, and to a lesser extent the low social anxiety group, reaction times for recording the observation of a social cue were slower compared to a more moderately anxious group who initially appeared to be less aware of the social cues.

The difference between reaction times for noting a positive or negative social cue between Study 4 (moderate social stressor: imagined social performance) and Study 5 (high social stressor: actual social performance) are noteworthy in being similar to the pattern found by Mullins and Duke (2004). High social anxiety participants in Study 4 processed clips more rapidly than the low social anxiety participants. Yet in Study 5, high social anxiety participants had significantly slowed reaction time relative to the moderate social anxiety group. This may reflect the increase self-relevant processing of the faces in a situation where the participants had been led to believe that their performance was being evaluated in real time.

As high social anxiety participants performed and noticed social cues they may have had to reflect on what they had just being saying and how they expect the panel to respond to it in combination with trying to read the expression on the panel member's face to help them to make a decision on whether the response was positive or negative. This involves a self-monitoring component in addition to the generation of expectations and categorisation in order to arrive at a decision making process.

The high social anxiety group may have been more likely to ruminate on their performance at the self-monitoring stage than the less anxious group because of their lack of confidence, and they may also find it more difficult to distinguish facial expressions as a result of this.

The lack of a difference between the high and low anxiety group may be the result of over-confidence in the latter group leaving them unprepared for the situational anxiety experienced during a speech task in which they were faced with six ‘live’ panel members. This may have slowed their responses somewhat as well which may have resulted in them being slightly more aware of social cues because they have taken more time to process them, although less so than the high anxiety group. Furthermore, overall social cues were categorised substantially faster in Study 5 than they were in Study 4. However, this may have been due to task effects since Study 4 was a basic categorisation task without an additional stressor whilst in Study 5, categorisation of observed social cues was a secondary task to the main anxiety provoking performance task.

Summary of findings from dynamic social cue tasks

In summary the findings from the dynamic social cue studies used in this thesis suggest that contrary to popular models of social anxiety, attentional biases may not be central to the maintenance of social anxiety. Rather the briefest of observations with a negatively perceived social cue may enough to start a cascade of negative cognitions about the negative self-relevance of the observed facial expression or gesture. Processing of social cues may be generally more efficient in socially anxious individuals but may be slowed by a particularly high social threat.

However, socially anxious individuals appear to find it more difficult than less anxious individuals to discern a genuine social threat and also appear to have difficulty accepting the authenticity of positive evaluation and these difficulties may be central to them perceiving social threat cues as more threatening than less anxious individuals do. This could explain the occurrence of an online negativity bias that depends on some interaction with the audience but does not depend on an attentional bias towards or away from social cues.

Limitations and future directions

It is important to note some general limitations in the studies conducted in this thesis. For example, social anxiety scores were not generally at clinical levels although there were some variations in this. Therefore it cannot be concluded that any of the effects found in these studies are typical of the responses that may be associated with clinical social anxiety disorder or social phobia. Yet the conclusions provide a possible explanation for the role that visual attention to the external social environment may play in social anxiety at any level. Another general weakness was that none of the studies included a control group (i.e. with OCD or trait anxiety) so it cannot be verified that any group differences were exclusive to social anxiety rather than the general effect of anxiety. However, there did not appear to be evidence of trait anxiety contributing substantially to any effects found in the high social anxiety group given the non-significant correlations between task measures and trait anxiety. Nonetheless, the next natural step for researchers would be to test some of the studies used in this theses with a clinically socially anxious sample including various other types of non-social anxiety disorders as well as sub-types of social anxiety.

Studies 1 and 2 involved processing of composite faces, which may have somewhat lacked ecological validity. However, the nature of the categorisation task was to ascertain decisions made based on the more dominant feature and as such these configurations were necessary to draw out conclusions about this. An alternative paradigm would have been to use isolated features but this would have lacked the competitive element. Notwithstanding the objectives of these experiments, it may be useful to measure attention to facial features in dynamic video based faces. The quality of the videos in the current study and the size within the presentations on screen made it difficult to extract this type of information in Study 5 but it would be useful for researchers to conduct eye tracking studies of this nature in a more controlled context.

Another general limitation was in regard to the use of control stimuli. For example in Study 3, an inverted face appeared to be an inadequate control because of the social relevance that still may be applied to it rather than an object. In light of potential differences in salience between objects and faces, it may be useful for researchers in future studies to include a skin coloured oval to represent a control stimulus. The studies contained within this thesis were also limited by the lack of inclusion of a state anxiety measure. It was initially considered that since state anxiety was likely to fluctuate over the course of the experiments and particularly in relation to Study 5, it may be misrepresentative of state anxiety on the whole to include a measure of this at the beginning of the experiment only. Thereafter there was not an adequate opportunity to include this during the interview process or during any of the other experimental procedures. However, in retrospect it would have been useful to have included a state anxiety measure at break points in experiments as well as before and after the experiments. This could have helped to build a picture of the contribution of state anxiety to effects found in each of the trait anxiety groups. Physiological measures of state anxiety during the task would also be a useful addition.

Furthermore, notwithstanding the novel contribution of Study 5 in particular to knowledge about attention and interpretation of social cues in social anxiety using an ecologically valid paradigm, it must be noted that this did not represent a fully natural situation. Although there were benefits in this approach in terms of being able to obtain a measure of online interpretation, it may be useful for researchers to conduct similar studies without the manual response and also in a more naturalistic setting by making use of mobile eye tracking technology. Moreover, the conclusions drawn regarding lack of differences in attention were made on the basis of overall attention to the clip rather than to initial orientation or reduced/prolonged engagement to particular elements within the clip.

It is possible that by measuring attention in a more controlled way evidence of attentional biases would have emerged. However, it would be likely that this would be evident in the overall durations of attention to each clip type since there were only a small number of rapid fixations made to each clip type. In addition, in relation to the Clark and Well’s (1995) and Rapee and Heimberg (1997) models of social anxiety one would expect a significant reduction or enhancement of attention to social cues which was not evident in Study 5.

Conclusion

In summary Studies 1 and 2 using static face categorisation paradigms suggest that attentional patterns when processing faces do not appear to be related to differences in cognitions across anxiety groups, suggesting that they may have limited application in providing evidence for cognitive-behavioural models of social anxiety. The antisaccade paradigm with a sociocognitive load component used in Study 3 was informative in indicating that the extra processing demands of processing social information whilst trying to inhibit a face may result in poor attentional control to neutral faces which have less salient emotional cues than emotional faces in socially anxious individuals. If neutral dynamic social cues are perceived negatively by socially anxious individuals as the results of Study 4 suggest they are, then difficulties in inhibiting them could lead to a more negative impression of the audience.

However, the results for the more ecologically valid dynamic social cues paradigm used in Study 5 suggest that biased attention is not likely to be central to the maintenance of social anxiety. A brief observation of a negatively perceived social cue would be sufficient to precipitate a cognitive bias in conjunction with negative expectations of social evaluation. Overall, attention and categorisation appear to be based on salience of facial features in that attention is drawn to the most expressive features and categorisations are made on the basis of features that are most attended to. Discrete categorisations of facial expressions may interact with prior negative expectations to increase negative perceptions of social cues in socially anxious individuals. As facial expressions and gestures are being encoded and rapidly categorised they may be automatically compared to the individual's expectations and social cues that are congruent with negative expectations may be more readily integrated in the negative self-construct and perception of the audience evaluation. This is then likely to be the pivotal stage that determines the occurrence of an online negativity bias yet it does not rely on an attentional bias.

As demonstrated by Study 4, processing of dynamic social cues may be generally more efficient in socially anxious individuals, but a high social threat such as a real performance situation such as that employed in Study 5 may disrupt this process because of the interference of situational anxiety. This may reflect the further finding that socially anxious individuals appear to find it more difficult than less anxious individuals to discern a genuine social threat, and also appear to have difficulty accepting the authenticity of positive evaluation and these difficulties may be central to them perceiving social threat cues as more threatening than less anxious individuals do. This could explain the occurrence of an online negativity bias that depends on some interaction with the audience but does not depend on an attentional bias towards or away from social cues. Further research should be conducted to validate and extend the findings discussed in this thesis. However, the studies contained herein contribute knowledge to the field by exploring the relationships between social anxiety, salience of emotional social cues, context, processing efficiency and awareness in novel static and ecologically valid dynamic social cue paradigms with direct measures of attention.

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Appendices

Appendix I(i) Pilot Study A. *Validation of evaluative and contextual primes*

In order to prime expectancies about the context of the facial expressions used in study 1, a pilot study was conducted to validate the valence of prime sentences. The content of the sentences was based on valences and references towards or away from the self. It was predicted that statements that were self-referential would be rated more intensely for valence than non-self-referential or neutral statements.

Method

Participants

47 participants were recruited through the university campus and the community to rate a series of statements. These had been constructed to mimic the types of negative self-referential thoughts about public evaluation that is thought to occur in the cognitions regarding negative evaluation in socially anxious individuals (i.e. Rapee & Heimberg). Demographic information was not recorded for the pilot statement rating stage. The study was given ethical approval by the University of Strathclyde School of Psychological Sciences and Health Committee.

Materials and procedure

250 prime statements (Appendix I(ii)) were constructed to be positive, negative or neutral and self or non-self-referent with only the target words changed in valenced statements so that each was of equal length and structure. For example,

‘Kate was convinced that with [you] *or* [them] the night would be a [disaster] *or* [success]’. Neutral primes included statements such as ‘Kate opened the window’. The valence of each emotional statement depended on a depressogenic word and its antonym such as ‘crestfallen’ or ‘elated’ and the statement was designed to reflect either a social performance or a social interaction situation.

The information sheet was presented at the beginning of the experiment and the consent form was signed. Emotional statements were independently rated for valence by 20 independent raters. In order to retain consistency in valence ratings between primes, statements which fell within the range of above 3.5 to 4.5 on a 5 point Likert scale for agreement that the statement was positive, negative, social or performance type were included in the final selection and those which fell out with this range were replaced with new statements which were again rated until a final sample of 250 statements with 50 positive statements of each type was obtained. Neutral statements were accepted if they fell within the range of -0.5 to 0.5. The final selection of statements were then rerated by a separate 27 raters who were asked to rate the valence of the statement on an 11-point scale ranging from –5(*very negative*) to 0 (*neutral*) to +5 (*very positive*) (e.g. Weary & Reich, 2001).

Results

Descriptive statistics presented in Table A.1 suggests that positive, negative and neutral statements differed considerably on ratings based on an 11-point scale ranging from –5(*very negative*) to 0 (*neutral*) to +5 (*very positive*).

Table A.1

Mean ratings for each prime type

Statement type	Mean	SD
Negative non self-referential (Neg-Non-Self-Ref)	-2.34	0.83
Negative self-referential (Neg-Self-Ref)	-2.62	0.94
Neutral	0.17	0.33
Positive non self-referential (Pos-Non-Self-Ref)	2.49	0.81
Positive self-referential (Pos-Self-Ref)	2.70	0.72

A Shapiro Wilk's test showed that responses to the neutral primes were not normally distributed (p < 0.001) and Mauchly's test indicated that the assumption of sphericity had been violated ($\chi 2(9) = 178.15$, p < 0.001). Therefore ANOVA was used with degrees of freedom corrected using the Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.28$) and followed up with non-parametric analysis to confirm the results.

A one-way ANOVA with prime type (5) as a repeated measures factor revealed a highly significant main effect of statement type $F(1.11, 28.79) = 257$, $MSE = 2.45$, $p< 0.001$, $\eta_p{}^2 = 0.91$ *Power* = 1. Bonferroni contrasts revealed that positive primes (positive non-self-referential: M = 2.49, SE = 0.16; Positive self-referential: M = 2.7, SE = 0.14) were rated positively and significantly more positive than neutral (M = 0.17, SE = 0.06, p <0.001) or negative primes (Negative non-self-referential: M = -2.34, SE = 0.16; p <0.001; Negative self-referential: M = -2.62, SE = 0.18) which were rated negatively and significantly more negatively than neutral primes (p <0.001). Furthermore, positive self-referential statements were rated significantly more positively than positive non-self-referential statements (p <0.001) and negative self-referential statements were rated significantly more negatively than Negative non-self-referential statements ($p = 0.001$).

Results from the pilot study confirmed that prime sentences were reliably different in terms of valence ratings and that self-referential sentence primes were as predicted, associated with more extreme ratings in each valence direction. As well as validating the prime sentence for use in the subsequent study, the results from the sentence rating pilot study suggest that self-relevant context alone can increase emotional responses to public evaluation.

Appendix I(ii) Pilot Study A *Prime statements*

PRIMETYPE	PRIME
Positive – Internal	Ben looked cheerful when you approached him
Positive – External	Ben looked cheerful when they approached him
Negative – Internal	Ben looked dejected when you approached him
Negative – External	Ben looked dejected when they approached him
Neutral	Ben opened the envelope
Positive – Internal	Sue was elated to hear she would be spending time with you
Positive - External	Sue was elated to hear she would be spending time with them
Negative - Internal	Sue was dejected to hear she would be spending time with you
Negative - External	Sue was dejected to hear she would be spending time with them
Neutral	Sue bought the ticket
Positive - Internal	Ben gladly approached you to join him
Positive - External	Ben gladly approached them to join him
Negative - Internal	Ben reluctantly approached you to join him
Negative - External	Ben reluctantly approached them to join him
Neutral	Ben opened the window
Positive - Internal	Sue was filled with glee at the prospect of being with you
Positive - External	Sue was filled with glee at the prospect of being with them
Negative - Internal	Sue was filled with gloom at the prospect of being with you
Negative - External	Sue was filled with gloom at the prospect of being with them
Neutral	Sue poured a drink
Positive - Internal	Ben experienced emotions of pure bliss when he saw you
Positive - External	Ben experienced emotions of pure bliss when he saw them
Negative - Internal	Ben experienced emotions of pure misery when he saw you
Negative - External	Ben experienced emotions of pure misery when he saw them
Neutral	Ben walked outside
Positive - Internal	Sue was happy about having you for the duration

Positive - External	Sue was happy about having them for the duration
Negative - Internal	Sue was gloomy about having you for the duration
Negative - External	Sue was gloomy about having them for the duration
Neutral	Sue sat quietly
Positive - Internal	Ben felt cheerful that you would be included
Positive - External	Ben felt cheerful that they would be included
Negative - Internal	Ben felt glum that you would be included
Negative - External	Ben felt glum that they would be included
Neutral	Ben emptied the bucket
Positive - Internal	Sue looked jolly when she saw you
Positive - External	Sue looked jolly when she saw them
Negative - Internal	Sue looked miserable when she saw you
Negative - External	Sue looked miserable when she saw them
Neutral	Sue walked home
Positive - Internal	Ben appeared elated to be associated with you
Positive - External	Ben appeared elated to be associated with them
Negative - Internal	Ben appeared crestfallen to be associated with you
Negative - External	Ben appeared crestfallen to be associated with them
Neutral	Ben brushed the floor
Positive - Internal	Sue was overwhelmed with joy when she saw you
Positive - External	Sue was overwhelmed with joy when she saw them
Negative - Internal	Sue was overwhelmed with sorrow when she saw you
Negative - External	Sue was overwhelmed with sorrow when she saw them
Neutral	Sue walked to work
Positive - Internal	Mark always felt happy when he socialized with you
Positive - External	Mark always felt happy when he socialized with them
Negative - Internal	Mark always felt low when he socialized with you
Negative - External	Mark always felt happy when he socialized with them
Neutral	Mark drove home
Positive - Internal	Gail was jubilant at the thought of spending time with you
Positive - External	Gail was jubilant at the thought of spending time with them
Negative - Internal	Gail was downcast at the thought of spending time with you
Negative - External	Gail was downcast at the thought of spending time with them
Neutral	Gail turned the light on
Positive - Internal	Mark appeared happy when you came in
Positive - External	Mark appeared happy when they came in
Negative - Internal	Mark appeared melancholy when you came in
Negative - External	Mark appeared melancholy when they came in
Neutral	Mark listened to the radio
Positive - Internal	Gail felt happy when she realized that you would be involved
Positive - External	Gail felt happy when she realized that they would be involved
Negative - Internal	Gail felt miserable when she realized that you would be involved
Negative - External	Gail felt miserable when she realized that they would be involved
Neutral	Gail listened to the music

Positive - Internal	Mark felt overjoyed that you had accompanied him
Positive - External	Mark felt overjoyed that they had accompanied him
Negative - Internal	Mark felt heartbroken that you had accompanied him
Negative - External	Mark felt heartbroken that they had accompanied him
Neutral	Mark was on the telephone
Positive - Internal	Gail felt enormous satisfaction that you were with her
Positive - External	Gail felt enormous satisfaction that they were with her
Negative - Internal	Gail felt enormous regret that you were with her
Negative - External	Gail felt enormous regret that they were with her
Neutral	Gail walked to the newsagents
Positive - Internal	Mark was satisfied when he discussed it with you
Positive - External	Mark was satisfied when he discussed it with them
Negative - Internal	Mark was disappointed when he discussed it with you
Negative - External	Mark was disappointed when he discussed it with them
Neutral	Mark waited at home
Positive - Internal	Gail was filled with happiness when she knew you had arrived
Positive - External	Gail was filled with happiness when she knew they had arrived
Negative - Internal	Gail was filled with woe when she knew you had arrived
Negative - External	Gail was filled with woe when she knew they had arrived
Neutral	Gail heard the noise
Positive - Internal	Mark was euphoric about sitting next to you
Positive - External	Mark was euphoric about sitting next to them
Negative - Internal	Mark was despondent about sitting next to you
Negative - External	Mark was despondent about sitting next to them
Neutral	Mark put the packet away
Positive - Internal	Gail attributed her exhilaration to spending time with you
Positive - External	Gail attributed her exhilaration to spending time with them
Negative - Internal	Gail attributed her depression to spending time with you
Negative - External	Gail attributed her depression to spending time with them
Neutral	Gail looked out of the window
Positive - Internal	Ross felt he was fortunate because he was with you
Positive - External	Ross felt he was fortunate because he was with them
Negative - Internal	Ross felt he was unfortunate because he was with you
Negative - External	Ross felt he was unfortunate because he was with them
Neutral	Ross put the shoes away
Positive - Internal	Anne was proud because you had accompanied her
Positive - External	Anne was proud because they had accompanied her
Negative - Internal	Anne was ashamed because you had accompanied her
Negative - External	Anne was ashamed because they had accompanied her
Neutral	Anne walked towards the door
Positive - Internal	Ross appeared cheerful because you were at the party
Positive - External	Ross appeared cheerful because they were at the party
Negative - Internal	Ross appeared dejected because you were at the party
Negative - External	Ross appeared dejected because they were at the party

Neutral	Ross went swimming
Positive - Internal	Anne was happy as soon as she saw you
Positive - External	Anne was happy as soon as she saw them
Negative - Internal	Anne was unhappy as soon as she saw you
Negative - External	Anne was unhappy as soon as she saw them
Neutral	Anne sliced the bread
Positive - Internal	Ross felt superior to the others because of you
Positive - External	Ross felt superior to the others because of them
Negative - Internal	Ross felt inferior to the others because of you
Negative - External	Ross felt inferior to the others because of them
Neutral	Ross went to bed
Positive - Internal	Anne looked cheerful when she heard of your contribution
Positive - External	Anne looked cheerful when she heard of their contribution
Negative - Internal	Anne looked dejected when she heard of your contribution
Negative - External	Anne looked dejected when she heard of their contribution
Neutral	Anne was eating
Positive - Internal	Ross was elated when he heard your performance
Positive - External	Ross was elated when he heard their performance
Negative - Internal	Ross was dejected when he heard your performance
Negative - External	Ross was dejected when he heard their performance
Neutral	Ross cooked the meal
Positive - Internal	Anne was glad about your level of achievement
Positive - External	Anne was glad about their level of achievement
Negative - Internal	Anne was unhappy about your level of achievement
Negative - External	Anne was unhappy about their level of achievement
Neutral	Anne was reading
Positive - Internal	Ross was filled with glee at your level of skill
Positive - External	Ross was filled with glee at their level of skill
Negative - Internal	Ross was filled with gloom at your level of skill
Negative - External	Ross was filled with gloom at their level of skill
Neutral	Ross boiled some water
Positive - Internal	Anne experienced emotions of pure bliss as she watched you perform
Positive - External	Anne experienced emotions of pure bliss as she watched them perform
Negative - Internal	Anne experienced emotions of pure misery as she watched you perform
Negative - External	Anne experienced emotions of pure misery as she watched them perform
Neutral	Anne had a shower
Positive - Internal	Tom was happy about your level of effort
Positive - External	Tom was happy about their level of effort
Negative - Internal	Tom was gloomy about your level of effort
Negative - External	Tom was gloomy about their level of effort
Neutral	Tom looked at the clock
Positive - Internal	Kate felt hopeful about your ability to meet the target
Positive - External	Kate felt hopeful about their ability to meet the target
Negative - Internal	Kate felt hopeless about your ability to meet the target

Negative - External	Kate felt hopeless about their ability to meet the target
Neutral	Kate prepared a sandwich
Positive - Internal	Tom felt superior because you had assisted with the project
Positive - External	Tom felt superior because they had assisted with the project
Negative - Internal	Tom felt inferior because you had assisted with the project
Negative - External	Tom felt inferior because they had assisted with the project
Neutral	Tom trimmed the hedge
Positive - Internal	Kate appeared elated when told of your results
Positive - External	Kate appeared elated when told of their results
Negative - Internal	Kate appeared crestfallen when told of your results
Negative - External	Kate appeared crestfallen when told of their results
Neutral	Kate typed the letter
Positive - Internal	Tom's joy overflowed when he watched you carry out the task
Positive - External	Tom's joy overflowed when he watched them carry out the task
Negative - Internal	Tom's sorrow overflowed when he watched you carry out the task
Negative - External	Tom's sorrow overflowed when he watched them carry out the task
Neutral	Tom watered the flowers
Positive - Internal	Kate felt happy about your ability to succeed at the challenge
Positive - External	Kate felt happy about their ability to succeed at the challenge
Negative - Internal	Kate felt low about your ability to succeed at the challenge
Negative - External	Kate felt low about their ability to succeed at the challenge
Neutral	Kate shredded the paper
Positive - Internal	Tom was jubilant as he watched your level of effort
Positive - External	Tom was jubilant as he watched their level of effort
Negative - Internal	Tom was downcast as he watched your level of effort
Negative - External	Tom was downcast as he watched their level of effort
Neutral	Tom fed the cat
Positive - Internal	Kate appeared happy about your level of accomplishment
Positive - External	Kate appeared happy about their level of accomplishment
Negative - Internal	Kate appeared melancholy about your level of accomplishment
Negative - External	Kate appeared melancholy about their level of accomplishment
Neutral	Kate switched off the light
Positive - Internal	Tom felt happy when watching you give the speech
Positive - External	Tom felt happy when watching them give the speech
Negative - Internal	Tom felt miserable when watching you give the speech
Negative - External	Tom felt miserable when watching them give the speech
Neutral	Tom wrote a letter
Positive - Internal	Kate felt overjoyed at your test score
Positive - External	Kate felt overjoyed at their test score
Negative - Internal	Kate felt heartbroken at your test score
Negative - External	Kate felt heartbroken at their test score
Neutral	Kate put the books away
Positive - Internal	Jack was proud of your level of achievement
Positive - External	Jack was proud of their level of achievement

Negative - Internal	Jack was ashamed of your level of achievement
Negative - External	Jack was ashamed of their level of achievement
Neutral	Jack used the glue
Positive - Internal	Jill felt enormous satisfaction that she had chosen you for the task
Positive - External	Jill felt enormous satisfaction that she had chosen them for the task
Negative - Internal	Jill felt enormous regret that she had chosen you for the task
Negative - External	Jill felt enormous regret that she had chosen them for the task
Neutral	Jill put the picture up
Positive - Internal	Jack was satisfied with the outcome of your work
Positive - External	Jack was satisfied with the outcome of their work
Negative - Internal	Jack was disappointed with the outcome of your work
Negative - External	Jack was disappointed with the outcome of their work
Neutral	Jack opened the cupboard
Positive - Internal	Jill felt triumphant as a result of your contribution
Positive - External	Jill felt triumphant as a result of their contribution
Negative - Internal	Jill felt defeated as a result of your contribution
Negative - External	Jill felt defeated as a result of their contribution
Neutral	Jill made some gravy
Positive - Internal	Jack was filled with happiness when he saw your results
Positive - External	Jack was filled with happiness when he saw their results
Negative - Internal	Jack was filled with woe when he saw your results
Negative - External	Jack was filled with woe when he saw their results
Neutral	Jack walked along the corridor
Positive - Internal	Jill was euphoric about your ability to meet the deadline
Positive - External	Jill was euphoric about their ability to meet the deadline
Negative - Internal	Jill was despondent about your ability to meet the deadline
Negative - External	Jill was despondent about their ability to meet the deadline
Neutral	Jill washed the car
Positive - Internal	Jack's exhilaration was attributed to watching you perform
Positive - External	Jack's exhilaration was attributed to watching them perform
Negative - Internal	Jack's depression was attributed to watching you perform
Negative - External	Jack's depression was attributed to watching them perform
Neutral	Jack went to the café
Positive - Internal	Jill's delight was clear when she heard you sing
Positive - External	Jill's delight was clear when she heard them sing
Negative - Internal	Jill's displeasure was clear when she heard you sing
Negative - External	Jill's displeasure was clear when she heard them sing
Neutral	Jill swept the leaves
Positive - Internal	Jack was overwhelmed with joy as he saw you deliver the speech
Positive - External	Jack was overwhelmed with joy as he saw them deliver the speech
Negative - Internal	Jack was overwhelmed with grief as he saw you deliver the speech
Negative - External	Jack was overwhelmed with grief as he saw them deliver the speech
Neutral	Jack sat at the table
Positive - Internal	Jill listened in ecstasy to you playing the tune

Positive - External	Jill listened in ecstasy to them playing the tune
Negative - Internal	Jill listened in agony to you playing the tune
Negative - External	Jill listened in agony to them playing the tune
Neutral	Jill painted the room

Appendix I(iii) Pilot Study B. *Validation of feature configuration in emotional face categorisation across social anxiety levels.*

Pilot Study B was conducted in order to validate the composite faces used in study 2. The aim was to ascertain whether there were any differences in categorisations between sub-configuration types for each chimeric face in a single male and female example. It was predicted that there would be no differences between each of the three sub-configurations (i.e. angry nose, fearful nose, happy nose or neutral nose) for each subtype (i.e. configuration of angry, happy, fearful and neutral eyes and mouths) in terms of valence ratings, feature based categorisation and approach/avoidance behaviours.

Method

Participants

40 participants were recruited from a Science Festival event run by the University of Glasgow, a pre-entry class at the University of Strathclyde and from the University's website. Since this was a pilot study, participant demographics were not recorded. The information sheet was presented at the beginning of the experiment and consent was obtained by clicking on a consent box before the participant was able to proceed to the next stage of the experiment. The study was given ethical approval by the University of Strathclyde School of Psychological Sciences and Health Committee.

Design

Because the stimuli in the task consisted of one trial only in order to accommodate an appropriate length of the task in a community engagement environment, caution was applied given that there may be a considerable degree of variability in the results. Thus, it was considered that it was most appropriate to observe trends from descriptive statistics and conduct non-parametric analysis with the caveat that with only one trial per condition for each participant, conclusions must be treated with caution. However as this is only preliminary data designed simply to ascertain the best configuration to use in Study 2, this was deemed to be an adequate approach.

Apparatus and stimuli

Whilst fearful eyes have been linked to dominant emotional salience (Schyns et al., 2007), they may signal a non-socially threatening environmental threat since an evaluator has no reason to be fearful in response to a social performance. Anger, on the other hand, may convey a social self-reverential threat with respect to an evaluator's response to a social performance that is under par with their expectations. This may be the case where, for example, an employee must present a company idea in line with expectations of their Manager. Thus, in order to compare the effect of bottom up salience properties with top down contextual factors, both anger and fear were included as negative emotions. 2 photo face stimuli: 1 male model (34M) and 1 female model (01F) consisting of four emotional expressions (angry, fearful, happy and neutral) were selected from the NimStim Set of Facial Expressions (Tottenham et al., 2009) for use in the study.

40 composite face photos were constructed using Photoshop elements 5 by combining various arrangements of emotional and neutral features into 20 ambiguous face types for each identity. Face configurations are defined in table B.1. The study was presented on a Dell laptop via a Qualtrics survey link (Qualtrics Labs, Inc.).

Table B.1

Face configurations

1	Angry eyes Angry nose Happy mouth (AAH)	2	Angry eyes Happy nose Happy mouth (AHH)	3	Angry eyes Neutral nose Happy mouth (ANH)	4	Angry eyes Angry nose Neutral mouth (AAN)	5	Angry eyes Neutral nose Neutral mouth (ANN)
6	Happy eyes Happy nose Angry mouth (HHA)	7	Happy eyes Angry nose Angry mouth (HAA)	8	Happy eyes Neutral nose Angry eyes (HNA)	9	Neutral eyes Neutral nose Angry mouth (NNA)	10	Neutral eyes Angry nose Angry mouth (NAA)
11	Fearful eyes Fearful nose Happy mouth (FFH)	12	Fearful eyes Happy nose Happy mouth (FHH)	13	Fearful eyes Neutral nose Happy mouth (FNH)	14	Fearful eyes Fearful nose Neutral mouth (FFN)	15	Fearful eyes Neutral nose Neutral mouth (FNN)
16	Happy eyes Happy nose Fearful mouth (HHA)	17	Happy eyes Fearful nose Fearful mouth (HAA)	18	Happy eyes Neutral nose Fearful eyes (HNA)	19	Neutral eyes Neutral nose Fearful mouth (NNA)	20	Neutral eyes Fearful nose Fearful mouth (NAA)

Examples stimuli are presented in figure B.1.

Configuration 1
Angry Nose

Configuration 2
Happy Nose

Configuration 3
Neutral nose

Figure B.1 *Example of configurations for faces with angry eyes and happy mouths*

Procedure

Participants were asked to read the information sheet and sign the online consent form before being asked to view a series of composite faces, which comprised one presentation of each face type via a Qualtrics survey link (Qualtrics Labs, Inc.). Participants were randomly allocated to view either the male or the female face. While the face was on the screen, participants were asked to rate the valence of the face by filling in an online Likert Scale with a response option from 1-5, ranging from ‘extremely negative’; ‘slightly negative’; ‘neutral’; ‘slightly positive’ to ‘extremely positive’. They were then asked to select the feature that they think most conveyed the emotion of the face (i.e. forehead; eyes; nose; cheeks or mouth). They were also asked to click once on the face if they would be more likely to wish to approach than avoid the face or twice if they were more likely to wish to avoid than approach the face.

Approach responses were indicated by a green mask appearing on the face and avoid responses were indicated by a red mask and participants were instructed to make sure that a coloured mask had appeared on the face (see Figure B.2) before proceeding to the next face. The purpose of this was to increase the likelihood that participants would be able to check that they had made a correct response. The experimental process lasted for approximately 10 minutes.

Figure B.2 *Example stimuli in approach (green) /avoidance (red) task*

Results

Data for approach-avoidance responses could not be analysed because of an excessively high number of missing responses as a result of the lack of a forced choice option on the particular survey question type selected for this question. However the pilot exercise was useful in this regard in order to guide the format for approach/avoid questions selected for the subsequent survey employed in Study 2. The percentages for approach/ avoidance responses, illustrated in Figure B.3, suggest that the presence of just one angry feature is generally sufficient to elicit avoidance. This seems to be particularly the case for faces with angry eyes whilst in contrast faces with fearful eyes appear to elicit approach tendencies. However crucially, this did not appear to differ substantially as a function of the emotion of the nose, particularly when negative eyes are present.

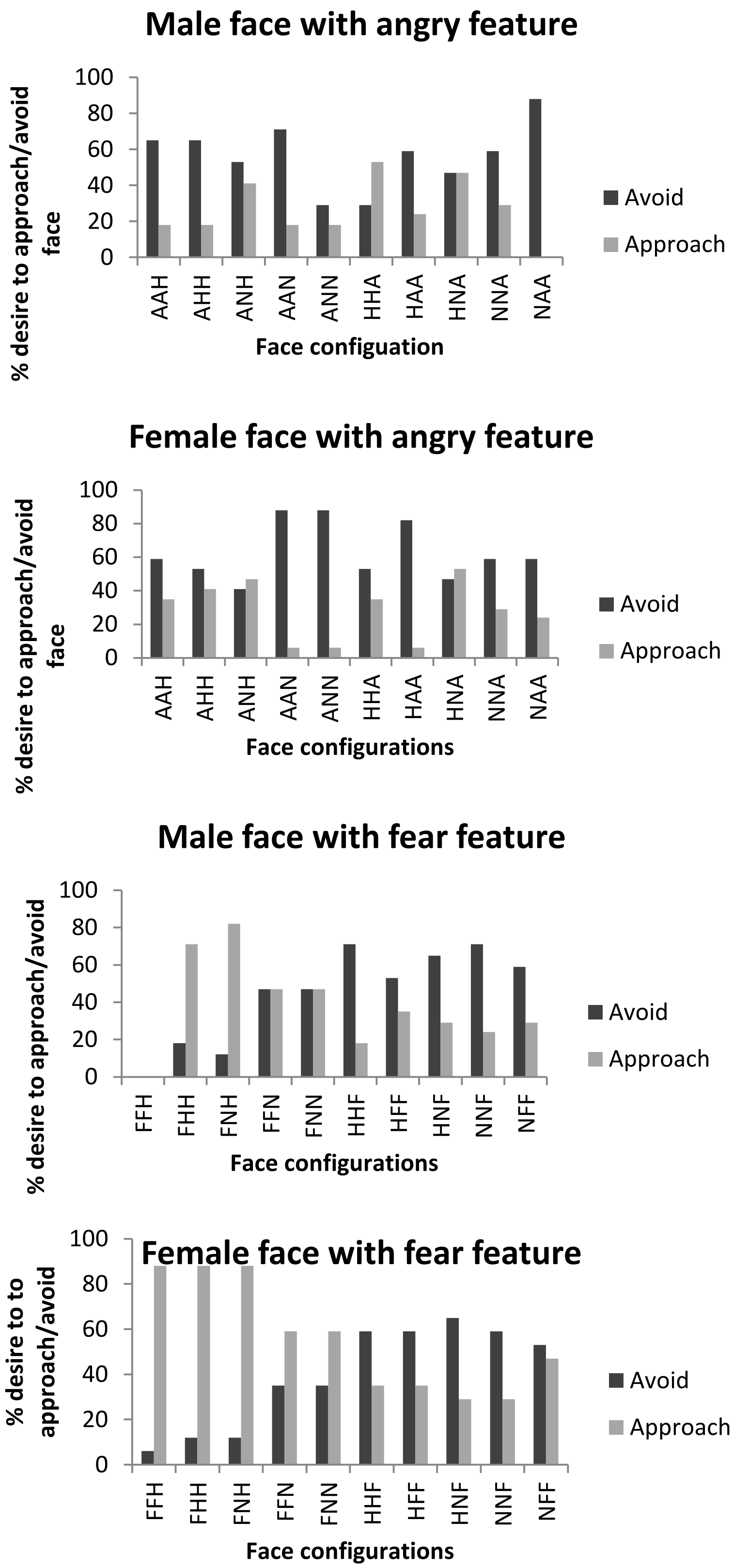

Figure B.3 *Percentage of approach and avoidance responses for each face configuration (Configuration labels refer to eyes/nose/mouth emotion: A(angry); F(fearful); H(happy); N(neutral).*

Feature based decisions categorisation

Multiple discrete categories were used for choice of features that most categorised the expression of the face in the opinion of the participant and responses were looked at simply in terms of percentages (Table B.2) rather than using inferential statistics. It was felt that for the pilot study, this would be sufficient to guide the design of the subsequent online study reported in Chapter 3. Although without inferential statistics, it cannot be concluded whether any differences between configurations are significant, the mean percentages on feature selection suggest that both the male and female face tended to be categorised more on the basis of the negative feature for both angry and fear regardless of whether it is the eyes or mouth that is negative. Again, having a neutral nose did not appear to substantially alter this pattern. The relative percentages for the upper or lower face being used to categorise the emotion of the face for each configuration are illustrated in Figure B.4.

Table B.2

Relative responses for the feature that the categorisation was most based on

		% Attention to forehead (FH); eyes (E); upper face total (U); nose (N); cheeks (C); mouth (M)									
Angry feature: Eyes/ mouth/ nose											
		AAH	AHH	ANH	AAN	ANN	HHA	HAA	HNA	NNA	NAA
Male	FH	6	6	24	24	35	0	0	6	0	
Anger	E	47	53	24	24	53	18	12	29	18	12
	U	53	59	48	48	88	18	12	35	18	12
	N	18	12	18	47	12	0	18	0	0	6
	C	0	6	0	0	0	0	0	6	0	6
	M	29	24	35	6	0	82	71	59	82	76
Female	FH	24	18	24	29	41	6	6	6	0	0
Anger	E	29	35	47	41	59	18	41	24	12	12
	U	53	53	71	70	100	24	47	30	12	12
	N	18	0	6	24	0	0	0	0	0	0
	C	0	0	0	0	0	6	0	12	0	0
	M	29	47	24	6	0	71	53	59	88	88
Fear feature: Eyes/ mouth/ nose											
		FFH	FHH	FNH	FFN	FNN	HHF	HFF	HNF	NNF	NFF
Male	FH	6	0	0	6	24	0	0	6	0	0
Fear	E	41	35	41	76	59	18	6	6	12	12
	U	46	35	41	82	83	18	6	6	12	12
	N	6	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	6	0	0	6	0
	M	47	65	59	18	18	76	94	88	82	88
Female	FH	41	6	0	24	12	0	0	6	0	0
Fear	E	0	41	53	71	71	24	24	41	29	18
	U	41	47	53	95	83	24	24	41	29	18
	N	0	0	0	0	0	0	0	0	0	0
	C	6	12	0	0	0	6	6	0	6	6
	M	53	41	47	6	18	71	71	53	65	76

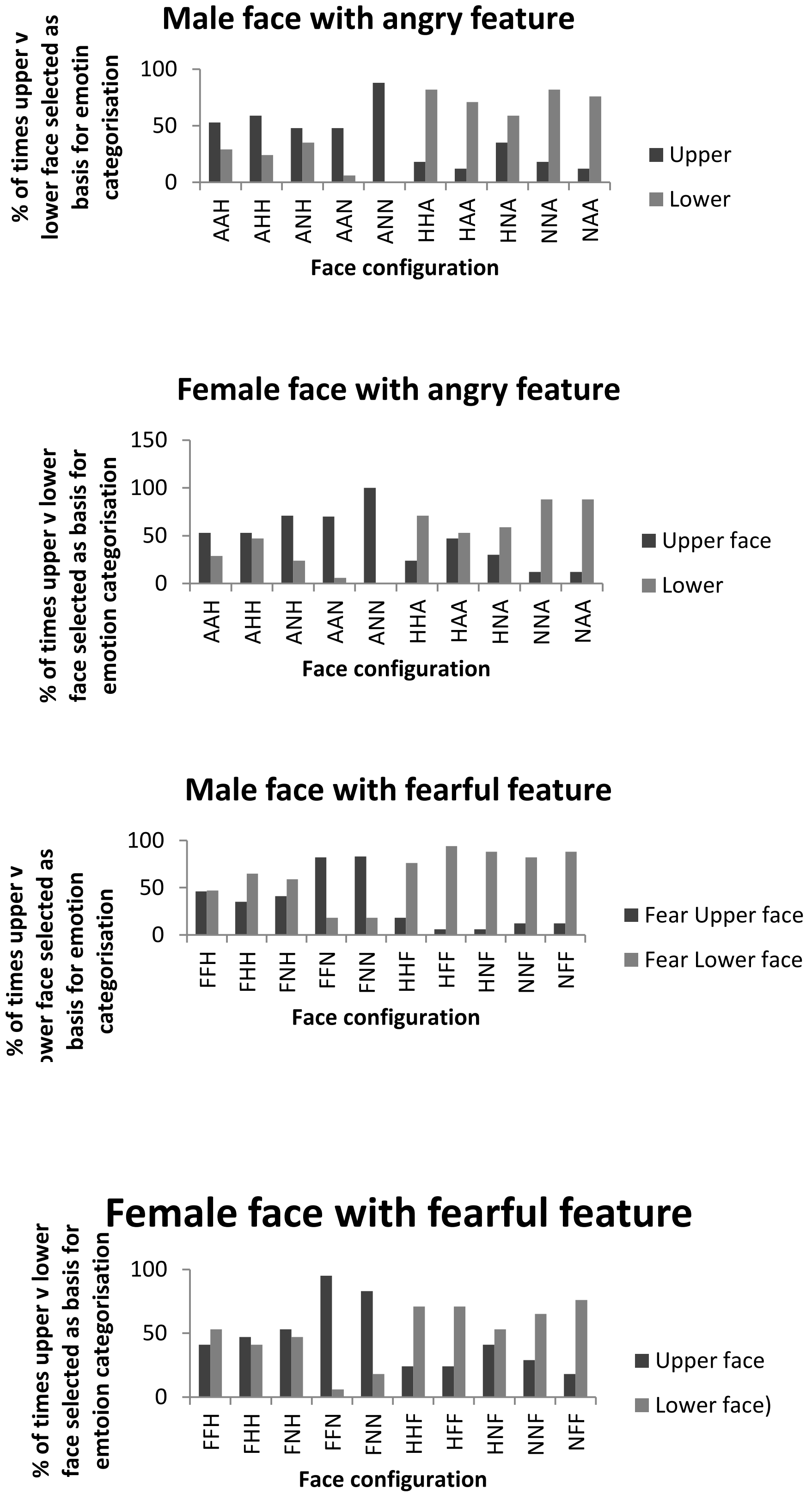

Figure B.4 *Percentage of relative attention to eyes and mouth (Configuration labels refer to eyes/nose/mouth emotion: A(angry); F(fearful); H(happy); N(neutral).*

Ratings for the valence of the face were measured using a Likert Scale with a response option from 1-5, ranging from ‘extremely negative ’; ‘slightly negative’; ‘neutral’; ‘slightly positive’ to ‘extremely positive’. Descriptive statistics for ratings of the male and female face respectively are presented in table B.3. Although the standard deviations suggest a large degree of variability as expected from one trial observations, the means and histograms suggest that there is a fairly constant pattern over each of the configurations within each face type.

Table B.3
Mean valence ratings

	Male		Female	
	M	*SD*	*M*	*SD*
AAH	2.53	1.37	2.53	1.37
AHH	2.88	1.36	2.88	1.36
ANH	2.65	1.32	2.65	1.32
HHA	2.24	1.15	2.24	1.15
HAA	1.82	0.95	1.82	0.95
HNA	2.88	1.36	2.88	1.36
AAN	1.24	0.44	1.24	0.44
ANN	1.18	0.39	1.18	0.39
NNA	1.88	0.86	1.88	0.86
NAA	1.76	0.83	1.76	0.83

(Configuration labels refer to eyes/nose/mouth emotion: A(angry); F(fearful); H(happy); N(neutral).

As expected, Shapiro-Wilk’s tests of normality were significant ($p < 0.05$) for all ratings variables. Thus in order to gauge whether there were any significant differences between configurations, non-parametric analysis was conducted using several Wilcoxon Signed-rank tests for angry faces pairs with neutral versus emotional noses with alpha set at 0.025 (Field, 2009). The aim of this analysis was to ascertain whether there was any reason that neutral noses should not be used in the subsequent study since eyes and mouths were the features that were of particular interest to the hypotheses in Study 2. If in general the difference with a neutral nose is not significantly different in terms of ratings of the emotion of the face, then in addition to the observations of the approach/avoidance and feature selection data, it would be reasonable to conclude that using a neutral nose in Study 2 face stimuli will be acceptable.

Angry eyes

For faces with angry eyes and a happy mouth, results revealed no significant differences between ratings for a face with a happy nose or a neutral nose (Male: z = - 0.212, p = 0.83; Female: z = -.13, p = 0.19) or an angry nose and neutral nose (Male: z = - 0.641, p = 0.52; Female: z = - 0.513, p = 0.61). There were also no significant differences between ratings for a male face with angry eyes and a neutral mouth whether the nose was angry or neutral (Male: z = -0.302, p = 0.76; Female: z = -0.378, p = 0.71).

Angry mouth

For a male face with an angry mouth and happy eyes, there was no significant difference between a happy nose or a neutral nose (Male: z = - 0.333, p = 0.74; Female: z = - 1.183, p = 0.07) although ratings were significantly different in a male face with an angry nose and neutral nose (Male: z = - 3.14, p = 0.002; Female: z = - 3.025, p = 0.002;) with mean ranks in favour of a more negative rating for a face with an angry nose (Male: 6.5; Female: 6) compared to faces with a neutral nose (with a mean rank of 0 for the male and the female face). There were no significant differences between a face with neutral eyes and an angry mouth in terms of ratings (Male: z = 1.39, p = 0.17; Female: z = 0.632, p = 0.53). Therefore on the whole as predicted, the neutral nose did not influence ratings.

In summary of the valence ratings, the results revealed that for both the male and the female face, angry-happy face composites were associated with increasingly negative ratings as the negativity of the nose increased, suggesting an additive effect of the valence of the nose. However on the whole a neutral nose made no difference to valence ratings or selection of the upper of lower face for categorisation. Thus it was decided that it would be most appropriate to keep the nose neutral in Study 2.

Conclusions from the approach/ avoidance data are speculative but it is consistent with the idea that angry eyes signal a personally relevant social threat and fearful eyes signal threat from the environment. This may engage an empathetic response rather than a direct threat which could explain a higher willingness to approach a fearful than an angry face. Alternatively, the combination of fearful eyes with a surprised mouth could lead to the expression being mistaken for surprise (i.e. a positive emotion). Further discussion of the possible reasons for approach responses to fear features is outside of the scope of the current investigation. However as a result of the clearer link between angry features and threat from these results, fear features were eliminated from Study 2.

Clearly the study was limited by the presentation of only one face example for each configuration, which limited the observations to one trial. This may explain the variability found but to counter this problem, it was decided to use multiple identities for each face type in Study 2. The method of collecting approach/avoidance responses was also limited by lacking an option to obtain a forced response on the survey. This resulted in several missing responses. It was considered that this could be improved by posing the approach/ avoidance response options in the form of a bipolar scale (i.e. percentage of approach desirability relative to avoidance desirability), which would not only enable a forced response option to be selected but it would also provide data on the degree of approach/ avoidance behaviours indicated.

Looking at the feature selection data suggested that the eyes and the mouth were the main source for valence categorisation. With regard to ascertaining the feature most focussed on to derive the emotional content of the face, categorical responses were unable to provide information on the degree to which each half of the face was used to base the categorisation on. Thus the design would be improved by posing this question on the basis of a bipolar scale with options ranging from the degree of categorisation based on the mouth to the degree based on the eyes.

Overall the results suggested that on average, emotionally ambiguous chimeric faces were rated towards the negative end of the scale although there was considerable variability in the results. Only faces which featured fearful eyes and happy mouths were rated towards the more positive end of the scale. It is possible that composite faces of this type may appear to convey surprise rather than fear but the pilot data is not robust enough to be able to draw any firm conclusions regarding this. However in light of this ambiguity and in reflection of the number of trials required in the subsequent study it was decided that only angry, happy and neutral features would be included in composite faces for Study 2.

Appendix I(iv) *Pilot Study C. Validation of sentence primes*

Pilot study C was designed to validate prime sentences to be used in Study 3 in terms of their valence ratings and self-reference. It was thought that by increasing the social salience of faces in an antisaccade task in Study 3, by facilitating socio cognitive load in a non-socially threating context, this would result in a somewhat ecologically valid measure of inhibition across social anxiety levels. It was predicted that negative non-self-referential primes would be rated as less negative and less self-referential than negative self-referential and neutral primes. Furthermore, it was predicted that positive self-referential primes would be rated as significantly more positive and self-referential than positive non-self-referential or neutral primes.

Method

Participants

The study was originally designed to include two groups (high and low socially anxious participants but a moderate anxiety (MSA) group was added later upon reflection as an intermediate group. Using the original two groups would have yielded a target sample size of 50 and it was intended that the primes would be rated a sample a third of the size of that used in Study 3 (e.g. Weary & Reich, 2001). Thus 17 participants were asked to rate the primes. Ethical approaval was obtained from the School of Psychological Sciences and Health Ethics committee.

Design, materials and procedure.

Prime sentence ratings were analysed using a series of one way ANOVAs. Training primes were based on positive self-referent (SR) and negative non-self-referential (NSR) primes (i.e. non-threatening) as well as neutral primes. 240 prime statements were initially designed and these included 80 positive evaluative: self-referential (SR), 80 negative contextual: non-self-referential (NSR) and 80 neutral sentences. Training primes were considered to be non-socially threatening by directing the source of negative information away from the individual and directing positive self-affirming information towards them. Each statement was comprised of 6 words to standardize the length of statements. 10 statements for each prime type were generated.

From each of these 10 statements a further 8 statements were generated which retained the same structure but changed some individual words in order to vary the primes whilst keeping a similar meaning. Statements were designed such that each identity would be paired with a similarly themed statement. For example for each identity, neutral statements included sentences about where the person named in the sentence was, where they worked; what mode of transport they used to travel; what colour they were wearing etc. Negative non-self-referential sentences included information for each identity which referred to the cause of their negative emotional response as being with another person or a situation which had nothing to do with the participant reading the sentence.

In contrast, positive self-referential sentences all attributed the cause of the protagonists' positive response to the participant reading the sentence. An example of a positive self-referential prime was 'Sara is impressed by your speech' while a negative non-self-referential prime was, 'Sara is annoyed with her boss' and a neutral prime included the statement, 'Sara takes the train to work'. It was important to ensure the non-threatening status of primes in order that they provided an explanation for the expression of the face unlike the neutral primes which were more open to interpretation of the facial expression. Thus in order to validate the effectiveness of the target negative non-self-referential primes as being less threatening than negative self-referential primes and the positive self-referential primes as being more positively perceived than a positive non-self-referential context, a further 160 negative self-referential evaluative and positive other referential contextual primes were also generated, yielding a total of 400 primes for the validation procedure (Appendix I(v)).

Evaluative primes consisted of positive and negative self-referent primes (i.e. attributes prime subject's cognitions to participant) and contextual primes consisted of positive and negative other referential primes (i.e. attributes prime subject's cognitions to someone or something else other than participant). Neutral primes did not refer to the subject's emotions or cognitions at all. Participants were asked to read and sign the consent form before rating the valence of statements presented on paper on an 11-point scale ranging from –5(*very negative*) to 0 (*neutral*) to +5 (*very positive*) (e.g. Weary & Reich, 2001) and reference ranging from –5 (definitely self-referential) to 0 (neutral) to +5 (definitely other-referential).

Results

A Shapiro Wilk's tests suggested that the data was not normally distributed for neutral primes ($p < 0.001$); negative non-self-referential primes ($p = 0.01$) and positive non-self-referential primes ($p = 0.04$) and histograms suggested that this was due to a positive skew. Mauchly's test indicated that the assumption of sphericity had been violated, ($\chi2(9) = 125.48$, $p < 0.001$). Transformations failed to normalise the data so degrees of freedom were corrected using the Greenhouse Geisser epsilon (ε = 0.28), since Mauchly's test was < 0.75 (Field, 2009) and the results were checked using non-parametric analysis.

A repeated measures one-way ANOVA with five levels (corrected for non-sphericity at Greenhouse Geisser level) revealed a significant main effect for valence, $F(1.14,18.25) = 363.14$, $MSE = 1.15$, $p < 0.001$, *partial* $\eta^2 = 0.96$, *Power* = 1. Bonferroni comparisons revealed that negative non-self-referential primes (M = -2.37, SE = 0.01) were rated significantly more negatively than positive non-self-referential primes (M = 2.36, SE = 0.13, p< 0.01) or neutral primes (M = 0.02, SE = 0.01, p< 0.01) but significantly less negative than negative self-referential primes (M = -2.96, SE = 0.15). The fact that negative primes were viewed less negatively when the information was directed away from rather than towards the participant suggests that that non-self-referential negative primes are less socially threatening than negative-self-referential primes. Therefore, although on their own neutral primes were rated less negatively than negative non-self-referential primes, if socially anxious individuals generate self-referential negative contextual information as expected in the presence of faces that are presented following neutral primes in Study 3, these should be perceived as being more negative than when faces are presented with negative non-self-referential primes.

Positive self-referential primes were rated significantly more positively than negative self-referential primes (M = -2.37, SE = .13, $p < 0.001$) and neutral primes ($p < 0.001$). Again this suggests that faces presented after positive self-referential primes should be perceived less negatively than faces presented after neutral primes if socially anxious participants generate negative self-reverential primes in response to the faces.

There was also a significant main effect for reference (Greenhouse Geisser corrected), $F(1.1, 17.66) = 284.48$, $MSE = 2.67$p< 0.001, *partial* $\eta^2 = 0.95$, *Power* = 1. Bonferroni comparisons revealed that negative non-self-referential primes were rated as referring significantly more to others (M = -3.35, SE = 0.2) than negative self-referential primes (M = 3.87 SE = 0.23) or neutral (M = 0.04, SE = 0.03, p< 0.001) primes and positive self-referential primes (M = 3.67, SE = 0.23) were rated as referring significantly more to the participant than neutral primes ($p < 0.001$) or negative self-referential primes ($p<0.001$). This reinforces the likelihood that negative self-generated contextual thoughts that may be generated by socially anxious participants in Study 3 when exposed to faces in the saccade task may result in the face being perceived as being more socially threatening than a face preceded by a negative non-self-referential prime or by a positive self-referential prime.

In order to balance the pro and antisaccades with the same primes in Study 3, 40 primes of each target type in the subsequent antisaccade study were selected from the original list on the basis of the most extreme valence for positive and negative primes and the lowest valance for neutral primes. Neutral primes were also selected on the basis of having a 0 reference rating. Inter-item correlations could not be conducted because there was no variance on the 0 ratings.

However five extreme values indicated by absolute z-scores of 2.61 were found for valence ratings of neutral primes. Notwithstanding the preferred 0 valence rating, the available alternatives for each identity were either higher in valence or had a non 0 rating for reference. Furthermore, the valence values were extremely low at

0.06 and are set within a set of primes with absolute 0 values otherwise. Therefore these primes were retained in the study.

A further 1-way repeated measures ANOVA was conducted for the final prime set, which when adjusted for non sphericity using the Greenhouse Geisser correction, revealed a significant main effect of valence, $F(1.11, 17.73) = 482.25$, $MSE = 0.6$, $p < 0.001$, *partial* $\eta^2 = 0.97$, power = 1. Bonferroni contrasts showed that negative non-self-referential sentences were rated significantly more negatively (M = -3.12, SE = 0.15) than neutral (M= 0.01, SE = 0.01, $p< 0.001$) or positive self-referential sentences (M= 3.04, SE = 0.14, $p<0.001$), which were rated significantly more positively than neutral sentences. However again despite negative non-self-referential primes being rated as more negative than neutral primes, a significant main effect of reference was also found in a 1-way repeated measures ANOVA, $F(1.23, 19.69) = 319.93$, $MSE = 1.13$, $p< 0.001$, *partial* $\eta^2 = 0.95$, *power* = 1. Bonferroni contrasts showed that negative non-self-referential sentences were rated significantly more as referring to others (M = -3.3, SE = 0.22) than neutral (mean = 0, SE = 0) or positive self-referential sentences (M = 3.92, SE = 0.23), which were rated significantly more self-referential than neutral sentences.

In summary, the aim of Pilot Study C was to validate contextual sentence primes to be used in Study 3 as a means of increasing the social salience of faces in an antisaccade task by facilitating socio cognitive load in a non-socially threating context. Results confirmed that as predicted, directing positive information towards an individual was perceived as a stronger sign of social approval than if the information was directed at another person or no contextual information was given (i.e. with a neutral prime). Furthermore, directing negative information towards a person other than the participant decreased the perceived social threat of the information compared to negative information that was directed towards the individual. This suggests that although in partial contrast to the hypothesis, negative non-self-referential information was perceived more negatively than neutral information in a general sample, it may not be socially threatening to an individual compared to the negative self-referential thoughts that they may generate in a neutral social context. Therefore there is reason to be confident that the primes used in Study 3 simply demonstrate the effect of socio-cognitive load where increased socio evaluative processing may occur rather than a threat prime where threat specific processing is likely to occur.

Appendix I(v) *Sentence primes for Study 3*

Chapter 4

Pilot Study C *Prime statements*

PRIME TYPE	PRIME
Neutral	Sara sits in a black chair
Neutral	Kate drinks milkshakes on the grass
Neutral	Ken reads sports pages at halftime
Neutral	Anne sits on a brown bench
Neutral	Jill is at university this afternoon
Neutral	Kate wears a cardigan to college
Neutral	Tom gets the bus to university
Neutral	Ken was at the park before
Neutral	Kate teaches for one hour periods
Neutral	Sara takes a muffin to university
Neutral	Anne nibbles an apple at work
Neutral	Anne reads lab reports while waiting
Neutral	Anne enrolled in the media unit
Neutral	Anne shops for twenty minutes usually
Neutral	Anne studies at university these days
Neutral	Bill drinks some cola during discussions
Neutral	Bill studies for half day sessions
Neutral	Jill types for eight hours daily

Neutral	Anne takes the train to work
Neutral	Sara wears an apron to work
Neutral	Neil sits at a red desk
Neutral	Anne wears a vest during training
Neutral	Bill wears a coat when shopping
Neutral	Bill reads a novel to relax
Neutral	Bill takes protein bars before training
Neutral	Tom eats nuts at the park
Neutral	Sam wears a hat to meetings
Neutral	Sam is at college tomorrow morning
Neutral	Kate works for a small company
Neutral	Bill types on a silver computer
Neutral	Sam attends the gym these days
Neutral	Bill teaches in the maths department
Neutral	Sam usually walks to the shop
Neutral	Rose works from the office usually
Neutral	Bill works in a cafe now
Neutral	Jill chews chewing gum at meetings
Neutral	Rose reads journal papers during lunch
Neutral	Jill drinks hot chocolate during shifts
Neutral	Jill goes shopping most days now
Neutral	Kate was at the institute earlier
Neutral	Neil strolls around the park daily
Neutral	Jill rides her bike to college
Neutral	Kate reads a broadsheet before work
Neutral	Tom attends college in the evening
Neutral	Sam is employed by a multinational
Neutral	Jill trains at a large gym
Neutral	Sam drinks some tea each afternoon
Neutral	Jill wears some jeans when walking
Neutral	Kate buys some chocolate while shopping
Neutral	Sam reads magazines on his break
Neutral	Kate plays on a green pitch
Neutral	Ken dinks some coffee while typing
Neutral	Ken catches the tube to meetings
Neutral	Tom is at work this morning
Neutral	Neil is at the stadium later
Neutral	Sara drinks energy drinks before play
Neutral	Ken wears a blazer to university
Neutral	Tom shops at his local store
Neutral	Rose runs to the sport centre
Neutral	Ken works for four hours daily
Neutral	Tom talks round a white table
Neutral	Neil drinks fruit juice between shops

Neutral	Rose is at the shop today
Neutral	Sam wanders round the pond sometimes
Neutral	Tom wears suits to the office
Neutral	Sara reads tabloid on the shelf
Neutral	Neil surfs the net during break
Neutral	Neil hires the institute board room
Neutral	Neil generally drives to the office
Neutral	Ken eats some crisps in college
Neutral	Sara meets at the institute sometimes
Neutral	Rose uses the park in town
Neutral	Rose drinks a smoothie most mornings
Neutral	Ken waits beside a grey till
Neutral	Sara often jogs around the park
Neutral	Neil has a sandwich in work
Neutral	Rose meets for two hours nightly
Neutral	Rose works at a blue counter
Neutral	Tom exercises for three hours weekly
Neutral	Sara was at the office yesterday
Negative non-self-referential	Ken is irritated with his superior
Negative non-self-referential	Anne is cross with her son
Negative non-self-referential	Rose feels fractious about the commotion
Negative non-self-referential	Sam is irate with his director
Negative non-self-referential	Bill is discontented with his associate
Negative non-self-referential	Jill is mad at her colleagues
Negative non-self-referential	Neil feels annoyed about the disturbance
Negative non-self-referential	Bill is frustrated by the problem
Negative non-self-referential	Tom is disgruntled with his companion
Negative non-self-referential	Tom is upset with his superintendent
Negative non-self-referential	Bill angry with his supervisor
Negative non-self-referential	Rose is bothered by being delayed
Negative non-self-referential	Sara is frustrated with her tally
Negative non-self-referential	Jill is aggravated with her employment
Negative non-self-referential	Rose is furious at her teacher
Negative non-self-referential	Jill is dissatisfied with her acquaintance
Negative non-self-referential	Sam is exasperated at his players
Negative non-self-referential	Anne is frustrated at being late
Negative non-self-referential	Tom is incensed by the impasse
Negative non-self-referential	Kate is enraged at her professor
Negative non-self-referential	Ken is maddened by his predicament
Negative non-self-referential	Jill is perturbed by being overdue
Negative non-self-referential	Tom feels irritated about the noise
Negative non-self-referential	Ken is incensed at his coach
Negative non-self-referential	Sam feels snappy about the disruption
Negative non-self-referential	Tom is irate at his co-workers

Negative non-self-referential	Sara is angry at her panel
Negative non-self-referential	Neil is riled at his squad
Negative non-self-referential	Rose is incensed at the others
Negative non-self-referential	Sam is enraged by the inconvenience
Negative non-self-referential	Sam is upset with his results
Negative non-self-referential	Rose is disappointed with her score
Negative non-self-referential	Sam is irritated at being tardy
Negative non-self-referential	Ken is annoyed with his attainment
Negative non-self-referential	Tom is miserable in his career
Negative non-self-referential	Bill is infuriated at his team
Negative non-self-referential	Kate is infuriated by her uncle
Negative non-self-referential	Rose is disillusioned with her peers
Negative non-self-referential	Bill is disillusioned with his trade
Negative non-self-referential	Tom is annoyed at his lecturer
Negative non-self-referential	Tom is aggravated at being behind
Negative non-self-referential	Neil is disconcerted by his performance
Negative non-self-referential	Ken feels angry about the intrusion
Negative non-self-referential	Ken is annoyed with his post
Negative non-self-referential	Kate is discouraged with her progress
Negative non-self-referential	Sara is infuriated with her work
Negative non-self-referential	Bill is discontent with his accomplishment
Negative non-self-referential	Neil is fuming with his wife
Negative non-self-referential	Rose is exasperated by the impediment
Negative non-self-referential	Rose is irritated by her mother
Negative non-self-referential	Sam is disappointed with his partner
Negative non-self-referential	Sara is annoyed at being deferred
Negative non-self-referential	Bill is mad at his trainer
Negative non-self-referential	Anne is enraged at her group
Negative non-self-referential	Anne is dissatisfied with her grades
Negative non-self-referential	Anne is displeased with her chief
Negative non-self-referential	Sara is livid with her daughter
Negative non-self-referential	Jill feels cross about the distraction
Negative non-self-referential	Ken is irate with his father
Negative non-self-referential	Neil is disenchanted with his cohort
Negative non-self-referential	Neil is fuming at his tutor
Negative non-self-referential	Kate is unhappy with her friend
Negative non-self-referential	Anne is discontented with her profession
Negative non-self-referential	Sam is annoyed with his sister
Negative non-self-referential	Sara is livid at her instructor
Negative non-self-referential	Kate is infuriated with her manager
Negative non-self-referential	Anne is displeased with her accomplice
Negative non-self-referential	Jill is angry with her son
Negative non-self-referential	Ken is upset at being last
Negative non-self-referential	Neil is exasperated with his job

Negative non-self-referential	Anne is exasperated by the difficulty
Negative non-self-referential	Neil is frustrated at being postponed
Negative non-self-referential	Bill is furious with his niece
Negative non-self-referential	Kate feels incensed about the fracas
Negative non-self-referential	Jill is disgruntled with her administrator
Negative non-self-referential	Jill is infuriated by the complexity
Negative non-self-referential	Kate is frustrated with her occupation
Negative non-self-referential	Kate is angered by the quandary
Negative non-self-referential	Sara feels irritated about the upheaval
Negative non-self-referential	Sara is annoyed with her boss
Negative self-referential	Sam is unhappy with your ability
Negative self-referential	Bill judges your speech with rejection
Negative self-referential	Sara thinks that you display agitation
Negative self-referential	Sara considers you an inept talker
Negative self-referential	Rose is displeased with your commentary
Negative self-referential	Rose is disapproving about your speech
Negative self-referential	Jill believes you are presenting ineptly
Negative self-referential	Ken is unenthusiastic about your ineffectiveness
Negative self-referential	Kate rates your delivery very amateur
Negative self-referential	Sara is unflattering about your presentation
Negative self-referential	Jill considers you an untalented presenter
Negative self-referential	Rose considers you an inept communicator
Negative self-referential	Sara is unimpressed by your ability
Negative self-referential	Tom considers you an incompetent speaker
Negative self-referential	Sam thinks that you show uncertainty
Negative self-referential	Bill is unenthusiastic about your ability
Negative self-referential	Neil is displeased with your delivery
Negative self-referential	Kate is unimpressed by your talk
Negative self-referential	Anne judges your talk as insignificant
Negative self-referential	Sam is displeased with your narration
Negative self-referential	Anne regards your aptitude as disputable
Negative self-referential	Bill is unimpressed by your incompetence
Negative self-referential	Ken is unimpressed by your performance
Negative self-referential	Ken considers you a flawed narrator
Negative self-referential	Ken regards your narration as amateur
Negative self-referential	Jill judges your uncertainty as unenviable
Negative self-referential	Anne is disappointed with your address
Negative self-referential	Jill is unfavourable towards your delivery
Negative self-referential	Anne thinks that you look insecure
Negative self-referential	Bill believes you are performing badly
Negative self-referential	Kate regards your ability as mediocre
Negative self-referential	Anne rates your ability entirely unsuitable
Negative self-referential	Sam considers you an unskilled orator
Negative self-referential	Tom is unhappy with your performance

Negative self-referential	Tom is unimpressed by your uncertainty
Negative self-referential	Kate is unhappy with your talk
Negative self-referential	Sara believes you are exhibiting ineptness
Negative self-referential	Tom rates your confidence entirely inappropriate
Negative self-referential	Sam is negative about your ability
Negative self-referential	Rose is disappointed with your talk
Negative self-referential	Rose regards your speech as unimpressive
Negative self-referential	Ken is unhappy with your discourse
Negative self-referential	Jill Is unhappy with your appearance
Negative self-referential	Jill rates your narration indisputably unimpressive
Negative self-referential	Neil rates your presentation low quality
Negative self-referential	Neil thinks that you demonstrate chaos
Negative self-referential	Tom thinks that you appear flustered
Negative self-referential	Tom judges your talent as limited
Negative self-referential	Anne believes you are performing poorly
Negative self-referential	Sam believes you are demonstrating inability
Negative self-referential	Ken rates your performance as inferior
Negative self-referential	Rose is unimpressed by your speech
Negative self-referential	Kate judges your delivery as unimpressive
Negative self-referential	Neil is unimpressed by your presentation
Negative self-referential	Anne is displeased with your performance
Negative self-referential	Kate is disappointed with your discussion
Negative self-referential	Kate is critical about your performance
Negative self-referential	Anne is unimpressed by your agitation
Negative self-referential	Rose thinks that you exhibit agitation
Negative self-referential	Sara regards your presentation as untrained
Negative self-referential	Tom is displeased with your presentation
Negative self-referential	Rose believes you are showing incompetence
Negative self-referential	Kate considers you incompetent at speeches
Negative self-referential	Neil believes you are illustrating incompetence
Negative self-referential	Sara judges your pitch as unfavourable
Negative self-referential	Bill regards your agitation as uninspiring
Negative self-referential	Sam regards your performance as poor
Negative self-referential	Neil is discouraging about your commentary
Negative self-referential	Jill is disappointed with your delivery
Negative self-referential	Bill is displeased with your speech
Negative self-referential	Neil considers you an inept public speaker
Negative self-referential	Bill rates your commentary quite unacceptable
Negative self-referential	Bill is disappointed with your speech
Negative self-referential	Neil regards your ability as low
Negative self-referential	Sam judges your ability as unremarkable
Negative self-referential	Tom believes you are acting tentatively
Negative self-referential	Ken thinks that you seem uncertain
Negative self-referential	Ken judges your presentation with disapproval

Negative self-referential	Jill thinks that you seem disorganized
Negative self-referential	Sara rates your speech third rate
Positive non-self-referential	Kate is contented with her occupation
Positive non-self-referential	Tom is content to be behind
Positive non-self-referential	Bill is pleased with his trainer
Positive non-self-referential	Jill is relieved at being overdue
Positive non-self-referential	Sam feels happy about the disruption
Positive non-self-referential	Tom feels excited about the noise
Positive non-self-referential	Ken is happy with his coach
Positive non-self-referential	Sam is pleased with his results
Positive non-self-referential	Sam is delighted with his partner
Positive non-self-referential	Anne is contented with her profession
Positive non-self-referential	Rose feels excited by the commotion
Positive non-self-referential	Bill is fascinated by the problem
Positive non-self-referential	Bill is inspired by his trade
Positive non-self-referential	Jill is content with her employment
Positive non-self-referential	Sara is delighted with her daughter
Positive non-self-referential	Jill is satisfied with her acquaintance
Positive non-self-referential	Bill is content with his accomplishment
Positive non-self-referential	Sam is happy with his director
Positive non-self-referential	Bill is cool with his team
Positive non-self-referential	Kate is encouraged by her progress
Positive non-self-referential	Bill is contented with his associate
Positive non-self-referential	Tom is content in his career
Positive non-self-referential	Rose is excited by the challenge
Positive non-self-referential	Jill is intrigued by the complexity
Positive non-self-referential	Neil is relieved at being postponed
Positive non-self-referential	Sam is impressed at the convenience
Positive non-self-referential	Ken is annoyed with his post
Positive non-self-referential	Kate is impressed by her professor
Positive non-self-referential	Anne is calm at being early
Positive non-self-referential	Bill is proud of his niece
Positive non-self-referential	Kate is happy with her friend
Positive non-self-referential	Rose is relieved at being delayed
Positive non-self-referential	Kate is intrigued by the quandary
Positive non-self-referential	Sara is livid at her instructor
Positive non-self-referential	Ken is happy with his superior
Positive non-self-referential	Ken is satisfied with his attainment
Positive non-self-referential	Anne is pleased with her chief
Positive non-self-referential	Ken is pleased by his position
Positive non-self-referential	Anne is enthused with her group
Positive non-self-referential	Sara feels positive about the upheaval
Positive non-self-referential	Neil feels relieved about the interruption
Positive non-self-referential	Neil is happy with his cohort

Positive non-self-referential	Kate is relaxed with her manager
Positive non-self-referential	Anne is happy with her son
Positive non-self-referential	Tom is contented with his companion
Positive non-self-referential	Jill is pleased with her colleagues
Positive non-self-referential	Tom is happy with his superintendent
Positive non-self-referential	Ken is proud of his father
Positive non-self-referential	Sam is amused by his players
Positive non-self-referential	Sara is contented with her tally
Positive non-self-referential	Rose is happy with her teacher
Positive non-self-referential	Sara is happy with her panel
Positive non-self-referential	Jill is happy with her son
Positive non-self-referential	Kate is pleased by her uncle
Positive non-self-referential	Anne is relieved by the simplicity
Positive non-self-referential	Ken is pleased at being first
Positive non-self-referential	Neil is relaxed with his wife
Positive non-self-referential	Kate feels excited about the fracas
Positive non-self-referential	Bill is happy with his supervisor
Positive non-self-referential	Sara is pleased with her work
Positive non-self-referential	Tom is excited by the standoff
Positive non-self-referential	Sam is happy at being early
Positive non-self-referential	Anne is satisfied with her grades
Positive non-self-referential	Rose is irritated by her mother
Positive non-self-referential	Tom is calm with his co-workers
Positive non-self-referential	Rose is impressed by the others
Positive non-self-referential	Sara is pleased with her boss
Positive non-self-referential	Jill is satisfied with her administrator
Positive non-self-referential	Rose is inspired by her peers
Positive non-self-referential	Ken feels relieved about the intrusion
Positive non-self-referential	Jill feels relieved about the distraction
Positive non-self-referential	Sam is pleased with his sister
Positive non-self-referential	Neil is disconcerted by his performance
Positive non-self-referential	Neil is contented with his job
Positive non-self-referential	Sara is relieved at being deferred
Positive non-self-referential	Rose is impressed with her score
Positive non-self-referential	Tom is impressed with his lecturer
Positive non-self-referential	Neil is delighted at his tutor
Positive non-self-referential	Anne is pleased with her accomplice
Positive non-self-referential	Neil is impressed with his squad
Positive self-referential	Jill is delighted with your delivery
Positive self-referential	Tom judges your talent as boundless
Positive self-referential	Sam is positive about your ability
Positive self-referential	Rose regards your speech as impressive
Positive self-referential	Neil is impressed by your presentation
Positive self-referential	Tom is impressed by your confidence

Positive self-referential	Neil is pleased with your delivery
Positive self-referential	Bill regards your composure as inspiring
Positive self-referential	Neil considers you an adept speaker
Positive self-referential	Jill thinks that you seem prepared
Positive self-referential	Ken rates your performance top notch
Positive self-referential	Jill rates your narration unquestionably impressive
Positive self-referential	Bill judges your speech with favour
Positive self-referential	Anne rates your ability entirely suitable
Positive self-referential	Sam is pleased with your narration
Positive self-referential	Rose thinks that you exhibit composure
Positive self-referential	Kate regards your skills as extraordinary
Positive self-referential	Sam considers you a skilled orator
Positive self-referential	Kate judges your delivery as impressive
Positive self-referential	Sam believes you are demonstrating aptitude
Positive self-referential	Bill is delighted with your speech
Positive self-referential	Rose is pleased with your commentary
Positive self-referential	Neil believes you are illustrating proficiency
Positive self-referential	Anne judges your talk as notable
Positive self-referential	Rose considers you a capable communicator
Positive self-referential	Sam thinks that you show confidence
Positive self-referential	Sam judges your ability as striking
Positive self-referential	Jill judges your confidence as enviable
Positive self-referential	Sam is delighted with your ability
Positive self-referential	Rose is impressed by your speech
Positive self-referential	Ken thinks that you seem assured
Positive self-referential	Jill is pleased with your appearance
Positive self-referential	Kate is pleased with your talk
Positive self-referential	Jill is favourable towards your delivery
Positive self-referential	Bill is pleased with your speech
Positive self-referential	Rose is delighted with your talk
Positive self-referential	Bill believes you are performing well
Positive self-referential	Ken regards your narration as talented
Positive self-referential	Anne is pleased with your performance
Positive self-referential	Ken is impressed by your performance
Positive self-referential	Rose is approving about your speech
Positive self-referential	Ken is delighted with your discourse
Positive self-referential	Kate is impressed by your talk
Positive self-referential	Kate is complimentary about your performance
Positive self-referential	Ken considers you a gifted narrator
Positive self-referential	Jill considers you a talented presenter
Positive self-referential	Jill believes you are presenting adeptly
Positive self-referential	Bill is enthusiastic about your skills
Positive self-referential	Bill rates your commentary perfectly acceptable
Positive self-referential	Anne is impressed by your composure

Positive self-referential	Anne believes you are doing impressively
Positive self-referential	Tom is pleased with your presentation
Positive self-referential	Neil is encouraging about your commentary
Positive self-referential	Sara rates your speech first rate
Positive self-referential	Sara considers you a capable talker
Positive self-referential	Ken is excited about your talent
Positive self-referential	Tom thinks that you appear composed
Positive self-referential	Tom believes you are acting confidently
Positive self-referential	Tom rates your confidence flawlessly appropriate
Positive self-referential	Kate considers you proficient at speeches
Positive self-referential	Sara is flattering about your presentation
Positive self-referential	Bill is impressed by your talent
Positive self-referential	Anne regards your aptitude as indisputable
Positive self-referential	Sara is impressed by your ability
Positive self-referential	Tom considers you an able speaker
Positive self-referential	Neil regards your ability as high
Positive self-referential	Tom is delighted with your performance
Positive self-referential	Anne thinks that you look confident
Positive self-referential	Sara thinks that you display calmness
Positive self-referential	Sara judges your pitch as favourable
Positive self-referential	Kate rates your delivery as professional
Positive self-referential	Sara regards your presentation as skilled
Positive self-referential	Neil rates your presentation high quality
Positive self-referential	Ken judges your presentation with approval
Positive self-referential	Neil thinks that you demonstrate control
Positive self-referential	Anne is delighted with your address
Positive self-referential	Kate is delighted with your discussion
Positive self-referential	Sara believes you are exhibiting talent
Positive self-referential	Sam regards your performance as good
Positive self-referential	Rose believes you are showing ability

Appendix II: Descriptive statistics tables

Appendix II(i)

Table 3.2

Mean latencies for correct saccades

			Antisaccade Latencies		Prosaccade Latencies	
Prime	Face	SocAnx	Mean	SD	Mean	SD
Neg	Angry	High	262.67	45.56	184.88	16.38
		Medium	259.26	41.97	180.82	19.74
		Low	254.68	34.36	178.80	14.42
		Total	258.87	40.45	181.50	16.94
	Happy	High	267.87	41.91	183.50	17.49
		Medium	275.61	68.81	184.44	26.74
		Low	264.13	34.61	176.89	14.09
		Total	269.20	50.14	181.61	20.16
	Inverted	High	266.31	56.44	185.52	20.71
		Medium	257.73	47.38	180.81	19.59
		Low	257.20	31.98	177.90	13.40
		Total	260.41	45.91	181.41	18.20
	Neutral	High	280.62	59.92	180.31	15.99
		Medium	278.23	84.74	183.90	26.63
		Low	258.44	23.53	177.48	12.08
		Total	272.43	61.39	180.56	19.15
Neutral	Angry	High	260.20	46.07	181.55	15.35
		Medium	263.90	51.69	186.22	40.56
		Low	259.55	29.21	178.37	16.90
		Total	261.22	42.82	182.05	26.69
	Happy	High	275.57	50.61	183.49	17.74
		Medium	273.26	71.93	181.40	17.81
		Low	256.52	25.73	178.01	16.66
		Total	268.45	52.85	180.97	17.31
	Inverted	High	261.46	38.31	183.82	21.05
		Medium	290.89	94.77	182.65	19.35
		Low	258.80	26.49	177.92	16.09
		Total	270.39	61.86	181.46	18.85
	Neutral	High	259.66	45.62	182.90	19.61
		Medium	263.83	54.75	184.46	30.57
		Low	262.57	34.13	176.62	14.84
		Total	262.02	45.01	181.33	22.59
Positive	Angry	High	271.65	57.07	183.90	21.41
		Medium	265.83	74.71	182.80	21.72
		Low	253.72	43.66	178.15	16.63
		Total	263.73	59.47	181.62	19.93

Happy	High	271.38	49.66	183.50	20.10
	Medium	268.67	44.41	181.86	26.62
	Low	267.71	29.01	176.81	16.62
	Total	269.25	41.39	180.72	21.40
Inverted	High	270.20	46.34	183.50	20.10
	Medium	272.77	66.09	181.86	26.62
	Low	261.72	27.37	176.81	16.62
	Total	268.23	48.74	180.72	21.40
Neutral	High	265.16	45.74	184.83	17.93
	Medium	266.63	44.73	184.73	32.14
	Low	252.96	26.20	177.66	14.60
	Total	261.59	39.83	182.41	22.79

Appendix II(ii)

Table 3.3

Mean saccadic errors

			Antisaccade Error		Prosaccade error	
Prime	Face	SocAnx	Mean	SD	Mean	SD
Neg	Angry	High	0.17	0.15	0.00	0.02
		Medium	0.15	0.23	0.01	0.03
		Low	0.23	0.21	0.01	0.03
		Total	0.18	0.20	0.01	0.03
	Happy	High	0.14	0.12	0.01	0.03
		Medium	0.13	0.21	0.00	0.02
		Low	0.22	0.21	0.01	0.03
		Total	0.16	0.19	0.01	0.03
	Inverted	High	0.15	0.13	0.00	0.02
		Medium	0.16	0.22	0.00	0.02
		Low	0.22	0.25	0.00	0.00
		Total	0.18	0.21	0.00	0.02
	Neutral	High	0.21	0.20	0.01	0.04
		Medium	0.13	0.21	0.00	0.02
		Low	0.17	0.15	0.00	0.02
		Total	0.17	0.19	0.01	0.03
Neutral	Angry	High	0.13	0.12	0.00	0.02
		Medium	0.17	0.22	0.00	0.00
		Low	0.17	0.18	0.01	0.05
		Total	0.16	0.18	0.01	0.03
	Happy	High	0.15	0.13	0.00	0.02
		Medium	0.13	0.15	0.00	0.00
		Low	0.19	0.22	0.01	0.05
		Total	0.16	0.17	0.01	0.03

	Inverted	High	0.19	0.15	0.00	0.00
		Medium	0.13	0.19	0.02	0.05
		Low	0.25	0.27	0.00	0.00
		Total	0.19	0.21	0.01	0.03
	Neutral	High	0.23	0.19	0.01	0.03
		Medium	0.14	0.18	0.00	0.00
		Low	0.18	0.20	0.00	0.00
		Total	0.18	0.19	0.00	0.02
Positive	Angry	High	0.11	0.12	0.01	0.03
		Medium	0.13	0.18	0.00	0.02
		Low	0.20	0.22	0.01	0.03
		Total	0.15	0.18	0.01	0.03
	Happy	High	0.19	0.19	0.00	0.02
		Medium	0.12	0.16	0.00	0.02
		Low	0.22	0.20	0.00	0.02
		Total	0.18	0.19	0.00	0.02
	Inverted	High	0.14	0.13	0.00	0.02
		Medium	0.13	0.18	0.01	0.03
		Low	0.17	0.19	0.01	0.03
		Total	0.15	0.17	0.01	0.03
	Neutral	High	0.20	0.15	0.00	0.00
		Medium	0.19	0.21	0.00	0.00
		Low	0.18	0.19	0.01	0.03
		Total	0.19	0.18	0.00	0.02

Appendix II(iii)

Table 5.6

Mean self-report observations of positive and negative behaviours when fixations have been directed towards a dynamic clip: Block 2

Key valence	Clip valence	Anx	Feedback	Mean	SD
Negative	Negative	High	Pos	0.16	0.16
			Neut	0.21	0.15
			Total	0.19	0.15
		Mod	Pos	0.18	0.17
			Neut	0.16	0.12
			Total	0.17	0.14
		Low	Pos	0.19	0.15
			Neut	0.16	0.09
			Total	0.18	0.12
		Total	Pos	0.18	0.16
			Neut	0.18	0.12
			Total	0.18	0.14

Negative	Neutral	High	Pos	0.17	0.17
			Neut	0.20	0.12
			Total	0.19	0.15
		Mod	Pos	0.19	0.15
			Neut	0.13	0.10
			Total	0.16	0.13
		Low	Pos	0.19	0.15
			Neut	0.11	0.09
			Total	0.15	0.13
		Total	Pos	0.18	0.16
			Neut	0.15	0.11
			Total	0.17	0.14
Negative	Positive	High	Pos	0.15	0.17
			Neut	0.20	0.14
			Total	0.18	0.16
		Mod	Pos	0.21	0.18
			Neut	0.15	0.10
			Total	0.18	0.14
		Low	Pos	0.16	0.15
			Neut	0.14	0.11
			Total	0.15	0.13
		Total	Pos	0.17	0.16
			Neut	0.17	0.12
			Total	0.17	0.14
Positive	Negative	High	Pos	0.13	0.13
			Neut	0.14	0.09
			Total	0.13	0.11
		Mod	Pos	0.11	0.07
			Neut	0.14	0.09
			Total	0.12	0.08
		Low	Pos	0.16	0.12
			Neut	0.11	0.07
			Total	0.14	0.10
		Total	Pos	0.13	0.11
			Neut	0.13	0.08
			Total	0.13	0.10
Positive	Neutral	High	Pos	0.14	0.11
			Neut	0.15	0.09
			Total	0.15	0.10
		Mod	Pos	0.16	0.12
			Neut	0.12	0.09
			Total	0.14	0.10
		Low	Pos	0.09	0.10

			Neut	0.10	0.10
			Total	0.09	0.10
		Total	Pos	0.13	0.11
			Neut	0.12	0.09
			Total	0.13	0.10
Positive	Positive	High	Pos	0.12	0.10
			Neut	0.18	0.10
			Total	0.15	0.10
		Mod	Pos	0.13	0.12
			Neut	0.12	0.10
			Total	0.13	0.11
		Low	Pos	0.12	0.14
			Neut	0.09	0.05
			Total	0.10	0.11
		Total	Pos	0.12	0.12
			Neut	0.13	0.09
			Total	0.13	0.11

Appendix III: Supplementary statistics: non-parametric tests

Appendix III(i)

Study 1**:** Wilcoxon Signed rank tests *Categorisation: Main effects of context/configuration*

NegExtHS_Cat - NegExtHH_Cat	NegExtN_Cat - NegExtHH_Cat	NegExtSH_Cat - NegExtHH_Cat	NegExtSS_Cat - NegExtHH_Cat	NegExtN_Cat - NegExtHS_Cat	NegExtSH_Cat - NegExtHS_Cat	NegExtSS_Cat - NegExtHS_Cat	NegExtSH_Cat - NegExtN_Cat	NegExtSS_Cat - NegExtN_Cat	NegExtHS_Cat - NegExtSH_Cat	NegExtN_Cat - NegExtSH_Cat	NegExtSS_Cat - NegExtSH_Cat
-3.832[a]	-3.831[a]	-3.730[a]	-3.828[a]	-3.832[b]	-3.833[b]	-2.007[a]	-3.829[b]	-3.833[a]	-3.833[a]	-3.829[a]	-3.828[a]
.000	.000	.000	.000	.000	.000	.045	.000	.000	.000	.000	.000

NegIntHS_Cat - NegIntHH_Cat	NegIntN_Cat - NegIntHH_Cat	NegIntSH_Cat - NegIntHH_Cat	NegIntSS_Cat - NegIntHH_Cat	NegIntN_Cat - NegIntHS_Cat	NegIntSH_Cat - NegIntHS_Cat	NegIntSS_Cat - NegIntHS_Cat	NegIntSH_Cat - NegIntN_Cat	NegIntSS_Cat - NegIntN_Cat	NegIntHS_Cat - NegIntSH_Cat	NegIntN_Cat - NegIntSH_Cat	NegIntSS_Cat - NegIntSH_Cat
-3.826[a]	-3.826[a]	-3.666[a]	-3.828[a]	-3.729[b]	-3.828[b]	-1.386[a]	-3.506[b]	-3.686[a]	-3.828[a]	-3.506[a]	-3.824[a]
.000	.000	.000	.000	.000	.000	.166	.000	.000	.000	.000	.000

NeutHS_Cat - NeutHH_Cat	NeutN_Cat - NeutHH_Cat	NeutSH_Cat - NeutHH_Cat	NeutSS_Cat - NeutHH_Cat	NeutN_Cat - NeutHS_Cat	NeutSH_Cat - NeutHS_Cat	NeutSS_Cat - NeutHS_Cat	NeutSH_Cat - NeutN_Cat	NeutSS_Cat - NeutN_Cat	NeutHS_Cat - NeutSH_Cat	NeutSS_Cat - NeutSH_Cat
-3.826[a]	-3.833[a]	-3.785[a]	-3.831[a]	-3.833[b]	-3.828[b]	-1.839[a]	-3.667[b]	-3.831[a]	-3.828[a]	-3.826[a]
.000	.000	.000	.000	.000	.000	.066	.000	.000	.000	.000

PosExtNS_Cat - PosExtHH_Cat	PosExtN_Cat - PosExtHH_Cat	PosExtSH_Cat - PosExtHH_Cat	PosExSSt_Cat - PosExtHH_Cat	PosExtN_Cat - PosExtNS_Cat	PosExtSH_Cat - PosExtNS_Cat	PosExSSt_Cat - PosExtNS_Cat	PosExtSH_Cat - PosExtN_Cat	PosExSSt_Cat - PosExtN_Cat	PosExtNS_Cat - PosExtSH_Cat	PosExSSt_Cat - PosExtSH_Cat
-3.827[a]	-3.829[a]	-3.829[a]	-3.833[a]	-3.831[b]	-3.825[b]	-1.455[a]	-3.708[b]	-3.831[a]	-3.825[a]	-3.828[a]
.000	.000	.000	.000	.000	.000	.146	.000	.000	.000	.000

AppendixIII(ii)

Study 2: Wilcoxon Signed rank tests *Avoidance, feature and valence*

AvoidHA – AvoidAH	AvoidNA - AvoidAN	AvoidAN - AvoidAH	AvoidNA - AvoidHA
-2.765[a]	-4.286[a]	-1.843[b]	-.091[a]
.006	.000	.065	.927

Valence

ValenceHA - ValenceAH	ValenceNA - ValenceAN	ValenceAN - ValenceAH	ValenceNA - ValenceHA
-.394[a]	-5.210[b]	-5.343[a]	-1.335[a]
.693	.000	.000	.182

Feature

LowerHA – LowerAH	LowerNA - LowerAN	LowerAN - LowerAH	LowerNA - LowerHA
-5.634[a]	-6.333[a]	-5.327[b]	-3.693[a]
.000	.000	.000	.000

Appendix III(iii)

Chapter 4 Study 3 (Pilot) Wilcoxon Signed rank tests for prime type

Test Statistics[c]

NegOtherNC - NeutralN	NegSelfNE - NeutralN	PosOtherPC - NeutralN	PosSelfPE - NeutralN	NegSelfNE - NegOtherNC	PosOtherPC - NegOtherNC	PosSelfPE - NegSelfNE	PosSelfPE - PosOtherPC
-3.621[a]	-3.621[b]	-3.622[a]	-3.622[b]	-3.621[b]	-2.535[b]	-3.465[b]	-3.621[b]
.000	.000	.000	.000	.000	.011	.001	.000

Appendix III(iv)

Study 3 (Pilot) *Kruskal Wallis Test tests for prosaccade latencies*

Error_Pro_A_Neg	Error_Pro_H_Neg	Error_Pro_I_Neg	Error_Pro_N_Neg	Error_Pro_A_Neut	Error_Pro_H_Neut	Error_Pro_I_Neut	Error_Pro_N_Neut	Error_Pro_A_Pos	Error_Pro_H_Pos	Error_Pro_I_Pos	Error_Pro_N_Pos
.406	.374	1.015	1.765	2.086	2.086	6.171	4.056	.374	.000	1.591	4.056
2	2	2	2	2	2	2	2	2	2	2	2
.816	.830	.602	.414	.352	.352	.046	.132	.830	1.000	.451	.132

Appendix III(v)

Study 4 Wilcoxon Signed rank tests for clip type ratings

Test Statisticsa	B1_NegClip_PosKeyPress - B1_NegClip_NegKeyPress	B1_PosClip_PosKeyPress - B1_PosClip_NegKeyPress	B1_PosKeyPress - B1_NegKeyPress
Z	-5.700b	-1.267b	-6.388b
Asymp. Sig. (2-tailed)	0	0.205	0
Exact Sig. (2-tailed)	0	0.207	0
Exact Sig. (1-tailed)	0	0.104	0
Point Probability	0	0	0

Appendix III(vi)

Study 4 *Kruskal Wallis Test tests for RT*

	FillRT - NeutRT	NegRT - NeutRT	PosRT - NeutRT
Z	-6.031[a]	-6.325[a]	-6.204[a]
Asymp. Sig. (2-tailed)	.000	.000	.000

Appendix III(vii)

Study 5 Mann Whitney & Wilcoxon Signed rank tests for observed clip type

B1_NegClip_NegKeyPress	B1_NegClip_PosKeyPress	B1_NeutClip_NegKeyPress	B1_NeutClip_PosKeyPress	B1_PosClip_NegKeyPress	B1_PosClip_PosKeyPress
321.000	303.000	251.500	290.500	309.000	304.500
699.000	681.000	629.500	668.500	687.000	682.500
-1.690	-1.984	-2.750	-2.182	-1.877	-1.946
.091	.047	.006	.029	.060	.052

B2_NegClip_PosKeyPress - B2_NegClip_NegKeyPress	B2_NeutClip_PosKeyPress - B2_NeutClip_NegKeyPress	B2_PosClip_PosKeyPress - B2_PosClip_NegKeyPress
-3.295[a]	-3.352[a]	-3.263[a]
.001	.001	.001

B2_NeutClip_NegKeyPress - B2_NegClip_NegKeyPress	B2_PosClip_NegKeyPress - B2_NegClip_NegKeyPress	B2_NeutClip_NegKeyPress - B2_PosClip_NegKeyPress	B2_NeutClip_PosKeyPress - B2_NegClip_PosKeyPress	B2_PosClip_PosKeyPress - B2_NegClip_PosKeyPress	B2_NegClip_PosKeyPress - B2_PosClip_PosKeyPress
-.828[a]	-.638[a]	-.530[a]	-.127[a]	-1.189[a]	-1.189[b]
.408	.523	.596	.899	.234	.234

Appendix IV Correlations

Appendix IV(i) Study 3 *Non-significant correlations between ACS and errors*

		ACS
ACS	Correlation Coefficient	1
	Sig. (2-tailed)	.
Error_Anti_A_Neg	Correlation Coefficient	-0.104
	Sig. (2-tailed)	0.547
Error_Anti_H_Neg	Correlation Coefficient	0.044
	Sig. (2-tailed)	0.798
Error_Anti_I_Neg	Correlation Coefficient	0.11
	Sig. (2-tailed)	0.523
Error_Anti_N_Neg	Correlation Coefficient	0.144
	Sig. (2-tailed)	0.401
Error_Anti_A_Neut	Correlation Coefficient	0.201
	Sig. (2-tailed)	0.24
Error_Anti_H_Neut	Correlation Coefficient	0.188
	Sig. (2-tailed)	0.272
Error_Anti_I_Neut	Correlation Coefficient	-0.083
	Sig. (2-tailed)	0.632
Error_Anti_N_Neut	Correlation Coefficient	0.216
	Sig. (2-tailed)	0.206
Error_Anti_A_Pos	Correlation Coefficient	0.065
	Sig. (2-tailed)	0.708
Error_Anti_H_Pos	Correlation Coefficient	-0.142
	Sig. (2-tailed)	0.408
Error_Anti_I_Pos	Correlation Coefficient	0.08
	Sig. (2-tailed)	0.642

Appendix IV(ii)

Study 3 *Correlations between depression/anxiety and error rates*

		Depression	Anxiety
Error_Anti_A_Neg	Correlation Coefficient	-0.121	0.067
	Sig. (2-tailed)	0.311	0.574
Error_Anti_H_Neg	Correlation Coefficient	0.022	-0.027
	Sig. (2-tailed)	0.851	0.822
Error_Anti_I_Neg	Correlation Coefficient	0.018	0.13
	Sig. (2-tailed)	0.884	0.276
Error_Anti_N_Neg	Correlation Coefficient	-0.028	0.085
	Sig. (2-tailed)	0.813	0.476
Error_Anti_A_Neut	Correlation Coefficient	-0.065	0.039
	Sig. (2-tailed)	0.585	0.743
Error_Anti_H_Neut	Correlation Coefficient	-0.016	0.204

	Sig. (2-tailed)	0.892	0.085
Error_Anti_I_Neut	Correlation Coefficient	-0.045	0.002
	Sig. (2-tailed)	0.705	0.989
Error_Anti_N_Neut	Correlation Coefficient	0.054	0.111
	Sig. (2-tailed)	0.654	0.354
Error_Anti_A_Pos	Correlation Coefficient	-0.037	0.019
	Sig. (2-tailed)	0.755	0.877
Error_Anti_H_Pos	Correlation Coefficient	-0.182	-0.053
	Sig. (2-tailed)	0.125	0.657
Error_Anti_I_Pos	Correlation Coefficient	-0.006	-0.026
	Sig. (2-tailed)	0.962	0.831
Error_Anti_N_Pos	Correlation Coefficient	-0.051	0.031
	Sig. (2-tailed)	0.671	0.796
Depression	Correlation Coefficient	1	.595**
	Sig. (2-tailed)	.	0
Anxiety	Correlation Coefficient	.595**	1
	Sig. (2-tailed)	0	.

Appendix IV(iii)

Study 5: *Correlations between depression/anxiety and valence ratings*

		BDI	BAI
BDI	Correlation Coefficient	1	.606**
	Sig. (2-tailed)	.	0
BAI	Correlation Coefficient	.606**	1
	Sig. (2-tailed)	0	.
B1_NegClip_NegKeyPress	Correlation Coefficient	0.128	-0.015
	Sig. (2-tailed)	0.232	0.891
B1_NegClip_PosKeyPress	Correlation Coefficient	-0.025	-0.056
	Sig. (2-tailed)	0.816	0.604
B1_NegClip_KeyReactime	Correlation Coefficient	0.132	0.018
	Sig. (2-tailed)	0.219	0.869
B1_NeutClip_NegKeyPress	Correlation Coefficient	0.013	-0.063
	Sig. (2-tailed)	0.902	0.556
B1_NeutClip_PosKeyPress	Correlation Coefficient	-0.201	-0.095
	Sig. (2-tailed)	0.059	0.376
B1_NeutClip_KeyReactime	Correlation Coefficient	-0.088	-0.089
	Sig. (2-tailed)	0.411	0.408
B1_PosClip_NegKeyPress	Correlation Coefficient	-0.059	-0.021
	Sig. (2-tailed)	0.584	0.846
B1_PosClip_PosKeyPress	Correlation Coefficient	.296**	0.026
	Sig. (2-tailed)	0.005	0.806

B1_PosClip_KeyReactime	Correlation Coefficient	0.201	0.003
	Sig. (2-tailed)	0.059	0.975

Appendix IV(iv)

Study 5 *Correlations between depression/anxiety and post task evaluative ratings*

Spearman's rho		BDI	BAI	Self_a	Other_a	Self_b	Other_b	TotalActor_a	TotActor_b
BDI	Correlation Coefficient	1	.606**	-0.184	-0.173	-.230*	-0.068	-0.073	-0.173
	Sig. (2-tailed)	.	0	0.085	0.105	0.03	0.528	0.497	0.105
BAI	Correlation Coefficient	.606**	1	-0.18	-0.17	-.221*	-0.105	-0.125	-.221*
	Sig. (2-tailed)	0	.	0.091	0.112	0.038	0.329	0.245	0.037
Self_a	Correlation Coefficient	-0.184	-0.18	1	.768**	.694**	.632**	.651**	.484**
	Sig. (2-tailed)	0.085	0.091	.	0	0	0	0	0
Other_a	Correlation Coefficient	-0.173	-0.17	.768**	1	.563**	.677**	.668**	.491**
	Sig. (2-tailed)	0.105	0.112	0	.	0	0	0	0
Self_b	Correlation Coefficient	-.230*	-.221*	.694**	.563**	1	.745**	.621**	.613**
	Sig. (2-tailed)	0.03	0.038	0	0	.	0	0	0
Other_b	Correlation Coefficient	-0.068	-0.105	.632**	.677**	.745**	1	.666**	.671**
	Sig. (2-tailed)	0.528	0.329	0	0	0	.	0	0

TotalActor_a	Correlation Coefficient	-0.073	-0.125	.651**	.668**	.621**	.666**		1	.632**
	Sig. (2-tailed)	0.497	0.245	0	0	0	0	.		0
TotActor_b	Correlation Coefficient	-0.173	-.221*	.484**	.491**	.613**	.671**	.632**		1
	Sig. (2-tailed)	0.105	0.037	0	0	0	0		0	.

Appendix V

Study 5 *Interview schedule*

1. Describe your dream job.
2. Are You A Good Leader?
3. How Do You Feel About Taking Direction From Your Superiors?
4. How Do You Feel About Carrying Out Mundane or Repetitive Work?
5. How Well Do You Handle Criticism?
6. How Well Do You Work Within A Team Environment?
7. What Motivates You?
8. How Would Your Current Boss Describe You?
9. What Part Of Your Job Do You Dislike The Most?
10. If You Were Starting Out Again In Your Career Are There Any Decisions You Would Make Differently?
11. How Well Do You Work In A Stressful Environment?
12. Tell me about the worst boss you ever had.
13. Do you check voicemail and email when on holiday?
14. What Would Your Work Colleagues Say About You?
15. What Would Your Friends Say About You?
16. Discuss a time when your integrity was challenged. How did you handle it?
17. What Interests Do You Have Outside Of Your Work?
18. What changes have you made in your life that you are most proud of?
19. What Do You Think About the economic cuts
20. How do you measure success?
21. Describe your dream job.
22. Are You A Good Leader?
23. How Do You Feel About Taking Direction From Your Superiors?
24. How Do You Feel About Carrying Out Mundane or Repetitive Work?
25. How Well Do You Handle Criticism?
26. How Well Do You Work Within A Team Environment?
27. What Motivates You?
28. How Would Your Current Boss Describe You?
29. What Part Of Your Job Do You Dislike The Most?
30. How Well Do You Work In A Stressful Environment?
31. Tell me about the worst boss you ever had.
32. Do you check voicemail and email when on holiday?
33. What Would Your Work Colleagues Say About You?
34. What Would Your Friends Say About You?
35. Discuss a time when your integrity was challenged. How did you handle it?
36. What Interests Do You Have Outside Of Your Work?
37. What changes have you made in your life that you are most proud of?
38. What Do You Think About the economic cuts

Appendix VI : Construction and validation of video stimuli

Studies 4 & 5 *Construction and validation of video stimuli*

13 amateur and semi-professional actors were recruited through the Strathclyde Theatre School and from a Psychology Master's program. They were each filmed using a Canon Legria FS10 SD digital video camera, at the University of Strathclyde in the same room and lighting conditions and were all asked to wear a neutral coloured outfit. Each actor was issued with a script of 18 valenced behaviours prior to the recording day in order to practice their performance.

Each of these 18 behaviours were filmed four times culminating in a total of 72 behaviours each. Actors were instructed to display behaviours for two seconds. Between each of the scripted behaviours, actors were asked to adopt a static neutral position for 10 seconds in order to provide material for the neutral filler clips. Videos were then edited using Avidmux editing software. One of the possible reasons discussed at the beginning of Chapter 5 for the lack of group interpretation differences in previous studies was the lack of response time limit which would enable more elaborative processes to be engaged whilst attempting to classify the emotion of the face. In the current study, in order to enable time for the build-up and tailing off of the behaviour to make it look natural between filler clips, the clips were extended to one minute either side of the two second behaviours. Each clip contained 100 video frames.

Data from the first 27 participants who completed Study 4 was used to validate the clips to be used in Study 5. This constituted a third of the target sample size for each of these studies (e.g. Weary & Reich, 2001). Behaviours were designated to be neutral if they fell within the range of -0.05 to 0.05; negative if they were between -1 and -3 and positive if they were between 1 and 3. In order to select the most appropriate clips, 288 of the most prototypical clips were firstly selected from the original 648; providing 6 filler clips where no action on facial expression was displayed; as well as 6 negative clips where the panel member frowned or shook head etc; 6 neutral dynamic clips where the panel member scratched head or played with pen etc. and 6 positive dynamic behaviours (i.e. where panel member smiled or nodded head etc.) for each of the 12 actors.

Although it was originally intended to use 18 filler clips for each actor, on inspection of the data it was decided that selecting just six fillers would enable the most neutral fillers to be selected whilst maintaining a realistic impression of the 'audience' by using dynamic rather than static filler clips. Actors who had mean valence scores that were consistently closest to each target clip valence type (i.e. positive, negative, neutral subtypes as listed in the method section) were selected but one was excluded due to a slight discrepancy with the positioning of one of the props (i.e. a score sheet) between clips.

Because neutral behaviours may be interpreted positively or negatively to some degree rather than simply neutral, actors who were rated closest to a zero rating were selected for neutral clips. Ratings for neutral fillers ranged across the 12 actors ranged from -0.38 to 0.02. Actors judged to be most negative were excluded from the selection process. Ratings for the remaining actors ranged from -0.02 to 0.02 which is within the neutral threshold of -0.05 to 0.05. Neutral dynamic behaviours were rated more negatively on the whole than neutral static behaviours, with ratings ranging from – 0.11 to -1.04. From these the six most neutral actors were selected whilst maintaining an equal gender balance across the panel.

Valence ratings for selected actors thus ranged from – 0.03 to 0.02 for neutral fillers and – 0.64 to -0.11 on a scale of -3 (most negative) to 3 (most positive).Thus neutral static clips for selected actors met the criteria for neutral valence whilst neutral dynamic behaviours were just slightly above the threshold. For negative behaviours, ratings for both the 12 actors and the selected six ranged from -1.38 to -2.09. Overall ratings for positive behaviours ranged from 1.33 to 2.06 and for selected actors, from 1.51 to 2.06. Thus behaviours for selected actors meet the criteria for negative and positive valence.

In order to check whether there were significant differences between ratings across clip valence a one-way repeated measure ANOVA was conducted for the remaining clips with four levels of clip type (positive dynamic, negative dynamic, neutral dynamic, neutral filler) as a repeated measures independent variable. Mauchly's test indicated that the assumption of sphericity had been violated for clip type, (χ^2 (5) = 88.68, p< 0.001) therefore degrees of freedom were corrected using the Greenhouse Geisser estimates of sphericity (ε = 0.39). Results revealed a significant main effect, $F(1.18, 30.72) = 135.40$, $MSE = 39.64$, p<0.001, *partial* η^2= 0.84, *Power* = 1.

Bonferroni post hoc comparisons found that neutral fillers (M = 0.002, SE = 0.06) were significantly less negative than negative behaviours (M = - 1.81, SE = 0.17, p<0.001) and neutral dynamic behaviours (M = -0.33, SE = 0.09, p<0.001), which were also significantly less negative than negative behaviours (p<0.001). Positive behaviours (M = 1.78, SE = 0.14) were rated significantly more positively than negative behaviours (p<0.001); neutral dynamic behaviours (p<0.001) and neutral fillers (p<0.001). The means and standard errors are illustrated in Figure 5.1.1.

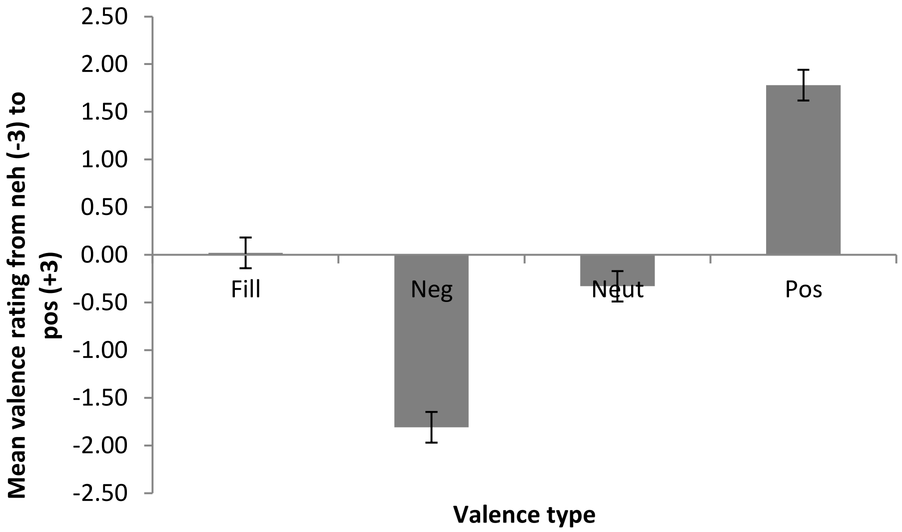

Figure D.1 *Mean valence ratings across each social cue type (bars denote standard errors)*