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Exploring Links between Anxiety, Attention and Social Adjustment in Youths and Adults

by

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ABSTRACT

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A vast amount of research has found links between anxiety and attention biases towards threatening stimuli. Theoretical models of attention in anxiety focus on two main attentional pathways; these are selective attention to threat (e.g., Mogg & Bradley, 1998), where attention is automatically capture by threatening stimuli, and hypervigilance for threat (e.g., Richards, Benson & Hadwin, 2011), where attention is spread across the visual field and threat is detected and processed by covert attention. Attentional control is argued to have a moderating role in the relationship between anxiety and attention biases to threat (i.e. attention biases to threat are most evident in anxious individual with low attentional control). In addition, research indicates that reduced attentional control and attention biases for threat stimuli are associated with poor social adjustment across development, including poor peer relationships and atypical social behaviour. The current thesis used an eye-movement paradigm to explore the relationship between anxiety, attention to threat and social adjustment in youths and adults. The remote distractor paradigm was used to measure attentional capture, as well as hypervigilance, for threat. In this paradigm, rapid eye movements to the angry face distractor provide evidence of attentional capture to threat. Slower latencies to initiate eye movements to the target in the presence of an angry distractor face provide evidence of hypervigilance for threat. Across three studies the results showed that anxious behaviour was unrelated to selective attention for threat. Instead the results showed that neuroticism (i.e. a personality trait characterised by increased levels of anxiety) was associated with hypervigilance for angry (but not happy or neutral) faces. In addition the current experiments revealed links between internalising traits (trait anxiety and neuroticism) and impaired inhibition of threat and social adjustment difficulties including poor performance during social interaction and low socio-metric status. The results from the current experiments are in line with previous research suggesting that anxiety is characterised by impaired inhibition of threat, where this is facilitated by a broad attentional beam. In addition, the current result fit theoretical models and empirical findings that highlight links between attentional mechanisms and poor social adjustment.

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Declaration of Authorship

I, Katerina Pavlou

declare that thesis entitled

Exploring Links between Internalising and Externalising Traits, Attention and Social Adjustment in Youths and Adults

and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

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I dedicate this thesis in memory of my beloved grandmother. Although our time together was brief in the past few years, your contributions to my life will be felt forever.

Thesis Overview

Anxiety disorders are among the most common psychiatric problems observed in children and are typically chronic throughout adolescence and adulthood if left untreated (Benjamin, Costello, & Warren, 1990; Boyd, Gullone, Kostanski, Ollendick, & Shek, 2000; Last, Perrin, Hersen, & Kazdin, 1996). Similarly, externalising behaviours including conduct disorder (i.e. an emotional and behavioural disorder characterised by increased aggressiveness and inappropriate behaviour including the violation of others' rights) are found to manifest in childhood and can persist throughout a person's lifetime (Betz, 1995; Farrington, 1989).

Several different factors have been associated with the development and maintenance of anxiety and conduct problems including genetics, brain structure and brain function, modelling and cognitive vulnerability. Research on attention in anxiety for instance, suggests that anxious individuals show preference for threat processing, which maintains high levels of fear and negative emotionality. Similarly, studies on attention in individuals with conduct-like problems (i.e. aggressive behaviour) revealed that aggressive children are more likely than non-aggressive children to show enhanced processing of threat. However, theories and empirical findings proposed that high attentional control may moderate links between anxiety and aggressiveness and attention biases towards threatening information (Lonigan & Philips, 2001; Ellis, Weiss and Lochman. A study by Lonigan et al., (2004) for example, found that increased processing of threat and low effortful control interacted to predict high levels of pathological anxiety.

Clinical and sub-clinical anxiety (characterised by high but not extreme levels of anxiety) have been linked to negative outcomes in development, including poor

school attendance (Ingul & Nordahl, 2013; Richards & Hadwin, 2011) and academic performance (Wood, 2006) and the development of ineffective social relationships (Beidel, Turner & Morris, 1999). Research focusing on the impact of anxiety on social development, for example, suggested that high anxious individuals have fewer (Pedersen et al., 2007) and lower quality friendships (Rubin et al., 2006) and they are more likely to experience victimization or rejection from peer groups (La Greca & Harisson, 2005). Similarly, childhood externalising behaviours (e.g. conduct problems) have been associated with peer rejection and low socio-metric status, and with increased delinquency and violence in adulthood (Betz, 1995; Farrington, 1989; Moffitt, 1993). A study by Crick and Grotpeter (1995), for example, showed that aggressive children were less well-accepted by their peers and reported being more isolated and lonely compared to non-aggressive children.

A number of studies have suggested that the association between internalising and externalising traits and social adjustment difficulties is indirect, and potentially influenced by different factors including poor social skills (e.g. reduced eye contact and less verbal engagement during social interaction), dysfunctional coping strategies (e.g. avoidance of social situations) and poor emotional regulation (Vasey & Daleiden, 1996; Spence et al., 1999). Further research has proposed that attentional processes may also have an important role in social adjustment. Simonds (2007) for instance, found that low attentional control was associated with the expression of maladaptive emotional responses in a social context. Specifically, children that were more distracted by task irrelevant information, found it more difficult to smile when receiving an undesired gift. Impaired inhibition of threat has also been linked to social adjustment difficulties.

Findings suggesting links between anxiety and aggressiveness and impaired inhibition of threat (Eysenck et al., 2007; Gouze, 1987; Mogg et al., 2008; Richards et al., 2012), may offer some insight into the factors contributing to the development and maintenance of anxious and aggressive behaviour, as well as to the relationship between elevated anxiety and aggressiveness and social adjustment difficulties. Although internalising and externalising traits and attentional processes have both been associated with social adjustment difficulties, there is no research to date that has explored the differential effect of impaired inhibition of threat (i.e. selective attention or hypervigilance for threat) on social adjustment in individuals with internalising and externalising traits. The aim of the current work was to explore associations between internalising (i.e. anxiety) and externalising (i.e. conduct-like problems) behaviour, attention and social adjustment in children and adults. We anticipated that internalising and externalising traits would be associated with impaired inhibition of threat, where this relationship will be moderated by attentional control. Additionally, it is proposed that internalising and externalising traits will be associated with social adjustment difficulties, via impaired inhibition of threat. The objective of the current work is to explore the role of different attention mechanisms (i.e. selective attention versus hypervigilance) related to impaired inhibition of threat in the relationship between internalising and externalising behaviours and social adjustment difficulties, and to inform future prevention and interventions that will aim to improve social adjustment in individuals with anxiety and conduct-like difficulties.

We used the remote distractor paradigm to explore distractor interference from threatening and non-threatening faces, using real photographic faces and analysis was based on reaction times and eye movement data. In addition, a number of questionnaires were used to measure anxiety, attentional control, personality traits and

social adjustment. The first chapter focuses on the main factors related to the development and maintenance of anxious and aggressive behaviours. The following chapter will consider links between anxiety and aggressiveness and social adjustment, as well as the contribution of attentional processes in this relationship. In the third, fourth and fifth chapter the results from three different studies will be presented and discussed. The current thesis will end with a general discussion of the findings, highlighting limitations of the current work, and proposing suggestion for future research.

Chapter 1: Anxiety, Attention and Social Adjustment

1.1 Anxiety

Anxiety disorders are defined as mental health problems characterised by extreme, persistent (> 6 months) and intense fears that may have long-term effects on daily functioning (Marques, Pereira, Barros & Muris, 2013), which may include, for example, poor school attendance, low academic performance, decreased ability to cooperate and interact effectively with others (Donovan & Spence, 2000). Additionally, anxiety disorders are typically accompanied by increased state anxiety in situations perceived as threatening; i.e., increased physiological arousal (sweating, dizziness, nausea, palpitations, blushing, shortness of breath) and avoidance of any situation or object that causes fear. Socially anxious individuals, for example, show increased fear of being watched or negatively judged by others in social settings, and worry that an anxious response may cause embarrassment (American Psychiatric Association, 2013; see also La Greca, 2001).

The American Psychiatric Association (APA, 2013) highlights a number of anxiety disorders including generalised anxiety disorder (GAD) which is characterised by a consistent worry over multiple things in life, social anxiety disorder, specific phobia (e.g. fear of animals, the natural environment, blood-injection-injury), separation anxiety disorder (i.e. extreme fear over separation from home or from individuals to whom the child is attached) and panic disorder (DSM-5, 2013). Anxiety can be further divided into clinical and sub-clinical, where anxiety represents a dimensional construct and where the difference between high levels of anxiety in the typical range and clinical levels are argued to be 'fluid' (Rapee, 2001). Specifically, empirical findings suggest that clinical and subclinical anxiety manifest comparable

cognitive, behavioural and neurobiological components (Agarwal & Agarwal, 2012). Further research has revealed high levels of comorbidity in anxiety disorders, with 40%-80% of anxious individuals showing symptoms of more than one anxiety disorder (Benjamin et al., 1990, Kashani & Ovraschel, 1990, Last et al., 1987; Rodriguez et al., 2004). Furthermore, some studies have supported that anxious individuals are at higher risk compared to non-anxious individuals to also show symptoms of other psychopathological problems over time (e.g. depression, mood disorders, disruptive behaviours; Brady & Kendall, 1992; Kendler et al., 2007).

With the exception of generalised anxiety disorder and panic disorder which typically emerges in early adulthood, retrospective studies have found that anxious adults tend to report late childhood or early adolescence as the starting point of their anxiety (Donovan & Spence, 2000); with separation anxiety and specific phobias for example, emerging in early-middle childhood and social anxiety in early-mid adolescence (Kessler et al., 2005, Marikangas, Nakamura & Kessler, 2009; Ost, 1987). Research findings have also suggested that the mean onset age across anxiety disorders is around eleven years (Kessler et al., 2005).

Given the early onset, high prevalence and negative outcomes of anxiety disorders, theoretical frameworks and empirical research have focused on understanding vulnerability, risk and maintenance factors for elevated anxiety, with the aim of developing prevention and intervention methods (see Grüner, Muris, & Merckelbach, 1999; Donovan & Spence, 2000; McLeod, Wood, & Weisz, 2007; Wong, Mahar, Titchener & Freeman, 2013). Genetic vulnerability and cognitive risk, as well as socialisation processes (from parents and peers), have been the main focus related to the manifestation and maintenance of anxiety disorders in development (Beidel & Turner, 1997; Fyer Mannuza, Chapman, Martin & Klein, 1995; Stein et al.,

2007). For example, anxiety disorders have been linked to temperamental factors (i.e. behavioural inhibition) and personality traits (i.e. neuroticism), that reflect a tendency in infants and children for increased shyness and fearfulness and a predisposition to avoid unfamiliar people and novel stimuli and situations (Asendorpf, 1993; Hettema et al., 2006). Behaviourally inhibited infants and children with neurotic traits are found to be at high risk for developing anxiety disorders later in life (Fox & Pine, 2012; Gladstone & Parker, 2005).

1.1.1 Risk Factors for Anxiety: Genetic and Cognitive Risk

Twin studies have indicated that genetic factors have a relatively moderate contribution to the development of anxiety disorders. Approximately 30 –40% of the variance in generalized anxiety disorder, social phobia and panic disorder can be attributed to genetic factors (Gross & Hen, 2004). Genetic research has proposed that anxious individuals inherit a general propensity or temperamental vulnerability (i.e. behavioural inhibition and neuroticism). In support of this view, retrospective and prospective studies have suggested that behaviourally inhibited infants are more likely to exhibit symptoms of anxiety in childhood, where these symptoms may continue into adulthood (Hirshfeld, 1992; Muris, van Brakel, Arntz, Schouten, 2011).

A prospective study for example, found that behaviourally inhibited preschool children were at greater risk for developing an anxiety disorder in the following years compared to non-behaviourally-inhibited children (Biederman et al., 1993). Linked to the above proposition, is Gray's model (1972, 1981), which suggests that individual differences in two general motivational systems that underlie behaviour and affect (the behavioural inhibition system (BIS), and the behavioural activation system (BAS)) are responsible for generating individual differences in personality dimensions such as anxiety and impulsivity. The BIS is suggested to regulate

motivation and is sensitive to indicators of punishment, novelty and non-reward and it inhibits behaviour that may result in painful or negative outcomes. In contrast, the BAS (Gray, 1981, 1990) is sensitive to signals of non-punishment, reward and escape from punishment; hence its activity facilitates movement towards goals (Fowles, 1980). Based on Gray's model (1972, 1981) anxiety is related to the arousal of the BIS, where behaviour with possibly negative outcomes (e.g. painful or embarrassing experiences) is inhibited.

Temperament is traditionally defined as the biologically-based foundation of personality (Buss & Plomin, 1984; Turner, Beidel, & Wolff, 1996). This perspective suggests a sequential relationship, with personality being a product of the interaction between temperament and the environment, that develops over time and is broader in scope (i.e. involves thoughts, values, skills, morals, beliefs, defences and social cognitions). Studies exploring the associations between personality traits and psychopathology have proposed predictive links between Neuroticism[1] and internalizing behavioural problems. Specifically, increased neuroticism in childhood has been found to be related to the development of anxiety disorders later in life (Biederman et al., 1990; Van Brakel, Muris, Bogels, & Thomassen, 2006; Gladstone & Parker, 2005; Hirshfeld-Becker et al., 2007). For example, Lonigan, Kistner, Hooe, and David (1997) found that adolescents with neurotic traits are more likely than their peers to report anxiety symptoms in the next seven months. Similarly, a number of studies have found that anxious adults are more likely than non-anxious adults to retrospectively report neurotic traits in childhood or adolescence (see Rapee & Melville, 1997; Lipsitz et al., 1994; Pollack et al., 1996; Van der Molen, Van den Hout, Van Dieren, & Griez, 1989).

[1] Neuroticism is one of the big five personality traits, defined as the tendency to experience negative emotional states on a continuous basis and it is often linked to feelings of anxiety, guilt, anger and depressed mood.

However, some theorists (e.g. Lonigan and Philips, 2001) have proposed that the relationship between neuroticism and anxiety may be moderated by attentional control. Lonigan and Philips' (2001) theoretical framework for example, suggests that children with elevated neuroticism will show an attentional bias for threat, but a greater ability to control orienting responses (i.e. high attentional control) allows the child to disengage and shift attention away from threatening stimuli and focus on task relevant information. Similarly, Rueda, Checa and Rothbart (2010) suggested that low effortful control, which they defined as a temperamental aspect related to "the ability to inhibit a dominant response to perform a subdominant response" (Rothbart 1998, p. 137), is associated with internalizing and externalizing behavioural problems. The authors proposed that high effortful control allows individuals to shift their attention away from sources of threat and engage with more neutral or positive information in the environment, reducing the levels of fear and negative emotionality induced by the processing of threat. In support of this proposition, research findings suggest that high levels of attention shifting (i.e. a component of effortful control) can protect behaviourally inhibited and shy children from developing anxiety later in life by enabling the disengagement of attention from threatening stimuli or negative thinking (Degnan & Fox, 2007; White et al., 2011).

Elevated anxiety is found to be associated with enhanced threat processing in the context of low effortful control (Derryberry & Reed, 2002; Lonigan et al. 2004). Muris de Jong, and Engelen (2004), for example, explored links between neuroticism, attentional control and anxiety in children. They found that anxious children (8-13 years old) tended to show a combination of increased neuroticism and low attentional control. Similarly, adults with high levels of neuroticism and low attentional control reported more anxiety symptoms compared with adults with elevated neuroticism and

high attentional control (Derryberry & Reed, 2002). Additionally, in two studies Lonigan et al., (2004; 2009) found that temperamental risk (e.g. negative affectivity and behavioural inhibition) was a significant predictor of an attention bias towards threatening words, where this effect was moderated by effortful control; only individuals with high levels of negative affectivity and low effortful control showed an attention bias for threat.

1.2 Attention

1.2.1 Models of Visual Attention

Attempts to explain how visual attention works have led to the development of two main models: the spotlight model (see Cave & Bichot, 1999; Posner, Snyder, & Davidson, 1980) and the zoom-lens model (see Eriksen and James, 1986; Belopolsky, Zwaan, Theeuwes, & Kramer, 2007). Both models suggest that visual attention functions in a two-stage procedure. In the first stage, attention is spread across the visual field where various stimuli are processed at the same time. In the second stage, attention is allocated to a certain stimuli in the visual field and processing operates sequentially (Jonides, 1983). Selective attention may have a narrower or a broader focus, which is not necessarily related to the size of the stimuli or the discriminability between its features. Particularly, attention can be selectively allocated to a specific component of a stimuli (e.g. to the singular dots on a visual display) (Näätänen, 1992).

The spotlight model (Eriksen & James, 1986) was inspired by the early work of William James (1890), who viewed attention as a process involving the focus, the margin and the fringe. The focus is described as the area that allows the extraction of high-resolution information from the visual scene, with the direction of visual attention indicating its geometric center. The focus area is surrounded by the fringe of

attention from which information is also extracted but with lower visual acuity. Lastly, the margin is the extension of the fringe area, where visual acuity is significantly reduced.

The spotlight model suggests that attention selection occurs through covert attentional processing, where eye movements are not required prior to directing and allocating overt attention to a specific area or stimuli in the environment (Posner et al., 1980). In line with this proposition, the premotor theory of attention suggests that during covert attentional processing an eye movement to the next location is programmed but withheld (Rizzolatti et al., 1994). Some empirical findings have suggested that the default setting for a range of tasks is to overtly sample and process information; i.e. numerous eye movements are made in different locations of the visual field prior to allocating attention towards and further processing a specific stimulus in the environment (Liversedge & Findlay, 2000). However, other studies have shown that eye movements can be suppressed when covert processing is required to complete a task. For instance, studies in which participants are presented with a target and a distractor at the same time, and are asked to allocate attention directly towards the target and thus inhibit distractors (i.e. not to look at distractors) have found that participants were able to suppress exogenous saccades towards the distractor and direct their attention towards the target (see Richards et al., 2011; 2012). Hence, it seems that different attentional processes are applied depending on task demands.

The zoom-lens model adopts the same mechanisms (i.e. the focus, the margin, and the fringe) as the spotlight model, with the difference of having an additional property; that refers to flexibility in the size of the attentional focus. This model suggests that the size of attention focus can change (see Belopolsky et al., 2007); with

broad attentional focus resulting in the sacrifice of a more detailed processing of a specific stimulus in order to maintain the simultaneous processing of different information in the environment (Castiello & Umilta, 1990). Moreover, this model suggests that the maintenance of a broader attentional beam reduces the speed of processing as attention is distributed between different stimuli in the visual field (Eriksen & Hoffman, 1972).

1.2.2 Developmental Aspects of Attention

Selective attention is usually fully developed by adolescence, and individuals become capable of controlling attentional resources (e.g. to focus their attention on a specific stimulus; Hanania and Smith, 2010). Selective attention in the developmental literature has been explored using a central-incidental learning task (see Wightman, 2003), where individuals are presented with a number of cards, each of them displaying two objects of different categories (e.g. an animal and a tool), and are instructed to remember only the objects from one of the two categories (for example the tools). This task requires individuals to focus their attention only on the card object that they were asked to remember and ignore the other object. Participants are then asked to recall objects from both categories.

Findings from studies that used the central-incidental learning task have revealed individual differences in task performance, driven by the efficiency of visual selective attention. Slater and Bremner (2011) for instance, found that children with good selective attention processed and memorised more objects from the category they were asked to focus on (e.g. tools) than from the other category (e.g. animals), whereas children with low selective attention were as likely to recall objects from the incidental class as from the central class. Research has also highlighted the developmental aspects of selective attention. Plude et al., (1994) for example, found

that adolescents were more able to focus their attention on items from the central class and ignore objects from the incidental class, and this was reflected in their tendency to remember a significantly higher number of items from the former than from the latter category. In contrast, younger children were found to uniformly distribute their attentional resources between the two categories; therefore they were more likely than adolescents to remember a comparable number of objects from the two categories. These findings highlight that attentional distribution changes with age, where individuals become more able to focus their attention on goal-directed stimuli and suppress the processing of task irrelevant information. Of relevance to the current thesis is whether visual processing of threat is influenced by individual differences in internalizing traits (i.e. anxious behavior), and to determine the attentional mechanisms that might be contributing to this relationship. The theoretical models related to visual processing in anxiety are discussed in the following section.

1.3 Theoretical Models of Attentional Processing in Anxious Individuals

A considerable body of research has revealed an association between anxiety and an increased tendency to preferentially allocate attentional resources to aversive/ threat stimuli. Several theoretical models have been developed to explain this relationship and different cognitive tasks have been used to explore the attentional processes involved in attentional biases towards threat that are typically observed in anxious individuals.

A number of researchers have proposed that enhanced threat processing may have a causal role in the development and maintenance of anxiety (e.g., Beck & Emery, 1985; Eysenck, 1992, 1997; Mogg & Bradley, 1998; Williams, Watts, MacLeod, & Mathews, 1988, 1997; Shechner et al., 2013). And research has aimed to

delineate attentional mechanisms that work to place individuals at risk for the development of anxiety. Investigation of these components focuses around two contrasting accounts termed the "vigilance" and "maintenance" hypotheses, which can be better understood within the context of models that highlight the main mechanisms of spatial visual attention (see Posner & Peterson, 1990). In Posner's model the "shift" mechanism allows the reallocation of attention, whereas the engagement and disengagement mechanisms allow attention to be held and released between shifts. The vigilance hypothesis suggests that attentional bias to threat in anxiety results from anxious individuals' enhanced ability to detect threat, hence they allocate attentional resources to threatening cues faster or more frequently (i.e. facilitated engagement with threatening stimulus), whereas the maintenance hypothesis posits that attentional bias to threat results from anxious individuals' difficulty to withdraw attention from threatening information (i.e. impaired disengagement from threat) (Armstrong & Olatunji, 2012).

Williams, Watts, MacLeod and Mathews' (1997) model, for example, is based on the proposition that anxiety is characterized by enhanced engagement with or vigilance for threat. Their model specifies two mechanisms involved in visual processing: the affective decision mechanism (ADM) and the resource allocation mechanism (RAM). According to this model, the ADM pre-attentively evaluates the affective valence of different stimuli, where threat value increases with state anxiety. At the second stage, the RAM is suggested to guide attentional resources either towards or away from threatening stimuli, depending on high or low trait anxiety levels respectively. Specifically, when a stimulus is evaluated as threatening, individuals with high trait anxiety are proposed to allocate their attention towards it, whereas individuals with low trait anxiety shift their attention away from it.

Similarly, Muris and Field (2008) proposed a set of successive stages in attentional processing in the development of anxiety. These include initial scanning of the situation, encoding stimuli and interpreting stimuli. These stages independently contribute to the occurrence of different types of cognitive biases (i.e. attention, interpretation and memory biases). The authors noted that although high anxiety levels can involve biases in all three stages of information processing, it is the attention system that first processes the stimuli presented, and can therefore influence the next two stages (encoding stimuli, interpreting stimuli). Like other models, Muris and Field (2008) supported the assumption that anxiety directly affects attentional resources, where individuals with high anxiety detect threatening cues more easily, and hence engage with threat processing more often.

Beck's model also suggests links between anxiety and selective engagement with threatening stimuli (Beck, 1976; Beck & Clark, 1997; Beck, Emery, & Greenberg, 2005). The author proposed that selective attention to threatening information in anxiety is facilitated by the rapid scanning of the environment (i.e. increased number of eye movements) prior to allocating attention to threatening information. In contrast to the notion of excessive eye movements prior to detecting and allocating attention to threat, Eysenck (1992) suggested that anxious individuals maintain a broad focus of attention which allows them to pool information across the visual field, facilitating decisions about the presence or absence of threat. In line with this proposition, Richards et al. (2014) proposed two attentional mechanisms that facilitate threat detection in anxious individuals. These involve the hyperscanning of the environment for threat, where rapid eye movements are executed at different locations in the visual field, and the broadening of the attentional beam where decisions about the presence or absence of threat are made via covert attention. In

support of the broadening of attention theory, Richards et al. (2011; 2012) found in two studies that anxious individuals processed angry faces via a broadly tuned attentional mechanism (i.e. attention was spread across the visual field and threat was processed covertly). This was indexed in delayed saccade latencies towards a non-face target in the presence of angry face distractors presented in the parafoveal and peripheral vision. In addition, the authors suggested that elevated anxiety was also related to difficulties to disengage attention from threatening faces located in foveal vision, as indexed by increased latencies to fixate the target in the presence of centrally presented threat.

Some researchers argue that impaired inhibition of threat is best understood in the context of Attentional Control Theory (ACT; Eysenck, Derakshan, Santos & Calvo, 2007). These authors suggest three main components of executive function that are involved in attentional control and which, are influenced by anxiety. These components include inhibition (i.e. allows the inhibition of unattended and motivationally-irrelevant processing), shifting (i.e. allows the reorientation of mental sets) and updating (i.e. linked to the updating of information in working memory). Difficulties to inhibit threat processing are related to impairments of the inhibition system.

Different paradigms have been used to explore attentional biases in anxiety. The following section outlines the findings from research using the remote distractor paradigm (RDP), the emotional Stroop task, the dot probe task, the emotional spatial cueing task and visual search paradigms.

1.4 Anxiety and Attentional Processing

Different paradigms used to explore attention biases in anxious individuals focus on unique attentional processes. The RDP and the Stroop task, for instance, are typically used to test interference from task irrelevant stimuli (i.e. distraction from task-irrelevant threatening or non-threatening information), whereas the visual probe paradigm and visual search tasks are used to assess vigilance for threat. The large literature on attentional biases for threat-related stimuli in affective disorders involves mainly studies using reaction times (RTs) as a measure of attention. Reaction times have been extensively used to explore the level of interference of emotional (e.g. happy and angry faces, fearful words) versus neutral stimuli (e.g. neutral faces or words) with task performance (e.g. Stroop task) and vigilance for threat (e.g. dot probe task).

Research using reaction time measures have importantly contributed to the understanding of attentional biases in affective disorders. However, several researchers have argued that RT measurements only provide 'snapshots of attention' (Armstrong & Olatunji, 2012, p. 705); hence additional methodologies have been used to address this limitation. Eye tracking, for example, is generally considered as a more effective way of measuring attention, as it allows the online capture of visual behaviour. In eye tracking studies, individuals are presented with stimuli on the screen, and the exact position of individuals' eye gaze is recorded and where gaze direction is argued to reflect what is being processed (Just & Carpenter, 1976). Indeed, early and more recent eye-movement studies in different research areas, including reading and visual search, have suggested that eye movement measures provide a representative picture of the online cognitive processes that occur while performing a task (see Rayner, 1978; Liversedge & Findlay, 2000). Although eye tracking provides a direct

measure of overt attention, some information can be also obtained about covert attentional processing. In visual search tasks, for example, it is suggested that covert attention is reflected in better discrimination and rapid orienting towards targets in peripheral locations to which attention was allocated covertly (Deubel & Schneider, 1996). In the RDP task, covert attentional processing of task-irrelevant information is indexed by prolonged saccade latencies towards pre-specified targets in the presence of distractors presented in parafoveal and peripheral locations in the visual field (Richards et al., 2011; 2012).

1.4.1 The Remote Distractor Paradigm: Indices of Impaired Inhibition of Threat

The RDP has been developed to explore the effects of task-irrelevant stimuli (distractors) on visual behaviour and where distractors are positioned at different visual eccentricities (i.e. the angular distance from the centre of the screen) and to different hemispheres (i.e. sides of the visual field) in relation to the target (Gilchrist et al., 1998). The RDP task involves single target trials (the target is presented on its own) and distractor trials (a target and a distractor are presented simultaneously). Individuals are instructed to ignore task-irrelevant stimuli (distractors) and to move their eyes as quickly as possible to the target stimuli.

Remote distractors are argued to interfere with target localisation when eye movement latencies to the target are increased or when there are increased fixations on distractor stimuli (Walker & Findlay, 1999). For example, an early study by Levy-Schoen (1969) reported that first accurate saccade (i.e. first saccade to the target) latency increases by around 40 ms when a distractor appears with a target in the mirror symmetric position of the contralateral hemifield. Additionally, research found that saccade latency is modified by the eccentricity of the distractor; the closer the distractor is to the initial fixation point (typically the centre of the screen) the greater

the interference, leading to a greater delay in moving the eyes to the target (referred as the Remote Distractor Effect (RDE); see Walker et al., 1997). Further research has revealed that emotionally negative stimuli interfere more with task performance compared with neutral stimuli, as indexed by delayed reaction times and increased saccade latencies towards task-relevant stimuli (e.g. a target) in trials where threat is present, and this effect is stronger in individuals with elevated anxiety (Richards, Benson & Hadwin, 2012; Martin, Horder & Jones, 1992; Vasey, Elhag & Daleiden, 1996).

Richards, Benson and Hadwin (2012) used a modified version of the RDP to explore the cognitive processes underlying threat-related attentional biases in anxious adults. Threatening and non-threatening faces (angry, happy and neutral) were used for distractors and shapes (a square and a diamond) for targets. The authors explored the extent to which attentional biases in anxiety are linked to: an automatic capture of overt attention by threat, a difficulty to disengage overt attention from threatening stimuli when located within the foveal vision, or a difficulty to orient attention to the target when threat distractors are presented at different locations (foveal, parafoveal and peripheral) in the visual field. The results showed that anxious individuals were as able as non-anxious individuals to suppress automatic saccades towards threat distractors (angry faces); as indicated in the low percentage of directional errors (i.e. first saccades towards threatening distractor) in high anxious individuals. Likewise, studies using the anti-saccade task found similar performance (i.e. comparable error rates) between anxious and non-anxious participants when required to supress automatic orienting towards threatening information (Derakshan et al., 2009). These findings question the notion that attention is involuntarily captured by threat in highly anxious individuals (see Williams, Watts, MacLeod & Mathews, 1997; Wieser et al.,

2009). In contrast they indicate that anxiety is characterized by difficulties to disengage overt attention from threat presented in the foveal vision, and to regulate orienting responses in the presence of threat presented in the parafoveal and peripheral vision.

Findings from the RDP and anti-saccade tasks also provide support for the disengagement hypothesis. Richards, Benson and Hadwin (2012), for example, found that the latency of saccades towards the target increased in the presence of threatening distractors in trait anxious individuals. Although the interference from centrally presented threatening distractors was greater, parafoveal and peripheral threat distractors also delayed saccade latencies to the target in high anxious individuals, suggesting that impaired inhibition of threat occurs across a broader visual field and it is not merely related to foveal vision. Similarly, Deraksan et al., (2009) found that anxiety was related to longer latencies to execute an accurate saccade in the opposite direction to a threatening face. Taken together, these results suggest that enhanced processing of threat in anxiety is linked to a difficulty to regulate orienting responses in the presence of threatening stimuli positioned at various locations in the visual field. This provides support for Eysenck et al.'s (2007) theoretical model (ACT) which suggests impaired attentional control in anxiety; in this case to disengage attention from threat and execute a saccade towards the target in the RDP, and in difficulty to make a saccade to an opposite location from a threat stimulus in the anti-saccade task. Research using the RDP provides valuable insight into the attention mechanisms underlying impaired inhibition of threat, suggesting that interference from threatening information occurs across the visual field, and reaches its peak when threatening distractors are located in the foveal vision.

1.4.2 The Stroop Task: Indices of Impaired Inhibition of Threat

The emotional Stroop task (e.g. see McLeod, 1991) has been extensively used to explore attentional biases for negative information in individuals with elevated anxiety. In the traditional Stroop task (Stroop, 1935) participants are presented with a number of colour names, printed in conflicting colour inks (e.g. the word red is printed in green) and are asked to name the colour of the ink in which each colour word is printed as quickly as possible. Performance on this task is importantly influenced by participants' ability to suppress the processing of the semantic meaning of words and maintain attention on task-relevant information (i.e. the colour of the ink) (Compton et al., 2003). The control condition involves a number of coloured non-words. Meaningful words are found to interfere more with colour naming than non-words, as indicated by longer colour naming latencies.

Similar to the findings from the remote distractor paradigm (see Richards et al., 2012), results from studies using the Stroop task suggest a greater interference from threatening than non-threatening information in anxious individuals. Specifically, anxious individuals have typically shown longer colour naming latencies for threatening words than non-threatening words on the emotional Stroop task (see Mogg et al., 2000; Rutherford, MacLeod, & Campbell, 2004). Martin, Horder and Jones (1992), for example, used the card version of the emotional Stroop task with 6-13-year-old children to explore the effects of anxiety on colour naming threat related and neutral words. The authors found that spider-fearful children were slower to colour name spider-related words (e.g., "creepy" "hairy") in comparison to neutral words ("table" "cars"), where this effect was not evident in non-spider-fearful children. Their findings were replicated by Martin and Jones (1995), who used a modified version of the emotional Stroop task with children of three different age

groups (4-5 years, 6-7 years and 8-9 years). Children were asked to name the ink colour of images displaying either spiders, houses (control stimuli) or teddy bears (filler stimuli). Spider-fearful children have shown longer colour naming latencies for pictures displaying spiders and this effect was consistent across all age groups.

Similarly, Martin and Cole (2000) used the Stroop task in a study with 8-12-year-old children, where inhibition was measured using words related to acceptance (e.g. popular) and rejection (e.g. hated). Peer-reports of children's social status (i.e. popular or unpopular) were also collected. The authors reported that children rated as unpopular required significantly more time than their popular peers to name the colour of words with a negative social content. Hadwin et al., (2009) also found that high scores on the social concern subscale (measures dimensions linked to social anxiety, RCMAS; Reynolds & Richmond, 1985) in 6-12 year old children was associated with longer RTs to colour match the outline of angry faces (compared with neutral faces), where this effect was evident in all socially anxious children irrespective of their age. Findings from studies in children with generalized anxiety are consistent with findings from other studies suggesting links between anxiety and enhanced Stroop interference for threat. Richards, Richards and McGeeney (2000), for example used a card-based emotional Stroop task, involving neutral and threat-related words, to assess colour-naming interference from threat in adolescents (16-18 years old) with generalised anxiety. As in adult and child literature, high levels of trait anxiety were related to longer colour naming latencies for threat-related words in comparison to neutral words. Studies with clinical samples have confirmed the findings from studies with highly anxious individuals. For example, Taghavi et al., (2003) found that children and adolescents with GAD needed significantly more time to colour name emotionally aversive words (relative to neutral and positive words)

compared with non-anxious individuals. Similar results have been found in adolescents (Moradi et al., 1999) and children who had experienced sexual-abuse and suffered from PTSD (Dubner & Motta, 1999).

To summarise, findings from the Stroop task suggest that interference from threat stimuli is greater in anxious individuals compared with non-anxious individuals, where this effect is evident across different types of anxiety (i.e. GAD, PTSD, social anxiety and specific phobias) and age groups.

1.4.3 The Visual Search Paradigm: Indices of Enhanced Engagement with Threat

In visual search tasks participants are usually required to locate a target or to detect its presence or absence as quickly and accurately as possible. The vigilance and maintenance hypotheses are measured separately through different task settings. To assess enhanced detection of threat, a threatening target is presented amongst non-threatening distractors. Faster RTs and shorter latencies to fixate threatening targets indicate enhanced detection of threat. Additional eye movement measures (e.g. number of saccades and fixations prior to detecting the target) are used to further examine the attention mechanisms linked to facilitated threat detection. Disengagement from threat is typically measured with a neutral target presented among threatening distractors. Longer latencies to allocate attention to the target is argued to reflect difficulty to disengage from threatening distractors (Armstrong & Olatunji, 2012).

It has also been previously suggested that threatening stimuli can "pop-out" of an array of distractors and automatically capture attention, specifically in individuals with high levels of anxiety. However, studies investigating attentional biases in anxious individuals have provided little evidence in support of this proposition

(Vuilleumier, 2005); hence two alternatives have been proposed. First, enhanced detection of threat may be related to the execution of fewer saccades prior to threat detection or localisation. This may reflect automatic orienting to threat once attention is allocated to a nearby distractor, narrowing the eccentricity to a range from which it can capture attention. Alternatively, enhanced detection of threat may result from a rapid scanning of the environment, where non-threatening distractors are fixated for very short duration (Armstrong & Olatunji, 2012) until threat is detected. In line with this proposition, Becker (2009) found that following exposure to threatening stimuli, participants were faster to disengage their attention from neutral stimuli. Armstrong and Olatunji (2012) suggested that in anxious populations this "panic search" may be generated when threat is anticipated.

Derakshan and Koster (2010) used a visual search task to investigate whether attentional bias to threat in anxious individuals (mean age 31.16 years) was related to either facilitated engagement with or difficulties to disengage attention from threat. Participants were presented with displays containing a target (angry, happy or neutral face) located between distractors. If the target face was emotional then the distractors were neutral and vice versa. Stimuli were always presented in the peripheral vision and participants were instructed to determine the presence or absence of a discrepant face. The authors found no evidence to support enhanced engagement with or difficulties to disengage from threat in anxious individuals. Noticeably, the authors reported that anxious participants were slower to respond to emotional targets when these were presented between emotional distractors (i.e. angry target between happy distractors and vice versa), suggesting that both angry and happy distractors interfered with performance. This extends the findings from the RDP and the Stroop task (i.e.

that anxiety is related to greater interference from threatening information), to suggest that happy faces may also disrupt performance in anxious individuals.

Similarly, Hadwin et al., (2003) used a visual search task to explore the relationship between trait anxiety and detection of threatening and non-threatening faces. In this study children (7-10 years old) were required to indicate whether a target face (angry, happy or neutral) was present or absent. In contrast to their predictions, the authors found no evidence to support enhanced detection of threat in anxiety. However links were reported between anxiety and faster decisions about the absence of angry targets, compared with neutral and happy targets. These findings are consistent with those from localisation studies. Findings from work recently completed in our laboratory, for instance, found no evidence to support an association between anxiety and enhanced localization of threat. Although participants were faster and more accurate to locate angry targets compared with happy and neutral targets, this facial emotion effect was not modulated by anxiety.

In contrast to the above findings, a study by Richards and colleagues (2011) suggested that detection of threat is influenced by individual differences in anxiety. The authors used a redundant signals paradigm in which they presented participants with non-target and target (angry or happy face) displays and asked them to indicate whether a target was present or absent. Target trials contained either an emotional target face and a neutral face or two target faces presented in the parafoveal vision. The authors measured processing capacity for multiple (versus single) threats using estimates of the orderings on the hazard functions of RT distribution (i.e. capacity was quantified at the level of the hazard function of the RT distribution which provides a global measure of capacity at each time point). The results revealed that processing capacity for threat detection (specifically in multiple target displays) was facilitated

by increased trait anxiety, as reflected in faster reaction times when two threatening faces were present compared to one threatening and one neutral face. Additionally, the finding of a reduced number of eye movements executed prior to response provides evidence that anxiety is characterized by a broader attentional beam, which allows the parallel processing of information from various locations in the visual field, and hence facilitates threat detection (see Eysenck, 1992). Keogh and French (1999) argued that this distribution of attention across the visual field is triggered when anxious individuals anticipate danger, and is used as a tool for more efficient detection of impending threats.

In summary, the findings from visual search studies vary as to the evidence they provide related to the nature of attentional biases to threat in anxiety. Some studies reported that attentional bias to threat is associated with greater interference from threatening stimuli, whereas others suggested links between anxiety and enhanced detection of threat. However, it is possible that anxiety is characterized by both facilitated engagement with threat and difficulties to disengage attention from threat after it has been detected (see Fox, 2002).

1.4.4 The Visual Dot Probe Task: Indices of Enhanced Engagement to versus Avoidance of Threat

In a typical version of the dot probe task, participants are briefly presented with stimulus pairs (e.g. threatening-neutral words or faces). In all trials one of the words/faces is replaced by a visual probe and participants are asked to classify as quickly and accurately as possible the probes' location, type or onset, depending on the task version. Attentional bias towards threat is inferred from differences between RTs for probes replacing threatening versus neutral stimuli. Studies using the dot probe task in anxious adults have typically reported faster responses to probes

replacing threatening stimuli relative to probes replacing neutral stimuli (e.g., Garner, 2010), providing some support for the vigilance hypothesis in anxious individuals.

In contrast to the consistent profile generated in the adult literature, findings from the dot-probe task in children and adolescents vary across studies and anxiety disorders. For example, some studies have found a bias towards threat, others avoidance of threat (i.e. reduced maintenance of gaze on threat in free viewing tasks); whereas others have reported that threat bias is evident in both anxious and non-anxious youths (review by Armstrong & Olatunji, 2012). Furthermore, it has been suggested that specific threat stimuli (e.g. angry faces) are sufficient to produce the attentional bias in some types of anxiety but not in others. For instance, children identified as clinically anxious (Roy et al., 2008), non-selected children with increased trait anxiety (Telzer et al., 2008) and children diagnosed with both current bipolar disorder and a lifetime history of anxiety (but not those without a history of anxiety) (Brotman et al., 2007) have been found to show an attentional bias for angry facial expressions (i.e. faster RTs for probes replacing threatening than non-threatening stimuli), whereas youths diagnosed with test anxiety showed an attentional bias for physical and social threat-related words (Vasey, Elhag & Daleiden, 1996), but not for angry faces.

Roy et al., (2008) used the dot probe task to explore attentional biases in clinically anxious and non-anxious youths (7-18 years-old). Participants were presented with pairs of faces (angry-happy or happy-neutral), followed by a single-asterisk probe, that replaced one of the faces, and were asked to indicate the spatial location of the probe as quickly and accurately as possible. RT data were used to calculate attention bias for each face type, as well as to explore individual differences in bias scores. Results revealed a greater attentional bias for threatening faces in

clinically anxious individuals compared to non-anxious individuals, and this threat bias was consistent across different types of anxiety disorders. Groups did not show significant RT differences for neutral and happy faces. These results are consistent with the adult literature and theories suggesting links between anxiety and hypervigilance for threat.

However, further studies have suggested that children with GAD show an attentional bias for both negative and positive facial expressions. Waters et al., (2008), for example, used the dot probe task with 7-12 year-old children and found that GAD was related to enhanced engagement with emotional faces (angry and happy). This attentional bias was not evident in children with mild GAD (i.e. high but not extreme anxiety) and non-anxious youths. Notably, within the GAD group, attentional bias towards angry faces was only evident in participants with extreme levels of generalised anxiety, as well as social phobia.

In contrast to the above findings, some researchers have reported avoidance of threat in children with post-traumatic stress disorder (PTSD) (Pine et al., 2005), those who have been physically abused (Pine et al., 2005), non-selected socially anxious children (Stirling, Eley & Clark, 2006) and those diagnosed with GAD. Pine et al. (2005), for example, used the picture based version of the dot probe task to explore the association between attention bias to threatening facial photographs and maltreatment and PTSD in children. The study involved 34 children who had experienced maltreatment and 21 children who had not experienced any maltreatment. Participants were presented with photographs of actors depicting emotional (angry, happy) and non-emotional (neutral) faces. The authors found that high levels of physical abuse and PTSD were related to attentional avoidance of threat rather than attentional bias towards threat.

With regard to the inconsistency in findings, some researchers have noted that reported differences may stem from methodological factors, including stimulus duration and type of stimulus (i.e. pictorial or linguistic). Indeed, empirical findings have provided support for this notion, where attention bias for threat in anxious versus non-anxious individuals was only evident in studies that presented stimuli for short durations (i.e., < 500ms), but not in studies that presented stimuli for longer durations. Such findings provide evidence in support of more complex models of attention in anxiety, which propose that anxious individuals' initial attentional engagement with threat is followed by evaluative and avoidant processes (i.e. vigilance-avoidance hypothesis; Mogg & Bradley, 1998). The vigilance-avoidance model suggests that anxious individuals initially allocate their attention to threatening stimuli but thereafter this pattern is diverted with extended stimulus presentation. Both these behaviours are suggested to contribute to increased anxiety; excessively vigilant gaze results in over perceived and thus overestimated danger whereas avoidance gaze inhibits the individual from re-considering the level of threat, and hence regulating emotion (In-Albon, Kossowsky, & Schneider, 2010).

In contrast to the above findings, a recent meta-analysis highlighted that attention biases for threat in anxious children were observed in studies in which stimuli were presented for 1200 ms, but not in studies with shorter stimuli presentations (i.e. 500 ms). The authors argued that the lack of an attention bias in anxious children at short presentations can be explained by developmental differences in attentional processing; children require more time to process information than adults, especially in the case of linguistic stimuli (Dudeney, Sharpe & Hunt, 2015). The authors further suggested that the dot-probe paradigm was initially designed for adults, and in many studies it has not been modified to reflect children's cognitive

ability, contributing to the discrepancy between the findings reported across the developmental research literature.

Additionally, inconsistency in findings may result from individual differences in effortful control (see Derryberry and Reed, 2001). Specifically, anxious individuals with high attentional control are more likely to show visual patterns that are similar to non-anxious individuals compared to anxious individuals with low attentional control; hence if attentional control skills are comparable between the anxious and non-anxious group, then differences in task performance are prone to diminish.

1.5 Brain Function in Threat processing

Over the past years, a number of cognitive tasks have been used together with neuroimaging techniques to explore the neural substrates underpinning attentional processes, such as effortful control. Findings have demonstrated links between attentional processes and activation of specific areas of the brain. A number of studies have suggested that tasks demanding increased attentional control activate the anterior cingulate cortex (ACC) and areas of the lateral prefrontal cortex (Posner & Fan, in press).

Based on these empirical findings, it has been suggested that poor attentional control should be also evident in neural substrates. A variety of tasks have been used with different groups of people (including highly anxious individuals) to identify brain areas that may be linked to impaired attentional control. Brain imaging studies exploring selective attention to threat, interpretation of possible threatening stimuli and fear conditioning[2] have identified a common neural circuitry fundamental to each

[2] Fear conditioning is a behavioural paradigm in which organisms learn to predict aversive events. The relationship between an aversive stimulus (e.g., an electrical shock) and a neutral context (e.g., a room) or a neutral stimulus (e.g., a tone) is learned, leading to manifestation of fear responses towards the initially neutral context or stimulus (Maren, 2001).

of these cognitive aspects. Reciprocal links have been found between the areas in the frontal cortex (i.e. dorsolateral prefrontal cortex, dorsal medial prefrontal cortex, ventrolateral prefrontal cortex and anterior cingulate cortex) and the amygdala in response to threat-related stimuli, indicating that activity in both these brain areas may be connected to the manifestation of different responses towards stimuli or events that induce anxiety (Bishop et al., 2004; Taylor et al., 2003). Further research has revealed that amygdala arousal is linked to more intense conditioned fear reactions throughout the early stages of fear acquisition and to negative interpretations of emotional stimuli with an ambiguous meaning (Dunsmoor et al., 2011).

The notion of increased activation in the amygdala in threat exposure has been further supported by research exploring brain activation in anxious individuals. Increased amygdala activity has been found in anxious individuals in response to threat distractors and during conditioned fear acquisition (Phelps et al., 2004; Kim et al., 2003), whereas attempts to control the effect of negative attentional associative and interpretive biases, provoked by the view of threat stimuli, are found to be supported by prefrontal cortical activity. Noticeably, findings have revealed that anxiety is related to low activity in the prefrontal cortex in response to threat related stimuli. This reduced activity has been linked to anxious individuals' difficulty to supress threat processing in the presence of threatening stimuli (Bishop et al., 2004).

1.6 Specificity of Attentional Biases to Threat in Anxiety

Externalising behaviours (e.g. aggressiveness) reflecting conduct-like problems have also been linked to attention biases towards threat. Early research (e.g., Gouze,1987) for instance, found that aggressive behaviour was positively related to difficulties to disengage attention from threat in preschool age boys (46 – 64 months

of age), as indexed by delayed latencies to shift attention away from hostile scenes and engage in another task (i.e. press a button as quickly as possible when a light came on). Similarly, a more recent study by Chan, Rain and Lee (2010) revealed greater interference from threat related words in males who use violent physical abuse compared to controls, as indexed by increased latencies to colour name negative affect words.

Visual search studies have also provided evidence in support of the proposition that conduct-like behaviour is related to greater interference from threatening than non-threatening distractors. A study by Smith and Waterman (2004) for example, found that violent and aggressive undergraduate students showed delayed latencies when searching for neutral words presented among threatening words than when searching for threatening words presented among positive words. In another study the authors found that violent offenders responded faster to probes replacing words related to aggression than to probes replacing neutral words (Smith & Waterman, 2003), highlighting that different attention mechanisms can be involved in attention biases to threat, depending on task demands. In line with these findings, Acremont and Van den Linden (2007) found that teacher-report conduct disorder problems (i.e. an emotional and behavioural disorder characterized by increased aggressiveness and inappropriate behaviour including the violation of others' rights) in adolescents were associated with better recognition of angry than happy faces. In addition, the authors reported that disruptive behaviour was related to a memory bias for angry faces, where the negative effect of this bias was moderated by the ability to control impulsive behaviour.

Theoretical frameworks and research findings suggest that attributional biases and enhanced attention to threat increases the probability of exhibiting aggressive

behaviour. Dodge (1996) for instance, proposed that aggressive behaviour is better understood in the context of social cognitive models, suggesting links between aggressive behaviour and biased social perceptions (i.e. misjudgements about the intentions and behaviour of others). Specifically, the model suggests that the expression of aggressive behaviour is associated with a bias toward attributing hostile acts to peers in benign or ambiguous situations.

Similarly, the attention allocation model (AAM), suggests that alcohol related violence is influenced by attentional processes related to impaired inhibition of hostile cues in the environment. Specifically, the model proposes that when attention is shifted away from threatening cues and oriented towards less salient provocative cues in the environment, then aggressive reaction can be inhibited (see Giancola & Corman, 2007). In line with the AAM, research findings have also suggested that inhibitory control plays an important role in the relationship between aggression and threat biases. A study by Ellis, Weiss and Lochman (2009) for example, found that response inhibition was related to teacher-report reactive aggression in individuals that also showed a recall bias for hostile acts (i.e. aggressive children recalled more hostile than neutral statements from nine different interviews of children describing interactions with peers).

Taken together, these findings suggest that aggressive behaviour is associated with attentional and attributional biases towards threatening stimuli and social cues. In addition, they provide some evidence to support that attentional control influences links between aggression and attention biases towards threat.

1.7 Anxiety, Attention and Social Adjustment

Empirical findings have shown that anxious individuals experience social adjustment difficulties including poor peer relationships, low quality friendships, low socio-metric status and poor social performance (i.e. difficulties to interact effectively with other people). Developing and maintaining good relationships with peers has been associated with positive outcomes (e.g. higher self-esteem, better academic performance etc) hence it is important to identify the factors that might be affecting peer relationships and friendships in anxious individuals (Criss et al., 2002; Ladd & Troop-Gordon, 2003; Woodward &Fergusson, 2000).

Friendship refers to a specific, affectionate attachment that develops between two people (Bukowski, Newcomb, & Hartup, 1996) and is found in most, if not all, societies. Although cultural differences influence the way that friendships manifest, some general aspects of friendship are suggested to be evident in all cultures, regardless of the life stage during which they are developed. Friendships are, for example, mutual and voluntary and involve reciprocity, sharing, cooperation, disclosure and commitment. Friendships may also involve negative aspects including conflict and competition. However, it is suggested that good friendships are characterized by high quality (e.g. Berndt, 1996), which is typically evaluated via methods that consider both the positive and negative dimensions of a current relationship. These dimensions of friendship are not evident in peer relationships, defined as the interaction of an individual with a larger group of people, with whom the individual does not necessarily develop close friendships. Peer crowds are merely based on popularity and consist of individuals that share similar stereotypes (Brown, 1990).

Most studies looking at social adjustment in anxiety focus on social phobia. Findings have shown that children exhibiting high levels of social phobia are more victimized and less well-accepted by their peers (i.e. they have lower socio-metric status; Beidel, Turner & Morris, 1999; Erath, Flanagan, & Biderman, 2007), and they tend to develop friendships of lower quality (i.e. friendships that involve low support, intimacy and self-disclosure, helpfulness and guidance from friends; see Beidel, Turner & Morris, 1999; Rubin et al., 2006). A study by Baker and Hudson (2015) for example, compared friendship quality between socially anxious and non-anxious dyads (7-13 years old), and found that socially anxious dyads reported lower overall friendship quality compared to non-anxious dyads. In line with these findings, Schneider's (1999) observational study reported links between behavioural inhibition and low quality friendships. The author found less communication between dyads of behaviourally inhibited children compared with non-behaviourally-inhibited dyads. Friendship quantity is also found to be influenced by anxiety and social withdrawal. A number of studies have reported that anxious and socially inhibited youths have fewer friends compared with their non-anxious and non-socially inhibited peers (Beidel, Turner, & Morris, 1999; Pedersen, Vitaro, Baker, & Borge, 2007).

A number of authors have suggested that anxious individuals' friendship problems result from their difficulty to understand coping strategies and use them effectively in social settings (e.g. Southam-Gerow & Kendall, 2000; Suveg & Zeman, 2004). For example, socially anxious youths are found to exhibit a preference towards immediate emotionally relieving coping strategies (e.g. avoidance of social interactions), although such behaviours may interfere with the development of positive peer relationships and friendships (Vasey & Daleiden, 1996). In support of this proposition, Compas et al., (2001) found that coping strategies involving escape-

avoidance and emotion-focused behaviour are often related to internalizing problems, while coping strategies that focus on problem solving are associated with fewer internalizing problems.

Some other studies have indicated that anxious individuals lack the social skills that would enable them to interact successfully with their peers (Coie & Kupersmidt, 1983; Erath et al., 2007; Spence et al., 1999). Spence et al., (1999), for example, reported that socially anxious youths (7-14 years old) exhibited difficulties sustaining a conversation with their peers. Furthermore, they tended to avoid initiating a conversation and showed a preference towards short responses when involved in role-play. The authors also noted that when socially anxious individuals attempted to interact with their peers, they were more likely than non-anxious youths to be ignored or to receive a negative response. Similarly, earlier research (Johnson & Glass, 1989) found that adolescent males identified as socially anxious and males who reported less organised and task-relevant thoughts made more pauses, gave more simplified responses, and asked less topic-relevant questions during a dialogue, than those who had no difficulty to sustain attention to their partner. Additionally, they reported that high levels of anxiety were related to a reduced positive affect in social contexts, as anxious individuals were found to receive less positive peer responses than the non-anxious group.

In contrast to the above findings, other studies supported that anxious individuals do not necessarily lack social skills. In a study by Cartwright, Hodges and Porter (2003) for example, 8-11 year olds were asked to complete a social performance task which involved giving a two-minute speech in front of a video camera. Participants were then asked to rate their performance on different social skill dimensions. In addition, social skill scores were obtained from neutral observers. The

results revealed that although socially anxious children rated themselves as less socially skilled than non-anxious children, observers did not find any significant differences between the groups with respect to social skills. The authors highlighted that anxious individuals' perspective about their own performance does not necessarily reflect reality, and anxious individuals' poor social performance may be attributed to increased nervousness and self-appraisals about their own social skills.

Increasingly theoretical frameworks and empirical research have suggested that cognitive factors have an important role in social adjustment. For example, it has been argued that attentional control influences social adjustment by contributing to the regulation of socio-emotional responses (James, 1890; Posner & Rothbart, 1998, 2000, 2007; Rueda, Posner, & Rothbart, 2004). Ruff and Rothbart (1996) viewed attention as a vital component of the larger construct of self-regulation, which they defined as the ability to adjust behaviour in order to fit into the cognitive, social and emotional demands of a certain situation. Low attentional control has been related to poor self-regulation, where the expression of maladaptive emotional responses cannot be supressed, influencing negatively social and emotional development (Kieras, Tobin, Graziano & Rothbart, 2005). In line with this proposition, Simonds et al., (2007) found that better performance in an attentional control task that involved ignoring distracting stimulations (i.e. flankers pointing towards the opposite direction from the correct button press response), was associated with greater ability to adjust to social norms, such as smiling when receiving an undesired gift. Conversely, inefficiency of the executive attention (measured with the adult version of the Flanker task[3]) as well as low effortful control were found to be associated with peer reports of antisocial

[3] Assesses the ability to match a target with a directional key response in the presence of congruent or incongruent distractors. In the congruent condition, directional response for distractors and target is matched, whereas in the incongruent condition directional response for distractors and target are different (Eriksen & Eriksen, 1974).

behaviour and greater risk for peer rejection (Fan et al., 2002). Eisenberg et al., (2000), for instance, explored the relationship between individual differences in negative emotionality, behavioural and attentional control and externalising behavioural problems. Teachers and parents were asked to rate children's attentional and behavioural regulation, problematic behaviour and emotionality at two time points; when children were in kindergarten (mean age 88.62 months) and two years later (mean age 112.62 months). A measure of persistence was also used to assess children's behavioural regulation. The authors showed that negative emotionality together with low attentional control predicted externalizing behavioural problems.

Rueda, Checa and Rothbart (2011) have similarly considered links between temperamental factors (e.g., negative affect) and attentional control to understand social and emotional development and academic achievement in children and adolescents. The authors proposed that negative temperamental traits interact with low attentional control leading to poorer socio-emotional regulation, which they defined as the neural and behavioural processes that function to modulate reactivity; defined as the excitability, responsivity, or arousability of the behavioural and psychological systems of an organism. As individuals mature they become more able to control reactivity due to the development of self-regulatory systems (Derryberry & Rothbart, 1997). Poor self-regulation has been associated with the expression of inappropriate emotional and behavioural responses. For example, Checa, Rodriguez-Bailon and Rueda (2008) considered the relationship between individual differences in temperamental and neurocognitive systems of self-regulation and youths' academic and social competence. The authors used the Flanker task with a group of 12-year-old youths and found that larger flanker interference and lower effortful control was

related to greater disruptive behaviour in the classroom, leading to poor academic achievement and rejection by peers.

Extending these findings to understand the impact of impaired inhibition of threat on social development, Pérez-Edgar and colleagues (2011) have found that behaviourally inhibited toddlers (24 and 36 months) were more likely to display social awkwardness in early childhood (5 years); but only if they have also shown an attentional bias towards threatening faces, as assessed by analysing RT and accuracy data from the dot-probe task. Data on behavioural inhibition were obtained through laboratory based observations whereas social withdrawal was measured via both observations and reports provided by the child's mother. Similarly, the presence of an attentional bias for angry faces (measured with the dot-probe task) in adolescence was found to be linked to parent-reported symptoms of social withdrawal in childhood (Pérez-Edgar et al., 2010) and the persistence of these symptoms in adolescence. The authors argued that attentional processes are important in understanding the developmental pathways and outcomes of young children who display an inhibited temperamental style. These findings fit with theoretical frameworks that highlight the role of poor attentional control in the development of anxiety (Eysenck, Derakshan, Santos, & Calvo, 2007; Lonigan, Vasey, Phillips & Hazen, 2004).

Together these findings suggest that learning processes, social adjustment and social relationships are better understood in terms of interactive effects between individual differences in self-regulation and attentional control mechanisms. Understanding the factors related to poor self-regulation and impaired inhibition of threat has the potential to help in improving individuals' socio-emotional development. The current work takes an important step forward by exploring associations between internalising traits, attention biases to threat, and social

outcomes in children and adults. Specifically, the current work suggests that links between internalising (i.e. anxiety) traits and social adjustment difficulties will be influenced by attentional processes related to impaired inhibition of threat. Chapters 3-5 will present and discuss the findings from three experiments exploring links between anxiety attention and social adjustment in children and adults. In addition, and in order to look at the specificity of these processes to anxiety the current thesis also considered links between conduct-like behaviour, attention to threat and social adjustment.

1.8 Anxiety, Attention and Social Adjustment Summary

Theoretical frameworks and empirical findings suggest that anxiety is influenced by several factors including cognitive vulnerability, temperament/ personality and socialisation factors (Beidel & Turner, 1997; Fyer Mannuza, Chapman, Martin & Klein, 1995; Stein et al., 2007). This section reviewed findings from studies using different paradigms to explore visual processing in anxiety, including the RDP, Stroop task and visual search paradigms. The findings provide evidence to suggest that anxious individuals show an attentional bias for threatening information, and they highlight the importance of identifying the attentional mechanisms that contribute to this bias. While attentional biases to threat together with high behavioural inhibition/neuroticism are considered to be important risk factors associated with the development and maintenance of anxiety, high attentional control is suggested to modulate this relationship as this allows individuals to shift their attention away from anxiety inducing information (Lonigan & Philips, 2001). Research further suggests that attention biases to threat are also found in conduct-like

behaviour, where this relationship may be moderated by attentional control (Ellis, Weiss & Lochman (2009).

Anxious and aggressive behaviours have been also associated with poor peer relationships and friendship problems. Several theoretical frameworks have highlighted that attentional control plays an important role in social development due to its impact on self-regulation. Difficulties to regulate the expression of inappropriate or maladaptive social and emotional responses interfere with the development of good social relationships. Impaired inhibition of threat has been also found to associate with poor social adjustment. However the differential impact of attention mechanisms related to threat processing on social adjustment has not yet been explored in anxious and aggressive individuals. The current work suggests that impaired inhibition of threat and difficulties to withdraw attention from threatening information may interfere with the development of effective social relationships and social performance in individuals with internalising and externalising traits.

1.10 Empirical Overview of the Current Studies

Research has consistently demonstrated that internalising and externalising personality traits are associated with poor social adjustment, including low quality friendships (i.e. characterized by less intimacy and self-disclosure and less help and guidance received from friends) and lower socio-metric status (i.e. fewer reciprocal friendships), (Beidel, Turner & Morris, 1999; Erath, Flanagan, & Biderman, 2007). In an early observational study, for example, Schneider (1999) found that social interactions of behaviourally inhibited children involved less communication compared to their non-inhibited peers. Similarly, individuals with externalising behavioural problems were more likely to experience poor quality friendships and peer-rejection (Fanti, Brookmeyer, Henrich & Kuperminc, 2009; Laird et al., 2001). It

has been suggested that friendships and peer relationships are important in enhancing children's independence from their parents and facilitating their sense of personal identity; hence it is critical to explore and understand the factors that may have a negative impact on the development of healthy peer relationships.

Theoretical frameworks have highlighted the importance of attentional processes in understanding developmental outcome in children and adolescents, including social relationships. Rueda, Checa and Rothbart (2010) proposed a theoretical framework that highlighted links between temperamental risk factors and emotional regulation with social adjustment, schooling skills and academic achievement via attentional networks including measures of attentional control. The ability to ignore distracter stimuli is one factor that is argued to play an important role in social adjustment. For example, Simonds et al., (2007) found that greater ability to accommodate to social norms (i.e smiling when receiving an undesired gift) was related to increased attentional control; as indicated in less interference from task irrelevant stimuli during a flanker task in 7-10 year olds. Similarly, Checa, Rodriguez-Bailon and Reuda (2008) found that greater interference from task-irrelevant distractors while performing the flanker task, and lower effortful control as measured with the Early Adolescence Temperament Questionnaire (EATQ-R; Ellis & Rothbarth, 2001), were related to teacher-report poor academic achievement, greater disruptive behaviour in the classroom, and peer rejection in 12 year-olds.

In addition to the above findings, further research has shown links between poor attentional control as reflected in impaired inhibition of attention to threat stimuli and poor social adjustment. In two studies, Perez-Edgar (2010, 2011) found that early behavioural inhibition was related to observed social withdrawal in childhood (5 year olds) and parent report withdrawal in adolescence (mean age = 15.04 years) for

behaviourally inhibited individuals that showed a concurrent attention bias towards angry faces. Researchers have increasingly argued that attentional biases for threat (e.g. angry faces) place individuals at increased risk for the development of psychopathological traits, including anxiety (Perez-Edgar, 2010), and are associated with the expression of conduct difficulties (e.g. Chan, Rain and Lee, 2010); therefore research has used increasingly sophisticated methodologies to explore attentional mechanisms and attentional biases for threatening information in development and psychopathology.

A growing body of research has increasingly applied eye movement methodology to measure attentional processes in children and adolescents. Typically, cognitive models of anxiety focus on selective attention to threat, where rapid and accurate saccades (fast eye movements that move the point of fixation from one location to another) to threat stimuli are argued to characterize individuals with increase anxious affect. More recently Richards and colleagues (Richards, Benson, Donnelly & Hadwin, 2014) suggested that eye movement methodologies can distinguish selective attention from hypervigilance. Hypervigilance for threat is a feature of several models of anxiety which propose that elevated anxiety can be characterised by a broadening of attention to enhance threat detection (see for example Richards et al., 2011). In relation to eye movement indices Richards et al. (2011) suggest that this would be reflected in a delay (latency) to initiate a saccade towards task-relevant stimuli in the presence of threat (i.e. threat is covertly processed) or a reduced number of eye movements made prior to making a manual response in a task where more than one threatening face is present across the visual field (Richards, Benson, Donnelly & Hadwin, 2013). In support, Richards, Benson and Hadwin (2012) used a modified version of the remote distractor paradigm (RDP) to explore the

attentional mechanisms in anxious individuals. They found that high anxious individuals showed delayed latencies to initiate a first saccade towards the non-face target in the presence of angry face distractors located in paravofeal and peripheral regions of the visual field; suggesting that angry faces were covertly processed. Delayed saccade latencies towards the target where also found for trials in which angry distractors were presented in the centre of the screen, suggesting links between anxiety and difficulties to disengage attention from centrally presented threat stimuli. Similar findings have been found for individuals with externalising behavioural problems. Gouze (1987) for instance, found that observed aggressive behaviour was related to difficulties to disengage attention from aggressive social scenes in pre-school age boys, as indexed by delayed latencies to shift attention away from threat and engage in another task (i.e. press a button as quickly as possible when a light came on; Gouze, 1987).

Theoretical models and empirical findings suggest that attentional control moderates the relationship between temperamental risk and attention biases towards threat indicating that increased control can protect individuals at high risk from developing anxiety disorders in childhood and adolescence. Good attentional control allows individuals to disengage attention from threatening cues and orient attentional resources towards neutral or task relevant information (Lonigan & Philips, 2001). In line with this proposition, Derryberry and Reed (2002) investigated the moderating effect of self-report attentional control on attention biases towards threat in trait anxious individuals. The authors found that the relationship between anxiety and attention bias for target locations preceded by cues where threatening targets could appear was moderated by attentional control for prolonged (i.e. 500 ms) but not for short (i.e. 250 ms) stimulus presentations. Specifically, all anxious individuals showed

an early attention bias towards threat-related locations at 250 ms but those with good control of voluntary attention were more able to shift their attention away from threatening locations at 500 ms delay. Similar links have been reported for individuals with externalising traits. Ellis, Weiss and Lochman (2009), for example, found that teacher reported reactive aggression was associated with recall bias for hostile acts in 9-12 year old boys with impaired inhibitory control but not in those with good inhibitory control.

The experiments presented in the current thesis build on the current research to link temperamental risk (i.e. internalising and externalising behaviours) and attention biases towards threat with social adjustment (i.e., peer relationships and social behaviour). Experimental measures of attention were employed to explore links between temperamental risk and attention biases towards threat, and to investigate the moderating role of attentional control in this association. In addition, it aimed to explore whether findings suggesting links between anxiety and a broadening of attention would be evident early in development.

In the three experiments presented in the current thesis attention bias for threat (i.e. preference for threat processing) was measured using a modified version of the RDP task (Walker, Deubel, Schneider & Findlay, 1997). This paradigm was developed to consider the cost of task-irrelevant stimuli (presented at different visual eccentricities) on the oculomotor system. In a typical RDP task participants are instructed to ignore distractors presented at different eccentricities in the visual field and to move their eyes as quickly as possible to identify a pre-specified target via a response button press. Longer latencies (the time taken to initiate an eye movement from the onset of the display) to fixate the target in the presence of distractors presented at different eccentricities in the visual field compared to the absence of

distractors (i.e. target is presented on its own) indicate that a remote distractor affected (RDE) the time taken to execute the saccade (Walker, Deubel, Schneider & Findlay, 1997).

The RDP task allows the identification of the attentional mechanisms underlying impaired inhibition of threat (i.e. selective attention versus hypervigilance for threat). In the current version of the RDP task an attention bias for threat can be reflected in: 1) increased directional errors towards threatening distractors (indicating attentional capture); 2) increased latencies to fixate the target in the presence of threatening distractors (reflecting hypervigilance), or; 3) a greater RDE magnitude in the threatening condition (also an indicator of hypervigilance). We used angry, happy and neutral face stimuli as distractors and geometrical shapes as targets (a white square and a white diamond). If temperamental risk is related to selective attention towards threatening information (automatic capture of attention from threat) then individuals at risk will show increased directional errors towards angry (but not happy and neutral) distractors. If however, temperamental risk is associated with hypervigilance for threat then this should be reflected in longer latencies to fixate the target in the presence of angry distractors compared with happy and neutral distractors at all distractor eccentricities. Although the current study focuses on participants' eye movement behaviour, a lot of previous research on attention in anxiety used reaction times (RTs) as an experimental measure of attention biases to threat (Fox, 1993, 1994, 1996; Georgiou et al., 2005). Hence, in order to make comparisons between the current results and previous findings, the current study also assessed distractor interference in the context of manual responses. The results from three different experiments will be presented and discussed in the following three chapters.

Chapter 2: Anxiety, Attention to Threat and Peer Relationships in Childhood

2.1 Introduction

The relationship between temperamental risk and attentional biases towards threatening information has been well established. However research exploring the impact of impaired inhibition of threat on social adjustment among individuals at risk for internalising and externalising behaviour problems, including elevated anxiety and aggressive behaviour, is very limited. The current study aimed to explore links between temperamental risk, attention to threat and social adjustment in children (aged 9-11 years old). It tests the possibility that poor peer relationships observed in individuals with internalising and externalising behavioural problems are influenced by broader skills linked to attentional control and inhibition of threatening information. Following previous findings (i.e., Pérez-Edgar et al., 2010; 2011), it was predicted that temperamental risk will be associated with an attention bias to threat (i.e. greater distraction from angry versus happy and neutral faces), where this relationship will be moderated by attentional control. Additionally, it was anticipated that links between anxiety and attention broadening previously found in anxious adults (Richards et al., 2012) will also be evident in children. Lastly, it was hypothesised that temperamental risk will be related to poor peer relationships via an attentional bias towards threat (i.e. enhanced processing of threat).

2.2 Method

2.2.1 Participants

Forty two children (*mean age* = 10.40, *SD* = .54, *age range* = 9-11 years, 25 males) participated in the current study. Children were recruited from Year 5 and 6 of

a local school in Southampton, UK. Information letters with a detailed description of the current study were given to children to take home to obtain parental/guardian consent for participation, and where they were given the opportunity to say if they did not want their child to take part. Children also provided their assent to take part in the study on the day of testing.

2.2.2 Stimuli and Apparatus

Sixteen models (8 males and 8 females) from the NimStim face set and a white oval shape (all 165 x 256 pixels in size or 4.2° horizontally and 6.5° vertically at 70 cm viewing distance) were used as distractors. Face distractors were emotional (angry and happy) and non-emotional (neutral) faces and a non-face distractor (i.e. a white oval). The oval shape distractor block was initially created to provide a non-face distractor baseline control condition. However, it did work in the expected way (i.e. produced unexpected increased effects upon saccade latencies to the targets), hence it was removed from the data set, and was not used in the following experiments. Specifically, it was expected that the oval shape distractor (as a distractor stimuli with no social content) would interfere less with task performace compared with the face distractors. However, a one way Anova revealed that first saccade latencies to the target in the oval shape distractor condition (M = 225,89, SD = 30,11) and the angry (M = 223,99, SD = 30,15), happy (M = 224,93, SD = 36,91), and neutral (M = 219,04, SD = 28,99) distractor conditions did not differ significantly, $F(3,99) = 1.24$, $p = .30$. In fact, in some cases saccade latencies to the target in the non-face distractor condition were greater than saccade latencies in the face distractor conditions (see basic effect analysis for the results).

In addition, a one way Anova was conducted to assess whether RTs differed between distractor conditions. The results revealed that there was a significant

difference between RTs, $F(3,117) = 3.19$, $p = .03$. However, pairwise comparisons showed that RTs in the neutral distractor condition differed significantly from RTs in the non-face distractor condition, but the difference between RTs in the oval shape distractor condition and the angry and happy distractor conditions was not significant. These unexpected effects were probably a result of study design issues rather than an actual increase in the processing of the oval distractor (i.e. the oval and the target had the same color and luminance, which made it difficult to distinguish between the target and the distractor). The prolonged saccade latencies to the target and the delayed RTs observed in the oval shaped distractor condition did not allow the use of this block as a baseline measure, hence single target trials (i.e. the target was presented on its own) were used to assess whether the presence of social cues (i.e. different emotional faces), interfered with participants' performance.

Four additional models were used for practice blocks. A white diamond and a white square were used as target stimuli. The size of the target stimuli was 59 x 59 pixels (1.5° x 1.5° of visual angle) at a viewing distance of 70 cm. Stimuli were presented on a black background. In single target trials a target was presented on its own (at 4° or 8°). Distractor trials contained a target and a distractor. The distractor could appear in the foveal (0°), parafoveal (4°) or peripheral vision (8°). In trials where the distractor appeared in the parafoveal or peripheral vision the target would appear in its mirror position. If the distractor appeared in the foveal vision then the target would appear on the right or left side of the distractor in a paravofeal or peripheral position. The Eyelink 1000 Desk Mount eye-tracking system (SR Research Ltd.) was used to record participants' right-eye vertical and horizontal eye-movements. See figure 2.1 for examples of possible locations for distractors and

targets in central distractor trials, parafoveal distractor trials and peripheral distractor trials.

2.2.3 Materials

Total anxiety. The Revised Children's Manifest Anxiety Scale (RCMAS) is a self-report measure of total anxiety. It consists of 49 yes/no items and provides scores for total anxiety, worry, social anxiety and defensiveness. The current study only used total anxiety and social anxiety scores. Total scores on this scale can range between 0 and 80. The authors suggested that T-scores falling one standard deviation from the mean (T > 60), at the appropriate grade level indicate clinical levels of anxiety.

State anxiety. The state anxiety scale from the State-Trait Anxiety Inventory for Children (STAI-S) consists of 20 items asking participants to decide how they feel "right now" (e.g. I feel…very calm / calm / not calm). Scores on the state anxiety scale can range between 20 and 60. There are no fixed clinical cut-off scores for the STAI-S, hence the norms provided in the development of this scale from a community sample were used to calculate a cut off score (i.e. scores falling above one standard deviation from the mean indicate high levels of state anxiety).

Depression. Ten items from the Revised Child Anxiety and Depression Scale (RCADS) were used to measure depression. Participants were asked to rate how often they have difficulties with sleep, appetite and energy levels on a 4-point Likert scale ranging from "never" to "always". Scores on this scale can range between 0 and 30.

Attentional control. The Attentional control scale (ACS) is a 20-item scale that measures individuals' ability to focus and shift attention on a 4-point Likert scale (ranging from "almost never" to "always"). Participants are asked to rate how often each statement is characteristic of them. Total scores on the ACS can range between 20 and 80.

Temperament. The Junior Eysenck Personality Inventory is an 81-item instrument asking participants to indicate with a yes/no answer whether each statement is true of them. The JEPQ provides scores for three personality factors including neuroticism (e.g. Do you feel "just miserable" for no good reason?), psychoticism (e.g. Do you enjoy hurting people you like?) and extraversion (e.g. Would you rather be alone instead of meeting other children?). For the current study, scores from the extraversion scale were not used. Scores on the neuroticism and psychoticism scales can range between 0 and 20 and 0 and 17 respectively. Norms reported in the JEPQ manual were used to identify children with elevated neuroticism and psychoticism (i.e. 15 for neuroticism and 7 for psychoticism).

Friendship. The Friendship Quality Scale (FQS) consists of 23 items asking participants to rate on a 5-point Likert scale (ranging from "strongly agree" to "strongly disagree") how much each of the statements describes their best friend and their friendship in general. The FQS provides separate scores for different indices of friendship including companionship, help, security, conflict and closeness. A total score is obtained by adding all scores from the different subscales.[4]

2.2.4 Procedure

Participants were asked to do a computer task based on the RDP, and to complete a number of questionnaires to measure anxiety, attentional control, personality traits, depression, friendship quality and quantity and peer acceptance.

The Remote Distractor Paradigm (RDP). Participants completed four experimental blocks of 144 trials; one for each distractor expression (angry, happy, neutral) and one for the oval distractor. Each block included 48 single target trials

[4] A nomination procedure was also used to measure friendship quantity and peer acceptance, and the PIU to measure preference for online interaction. These measures were removed from the analysis due to insufficient data points, and hence will not be reported in the analysis.

(used as a measure of baseline performance) and 96 distractor trials (32 central distractors, 32 parafoveal distractors, 32 peripheral distractors). Each trial began with a centrally-located fixation cross, presented on a black background, which participants had to fixate (the fixation cross was presented for a minimum duration of 1000 ms and participants had to look within 1.5 degree of the centre of the cross for 200 ms). The fixation cross was then replaced with a trial display that contained either a single target (single-target trials) or a target and a distractor (distractor trials). The trial display was presented for 1500 ms or until a key-press response was made. Participants were instructed to ignore the distractor and look at the target as quickly and accurately as possible and press a response button to indicate whether the target was a square or a diamond. In half of the experimental trials the target was a square.

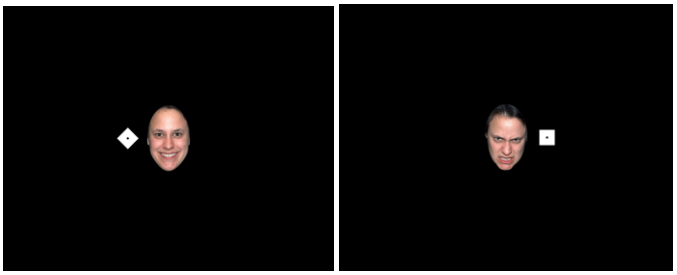
Distractor trials contained a distractor presented in the foveal (0° eccentricity), parafoveal (4° eccentricity) or peripheral (8° eccentricity) vision with equal frequency. Targets appeared in the mirror position of the distractor in displays containing parafoveal or peripheral distractors. If a distractor was presented in the centre of the display, then the target appeared in a parafoveal or peripheral location on the right or left of the central fixation point. In the single-target trials, the target appeared in a parafoveal or peripheral location on the right or left of the central fixation. Response buttons and experimental blocks were counterbalanced.

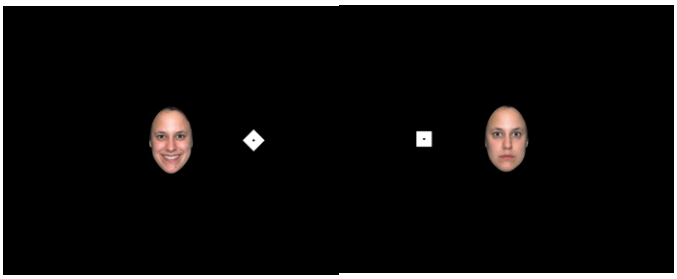
The processing of stimuli presented at different eccentricities in the visual field is influenced by visual limitations related to the oculomotor system (i.e. visual acuity varies across eccentricities). Foveal vision corresponds to the 2 degrees of central vision, and visual acuity in this part of the visual field is very high. Parafoveal vision corresponds to the part of the visual field that falls beyond the 2 degrees and extends up to 5 degrees to the right or left of the central fixation point. Visual acuity

at parafoveal locations in the visual field is also high, albeit lower than in the foveal vision. Peripheral vision corresponds to the field of vision that extends from the end of the parafovea out to about 9 degrees from the central fixation point, and visual acuity in this part of the visual field is significantly reduced (Rayner et al., 2003). In order to address these limitations, we conducted a pilot study (See Appendix B) with 6 children (aged 11-14 years old) to assess whether facial emotions at parafoveal and peripheral locations were accurately recognised by children. The result revealed that emotional and non-emotional faces were recognised with high accuracy. The results revealed that the emotion of faces presented in parafoveal (i.e. at 4°) and peripheral (i.e. at 8°) locations in the visual field could be identified with high accuracy; 99% accuracy at 4° and 97% accuracy at 8°.

Participants completed the STAI-S questionnaire right before and after the RDP task, and the two scores were combined into summary measures. The rest of the questionnaires were completed in groups of four children within a week from the completion of the RDP task. Children were given a £5 bookstore voucher for their participation in the study.

a)





b)

c)

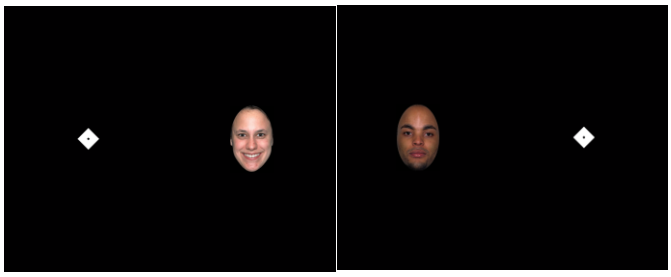


Figure 2.1. Example of possible locations for distractor and target in central distractor trials, parafoveal distractor trials and peripheral distractor trials.

2.2.5 Design

The experiment was a mixed design. Within -subject factors were: 1) Type of trial (single target or distractor trial) 2) Distractor eccentricity (central, parafoveal, peripheral) and 3) Distractor expression (angry, happy, neutral face distractors and oval shape distractor). Between-subject factors were self-report personality traits (neuroticism and psychoticism), anxiety (trait anxiety, state anxiety and social anxiety), attentional control, depression and friendship quality (i.e., companionship, help, security, conflict, closeness). Note that the data obtained from the friendship quantity, peer acceptance and preference for online interaction measures were insufficient for statistical analysis (i.e. there were no enough data points due to drop outs and incomplete data); hence these questionnaires were excluded from the analysis[5]. The dependent variables were: 1) Percentage of directional errors; i.e. first saccades towards the distractor of any type or eccentricity with an amplitude of saccade greater than two degrees; 2) Latency of accurate first saccades; i.e. first saccades directed towards the target with an amplitude greater than two degrees 3) The time taken to make a manual response to identify the target (RTs).

2.2.6 Data Preparation

Data Viewer software was used to inspect and organise the behavioural and eye movement data. A total number of 5158/18151 (28 %) trials were excluded from the eye movement data analysis. Trials were excluded from the eye movement analysis if: 1) the fixation point at the beginning of the trial was greater than 1° away from the centre of the screen (3 %) 2) a blink occurred (4 %) 3) an anticipatory eye movement was executed (i.e. first saccades with latencies less than 80 ms; Wenban-

[5] The total number of mutual nominations (i.e. the child was nominated by a person that they had nominated as well) was used to measure friendship quantity and peer acceptance. Data were not available from individuals who were nominated but did not take part in the study or dropped out at a later stage. In addition, data from the online interaction questionnaire were insufficient because a lot of participants did not use social networks. Hence these questionnaires were removed from the data set.

Smith & Findlay, 1991) (1%) 4) the latency of the first saccade was greater or lower than 3 standard deviations away from the participant's mean first saccade latency (2%) 4) an incorrect button press response was made (18%)[6]. It should be noted that the percentage of incorrect trials removed from the curret dataset was high compared to previous research using the RDP task and the following studies in the current thesis. This might be due to age differences in attention and memory (i.e. participants were younger in the current study). Participants were required to memorise the buttons corresponding to each target (i.e. square versus diamond), and this might had an impact on their performance. In order to minimise error rates, future studies using this task with children should label the response buttons so that the partipants have the opportunity to remind themselves the button corresponding to each target. In addition, a high percentage of the incorrect trials excluded from the current analysis were from the oval shape distractor condition (i.e. 8%), which was removed from the analysis. However, although a high number of incorrect responses was removed, the data were sufficiently reliable for testing our hypothesis.

First saccades with amplitude less than 1º were replaced with second saccades (5 %). For the RT analysis trials were excluded from the analysis if 1) RTs were greater or lower than 3 standard deviations away from the participant's mean total RT (3 %) 2) an incorrect button press response was made (13%)

2.2.7 Data Analysis

Data analysis was completed in different stages. The first stage considered the basic effects related to the RDP. Paired-sample t-tests and repeated measures ANOVAs were conducted to assess the effects of distractor condition (i.e. present or

[6] Trials where an incorrect button press response was made were removed from the data because incorrect responses indicate that the instructions (i.e. look at the target and press the corresponding button to indicate its shape) were not followed by the participants. Additionally, in incorrect trials it is not clear whether the target was identified (but an incorrect button press response was made) or whether the information on the display was not processed.

absent) distractor type (i.e. angry, happy and neutral face distractors and oval distractor) and distractor eccentricity (i.e. central, parafoveal, peripheral) on the dependent variables across participants (i.e. directional errors, first saccade latencies towards the target and reaction times). Correlations and regression analysis were then computed to assess links between the measures of individual differences (i.e. neuroticism, psychoticism, trait anxiety, state anxiety, depression and attentional control), the eye movement measures (i.e. directional errors and first saccade latencies towards the target for all distractor conditions) and friendship quality. In order to avoid multiple testing when assessing links between temperamental risk and eye movement behaviour, the eye movement measures were initially collapsed across eccentricities for each distractor condition separately. Significant findings were followed up with post-hoc tests to see whether the effects would be evident across distractor eccentricities.

Moderation analysis was conducted to test the hypothesis that temperamental risk would be related to an attention bias towards threat (i.e. increased directional errors towards angry faces or delayed saccade latencies towards the target in the presence of angry faces) in individuals with poor attentional control. Mediation analysis followed to test a second hypothesis that temperamental risk will be related to poor quality friendships via an attention bias towards threat. Moderating and mediating effects were tested using a process that applies bootstrapping techniques. Bootstrapping is a statistical procedure that applies random sampling with replacement, and allows inferences rather than assumptions to be made about the population. It can be used for any statistic, including the estimation of mediating and moderating effects (Hayes, 2013).

2.3 Results

2.3.1 Basic Effects

Directional errors. Directional error rates were negatively skewed for all distractor conditions, hence non-parametric tests were used to assess the effects of distractor emotion and distractor eccentricity on directional errors. The Wilcoxon signed ranks test showed significant error rate differences between the parafoveal and the peripheral distractor trials in all distractor emotions (in parafoveal angry, happy, neutral and non-face trials *Mdns* were 27.59%, 19.35% , 17.24% and 6.90 %; and in peripheral angry, happy and neutral *Mdns* were 40%, 31.25%, 32.26% and 23.10%). A Friedman's ANOVA was used to assess whether the emotion of the distractor influenced directional error rates (for parafoveal and peripheral trials separately). The results revealed that error rates differed significantly between distractor emotions at both parafoveal distractor trials, $\chi_2(2) = 33.24$, $p < .001$ and peripheral distractor trials $\chi_2(2) = 20.30$, $p < .001$.

In parafoveal trials, non-parametric post-hoc tests showed that the error rate was significantly higher in angry distractor trials compared with neutral distractor trials, $\chi_2(2) = 4.57$, $p = .03$. Differences in error rates for angry and happy and happy and neutral distractor trials were not significant, $\chi_2(2) < 3$, *ps* > .05. Additionally, error rates were significantly higher in all face distractor trials compared with non-face distractor trials, $\chi_2(2) > 15$, *ps* < .001. In peripheral trials, the error rate was marginally significantly higher in angry distractor trials compared with happy distractor trials $\chi_2(2) = 3.67$, $p = .05$ and neutral distractor trials $\chi_2(2) = 4.00$, $p = .05$. The difference in error rates for happy and neutral distractor trials was not significant $\chi_2(2) = .26$, $p = .61$. The error rates were significantly higher for emotional distractor trials compared with non-face distractor trials $\chi_2(2) > 10$, $p < .001$. The difference

between error rates for neutral and non-face distractor trials was not significant $\chi_2(2) = .64$, *ns.* See Table 2.1 for descriptive statistics for directional error rates.

Accurate first saccade latency to the target. Paired sample T-tests were conducted to assess whether a Remote Distractor Effect was present (i.e. if the presence of distractors delayed saccade latencies towards the target in comparison to the single target trials). For each distractor condition and eccentricity (e.g. angry central, happy central, neutral central, non-face central etc.) the latencies of first saccades to the target in the distractor trials were compared with saccade latencies towards the target in the single-target trials from the same experimental block (e.g. angry central distractor trials were compared with single target trials embedded within the angry block etc.). As expected, first saccade latencies were shorter in single-target trials compared with distractor trials (i.e. a remote distractor effect was present; see Walker et al., 1995), and this was evident across all distractor emotions and eccentricities (all *t*s > 8, all *p*s < .001), see Figure 2.2. Thus, first saccade latencies to the target were delayed by the presence of distractors and across all distractor locations (i.e. foveal, parafoveal and peripheral vision), providing additional evidence in support of the RDE.

In order to assess distractor emotion and eccentricity effects, a repeated measures ANOVA (distractor expression x distractor eccentricity) was conducted on the latency of accurate first saccades to the target. The results revealed a significant main effect of eccentricity $F(2,66) = 11.49$, $\eta_p^2 = .26$, $p < .001$. Pairwise comparisons showed that first saccade latencies to the target were significantly longer in central distractor trials ($M = 229.00$ *ms, SD* = 29.91) compared with peripheral distractor trials (*M = 217.54 ms, SD = 28.63*), suggesting that distractors located in foveal vision interfered more with performance compared with distractors located in

peripheral regions of the visual field. Differences in first saccade latencies to the target between central distractor trials and parafoveal distractor (*M = 223.86, SD = 30.38)* trials and parafoveal distractor trials and peripheral distractor trials were not significant.

Additionally, a significant interaction was found between distractor eccentricity and distractor emotion $F(6,198) = 13.11$, $p < .001$. Post hoc tests revealed an emotion effect in all distractor eccentricities (all $Fs > 3$, all $ps < .05$). For central distractor trials, first saccade latencies were significantly longer in trials containing angry distractors (*M = 236.19, SD = 34.23)* compared with trials containing non-face distractors (*M = 219.60, SD = 29.45),* and marginally significantly longer in trials containing happy distractors (*M = 233.65, SD = 42.33)* compared with trials containing non-face distractors, which suggests that participants were more distracted by the presence of centrally located emotional faces compared with centrally located non-face distractors. For parafoveal distractor trials, first saccade latencies were significantly longer in non-face distractor trials *(M = 232.72, SD = 33.18)* compared with angry *(M = 221.10, SD = 33.82)* and neutral *(M = 218.33, SD = 31.37)* distractor trials. In peripheral trials, first saccade latencies were significantly longer in non-face distractor trials *(M = 225.35, SD = 32.07)* compared with neutral distractor trials *(M = 212.24, SD = 29.80)* and marginally significantly longer compared with angry distractor trials *(M = 214.71, SD = 29.15)*. No significant differences were found between first saccade latencies for face distractor trials in none of the distractor eccentricities, which indicates that the distractor emotion effect was particularly driven by the non-face condition. See Figure 2.3

In addition, a one-way ANOVA (with single target trials only) was conducted to assess whether any distractor emotion or eccentricity effects on saccade latencies

were carried over in the single-target trials embedded within each experimental block. The results revealed that first saccade latencies to the target did not differ significantly between the single-target trials (*Angry M* = 161.17 ms, *SD* = 24.84; *Happy M* = 166.75 ms, *SD* = 29.88; *Neutral M* = 168.51, *SD* = 32.10; *Nf M* = 165.44, *SD* = 27.84). Thus, distractors had no differential effect on the latencies for single target trials.

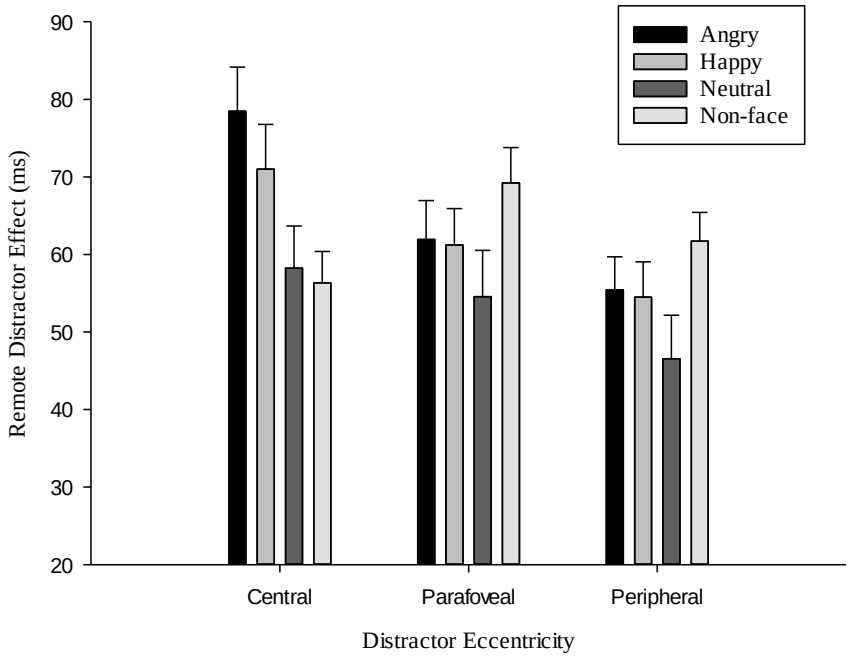


Figure 2.2. RDE magnitude as a function of distractor emotion and distractor eccentricity.

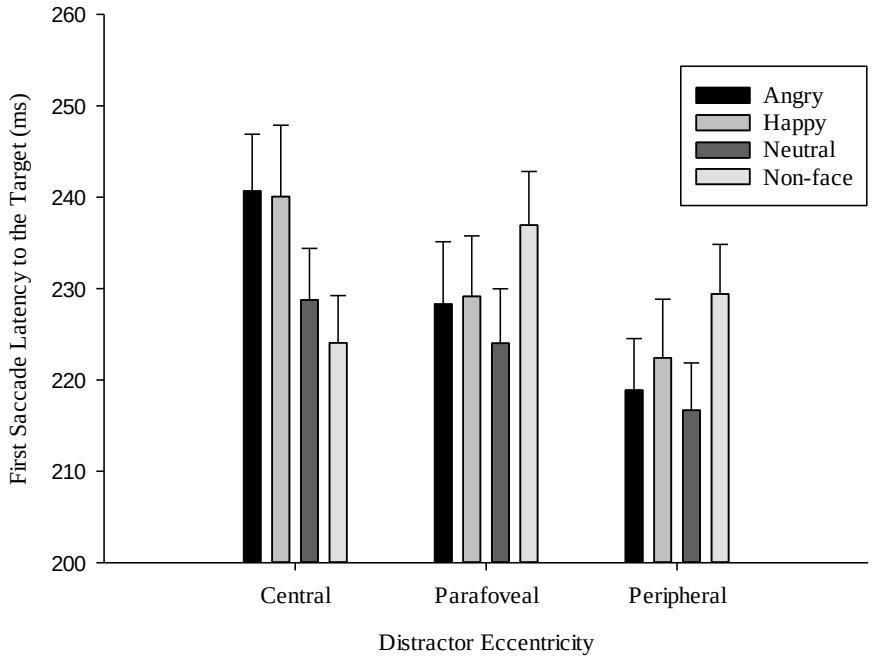


Figure 2.3. Mean (+SE) for the latency of accurate first saccades towards the target as a function of distractor emotion and distractor eccentricity.

Target discrimination response time (RTs). This analysis considered the total time taken to make a response in single target trials and distractor trials across participants. In order to assess whether the presence of a distractor presented at different eccentricities in the visual field increased (in comparison to single target trials) the total time taken to make a response, paired samples t-tests were conducted where RTs in distractor trials (for each distractor condition and eccentricity separately) were compared with RTs in the single target trials embedded within the same experimental block (i.e. RTs for the angry distractor trials were compared with RTs for the single target trials embedded in the angry distractor block). The results revealed that RTs were significantly longer in angry peripheral trials compared with single target trials and significantly longer in parafoveal and peripheral non-face trials compared with single target trials (all $ts > 2$, all $ps < .05$). Additionally, there was a trend towards longer RTs in happy and neutral peripheral distractor trials compared with single target trials and longer RTs in non-face central distractor trials compared with single distractor trials. Differences in RTs for central angry, happy and neutral distractor trials and single distractor trials were not significant, $ts < 1.5$, *ns*.

A repeated measures ANOVA was conducted to explore whether distractor emotion or distractor eccentricity influenced the total time taken to make a response, and the results showed a main effect of distractor emotion, $F(2, 118) = 16.98$, $p < .001$ and distractor eccentricity, $F(2, 118) = 16.98$, $p < .001$ on RTs. Pairwise comparisons showed that RTs were marginally significantly longer in non-face distractor trials ($M = 870.45$ ms, $SD = 170.70$) compared with neutral distractor trials ($M = 837.84$ ms, $SD = 159.70$). RTs were significantly longer in peripheral distractor trials ($M = 876.66$ ms, $SD = 159.95$) compared with central distractor trials ($M = 860.20$ ms, $SD = 162.16$) and parafoveal distractor trials ($M = 851.74$ ms, $SD = 159.95$). The

interaction between distractor emotion and eccentricity was not significant, $F < 1.5$, *ns*. Further analysis considered whether performance differed across the single target trials embedded in each experimental block. The results showed that there was no significant difference, $F < 2$, *ns*, between RTs for the single target trials in the angry (M = 857.39 ms, SD = 194.14), happy (M = 840.73, SD = 171.10), neutral (M = 825.94 ms, SD = 155.60) and non-face (M = 852.31 ms, SD = 167.76) distractor blocks. See Table 2.1 for mean RTs in single target trials and distractor trials.

Table 2.1.

Mean (+SD) for Error Rates (%), First Saccade Latencies to the Target (ms), Remote Distractor Effect and Reaction Times as a Function of Trial Type, Distractor Emotion and Distractor Eccentricity.

	Angry Block		Happy Block		Neutral Block		Non-face block	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Error rates (%)								
Parafoveal distractor	30.65	21.55	25.37	20.58	21.79	32.36	7.91	7.92
Peripheral distractor	39.54	23.20	34.46	21.46	19.88	22.03	23.42	13.19
Saccade latencies (ms)								
Single Target	162.88	25.27	167.92	32.26	170.84	32.87	167.71	30.09
Central distractor	240.69	37.79	240.07	48.19	228.76	34.36	224.05	32.38
Parafoveal distractor	228.30	42.10	229.15	41.35	224.01	36.83	236.94	36.63
Peripheral distractor	218.88	34.30	222.42	40.16	216.68	32.31	229.42	33.80
RDE (ms)								
Central distractor	77.81	34.59	72.15	35.51	57.92	33.09	56.33	25.33
Parafoveal distractor	65.42	30.51	61.23	29.31	53.17	36.78	69.23	28.47
Peripheral distractor	56.00	25.65	54.49	28.38	45.84	35.23	61.71	23.27
RTs (ms)								
Single Target	854.89	192.41	850.23	179.85	826.84	153.75	852.31	167.76
Central distractor	872.58	192.86	864.39	188.16	837.45	169.92	865.61	176.17
Parafoveal distractor	876.83	203.89	835.92	205.67	820.67	160.88	867.30	169.49
Peripheral distractor	902.98	188.69	871.12	196.67	846.87	151.30	878.45	182.28

2.3.2 Basic Effect Analysis Summary

In summary, the current analysis found that the eye movement measures were affected by the emotion and eccentricity of distractors. Specifically, an increase in directional errors was observed in trials where the distractor was presented in peripheral locations compared with trials where the distractor was presented in parafoveal locations, and this was evident in all distractor emotions. In addition, the proportion of directional errors was greater in the angry distractor condition compared

with the neutral distractor condition in parafoveal trials, and significantly higher in all face distractor trials compared with non-face distractor trials. The current results also found that the presence of a distractor interfered with performance. That is saccade latencies towards the target were longer in distractor trials compared with single target trials, and this was evident in all distractor emotions. Distractor eccentricity also influenced saccade latencies towards the target; saccade latencies were longer in trials where the distractor was presented in the foveal vision compared with trials where the distractor was presented in peripheral locations of the visual field. Emotion effects were found across all distractor eccentricities. In central distractor trials, first saccade latencies were significantly longer in trials containing angry distractors compared with trials containing non-face distractors, and marginally significantly longer in trials containing happy distractors compared with trials containing non-face distractors. In parafoveal distractor trials, first saccade latencies were significantly longer in non-face distractor trials compared with angry and neutral distractor trials. Finally, in peripheral trials, first saccade latencies were significantly longer in non-face distractor trials compared with neutral distractor trials and marginally significantly longer compared with angry distractor trials.

2.3.3 Temperamental Risk and Attentional Processing

Participant characteristics. The internal consistency of the questionnaires was acceptable (Cronbach's αs > .60, see Table 2.2 for descriptive statistics). Independent samples t-tests were conducted to assess whether the questionnaire scores differed between males and females, and the results revealed that there were no significant differences between gender (*ts* < 1.5, *ns*). The data showed that 8 children (19 %) of the sample reported levels of anxiety that were above the cut off, and 6 children (17 %) and 10 children (24 %) of the sample reported levels of neuroticism and psychoticism

respectively that were above the norms reported in the JEPQ manual. In addition, 7 children (17 %) and 10 children (24 %) scored above the cut off on the state anxiety and depression scales respectively.

The following analysis considers links between the measures of individual differences (i.e. anxiety, neuroticism, psychoticism, attentional control and depression) and attentional processing during the RDP task. At a first stage, Pearson's correlations were used to assess whether the measures of individual differences were associated with each other in the expected direction. In the second stage of the current analysis regressions and Spearman's correlations were conducted to assess links between temperamental risk and the eye movement measures. Lastly, bootstrapping techniques were used to assess whether attentional control moderated the relationship between temperamental risk and impaired inhibition of threat. To address issues of specificity we considered associations between psychoticism symptoms and attentional measures and friendship quality.

As expected, correlations between the measures of individual differences revealed a positive association between neuroticism and trait anxiety; high scores on the neuroticism scale were related to increased trait anxiety. The current study found no links between anxiety or neuroticism and attentional control and state anxiety (See table 2.3).

Table 2.2.

Descriptive Statistics and Internal consistency for Measures of Individual Differences.

	Possible range	*M*	*SD*	*Minimum (upper limit)*	*Maximum (upper limit)*	*Cronbach's a*
Neuroticism (EPQ)	0-20	9.70	5.13	1	20	.80
Psychoticism (EPQ)	0-17	3.31	2.47	0	10	.60
Trait Anxiety (RCMAS)	0-80	49.60	14.88	0	73	.92
State Anxiety (STAI-S)	20-60	28.50	3.28	22	36	.79
Attentional Control (ACS)	20-80	50.82	4.17	42	59	.85
Depression (RCADS)	0-30	7.50	4.96	0	17	.86
Friendship Quality Scale(FQS)	23-115	45.31	9.25	28	67	.79

Table 2.3.

Correlations between the Measures of Individual Differences, the Social Adjusmtent Measures and the Eye Movement Measures.

	Psychometric Measures					Friendship Quality					Directional Errors			Saccade Latency		
	2	3	4	5	6	7	7a	7b	7c	7d	An	Ha	Ne	An	Ha	Ne
1. Neuroticism	.19	.72**	.18	.19	.68**	.08	.05	.22	.07	.01	.10	.14	-.05	.61***	.27	.36*
2. Psychoticism	-	.28	.12	.003	.11	.41**	.21	.42**	.33*	.27	.34*	.39*	.40*	-.02	-.01	.11
3. Trait Anxiety		-	.02	.08	.60**	.09	-.09	.17	.12	.11	-.10	-.02	-.05	.33	.29	.37*
4. State Anxiety			-	.14	.29	.23	.30	.16	.19	-.02	-.05	-.04	-.26	-.21	-.45*	-.23
5. Attentional Control				-	.17	-.05	.04	.11	-.23	-.13	.37*	.18	.22	.01	.05	.01
6. Depression					-	.22	.34*	.35*	.002	.12	-.24	-.03	-.02	.17	.06	.19
7. Friendship Quality											.36*	.24	.23	-.09	-.01	.09
a. Companionship											.45**			-.07		
b. Conflict											.18			-.19		
c. Help											.13			.12		
d. Security											.39*			-.01		

Note. *** $p < .001$, ** $p < .01$, * $p < .05$

In order to assess whether temperamental risk was associated with selective attention towards threat (i.e. involuntary saccades towards angry faces), Spearman's correlations were conducted between the measures of individual differences (i.e. anxiety, neuroticism, psychoticism, depression, and attentional control) and the proportion of directional errors towards threatening and non-threatening distractors. Correlations between internalising traits (i.e. anxiety, neuroticism and depression) and directional error rates were not significant for any distractor condition ($p > .10$, *ns*). However, psychoticism was associated with increased directional errors towards distractors in all distractor conditions ($rs > .33$, $ps < .05$) suggesting that the attention of children who reported psychotic traits was automatically captured by task-irrelevant face distractors, irrespective of the emotional expression of the distractors. In addition, there was a significant positive relationship between the ACS and the percentage of directional errors in the angry (but not happy or neutral) distractor condition ($r = .37$, $p = .03$) which indicates that individuals with poor attentional control had difficulties to supress automatic responses towards threatening faces (See table 2.3).

Multiple regression analysis was conducted to explore links between the measures of individual differences (trait anxiety, state anxiety, social anxiety, neuroticism, attentional control and depression) and first saccade latencies towards the target in the presence and absence of different face distractors (i.e. angry, happy and neutral face distractors). The predictors were regressed against first saccade latencies towards the target for each distractor condition separately (at this stage of the analysis the different eccentricities at which the distractors were presented were collapsed). The regression model was not significant for the neutral distractor condition ($R^2 < .30$, $Fs < 2.15$, $p > .05$, *ns*). The regression model for the happy

condition was marginally significant, R^2 = .32, F(5, 32) = 2.60, p = .05, and state anxiety was a significant predictor within this model such that state anxiety predicted shorter first saccade latencies to the target in the presence of happy distractors.

Notably, the regression model was highly significant for the angry distractor condition, R^2 = .51, F(5, 30) = 5.45, p = .002, and, furthermore, neuroticism was a significant predictor within this model. There were no other significant predictors within this model, $|\beta s| < .30$, $ps > .05$, hence the redundant questionnaires were removed from the regression model and the analysis was repeated with neuroticism entered as the only predictor and first saccade latency for angry trials entered as the dependent variable. The model remained significant, R^2 =.39, F(1, 34) = 20.89, $p < .001$.

In order to explore whether links between neuroticism and delayed saccade latencies in the presence of threat were evident across distractor eccentricities, neuroticism was regressed against first saccade latencies to the target in angry central, angry parafoveal and angry peripheral trials separately. This comparison would allow the exact attentional mechanisms linked to impaired inhibition of threat (i.e. difficulty to disengage attention from centrally located threat or hypervigilance for threat) to be revealed in children with neuroticism. The regression models were significant for all distractor eccentricities. Neuroticism predicted longer first saccade latencies towards the target in angry central trials, R^2 = .20, F(1, 36) = 8.91, p = .01, angry parafoveal trials R^2 = .12, F (1, 36) = 4.75, p = .03, and angry peripheral trials R^2 = .16, F (1, 36) = 6.41, p = .01.

Moderation analysis followed to explore whether attentional control (measured with the ACS) moderated the relationship between neuroticism and impaired inhibition of threat. The results revealed that attentional control moderated

links between neuroticism and first saccade latencies towards the target in the presence of angry distractors presented in the centre of the screen only. This finding indicates that impaired disengagement from angry faces presented in the foveal vision was most evident in children with high levels of neuroticism and low attentional control (see Table 2.4 and Figure 2.4). However, attentional control did not moderate the relationship between neuroticism and saccade latencies towards the target in the presence of threat presented in parafoveal and peripheral regions of the visual field.

In addition, the current analysis considered links between the measures of individual differences and RTs. There were no significant correlations between internalising (i.e. anxiety, neuroticism and depression) and externalising behaviour (i.e. aggressiveness) and RTs, $r < -.28$, *ns*. However, attentional control was associated with increased RTs in angry (but not happy or neutral) distractor trials ($r = .42$, $p = .03$), suggesting that poor attention control was associated with delayed responses in the presence of threatening distractors.

Further analysis considered the possibility that links between anxiety and attention bias for threat would be evident in individuals with elevated anxiety and low attentional control (see Lonigan & Philips 2001). There was no significant moderating effect of attentional control on directional errors or saccade latencies in children that reported high levels of anxiety.

Table 2.4.

Linear Model of Predictors of Increased Saccade Latencies to the Target in the Presence of Central Threat.

	B	*SE B*	*T*	*p*
Constant	238.77 [226.96, 250.58]	5.79	41.23	p < .001
Neuroticism	3.26 [0.79, 5.72]	1.21	2.69	p = .01
Attentional control (AC)	1.24 [-1.89, 4.36]	1.53	.81	p > .05
Neuroticism x AC	.65 [0.01, 1.30]	.32	2.02	p = .05

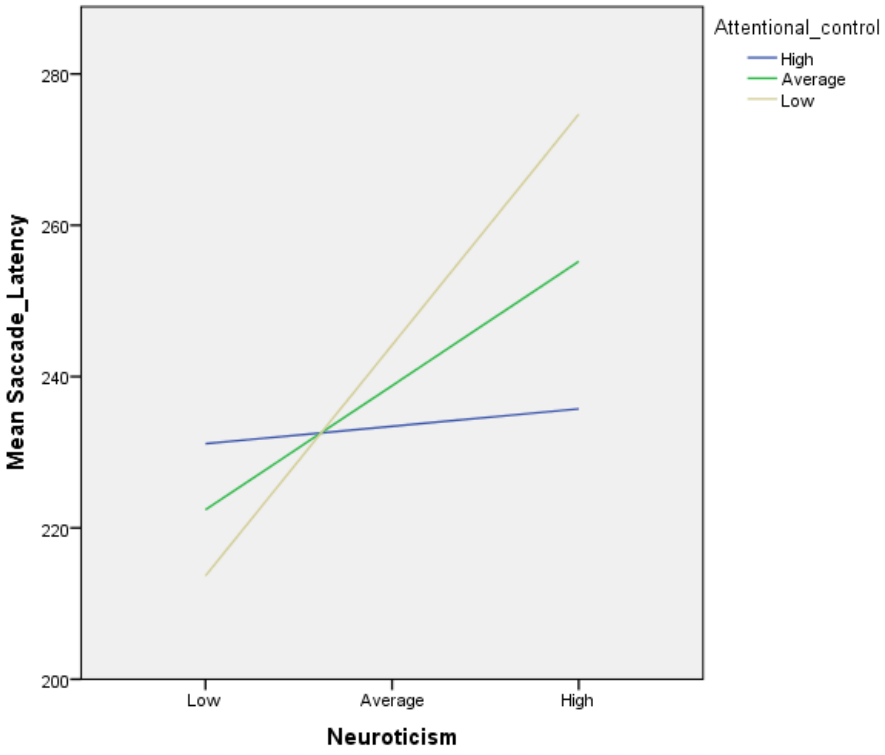


Figure 2.4. The moderating effect of attentional control (high, medium and low) on the relationship between neuroticism traits and saccade onset latency to the targets presented in the context of centrally presented angry faces.

2.3.4 Temperamental Risk and Attention Analysis Summary

The results showed an association between neuroticism and impaired inhibition of threat. Individuals with neurotic traits showed delayed saccade latencies towards the target in the presence of angry (but not happy or neutral) distractors, where this relationship was moderated by attentional control. That is individuals with elevated neuroticism and low attentional control found it more difficult to disengage attention from angry face distractors. However, neuroticism was unrelated to directional errors towards angry faces, which suggests that individuals with neuroticism were able to supress exogenous attention towards threatening distractors. Individuals with psychotic traits showed increased directional errors towards distractors in general (irrespective of the distractor emotion), indicating difficulties to supress overt attention towards task-irrelevant information.

2.3.5 Temperamental Risk, Attention to Threat and Social Adjustment

In this section we tested the hypothesis that temperamental risk will be associated with poor peer relationships via an attention bias towards threat. However, the data obtained from the friendship quantity, popularity and preference for online interaction questionnaires were insufficient for statistical analysis (i.e. data for friendship quantity and peer acceptance were obtained from 19 participants (45%), and for the online interaction scale data were obtained from 22 participants (52%), and hence these measures were removed from the database. The current analysis therefore only considered self-reports of friendship quality scores.

Initially, exploratory correlations were performed to assess links between temperamental risk and friendship quality. The results of this initial analysis revealed that there were no links between anxiety or neuroticism and friendship quality.

However, there was a positive association between psychoticism and friendship quality (high scores on the FQS indicated low quality friendships). Hence, children with externalising behavioural problems (i.e. aggressive behaviour) were more likely to also report low quality friendships ($r = .41$, $p = .01$). Additional correlations were conducted to consider links between psychoticism and the subscales from the friendship quality questionnaire (i.e. companionship, conflict, help, closeness and security) and these results revealed a positive association between psychoticism and the conflict ($r = .42$, $p = .01$) and help ($r = .33$, $p = .03$) subscales. That is, higher scores on the psychoticism scale were related to increased conflict with friends, and less help received from friends (See Table 2.3).

Correlations between the friendship quality scale and the eye movement measures revealed that increased directional errors towards angry (but not happy and neutral distractors) was associated with poorer quality friendships ($r = .36$, $p = .02$). Further analysis revealed that lower companionship and security within friendships was also related to increased directional errors towards threat. Specifically, children who were more distracted from threatening faces reported spending less time with their best friend and feeling less secure in their friendships than children who were less distracted by threat. In contrast with the findings from the eye movement error proportions, friendship quality was not associated with first saccade latencies towards the target for any distractor condition ($rs =< .10$, $p > .05$). See Table 2.3.

Correlations between temperamental risk, the eye movement measures and friendship quality were used to decide about the exact variables that would be entered into a mediation model. Mediation analysis requires that the mediator (B) is significantly correlated to the predictor (A) and the outcome (C). Elevated psychoticism (A) and low companionship (C) within friendships were both correlated

with increased directional errors towards angry distractors (B), but there was no relationship between A and C (see table 2.3). Mediation analysis was conducted to assess whether selective attention to threat mediated the relationship between psychoticism and low companionship within friendships. There was a significant indirect effect of psychoticism on companionship through directional errors towards angry faces, $b = 0.150$, BCa CI [0.006, 0.407], suggesting that selective attention towards threat in children with psychotic traits influences the amount of time they spend with their friends. It should be noted that although children with elevated psychoticism showed selective attention towards all distractor types, the mediating effect of directional errors on companionship was only found for angry faces. See Figure 2.3 for the significant mediation model.

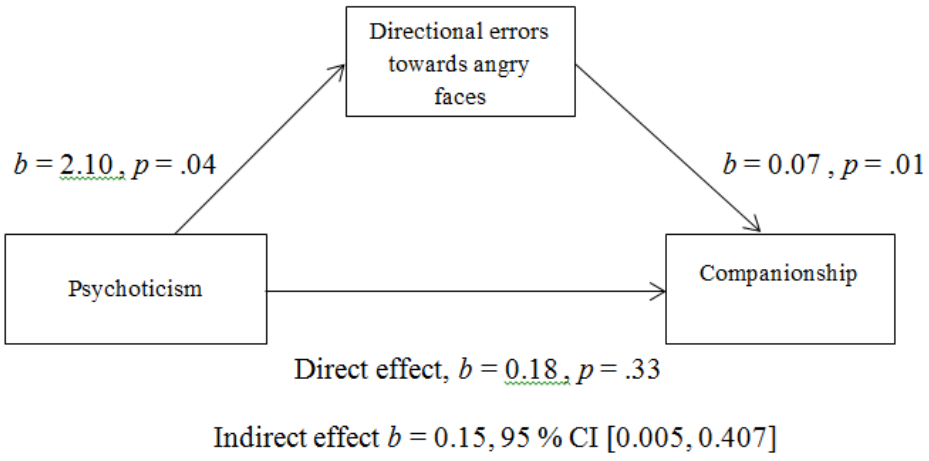


Figure 2.5. Mediation model demonstrating links between psychoticism and companionship via directional errors towards angry faces.

2.3.6 Temperamental Risk and Social Adjustment Summary

The current results found no links between internalising traits and friendship quality. There was an association between psychoticism (aggressive behaviour) and

friendship quality. Specifically, individuals with psychotic traits reported lower quality friendships, which involved more conflict and less help received from friends. In addition, there was an indirect effect of psychoticism on companionship via impaired inhibition of threat. Hence, although individuals with psychotic traits were generally more distracted by task irrelevant information (irrespective of the distractor emotion), only enhanced attention towards threat mediated links between psychoticism and companionship. The current analysis also revealed links between attention and friendship quality. Namely, selective attention towards threat (i.e. increased directional errors towards angry faces) was related to poorer quality friendships.

2.4 Discussion

The current study explored links between temperamental risk and attention biases towards threat, and the role of attentional control in this relationship. It further investigated associations between temperamental risk and friendship quality and whether such links were mediated by attention biases towards threat.

Following previous studies (e.g. Walker et al., 1995) using the RDP a reliable remote distractor effect was found in the current study; saccade latencies were delayed in the presence of face-distractors presented at different eccentricities in the visual field, and this was evident across distractor emotions (angry, happy and neutral faces). In addition, in line with previous studies (e.g. Richards et al., 2012) the magnitude of the RDE was influenced by distractor eccentricity; the difference between saccade latencies in single target trials and distractor trials was greater when distractors were located in the foveal vision than in parafoveal and peripheral locations of the visual field. These findings indicate that distractors located in the

foveal vision, where visual acuity is high, interfere more with performance than distractors presented in the parafoveal and peripheral vision, where visual acuity is reduced. However, it should be noted that the remote distractor magnitude was smaller in the original study (e.g. 20 ms for central distractors) compared to the current one. A plausible explanation for the larger RDE in the current study is that remote distractors were different type (i.e. the current study used faces as distractors) and bigger in size compared to the distractors used in the original study (i.e. crosses). In addition, a previous study (see Richards et al., 2012) with adults that used identical stimuli to the current one also found a smaller RDE compared to the current study. Age differences in attentional control might be a possible explanation for the current results (i.e. for reviews indicating poorer control of attention in children than in adults, see Gomes, Molholm, Christodoulou, Ritter, & Cowan, 2000; Plude, Enns, & Brodeur, 1994).The basic effect analysis also showed a main effect of eccentricity on the percentage of directional errors (inaccurate firs saccades towards the distractor). In line with previous research (e.g. Richards et al., 2012) directional error rates increased with eccentricity, which indicates that participants found it more difficult to inhibit involuntary first saccades towards peripheral distractors compared to parafoveal distractors.

In line with the predictions, we found that neuroticism was related to delayed saccade latencies towards the target in the presence of angry faces presented at different eccentricities across the visual field, and attentional control mediated this relationship, but only in displays containing angry face distractors presented in foveal vision. These findings suggest that children with elevated neuroticism found it more difficult to disengage attention from threat presented in the foveal vision, and to regulate orienting responses in the presence of threat located in the parafoveal and

peripheral vision. Delayed saccade latencies towards the target in the presence of parafoveal and peripheral threat indicate that attention was spread across the visual field and threat was covertly processed (i.e. broadening of attention). Similar findings were obtained from recently conducted research with adults, where trait anxious adults showed delayed saccade latencies towards the target in the presence of angry distractors presented at different eccentricities (0°, 4°, and 8°) in the visual field (Richards, Benson and Hadwin, 2012). Thus, it seems that children who may be susceptible to developing anxiety, and adults with high levels of trait anxiety, show the same broadening of attention across the visual field for threatening information. High psychoticism was linked to more directional errors towards all types of distractors (i.e. angry, happy and neutral faces).With respect to the second hypothesis, an indirect relationship between psychoticism and companionship via directional errors towards angry faces was observed, but no mediating pathways were found for anxiety or neuroticism and friendship quality.

The results suggest that the different patterns of effects upon different eye movement measures (errors or latencies) for emotional face distractors was related to individual differences in children. These differences were most apparent in children who reported elevated neuroticism versus those with elevated psychoticism. High neuroticism was related to difficulties to disengage attention from threatening stimuli presented in the foveal vision, and this was moderated by attentional control. Hence, children high in neuroticism and low in attentional control required more time to initiate a saccade towards the target in the presence of threatening faces located in foveal vision. This finding is consistent with previous reports suggesting that attentional control is an important factor in understanding links between temperamental risk and attentional biases towards threat (e.g. Lonigan, Vasey,

Phillips & Hazen, 2004). Additionally, neuroticism predicted delayed latencies to initiate a saccade towards the target in the presence of threat located in parafoveal and peripheral regions of the visual field, which provides evidence in support of the proposition that anxiety related symptoms are linked to a broadening of attention that enhances threat detection (i.e. children high in neuroticism were processing information in parafoveal and peripheral vision without moving their eyes; resulting in a delay in orienting towards the non-face target (see Richards et al., 2011; 2012).

In contrast to research suggesting links between anxiety and selective attention towards threat (e.g. Beck & Clark, 1997; Williams, Watts, MacLeod, & Mathews, 1997), anxiety and neuroticism in the current study were unrelated to the percentage of directional errors made towards angry faces. Children high in anxiety and neuroticism were able to supress automatic orienting towards angry face distractors located in parafoveal and peripheral regions of the visual field. One plausible explanation for the lack of an association between anxiety and impaired inhibition of threat in this study is that the measure for trait anxiety was not sensitive enough to pick up early signs of anxiety related symptoms. However, results from experimental research have repeatedly suggested that neuroticism is a strong predictor of the development of anxiety (Lonigan, Kistner, Hooe, & David, 1997; Rapee & Melville, 1997; Lipsitz et al., 1994; Pollack et al., 1996), hence it might be the case that links between anxiety and attention bias to threat emerge later in life. In addition, the current results found no association between anxiety and neuroticism and RTs in the angry distractor condition. Although saccade latencies to the target were delayed in the presence of threat, this was not reflected in the time taken to make a response.

Psychoticism was unrelated to saccade latencies towards the target in angry distractor trials, but was positively associated with the percentage of directional errors

in all distractor conditions and across both eccentricities, suggesting that individuals high in psychoticism had difficulties to supress exogenous (reflexive) saccades towards both threatening and non-threatening distractors located in parafoveal and peripheral vision. This finding is inconsistent with previous research suggesting that aggressive and hostile behaviour is specifically related to attentional/interpretation biases towards threatening and aggressive cues (see Chan, Rain and Lee, 2010; Gouze, 1987). In contrast, it suggests that aggressive individuals are generally distracted by task-irrelevant information. This fits with research which has found links between conduct disorder and atypical neural activity in networks of brain regions involved in face processing and social cognition (i.e. amygdala, superior temporal cortex, dorsolateral prefrontal cortex, and fusiform gyrus) during the processing of emotional and non-emotional facial expressions (see Fairchild et al., 2014).

In contrast to previous findings (e.g. Baker and Hudson, 2015), no links were found between anxiety or neuroticism and friendship quality. However, children high in psychoticism reported having poorer quality friendships, and further analysis revealed that their friendships involved increased conflict and less help received from friends. Interestingly, the results revealed a significant mediated pathway between psychoticism and friendship quality (i.e. companionship within friendships) via directional eye movement errors made towards angry faces. Although increased directional errors in psychoticism were also found for happy and neutral faces, these did not mediate the relationship between psychoticism and friendship quality, which suggests that it is not distraction from task-irrelevant stimuli in general that might be influencing friendship quality but the tendency to selectively attend to threat cues. These findings are consistent with theoretical models (e.g. Dodge et al., 1996) which suggest that hostile attributional and enhanced attentional processing of threat is

associated with the expression of deviant social behaviour, leading to poor peer relationships including peer rejection.

In summary, the results from the current study indicate that there are different attentional biases in children high in neuroticism versus psychoticism. Whereas children high in neuroticism showed hypervigilance for threat (i.e. increased processing of threat presented at different eccentricities in the visual field), children high in psychoticism showed selective attention towards all distractor types. The findings also suggest that attentional control is important in understanding links between temperamental risk and attentional biases towards threat. Although no associations were found between anxiety or neuroticism and friendship quality, the findings highlight the difficulties that children with externalising behavioural problems might experience in friendships. The data further provide evidence that attentional capture by threat in children with elevated psychoticism may be an important factor in understanding low levels of companionship within friendships.

The findings also suggest that children with internalising versus externalising personality traits might benefit from different treatment approaches in cases that merit treatment. One approach could be to aim to facilitate attentional control in children with temperamental risk for anxiety, whereas another could be designed to facilitate voluntary inhibition of attentional capture by threatening cues in children that show externalising behavioural problems (e.g. attention bias modification or training attentional control more broadly). The use of experimental measures of attention has allowed the exploration of different attentional pathways and serves as a strength of this investigation. However, individual differences and friendship quality data were based on self-report measures, and hence various variables might have affected the results including social desirability and feelings at the time they filled out the

questionnaires. The inclusion of multiple reporters for our measures of individual differences coupled with structured observations of peer interactions may enhance future investigations.

The current study allowed the investigation of different attentional processes via the application of eye movement methodologies. The findings suggest that differential treatments that focus on different aspects of attention might need to be developed and implemented to treat children with different personality traits. Specifically, the current eye movement data suggest that individuals at risk might benefit from attention training that will aim to improve attentional control in the presence of threat in individuals with internalising behaviour, and the control of involuntary attention to threat in individuals with externalising behaviour. In addition, they highlight that social relationships of children with externalising behaviour might benefit from attention training techniques that will aim to modify enhanced attention to threatening stimuli. The current results further highlight the importance of attentional control in understanding associations between temperamental risk and attention biases towards threat, and they emphasize the importance of the role of selective attention to threat in the relationship between temperamental risk and peer relationships in children. To conclude, these findings suggest differential risk at the level of attention between externalising and internalising disorders in childhood, and emphasize the need to look beyond direct links in the study of temperamental risk, attention to threat and peer relationships.

Chapter 3: Anxiety, Attention to Threat and Social Adjustment in Adolescents

3.1 Introduction

Experiment 1 found that neuroticism was associated with greater distraction from threatening faces; children who reported increased neurotic traits showed increased latencies to fixate on a pre-specified target in the presence of threatening (but not non-threatening) face distractors presented at different eccentricities in the visual field. In addition, the findings from experiment 1 revealed that reporting of elevated psychoticism was related to increased exogenous saccades towards all type of face distractors (i.e. irrespective of the distractor emotion).

Experiment 1 also explored links between temperamental risk and friendship quality. In contrast to our predictions and previous research (e.g. Beidel, Turner & Morris, 1999; Erath, Flanagan, & Biderman, 2007), no evidence was found to suggest an association between neuroticism and friendship quality. However, children who reported more psychotic traits also reported lower quality friendships linked to more conflict and less help received from friends. In addition, it was found that friendships of children with psychotic traits involved less companionship (i.e. they spend less time with their best friend), where this relationship was mediated by selective attention towards threatening distractors (i.e. increased involuntary saccades towards angry faces).

The following experiment aimed to replicate and extend the findings from Experiment 1 in older children (aged 12-14 years old). The current study used the remote distractor paradigm (RDP), and eye movements were recorded to explore links between temperamental risk and distraction from threatening and non-threatening faces. In addition, it aimed to explore links between temperamental risk, attention and

social adjustment difficulties. The current study extends experiment 1 by assessing the mediating effects of impaired inhibition of threat on social behaviour in adolescents who reported internalising and externalising behavioural problems. Following the findings from experiment 1, it was predicted that neuroticism would be related to greater distraction from threatening faces (i.e. increased saccade latencies towards the target in the presence of angry distractors), where this relationship will be moderated by attentional control. In addition, it was predicted that temperamental risk would be associated with social adjustment difficulties via impaired inhibition of threat. The current study also considered links between anxiety, attention and social adjustment.

3.2 Method

3.2.1 Participants

Twenty two adolescents participated in the current study (*mean age* = 12.45, *SD* = .91, *age range* = 12-14 years, 15 females). Participants were recruited via advertisement in a local newspaper, posters on the university campus and through opportunity sampling.

3.2.2 Stimuli and Apparatus

The eye tracking system and stimuli (i.e. faces for distractors and shapes for targets) were identical to those used in Experiment 1 (See chapter 2, section 2.2.2).

3.2.3 Materials

Psychometric Measures. Participants completed the State-Trait Anxiety Inventory for children (STAI-T and STAI-S; Spielberger, 1973) and the Social Anxiety Scale for children (SASC; La Greca et al., 1988). The STAI-T and STAI-S contain 20 items. Each item is rated on a 4-point scale. Scores on these scales can

range from 20 to 80. There are no fixed clinical cut-off scores reported for the STAI, thus norms provided in the development of the STAI-T and STAI-S were used to calculate a cut-off score. Scores falling above one standard deviation from the means reported in community samples were used to identify state and trait anxiety symptoms (the cut off scores were 43 for trait anxiety and 37 for state anxiety).

The SASC contains 22 items that measures social anxiety, from which 4 are filler questions (e.g. "I like to read"). Items are scored on a five-point scale ranging from 0 (not at all) to 5 (all the time) according to how much each statement describes the participant. Total scores on the SASC can range from 18-90. The means and standard deviations from reported norms were used to identify individuals with elevated social anxiety (the cut off used for the SASC was 50).

Participants also completed the Child Version of the Attentional Control Scale (ACS; Derryberry & Reed, 2002), the Junior Eysenck Personality Inventory (JEPQ; Eysenck, & Eysenck, 1975) and ten items from the Revised Child Anxiety and Depression Scale (RCADS; Chorpita, 2006) to measure depression (See chapter 2, section 2.2.3 for a description of the ACS, JEPQ and RCADS).

Social Adjustment Measures. The social adjustment measures included the Friendship Quality Scale (FQS; Bukowski et al., 1994), a procedure adapted from Subrahmanyam et al. (2008) to measure friendship quantity, the Preference for Internet Use Scale (PIU; Morahan-Martin and Schumacher , 2003) and the MacArthur Subjective Social Status Scale (SSS; Goodman et al.,2001 MacArthur). The FQS consists of 23 items designed to measure five different aspects of friendship including companionship, help, security, conflict and closeness. Items on the FQS are scored on a 5-point scale and total scores can range from 23-115 (high scores indicate poor quality friendships). To measure friendship quantity participants were asked to list up

to 10 same-sex individuals they spend most time with at school, 10 individuals they spend time with on weekends and 10 individuals they talk with most on the phone. Friendship quantity scores were attained via calculating the overlap between friends (i.e. the number of names repeated across all lists).

The PIU scale contains 11 items and it was used to measure preference for online interaction as opposed to face-face interaction. Items were scored on a 5-point scale according to the extent to which participants agreed or disagreed with each item. Scores on this scale can range between 11 and 55. The SSS was used to measure subjective family and personal social status. Participants were provided with two pictures of a "social ladder" and they were asked to place an "x" on a rung to indicate firstly where their family stands in the British society and secondly where they themselves stand in the school community.

Social Behaviour Assessment Task. A role play task was used to observe participants' behaviour while interacting with a gender-matched confederate (Beidel, Turner, Morris, 2000). The participant and a confederate were presented with six social situations (a practise scene and five experimental scenes) and were asked to imagine that these situations were really happening (see Table 3.1 for the role play task script). The confederate was asked to always initiate the conversation and the participant had to reply to what the confederate said. Participants were led to believe that the confederate was also a participant, and that they were randomly selected to act as the responder.

The role play scenarios involved offering help to an unfamiliar person, receiving help, giving and receiving a complement and responding to an invitation for a night out. In this task participants were assessed on several social behaviour factors (i.e. facial orientation while speaking to the confederate, facial orientation while the

confederate was speaking, motor movement, posture-stiffness, posture awkwardness, voice volume, vocal fluidity and inflection, affect, appropriateness of response and effort to maintain the conversation). In addition, this task provided total scores for social anxiety and effectiveness during the interaction. Participants were rated on a 4-point scale. Scores were attained for each scenario separately. Low scores indicated behavioural difficulties in social situations. High scores on the social effectiveness scale indicated high effectiveness during the interaction, whereas high scores on the social anxiety scale indicated increased social anxiety. Participants did not know that they were being assessed in this task. Table 3.2 shows an example of the procedure followed to code participant behaviour during the role play task (See Appendix E for the rating form for the social behaviour assessment task).

Table 3.1.

Script for the Social Scenarios Included in the Social Behaviour Assessment Task.

Practice scene	Scene 1:(offering to help)	Scene 2: (help being offered)	Scene 3: (giving a compliment)	Scene 4: (receiving a compliment)	Scene 5: (invitation to take part in a group activity)
Imagine that you are at the movies and you are buying some popcorn. You pay the cashier and receive your popcorn. There is a girl/boy standing behind you and she/he says: Actor: How's the popcorn? Actor: I would really like to have some, can I have a taste?	You are riding your bike in front of your house. A girl/boy is standing next to her/his bike and it looks like she/he had a crash, and is looking down at a flat tire. You approach her/him. She/he looks at you, and with a sad voice she/he says: Actor: How am I going to get this stupid bike home? Actor: I guess I ought to call my dad	In gym class, you are learning how to play basketball and how to shoot free throws. You are having trouble making some shots from the free throw line. Another girl/boy who is a good basketball player says: Actor: Would you like for me to help you with your free throws? Actor: Well, it was hard for me to learn at first. Actor: Would you like for me to give you some pointers?	A girl/boy who sits next to you in math class is having some trouble with her/his math test. She/ He has been working hard to get her/his grade up. The class gets back the most recent test with grades on them. She/ He says with a big smile: Actor: I finally got an A! Actor: I've been studying s	You have been working hard to memorise a poem to recite in English Literature class. You finish reciting the poem in front of the class and return to your seat. The girl/boy sitting next to you says: Actor: You did a great job. Actor: You remembered every word and you looked so calm and cool.	Some children in your class are playing a game during school brake. A girl/boy looks at you and says: Actor: We are playing hide and seek. Actor: Do you want to play with us?

Table 3.2.

Coding Procedure Followed to Assess Participants Social Skills.

	Scene 1	Scene 2	Scene 3	Scene 4	Scene 5
Facial orientation while speaking	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
1= No eye contact or staring 2= Minimal eye contact; Less than 50% of interaction 3= Moderately appropriate eye contact; Greater than approximately 50% of interaction 4= Appropriate eye contact; Approximately 70% of the interaction			Average of all scenes: ———		
Motor movement 1= Consistent throughout the entire interaction 2= During most of the interaction; greater than 50% of interaction 3= During some of the interaction; less than 50% of interaction 4= Less than 50% of the interaction			Average of all scenes: ———		

3.2.4 Design

The current study used a mixed design. Within-subject factors were trial type (single target trials and distractor trials), distractor condition (angry, happy and neutral faces) and distractor eccentricity (central, parafoveal and peripheral). Between-subject factors were the measures of individual differences (i.e. trait anxiety, state anxiety, social anxiety, attentional control, neuroticism, psychoticism and depression) and the social adjustment measures (i.e. friendship quality and quantity, social status, online friends and the role play task measures). The dependent variables were the following: a) Directional errors (i.e. the percentage of first saccades towards

the distractor with amplitude greater than 2°) b) Latency of accurate first saccades (i.e. the time taken to initiate a saccade towards the target) c) Remote distractor effect magnitude (i.e. the difference between first saccade latencies for single target and distractor trials) and d) Reaction times (i.e. the time taken to make a button press response to indicate the shape of the target).

3.2.5 Procedure

Information sheets and consent forms were given to parents and participants upon their arrival. Children and their guardians were informed that personal information related to the participant would not be released to or viewed by anyone other than the researchers involved in the project and that all data would remain confidential. To ensure anonymity of participants no identifying characteristics (e.g. name, age) were stored with the data collected or included in the results of the study. Data collected for this study were stored on a password protected computer. Individuals who agreed to take part in the current study were firstly asked to complete a modified version of the RDP task, which was used to measure distraction from threatening and non-threatening faces. The procedure followed during the RDP task was identical to the one described in Experiment 1 (See chapter 2, section 2.2.4). A role play task followed to assess participants' behaviour in a social context. Participants then completed a number of questionnaires to measure anxiety, attentional control, personality traits, depression and social adjustment.

Social Behaviour Assessment Task. The RDP task was followed by a role play task in which participants interacted with a confederate for a short period of time. This task took place in a second lab with video cameras attached to the walls. Participants were reminded that they would be video recorded during this task. The instructions were given to the participants through a microphone from the room next

door. Video-tapes were used to assess participants' behavior during the social behavior task.

Upon completing each task participants were asked to fill in the state anxiety questionnaire. The rest of the questionnaires (i.e. trait anxiety, social anxiety, personality, attentional control, depression and the social adjustment questionnaires) were completed shortly after the role play task. The order in which the questionnaires were completed was counterbalanced. Participants were given 8 pounds for their participation in the current study.

3.2.6 Data Preparation

A total number of 1487/12600 (11.80 %) trials were excluded from the eye movement data analysis for the following reasons: The fixation point at the beginning of the trial was more than 1° away from the centre of the display in 362 (2.87 %) trials, blinks occurred in 179 trials (1.42 %), anticipatory eye movements occurred in 77 (0.61 %) trials and the latency of first saccade was greater or lower than 3 standard deviations away from the participant's mean first saccade latency in 133 (1.05 %) trials. The amplitude of the first saccade was less than 1º in 695 (5.52 %) trials. The total number of incorrect button press responses removed from the eye movement data was 736 (5.84 %). Within the manual response data, 137 (1.08 %) trials were removed because RTs were 3 standard deviations above or below the participant's mean total RT. The total number of incorrect button press responses removed from the RT data was 750 (5 %).

The eye movement data were divided into trials where the initial saccade landed on the target (used to attain mean first saccade latencies towards the target) and trials in which the initial saccade landed on the distractor (used to attain directional error rates). The magnitude of the remote distractor effect (RDE) was also

calculated, by subtracting first saccade latencies in single target trials from first saccade latencies in distractor trials (e.g. saccade latencies in single target trials embedded in the angry block were subtracted from saccade latencies in angry distractor trials). A large RDE score indicates that saccade latencies towards the target were longer in the presence of distractors compared to single target trials (i.e. distractors interfered with performance), whereas a small RDE shows that saccade latencies towards the target between distractor trials and single target trials were comparable. The eye movement measures and RTs were calculated for each distractor condition separately.

The kappa statistic was used to test inter-rater reliability for the social behaviour assessment task, and the results showed that inter-rater reliability was modest (K= .49), albeit acceptable (see Appendix E for the inter-rater reliability analyses).

3.2.7 Data Analysis

The first stage of the analysis considered the basic effects related to the RDP task. Repeated measures ANOVAs and paired-sample t-Tests were conducted to assess whether trial type (single target trials and distractor trials), distractor condition (angry, happy and neutral faces) or distractor eccentricity (central, parafoveal and peripheral) influenced saccade latencies towards the target, the percentage of directional errors or the time taken to make a button press response.

In the second stage of the analysis, regressions and correlations were conducted to assess links between the measures of individual differences and the eye movement measures. Regression analysis was used to assess whether internalizing or externalizing traits were associated with saccade latencies towards the target in the presence of threatening and non-threatening distractors (distractor eccentricities were

collapsed at this stage). Note that due to the small sample size it was not appropriate to enter all the psychometric measures into one regression model; hence measures were included that allowed us to test our key hypotheses, these were run separately for neuroticism, psychoticism and trait anxiety. Following previous research, suggesting that threat biases are better understood in the context of current emotional states, state anxiety was also entered into the regression models. Significant regressions were followed up with post hoc tests to assess whether the effects would be evident across distractor eccentricities. Directional error rates were negatively skewed in all distractor conditions, hence Spearman's correlations were used to assess links between the measures of individual differences and the proportion of directional errors in each distractor condition separately (collapsed across parafoveal and peripheral trials).

Moderation analysis was used to test the hypothesis that temperamental risk will be related to impaired inhibition of threat, and where this relationship is moderated by attentional control. In addition, mediation analysis was used to test the hypothesis that impaired inhibition of threat will mediate links between temperamental risk and social adjustment difficulties. Moderation and mediation were tested using bootstrapping techniques (Hayes, 2013).

3.3 Results

3.3.1 Basic Effects

Directional errors. Directional errors rates were negatively skewed hence non-parametric tests were conducted to consider error rate differences between distractor conditions (angry, happy and neutral distractors) and distractor eccentricities (parafoveal and peripheral) across participants. A Friedman's ANOVA revealed that

there were no significant differences in directional error rates between distractor emotions, $\chi^2(2) = 2.38$, *ns* (angry *Mdn* = 19.71 %*;* happy *Mdn* = 8.80 %; neutral *Mdn* = 12.42 %). However, a significant effect of eccentricity was found, $\chi^2(1) = 10.71$, $p = .001$. Error rates were significantly higher in peripheral trials (*Mdn* = 7.73 %) compared to parafoveal trials (*Mdn* = 3.42 %). See table 3.3 for descriptive statistics for error rates in each distractor emotion and distractor eccentricity.

Accurate first saccade latency to the target. This analysis considered the elapsed time from the onset of the experimental display to the initiation of a saccade towards the target in the presence and absence of threatening and non- threatening face distractors across participants. To assess whether first saccade latencies towards the target were longer in distractor trials compared to single target trials (i.e. if a RDE was present), paired sample t-tests were conducted, where saccade latencies in each distractor condition and distractor eccentricity were compared to saccade latencies in the single target trials embedded within the same experimental block. In line with our findings in Experiment 1 and previous research using the RDP (Richards, Benson & Hadwin, 2012), the current study found evidence to support the presence of a reliable RDE. That is, saccade latencies towards the target were longer in distractor trials compared to single target trials, and this was evident across all distractor conditions and distractor eccentricities (all *ts* > 7, all *ps* < .001, all *ds* > 2.55). Figure 3.1 demonstrates the RDE magnitude for each distractor condition and distractor eccentricity.

In order to consider whether distractor emotion and eccentricity influenced saccade latencies towards the target, a repeated measures ANOVA (distractor condition x distractor eccentricity) was conducted. The results revealed a significant main effect of eccentricity, $F(2, 40) = 21.25$, $p < .001$, $\eta_p^2 = .52$. This main effect

was qualified by an interaction between emotion and eccentricity. Post hoc analysis showed that first saccade latencies were significantly longer in central distractor trials compared with peripheral distractor trials in the angry and happy distractor conditions, (*Fs* > 5, *ps* < .01, η_p^2 > .21). Saccade latencies did not differ significantly between eccentricities in the neutral distractor condition (*F* < .1, *ns*). The main effect of emotion was not significant, *F* < 1, *ns*. Thus, distractor eccentricity but not distractor emotion influenced the total time taken to initiate a saccade towards the target in the presence of a distractor (See figure 3.2).

A one way ANOVA was conducted to assess whether any effects of distractor emotion on saccade latencies were carried over the single target trials embedded within the same experimental block. The results revealed that first saccade latencies did not differ significantly between the single target trials in the angry (*M* = 172.65, *SD* = 21.70), happy (*M* = 166.72, *SD* = 22.59) and neutral (*M* = 165.76, *SD* = 18.24) distractor blocks. See table 3.3 for descriptive statistics for saccade latencies in each distractor emotion and distractor eccentricity.

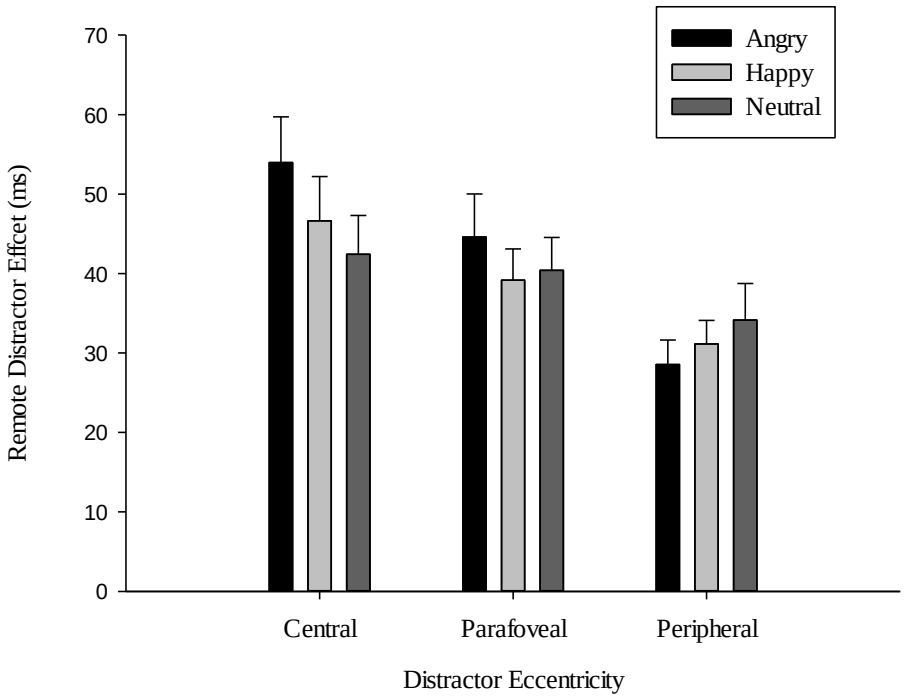


Figure 3.1. Mean RDE (+SE) magnitude as a function of distractor emotion and distractor eccentricity.

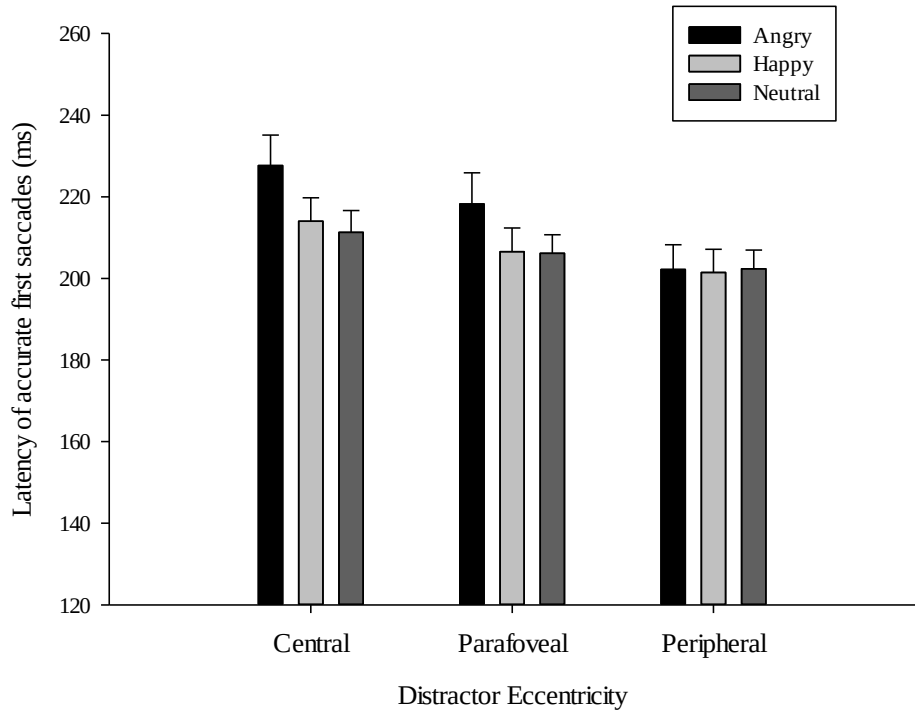


Figure 3.2. Mean (+SE) for the latency of accurate first saccades towards the target as a function of distractor emotion and distractor eccentricity.

Target Discrimination Reaction Time (RTs). This analysis assessed whether trial type (single and distractor trials), distractor condition (angry, happy and neutral faces) or distractor eccentricity (central, paravofeal and peripheral) influenced the total time taken to identify the target across participants. Paired sample t-Tests were used to compare RTs in distractor trials (for each emotion and eccentricity separately) with RTs in single target trials. The results showed that there was a significant difference between RTs in the single target trials and the central and peripheral distractor trials in all distractor conditions; RTs were shorter in single target trials compared with central and peripheral distractor trials (all *ts* > 2, all *ps* < .05, all *ds* > 0.91). RTs did not differ significantly between single target trials and parafoveal distractor trials in any distractor condition (*ts* < 2, *ns*). See table 3.3 for mean RTs in single target trials and distractor trials for each distractor emotion and distractor eccentricity.

A 3 (distractor emotion) x 3 (distractor eccentricity) repeated measures ANOVA was conducted to consider RT differences between distractor emotions and eccentricities. The results revealed a main effect of eccentricity on RTs, F (2, 42) = 4.83, p = .01, $\eta_p^2 = .19$. Pairwise comparisons showed that RTs were marginally significantly longer in central distractor trials (M = 753.72, SD = 138.97) compared with parafoveal distractor trials (M = 734.88, SD = 136.16). In addition, RTs were marginally significantly longer in parafoveal distractor trials compared with peripheral distractor trials (M = 748.21, SD = 136.02). The difference between RTs in central distractor trials and peripheral distractor trials was not significant. The distractor emotion effect and the interaction between distractor emotion and eccentricity were not significant, *Fs* < 1, *ns*.

A one way ANOVA was conducted to assess whether RTs differed between the single target trials embedded within each experimental block. The results revealed that RTs did not differ significantly between the single target trials embedded in the angry, happy and neutral distractor blocks $F < 1$, *ns*.

Table 3.3.

Mean (+SD) for Error Rates (%), First Saccade Latencies to the Target (ms), Remote Distractor Effect and Reaction Times as a Function of Trial Type, Distractor Emotion and Distractor Eccentricity.

	Angry Block		Happy Block		Neutral Block	
	M	*SD*	*M*	*SD*	*M*	*SD*
Error rates (%)						
Parafoveal distractor	20.86	21.30	13.45	13.52	16.14	16.12
Peripheral distractor	27.62	24.30	23.02	20.47	26.25	23.39
Saccade latencies (ms)						
Single Target	173.66	21.716	167.38	22.27	165.75	18.23
Central distractor	227.64	35.10	214.02	26.79	211.29	25.07
Parafoveal distractor	218.27	35.61	206.55	27.31	206.17	20.76
Peripheral distractor	202.21	28.38	201.47	26.61	202.38	21.48
RDE (ms)						
Central distractor	53.98	26.94	46.64	26.09	45.54	22.35
Parafoveal distractor	44.61	25.42	39.17	18.42	40.42	18.93
Peripheral distractor	28.55	14.57	34.09	13.59	36.63	21.06
RTs (ms)						
Single Target	731.35	153.93	716.55	148.92	706.05	139.79
Central distractor	780.95	162.28	744.70	134.83	735.50	148.35
Parafoveal distractor	756.38	165.86	726.70	147.36	721.57	149.76
Peripheral distractor	759.24	160.86	748.49	168.15	736.90	150.65

3.3.2 Basic Effect Analysis Summary

In summary, the current analysis showed that directional error rates, saccade latencies and RTs were influenced by the presence of distractors and distractor eccentricity. Specifically, error rates were significantly higher in peripheral trials compared to parafoveal trials. The current results also revealed an increase in saccade latencies to the target in distractor trials compared to single target trials. Distractor eccentricity also influenced saccade latencies to the target; saccade latencies were longer in central distractor trials compared to peripheral distractor trials. The RT analysis found that responses were faster in single target trials compared to central and peripheral distractor trials.

3.3.3 Individual Differences and Attentional Processing

In this section we tested the hypothesis that neuroticism will be associated with impaired inhibition of threat, where this relationship will be moderated by attentional control. This analysis was conducted in several stages. In the first stage of the analysis, Pearson's correlations were used to assess the relationship between the measures of individual differences (i.e. anxiety, neuroticism, psychoticism, attentional control and depression). In the second stage, regressions and Pearson's correlations were conducted to explore links between the measures of individual differences and the eye movement measures. The last stage of the current analysis considered the moderating effects of attentional control on impaired inhibition of threat.

Participant characteristics. The means and internal consistency for the measures of individual differences are provided in Table 3.4. An independent samples t-Test was conducted to assess whether scores on the questionnaires differed between males and females. The results showed that the questionnaire scores did not differ

significantly between males and females, *ts* < 1.5, *ns*. In the current sample there was one participant who scored above the cut off of 43 on the STAI-T, one participant who scored above 50 on the SASC, five (23%) participants who scored 15 or above on the Neuroticism scale, and one participant who scored 7 on the Psychoticism scale. Note that no one scored above the cut off of 37 on the STAI-S. One participant was an outlier on both the anxiety scales (state and trait anxiety), and hence was removed from the analysis.

Results from the inter-correlations between the questionnaires are presented in Table 3.5. As expected, trait anxiety was positively associated with social anxiety and neuroticism. In contrast to previous research, suggesting that high trait anxious individuals show increased state anxiety and low attentional control, the current study found no links between trait anxiety and state anxiety and attentional control. However, a positive association was found between neuroticism and psychoticism (i.e. aggressive behaviour) and attentional control. That is, increased neuroticism and psychoticism was related to difficulties to control attention. In addition, there was a positive association between psychoticism and neuroticism. Finally, depression was associated with increased trait anxiety, state anxiety and neuroticism.

Table 3.4.

Descriptive Statistics and Internal Consistency for the Measures of Individual Differences.

	M	*SD*	*Minimum (lower limit)*	*Maximum (upper limit)*	*Cronbach's a*
Neuroticism (EPQ-J)	8.95	5.85	0 (0)	19 (19)	.91
Psychoticism (EPQ-J)	1.82	1.76	0 (0)	7(10)	.57
Trait Anxiety (STAI-T)	33.00	7.95	20 (20)	59 (60)	.91
State Anxiety (pre STAI-S)	30.59	3.62	25(20)	41 (60)	.78
State Anxiety (post STAI-S)	30.09	4.56	21(20)	42 (60)	.86
Social Anxiety (SASC)	25.72	11.42	0 (0)	59 (88)	.89
Depression (RCADS)	7.04	4.39	0 (0)	17 (30)	.86
Attentional Control (ACS)	46.36	7.35	30 (20)	58 (80)	.79

Table 3.5.

Correlations between the Measures of Individual Differences, the Social Adjusmtent Measures and the Eye Movement Measures.

	Psychometric Measures					Social Measures				Directional Errors			Saccade Latency		
Psychometric Measures	2	3	4	5	6	7	8	9	10	angry	happy	neutral	angry	happy	neutral
1. Neuroticism	.46*	.72***	.61**	.45*	.70***	.13	-.05	.07	-.48*	.01	-.15	-.12	.35	.23	.19
2. Psychoticism	-	.40	.42	.42*	.27	-.19	-.12	.08	-.43*	.17	.07	-.05	.45*	.77***	.57**
3.Trait Anxiety		-	.33	.26	.56*	-.01	.08	.37	-.37	-.09	-.28	-.36	.17	.27	.30
4.State Anxiety			-	.35	.55**	.12	-.06	.28	-.42	.13	.15	-.01	-.05	.09	-.11
5.Attentional Control				-	.52*	.16	-.09	-.03	-.24	.20	.29	.23	.37	.38	.10
6. Depression					-	.07	-.10	-.12	-.31	.08	.03	-.003	.34	.15	.19
Social Measures															
7. Friendship Quality						-	.17	-.20	.07	.08	.07	.06	-.09	-.26	-.23
8.Facial Orientation							-	.45*	.22	.03	-.09	-.24	-.06	-.30	-.29
9.Motor Behaviour								-	.14	.07	.13	-.14	-.05	-.06	-.06
10.Speech Clarity									-	.25	.39	.17	.10	-.20	-.26

Note. *** $p < .001$, ** $p < .01$, * $p < .05$

Considering the results from experiment 1 presented in the current thesis, it was expected that links between anxiety-related traits and impaired inhibition of threat would be reflected in difficulties to disengage attention from threatening stimuli presented in the foveal vision, and to regulate orienting responses in the presence of threat presented in the parafoveal and peripheral vision (i.e. covert processing of threat). Neuroticism and state anxiety were regressed against first saccade latencies towards the target in each distractor condition separately (collapsed across eccentricities). The regression models were not significant for the happy and neutral distractor conditions, $R^2s < .20$, $Fs < 2.25$, *ns.* In line with our predictions, the regression model was significant for the angry distractor condition, $R^2 = .29$, $F = 3.79$, $p = .04$, and neuroticism was a significant predictor within this model, $\beta = .62$, $p = .007$, which suggests that individuals with neurotic traits processed threatening faces for longer duration. This was also reflected in increased RTs in the angry distractor condition; individuals with neurotic traits showed delayed responses in the presence of threat. In addition, an association was found between neuroticism and increased RTs in the happy distractor condition (see table 3.7). However, delayed RTs in the happy distractor condition cannot be explained by prolonged saccade latencies to the target in the presence of or increased directional errors towards happy faces.

Post-hoc regressions followed to assess whether the association between neuroticism and increased saccade latencies in the angry distractor trials would be evident across distractor eccentricities. Neuroticism and state anxiety were regressed against first saccade latencies towards the target in angry distractor trials for each eccentricity separately (central, parafoveal and peripheral). This would allow the identification of the exact attentional processes involved in delayed saccade latencies

towards the target in the presence of threat (i.e. impaired disengagement from threat and/or difficulties to regulate attention in the presence of parafoveal and peripheral threat). The regression models were significant for peripheral distractor trials, R^2 = .29, F = 3.68, p = .04 and marginally significant for parfoveal distractor trials, R^2 = .29, F = 3.29, p = .06. The regression model was not significant for central distractor trials, R^2 < .22, F < 2.5, *ns*. These findings suggest that individuals with neurotic traits found it more difficult to regulate orienting responses in the presence of threat presented in the parafoveal and peripheral vision. Longer saccade latencies towards the target in parafoveal and peripheral trials indicate that a broadening of attention occurred; i.e. attention was spread across the visual field and threat was covertly processed. Moderation analysis revealed that the relationship between neuroticism and delayed saccade latencies to the target in the presence of threat was moderated by attentional control, b = -0.39, 95% CI [0.12, 0.67], t = 3.04, p = .008, suggesting that impaired inhibition of threat was most evident in individuals with high neuroticism and low attentional control (See table 3.6 and Figure 3.3.).

In order to assess whether internalising traits were associated with directional errors towards threatening and non-threatening distractors, correlations were conducted between the measures of individual differences and directional errors in each distractor condition separately (collapsed across eccentricities). The correlations between the questionnaires and the error rates were not significant for any distractor condition, r < .30, *ns.* In addition, the current analysis found no association between psychotic traits and directional errors towards distractors of any type, r < .20, *ns* (See table 3.5).

Further analysis was conducted to explore whether the measures of individual differences were associated with RTs. The results showed that elevated neuroticism

and psycoticism and poor attentional control were related to longer RTs in angry and happy (but not neutral) distractor trials (see table 3.7).

Table 3.6.

Linear Model of Predictors of Increased Saccade Latencies to the Target in the Presence of Threat.

	B	*SE B*	*T*	*p*
Constant	460.51 [289.83, 631.20]	80.89	5.69	p < .001
Neuroticism	-14.64 [-27.09, -2.19]	5.90	-2.48	p = .02
Attentional control (AC)	-1.25 [-3.78, 1.27]	1.19	-1.04	p > .05
Neuroticism x AC	.39 [0.12, 0.66]	.13	3.03	p = .01

Note. *** $p < .001$, ** $p < .01$, * $p < .05$

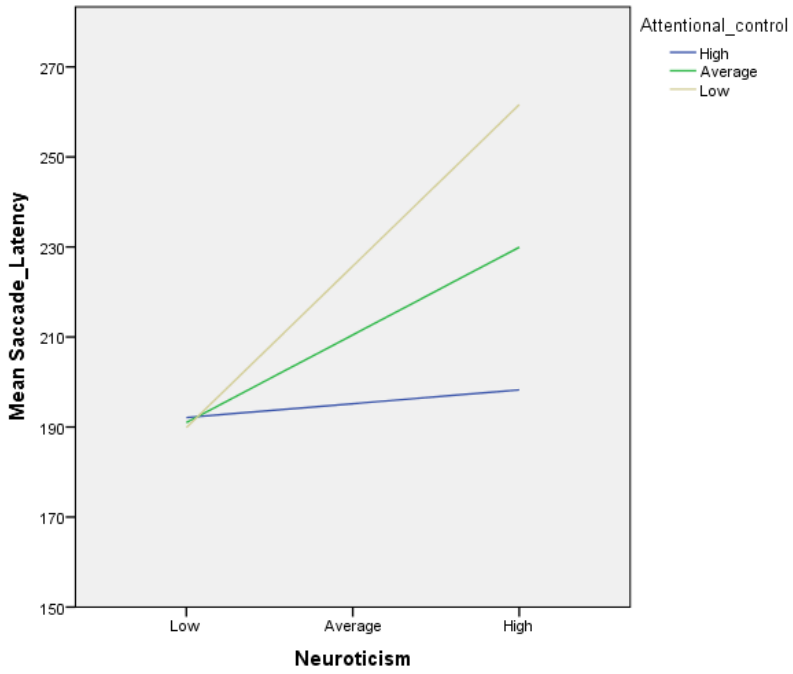


Figure 3.3 The moderating effect of attentional control (high, medium and low) on the relationship between neuroticism traits and saccade onset latency to the targets in the angry disctractor condition.

Table 3.7.

Correlations between the Measures of Individual Differences and RTs.

	RTs		
	Angry	Happy	Neutral
Neuroticism (EPQ)	.53*	.60**	.26
Psychoticism (EPQ)	.46*	.45*	.13
Trait Anxiety (STAI-T)	.12	.14	.06
State Anxiety (STAI-S)	.13	.35	.11
Attentional Control (ACS)	.49*	.49*	08
Depression (RCADS)	.30	.38	.06

Further analysis considered links between psychoticism (i.e. aggressive behaviour) and saccade latencies towards the target in the presence of threatening and non-threatening distractors. Psychoticism was associated with longer saccade latencies towards the target in the presence of angry, happy and neutral face distractors, $R^2s > .20$, $Fs > 5$, $p < .05$ (see table 3.5). Thus, individuals with psychotic traits were more distracted by task-irrelevant stimuli, and this was evident across distractor conditions (irrespective of the distractor emotion).

Additional analysis was conducted to consider links between trait anxiety and the eye movement measures. Trait anxiety and state anxiety were regressed against first saccade latencies in each distractor condition separately (collapsed across eccentricities). In line with our findings in experiment 1, the regression models were not significant for any distractor condition , $R^2s < .20$, $Fs < 2.25$, *ns*. Hence, trait anxious individuals did not show an attentional preference for threatening stimuli, which contradicts with previous research suggesting links between trait anxiety and impaired inhibition of threat.

In order to assess whether baseline performance was influenced by individual differences in internalising and externalising traits, the questionnaires were correlated with first saccade latencies towards the target in the single target trials. The correlations between the measures of individual differences and saccade latencies towards the target in the single target trials were not significant, $rs < .37$, *ns*, hence the effects of internalising and externalising traits on saccade latencies towards the target in distractor trials were not carried over to the single target trials embedded within each distractor block.

The current analysis also considered links between the measures of individual differences and RTs. The results revealed that neurotic and psychotic traits and poor attentional control were associated with delayed responses in the angry and happy distractor conditions. See table 3.6.

3.3.4 Individual Differences and Attentional Processing Summary

The current analysis showed an association between neuroticism and eye movement behaviour during the RDP task. Individuals who scored high on the neuroticism scale showed delayed saccade latencies towards the target in the presence of angry distractors. Notably, the relationship between neuroticism and impaired inhibition of threat was moderated by attentional control. Neuroticism was unrelated to directional error rates suggesting that individuals who reported high levels of neuroticism were able to supress exogenous saccades towards threatening and non-threatening distractors. In addition, individuals with psychotic traits showed delayed saccades towards the target in the presence of distractors, and this was evident across distractor emotions. The current work found no evidence to suggest that trait anxious individuals were slower to orient towards the target in the presence of threatening distractors or unable to inhibit involuntary saccades towards threatening distractors.

3.3.5 Individual Differences, Attention and Social Adjustment

Exploratory correlation analysis showed that there was no significant association between the measures of individual differences (anxiety, neuroticism, psychoticism, attentional control and depression) and the social adjustment questionnaires (i.e. friendship quality and quantity, preference for online friends and social status), $r < .42$, *ns,* which contradicts with previous research suggesting that individuals with internalising and externalising behavioural problems have fewer friends, lower quality friendships and are less-well accepted by their peers. However, the current study found links between internalising and externalising traits and speech clarity during the social interaction task. Specifically, individuals who reported high neuroticism, psychoticism and social anxiety spoke in a lower voice volume and showed increased voice tremor while interacting with the confederate, $rs > -.42$, $ps < .05$ (see table 3.5). In addition, role play anxiety was negatively associated with social effectiveness, face orientation and motor behaviour, $rs > -.55$, $ps < .01$. Hence, individuals who were more anxious during the role play task, had stiff or awkward body posture, avoided looking towards the confederate and were generally less effective during the interaction.

Further analysis was conducted to consider links between the eye movement and social adjustment measures. The current study found a negative association between first saccade latencies towards the target in all distractor conditions (i.e. angry, happy and neutral distractor trials) and personal self-report socio-metric status, $rs > -.45$, $ps < .05$. Thus, individuals who were more distracted by task-irrelevant information, considered themselves as less popular and academically successful than their peers. In addition, a positive association was found between saccade latencies in angry and happy distractor trials and scores on the security scale (high scores on this

scale indicate low security within friendships), $r = .49$, $p = .020$. Hence, individuals who were more distracted by emotional faces reported feeling less secure in their relationship with their best friend.

The current study found no links between directional error rates in the angry face distractor condition and scores on the total friendship quality scale. However, an association was found between selective attention towards happy faces and conflict within friendships. Specifically, individuals who showed increased directional errors towards happy distractors reported having less conflict within their friendships, $r = -.50$, $p = .021$ (See table 3.8).

Table 3.8.

Correlations between the Eye Movement Measures and the Social Adjustment Measures.

	Socio-metric Status	Companionship	Conflict	Security
Saccade Latencies (angry faces)	-.47*	-.12	.12	.49*
Saccade Latencies (happy faces)	-.61**	-.03	.18	.55**
Saccade Latencies (neutral faces)	-.46*	.16	.24	.27
Directional Errors (happy faces)	-.09	-.27	-.50*	.15
Directional Errors (angry faces)	-.14	-.54**	-.18	.03
Directional Errors (neutral faces)	-.05	-.41	-.20	.03

Note. *** $p < .001$, ** $p < .01$, * $p < .05$

Mediation analysis followed to assess whether impaired inhibition of threat mediated links between temperamental risk and social adjustment difficulties. Separate mediation models were tested for neuroticism and psychoticism. There was no indirect effect of neuroticism or psychoticism on speech clarity and socio-metric status via impaired inhibition of threat *bs* < 0.159, *ns* which suggests that

temperamental risk and impaired inhibition of threat are independently related to social adjustment difficulties. See figures 3.3 and 3.4.

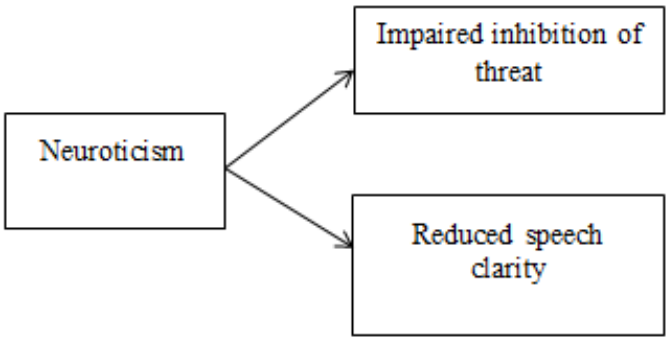


Figure 3.4. A diagram representing the association between neuroticism, saccade latencies in the angry distractor condition and social behaviour.

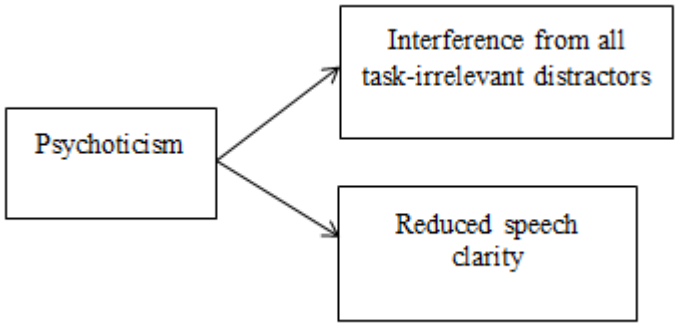


Figure 3.5. A diagram representing the association between psychoticism, saccade latencies in the angry distractor condition and social adjustment.

3.3.6 Individual Differences, Attention and Social Adjustment Summary

In summary, the current analysis found an association between temperamental risk and performance in the role play task. Individuals with internalising (social anxiety and neuroticism) and externalising traits (aggressive behaviour) showed

increased unclear speech (voice trembling and low voice volume) when interacting with the confederate. In addition, individuals who were more anxious during the role play task, showed stiff and awkward body posture, looked away from the confederate more frequently and were generally less effective during the interaction. In addition, links were found between eye movement behaviour and the social adjustment measures. Specifically, greater distraction from task irrelevant information was related to lower socio-metric status. Also, greater distraction from angry and happy faces (i.e. increased saccade latencies towards the target in the presence of angry and happy distractors) was associated with lower security within friendships.

3.4 Discussion

The current study used a modified version of the RDP task to test links between neuroticism and impaired inhibition of threat, and the moderating role of attentional control in this relationship. Specifically, it was predicted that neroticism would be associated with greater distraction from threatening faces, where this relationship would be influenced by individuals' ability to control their attention. In addition, the present study extended previous work by considering the mediating effects of impaired inhibition of threat and poor attentional control on social adjustment. It was predicted that impaired threat inhibition would mediate the relationship between neuroticism and social adjustment difficulties. Further analysis considered links between anxiety, attention to threat and social adjustment.

In line with the existing literature (e.g. Richards et al., 2012; Walker et al., 1995) and our findings in Experiment 1, a reliable remote distractor effect was found in the current study. That is, face-distractors presented at different eccentricities in the visual field delayed first saccade latencies towards the target, and this was evident

across emotion distractor conditions (angry, happy and neutral faces). In addition, following previous studies (Richards et al., 2012; Walker et al., 1995) the magnitude of the RDE increased with distractor eccentricity; the difference between saccade latencies in single target trials and distractor trials was greater when distractors were presented in the centre of the screen than in parafoveal and peripheral locations. This finding suggests that distractors presented in locations with high visual acuity interfered more with performance than distractors presented in locations with low visual acuity. The basic effect analysis also showed a main effect of eccentricity on the percentage of directional errors (inaccurate first saccades towards the distractor). In line with previous research (e.g. Richards et al., 2012) directional error rates increased with eccentricity, which indicates that participants found it more difficult to inhibit involuntary first saccades towards peripheral distractors compared to parafoveal distractors.

Consistent with previous findings (e.g. Richards, Benson & Hadwin, 2012), suggesting that high trait anxious individuals are able to supress involuntary saccades towards threatening information, the current study found that neuroticism was unrelated to the proportion of directional errors towards angry distractors. Previous research showed that neuroticism is a predictor for the development of anxiety later in life; hence the current findings indicate that the ability to control exogenous attention to inhibit the overt processing of threat is already developed in adolescents at risk (i.e. individuals who reported neurotic traits) for developing anxiety. However, the current study found that neuroticism predicted longer latencies to initiate a saccade towards the target in the presence of angry (but not happy or neutral) distractors, which is consistent with the results from experiment 1, where children with neurotic traits

showed prolonged saccade latencies to fixate the target in the presence of threatening faces presented at different eccentricities in the visual field.

Post hoc tests revealed that links between neuroticism and impaired inhibition of threat were mostly evident in parafoveal and peripheral distractor trials. Consistent with previous research using the RDP task, the current results indicated that a broadening of attention occurred in individuals with neuroticism, where attention is spread across the visual field to enhance threat detection, leading to a delay to fixate the target (see review by Richards, Benson, Donnelly & Hadwin, 2014).

Further analysis revealed that attentional control moderated the relationship between neuroticism and impaired inhibition of threat (i.e. increased saccade latencies to the target in the presence of threat were mostly evident in children with elevated neuroticism and low attentional control). These findings provide additional evidence in support of theoretical frameworks, which suggest that temperamental risk interacts with low attentional control to predict threat inhibition difficulties. Lonigan and Philip's model (2001) argues that attentional control protects individuals at high risk from developing psychopathological problems as it allows them to disengage attention from threatening cues and orient attentional resources towards neutral or task relevant information. In line with this proposition, previous research found that the relationship between anxiety and attention bias for target locations preceded by cues where threatening targets could appear was moderated by attentional control at prolonged stimulus presentations (Deryberry & Reed, 2002).

In experiment 1, psychoticism was associated with increased directional errors in all distractor conditions (angry, happy and neutral face distractors). In contrast, the current study found links between psychotic traits and increased saccade latencies (but not directional errors) towards the target in all distractor conditions. These

findings suggest that different attentional processes occurred in younger children versus adolescents with elevated psychoticism. A plausible explanation for this result is that inhibitory control improves with age (individuals in the current study were older than those in experiment 1), and hence individuals become more able to supress involuntary attention towards task-irrelevant information (Slater and Bremner, 2011). The current findings contradict with previous work (e.g. Gouze, 1987; Chan, Rain and Lee, 2010), suggesting that aggressive behaviour is specifically associated with impaired inhibition of threat.

Further analysis considered links between trait anxiety and performance in the RDP task. Theoretical frameworks and previous research suggested that trait anxious individuals show enhanced processing of threatening information. Older models of attention in anxiety focus on selective attention (i.e. enhanced involuntary attention) towards threat, whereas more recent theories and research highlight an association between anxiety and hypervigilance for threat (i.e. enhanced processing of threat by covert attention) (see Richards et al., 2014). The current study looked into both attentional pathways (i.e. selective attention versus hypervigilance), and found that there was no association between trait anxiety and performance on the RDP task; trait anxiety was unrelated to saccade latencies or the percentage of inaccurate first saccades or the RTs in the angry distractor condition, which is in direct contrast with previous work suggesting links between trait anxiety and impaired inhibition of threat. However, research findings have consistently supported that neuroticism is a risk factor for the development of anxiety disorders later in life. Hence, a possible explanation for the lack of an association between trait anxiety and impaired inhibition of threat is that trait anxiety symptoms are not yet expressed or recognisable by individuals at this age. Following theoretical frameworks suggesting

a moderating effect of attentional control on impaired inhibition of threat, the current study considered the possibility that links between anxiety and threat inhibition difficulties would be most evident in the context of high anxiety and low attentional control. There was no evidence to suggest that anxious individuals with low attentional control had difficulties to inhibit threat. These findings are consistent with the results from experiment 1, where no links were found between trait anxiety and threat processing in children aged 9-11 years old.

Following a theoretical model (see Rueda, Checa & Rothbard, 2010), the second hypothesis of the current study predicted a relationship between temperamental risk and social adjustment difficulties via an attention bias towards threat (see for example Perez-Edgar 2010, 2011). In contrast to previous findings, suggesting that individuals with internalizing and externalizing behavioral problems have lower quality friendships and fewer friends, the current study found no links between temperamental risk (i.e. anxiety, neuroticism or psychoticism) and the friendship measures. However, links were found between internalizing and externalizing traits and performance in a social behavior assessment task. Specifically, neuroticism, psychoticism and social anxiety were associated with increased voice tremor and low voice volume during an interaction task (i.e. participants interacted with a confederate for a short period of time). Thus, individuals who reported aggressive and anxious behavior were less comfortable in a social context.

The current study further considered links between attentional processes and the social adjustment measures. Previous research suggested that low attentional control and impaired inhibition of threat are related to social adjustment difficulties (e.g. peer rejection, atypical social behaviour and social withdrawal) and academic underachievement (Checa, Rodriguez-Bailon, & Rueda, 2008; Perez-Edgar, 2011).

The results revealed a negative association between first saccade latencies towards the target in all distractor conditions and personal self-report socio-metric status. Thus, individuals who were more distracted by task-irrelevant information were less popular and academically successful compared to their peers. Whereas experiment 1 found that poorer friendship quality (i.e. low companionship and security) was specifically associated with enhanced attention to threat (i.e. increased directional errors towards angry faces), the current study revealed that lower security within friendships was related to greater distraction (i.e. increased saccade latencies towards the target) from both angry and happy faces. These findings provide additional evidence in support of the proposition that attentional processes can influence social and academic performance (DuPaul et al., 2004).

The current study predicted that links between temperamental risk and social adjustment difficulties would be mediated by impaired inhibition of threat. In contrast to this prediction, enhanced processing of threat did not mediate the relationship between neuroticism or psychoticism and social adjustment difficulties (low socio-metric status and speech clarity). These findings suggest that attention and temperamental risk are independently related to social adjustment difficulties. Hence, the exact mechanisms contributing to social adjustment difficulties experienced by individuals with internalising and externalising traits remain unclear. It might be the case that these individuals experience self-focused attention in social settings (i.e. self-related negative thoughts, distorted images of how they appear to others and unpleasant physical responses including increased heart rate and sweating), that may in turn interrupt social behaviour (Clark & Wells, 1995).

In summary, the current study replicated the findings from experiment 1, to suggest that neuroticism is associated with an attention bias towards threat (i.e.

increased saccade latencies towards the target in the presence of threat), whereas psychoticism is linked to a more general distraction from task-irrelevant information that is not threat specific (increased saccade latencies to the target in the presence of all type of distractors). In addition, the current results support theories and previous research that highlight a moderating role of attentional control in the relationship between neuroticism and impaired inhibition of threat. These findings suggest that individuals with externalizing versus internalizing traits might benefit from different approaches that will aim to improve attentional control in the presence of threatening and task-irrelevant information respectively. The current results further highlight the unique effects of cognition and temperamental risk on social adjustment. Consistent with the findings from experiment 1, low attentional control and impaired inhibition of threat were independently related to social adjustment difficulties, above and beyond temperamental risk. These findings emphasize the need for further research into the unique impact of cognition and temperament on social relationships and social behavior. Future research could, for instance, investigate whether specific attention mechanisms (i.e. selective attention versus hypervigilance) relate to unique social adjustment difficulties.

To conclude, the current results can be used to inform future interventions that will aim to facilitate goal-directed behavior in individuals with low attentional control and threat inhibition difficulties. However, the current results should be considered with caution due to the small sample size. Although the questionnaires were treated as continues measures, the inclusion of a greater number of participants with high scores on the psychoticism and neuroticism scale would allow more robust conclusions to be drawn from these findings. In addition, the current results are based on traits reported

in a normal population. Additional research in a clinical sample would be useful before any application could be developed.

The next chapter will consider links between internalizing and externalizing traits, attention and social adjustment in adults. It will be interesting to see if the association between attention and social adjustment will be evident in adults, or whether the effects fade as individuals grow older. It may be that older individuals develop strategies that allow them to minimize the impact of distractors in the environment and focus on goal-directed behavior. The following study will apply eye movement methodologies to capture the attention mechanisms underlying impaired inhibition of threat, and to understand how attention relates to other factors, such as temperament and social adjustment.

Chapter 4: Anxiety, Attention Biases to Threat and Social Adjustment in Adults

4.1 Introduction

Experiments 1 and 2 found that neuroticism was related to difficulties to disengage attention from threatening faces, and to enhanced covert processing of threat presented in the parafoveal and peripheral vision. Specifically, children and adolescents with neurotic traits showed increased latencies to fixate on pre-specified targets in the presence of angry faces (but not happy and neutral faces) presented at different eccentricities in the visual field. In addition, the findings from experiments 1 and 2 revealed that elevated psychoticism was associated with greater interference from task irrelevant distractors, irrespective of the distractor emotion. Experiments 1 and 2 also found links been anxiety and conduct-like problems (i.e. aggressiveness), and social adjustment difficulties including low quality friendships and poor social performance. The current study aimed to explore the relationship between anxiety, attention biases towards threat and social adjustment in adults. Following previous studies and our findings from experiments 1 and 2 it was predicted that anxious individuals would show impaired inhibition of threat. The current study further aimed to explore whether links between anxious behaviour and social adjustment difficulties would be evident in adults. It was not possible to explore links between aggressive behaviour and attention in the current study as no participant scored above the cut-off point on the psychoticism scale in the adult sample and there was no variation in the data[7]. Hence, it remains unclear whether distractibility by task-irrelevant stimuli would also be evident in adults with aggressive behaviour traits.

7 The psychoticism scores, $D(37) = 0.19$, $p = .001$ were significantly non-normal.

4.2 Method

4.2.1 Participants

Thirty seven adults (*mean age* = 26.92, *SD* = 5.97, *age range* = 18-43 years, 16 males) participated in the current study.

4.2.2 Stimuli and Apparatus

The eye tracking system and stimuli (i.e. faces for distractors and shapes for targets) were identical to those used in Experiment 1 (See chapter 2, section 2.2.2).

4.2.3 Materials

Psychometric measures. Participants were asked to complete a number of self-report questionnaires. These included measures of personality traits (EPQ; Eysenck & Eysenck, 1975), trait and state anxiety (STAI; Spielberger, 1983), social anxiety (SIAS, Mattick & Clarke, 1998), attentional control (ACS; Derryberry & Reed, 2002) and depression (HADS; Zigmond & Snaith, 1983). A description of the EPQ, STAI, SIAS and ACS is provided in chapter 2, section 2.2.6. The HADS is a 14- item questionnaire developed to assess anxiety and depression. The current study used seven items from this scale to measure depression. Each item on this scale is scored from 0-3; hence total scores can range between 0 and 21. The means and standard deviations reported for community samples were used to calculate cut-off scores for the STAI-T and STAI-S. In a community sample of adults (aged 19-39), Spielberger (1983) reported means on the STAI-T of 35.55 (*SD* = 9.76) for males and 36.15 (*SD* = 9.53) for females and means on the STAI-S of 36.54 (*SD* = 10.22) for males and 36.17 (*SD* = 10.96) for females. Hence, the cut-off score used for the

STAI-T and STAI-S was 46. The cut off score for the SIAS derived from a mean of 18.8 (*SD* = 11.8) which was reported in a community sample, thus the cut off value on this scale was 31. The cut off score for the neuroticism scale was based on norms reported in the EPQ manual (the cut off value for neuroticism was 15).

Social adjustment measures. Participants also completed a number of social adjustment measures including the friendship quality scale (FQS; Mendelson & Aboud, 2012), a procedure adapted from previous work to measure friendship quantity (Subrahmanyam, Reich,Waechter, Espinoza, 2008), the preference for internet use scale (PIU; Morahan-Martin & Schumacher, 2003) and the MacArthur subjective social status scale (SSS; Goodman et al.,2001 MacArthur). The FQS is a 30-item scale designed to assess how the respondent feels about their best friend and how satisfied they are with the friendship. It consists of six subscales measuring stimulating companionship, help, intimacy, reliable alliance, self-validation and emotional security. Participants are asked to rate on a 5-point Likert scale how much they agree or disagree with each statement (e.g. "My friend and I spend all our free time together", "I can get into fights with my friend"). The total score on this scale can range between 0 and 240. The PIU scale consists of 11 items and it was used to assess participants' preference for online interaction as opposed to face-face interaction. Participants were asked to rate the extent to which they agree or disagree with the item on a 5-point Likert scale. Scores on this scale can range between 11 and 55. The SSS was used to measure subjective social status. Participants were presented with an image of a ladder with 10 rungs and were asked to imagine that it represented where people stand in their community. They were told that at the top of the ladder are the people who have the highest standing in their community whereas at the bottom of the ladder are the people who have the lowest standing in their community.

Participants had to mark a cross on a rung to indicate where they would place themselves in their society.

Behavioural assessment task. Participants were asked to complete a role play task which was used to assess social behaviour (Beidel, Turner, Morris, 2000). For this task participants were asked to interact with a gender-matched confederate for a while (i.e. male participants would interact with a male confederate and female participants would interact with a female confederate). Participants were presented with six scenarios (one practice scene and five experimental scenes) and were asked to imagine that these situations were really happening (see Appendix B for the role play task script). The confederate would always initiate the conversation and the participant had to respond to what the confederate said. Participants were led to believe that the confederate was also a participant and that their role in the task was randomly assigned.

The content of the scenes included offering help to an unfamiliar person, receiving help, giving and receiving a complement and responding to an invitation for a night out. Participants were rated on several social behaviour factors including face orientation during the interaction (while the confederate was speaking and while responding to the confederate), motor behaviour (frequency of motor movement, posture-stiffness and posture awkwardness), speech clarity (voice volume, vocal fluidity and vocal inflection) and communicativeness (affect, appropriateness of response, effort to maintain conversation). Participants were unaware of the evaluative nature of the task. See Chapter 3, Table 3.2 for an example of the coding procedure used for the behavioural assessment task.

4.2.4 Design

Within-subject factors were trial type (single target trials and distractor trials), distractor condition (angry, happy or neutral faces) and distractor eccentricity (central, parafoveal and peripheral). Between-subject factors were self-reported anxiety (trait anxiety, state anxiety and social anxiety), attentional control, neuroticism and depression. The dependent variables were the eye movement measures including the percentage of directional errors (i.e. first saccades towards the distractor with an amplitude greater than 1.5°) and the latency of first accurate saccades (i.e. the time taken to initiate a saccade towards the target from the onset of the experimental display), and response time (i.e. the time taken to make a key press response from the onset of the display). The outcome measures were the social adjustment questionnaires (i.e. friendship quality and quantity, social status, preference for online friends) and the social behaviour measures generated from the role play task (i.e. role play anxiety, social effectiveness, facial orientation, motor movement, speech clarity, talkativeness, communicativeness).

4.2.5 Procedure

Participants were asked to complete a computer task based on the remote distractor paradigm (RDP) to assess their ability to inhibit threatening and non-threatening distractors and attend to a pre-specified target. Participants were asked to ignore the distractor and look at the target as quickly as possible and to indicate whether the target was a square or a diamond by pressing a response button. The target appeared at different eccentricities on the left or right side of the distractor (parafovea left, parfovea right, periphery left, periphery right) with equal frequency. This task involved four experimental blocks of 144 trials; one for each distractor expression (angry, happy, and neutral faces). Each block comprised of 48 single target

trials (used as a measure of baseline performance) and 96 distractor trials (32 central distractors, 32 parafoveal distractors, 32 peripheral distractors). Experimental blocks and response buttons were counterbalanced.

The role play task followed in which participants were asked to interact with a confederate for a while. Immediately following each task (i.e. the computer task and the role play task) participants completed the state anxiety questionnaire. The remaining questionnaires (i.e. Eysenck Personality Questionnaire, Trait Anxiety Inventory, Social Interaction Anxiety Scale, Attentional Control Scale, Depression Scale, Friendship Questionnaire and the Subjective Social Status Scale) were completed after the role play task. Participants were paid 12 pounds for completing the study.

4.2.6 Data Preparation

Following the exclusion criteria outlined in section 2.2.11, a total number of 1926 (9%) trials were removed from the eye movement data. Blinks occurred in 162 of the trials (0.7%), the fixation point at the beginning of the trial was greater than 1° in 636 (3%) of the trials, an anticipatory eye movement occurred in 171 (0.8%) of the trials and latency of first saccade was greater or lower than 3 standard deviations away from the participant's mean first saccade latency in 272 (1%) of the trials. The total number of incorrect button press responses removed from the eye movement data was 793 (3.77%). First saccades with amplitude less than 1º were replaced with second saccades in 728 (3.5%) of the trials. Within the manual response data, 200 (0.01 %) trials were removed because RTs were greater or lower than 3 standard deviations away from the participant's mean total RT. The total number of incorrect button press responses removed from the RT data was 830 trials (3.89 %).

Eye movement data were split into trials where the first saccade landed on the target (used to calculate accurate first saccade latencies) and trials where the first saccade landed on the distractor (used to calculate directional error rates). First saccade latencies and directional errors were calculated in each distractor condition (e.g. angry foveal, angry paravofeal and angry peripheral) for each participant. In addition to directional errors and saccade latencies, the magnitude of the remote distractor effect (RDE) was calculated in each distractor condition for each participant, by subtracting first saccade latencies for the single target trials from first saccade latencies for the distractor trials (e.g. single target saccade latencies embedded in the angry block were subtracted from angry distractor saccade latencies).

4.2.7 Data Analysis

The current analysis was conducted in different stages. The first stage of the analysis considered the basic effects related to the RDP. Repeated measures ANOVAs and paired-sample t-Tests were used to assess whether the presence of distractors, distractor type and distractor eccentricity influenced the depended variables (i.e. the eye movement measures and RTs). Regression analyses and correlations followed to consider links between the measures of individual differences (i.e. anxiety, attentional control, neuroticism and depression) and the eye movement measures and RTs.

The six predictors (trait anxiety, state anxiety, social anxiety, neuroticism, attentional control and depression) were regressed against RTs and first saccade latencies towards the target for each distractor type separately (collapsed across eccentricities). Significant regressions were followed with post hoc tests to assess whether the effect would be present in each distractor eccentricity. Directional error rates were negatively skewed in all distractor conditions, hence Spearman's

correlations were used to assess links between the measures of individual differences and error rates in each distractor condition separately (collapsed across eccentricities).

Moderation analysis was conducted to test our hypothesis that anxiety will be related to an attention bias towards threat in individuals with low attentional control. Lastly, mediation analysis was used to test our hypothesis that anxiety will be linked to poor social adjustment via an attention bias towards threat. Correlations were used to determine which variables would be entered in the mediation model. Specifically, the predictor and the mediator should be significantly correlated for a mediation model to be tested.

4.3 Results

4.3.1 Basic Effects

Directional errors. This analysis was conducted to consider whether directional error rates (i.e. the percentage of inaccurate first saccades towards a distractor) differed between distractor emotions across participants. Note that directional errors (first saccades towards the distractor) could only occur in trials were distractors were presented in parafoveal and peripheral locations, hence central distractor trials were removed from this analysis. Directional errors were negatively skewed in parafoveal and peripheral distractor trials; hence non parametric tests were used. A Friedman's ANOVA showed that error rate did not differ significantly across distractor emotions, $\chi^2(2) = 1.93$, *ns* (*Angry Mdn* = 24.64%*; Happy Mdn* = 16.86%; *Neutral Mdn* = 16.29%). However, the Wilcoxon signed rank test revealed that the error rate was significantly higher in trials where distractors were presented in peripheral locations (*Mdn* = 7.94 %) compared with trials where distractors were

presented in parafoveal locations (*Mdn* = 3.33 %), *z* = -2.64, *p* = .008. See table 4.1 for descriptive statistics for error rates.

Accurate first saccade latency to the target. This analysis assessed the time taken to initiate a saccade towards the target in the presence and absence of threatening and non- threatening distractors across participants. Paired samples t-tests were conducted to assess whether a RDE occurred across participants. The latency of accurate first saccades to the target in each distractor condition and each distractor eccentricity was compared with the accurate first saccade latency in the single target trials displayed within the same block. The results revealed that saccade latencies were significantly shorter in single target trials compared to distractors trials in all distractor conditions (all *ts* > 7, all *ps* < .001, all *ds* > 2.55). First saccade latencies were delayed in the presence of a distractor and this was evident in all distractor conditions and distractor eccentricities, highlighting the presence of a reliable RDE. These findings provide additional evidence for the validity of this modified version of the RDP. Figure 4.1 shows the RDE magnitude for each distractor condition and each distractor eccentricity.

Further analysis was conducted to assess whether accurate first saccade latencies differed across distractor conditions and distractor eccentricities. A repeated measures ANOVA (distractor type x distractor eccentricity) revealed that there was a significant main effect of eccentricity, F (2, 66) = 10.25, $p < .001$, $\eta_p^2 = .24$. Pairwise comparisons revealed that first saccade latencies towards the target were longer in trials where distractors were presented in the centre of the screen (*M* = 193.81, *SD* = 24.78) compared with trials where distractors were presented in parafoveal (*M* = 184.25, *SD* = 18.48) and peripheral locations (*M* = 185.02, *SD* = 22.68). First saccade latencies in parafoveal distractor trials and peripheral distractor trials did not differ

significantly (see figure 4.2.). In addition, a one way repeated measures ANOVA was conducted to assess whether any effects of a particular distractor on the latency of first saccades were carried over to the single target trials embedded in the same experimental block. The results showed that the latency of accurate first saccades towards the target did not differ significantly ($F < 1.5$, *ns*) between the single target trials embedded in the angry ($M = 166.64$, $SD = 26.70$), happy ($M = 167.19$, $SD = 27.67$) and neutral ($M = 170.38$, $SD = 26.46$) distractor blocks. See table 4.1 for descriptive statistics for saccade latencies.

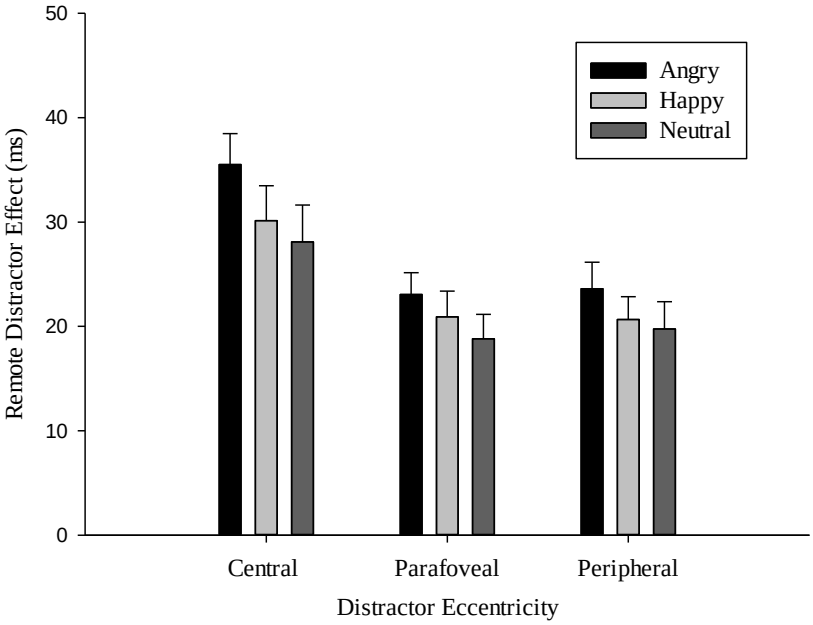


Figure 4.1. Mean (+*SE*) for the RDE as a function of distractor condition and distractor eccentricity.

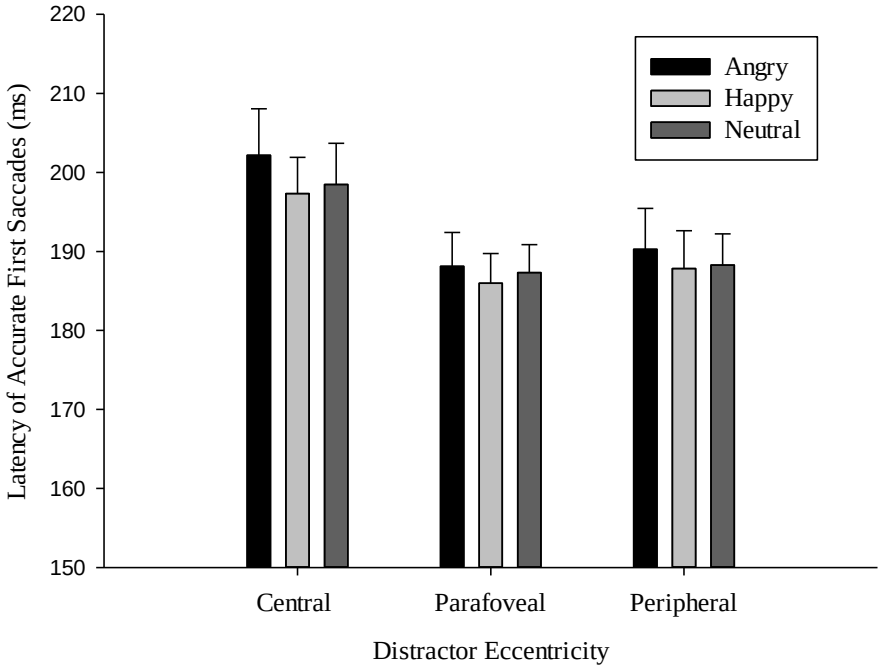


Figure 4.2. Mean (+SE) for the latency of accurate first saccades as a function of distractor type and distractor eccentricity.

Target Discrimination Reaction Time (RTs). This analysis considered the total time taken to make a button press response to indicate the shape of the target (i.e. square or diamond) in the presence and absence of distractors across participants. In order to assess whether RTs to discriminate the target were delayed in distractor trials compared to single target trials, paired sample t-tests were conducted where RTs in each condition at each eccentricity were compared with RTs in the single target trials embedded within the same experimental block (i.e. single angry trials were compared to angry central distractor trials etc). The results revealed that RTs were significantly longer in central distractor trials compared with single target trials in all distractor conditions, (all *ts* > 2, all *ps* < .05, all *ds* > 0.69). RTs differed significantly between peripheral distractor trials and single target trials in the happy and neutral distractor conditions (but not in the angry distractor condition), (*ts* > 2, *ps* < .05, *ds* > 0.70). There were no significant differences between RTs in parafoveal distractor trials and

single target trials in any of the distractor blocks (all *ts* > 2, all *ps* < .05, all *ds* < 0.25). See table 4.1 for descriptive statistics for RTs in single target trials and distractor trials.

In addition, a 3 (distractor type) x 3 (distractor eccentricity) repeated measures ANOVA was conducted to assess whether target discrimination RTs were influenced by distractor emotion and distractor eccentricity. There was a main effect of eccentricity on RTs, F (2, 70) = 5.13, p = .008, $\eta_p^2 = .13$. Pairwise comparisons revealed that RTs were significantly shorter in parafoveal trials (M = 624.11, SD = 124.26) compared to central trials (M = 634.45, SD = 126.18) and peripheral trials (M = 636.65, SD = 135.84). RTs did not differ significantly between central distractor trials and peripheral distractor trials. The effect of distractor emotion and the interaction between distractor emotion and eccentricity were non-significant, *Fs* < 2.5, *ns*.

A one way ANOVA was conducted to assess whether RTs differed across the single target trials embedded within each experimental block. The results revealed a main effect of single target condition, F (2, 72) = 3.25, p < .045, $\eta_p^2 = .08$. Pairwise comparisons revealed that RTs were marginally significantly longer in the single target trials embedded within the angry distractor block (M = 648.29, SD = 149.69) compared to RTs in single target trials embedded in the happy distractor block (M = 619.09, SD = 137.71). RTs did not differ significantly between the single target trials embedded within the angry and neutral and happy and neutral (M = 619.76, SD =151.58) distractor blocks.

Table 4.1.

Mean (+SD) for Error Rates (%), First Saccade Latencies to the Target (ms), Remote Distractor Effect and Reaction Times as a Function of Trial Type, Distractor Emotion and Distractor Eccentricity.

	Angry Block		Happy Block		Neutral Block	
	M	*SD*	*M*	*SD*	*M*	*SD*
Error rates (%)						
Parafoveal distractor	7.41	8.80	6.56	8.14	5.56	7.01
Peripheral distractor	11.14	11.21	11.16	13.44	8.62	8.69
Saccade latencies (ms)						
Single Target	166.64	26.71	167.19	27.71	170.37	26.47
Central distractor	202.16	35.80	197.33	27.77	198.47	31.67
Parafoveal distractor	188.12	25.72	185.99	22.44	187.33	21.22
Peripheral distractor	190.26	31.51	187.84	29.04	188.28	23.67
RDE (ms)						
Central distractor	35.52	18.02	30.14	20.34	28.09	21.46
Parafoveal distractor	21.48	12.51	18.80	14.90	16.96	14.03
Peripheral distractor	23.62	15.40	20.65	13.37	17.91	15.68
RTs (ms)						
Single Target	648.28	149.69	619.09	137.71	619.75	151.60
Central distractor	660.03	149.64	633.46	129.73	624.17	141.07
Parafoveal distractor	650.02	156.11	624.08	125.00	609.63	134.71
Peripheral distractor	657.16	154.36	632.11	130.21	645.24	172.05

4.3.2 Basic Effect Analysis Summary

In summary, the current analysis revealed that the presence of distractors and distractor eccentricity influenced eye movement behaviour. Specifically, the presence of distractors delayed saccade latencies towards the target, where this effect was evident across distractor emotions. In addition, saccade latencies were influenced by eccentricity; saccade latencies towards the target were longer in central distractor trials compared to parafoveal and peripheral distractor trials. The current analysis also found that directional error rates increased with eccentricity. RT differences were also found between distractor eccentricities; RTs were delayed in central distractor trials compared to parafoveal distractor trials.

4.3.3 Individual Differences and Attentional Processing

This analysis was conducted to test our hypothesis that anxiety would be related to an attention bias towards threat, where this relationship would be moderated by attentional control. In the first stage of this analysis Pearson's correlations were used to assess whether the measures of individual differences were correlated in the expected direction. In the next stage of the analysis regressions and Spearman's correlations were conducted to consider links between the measures of individual differences and the eye movement measures as well as the RTs. Finally, the moderating effect of attentional control was assessed using bootstrapping techniques.

Participant characteristics. The means and internal consistency for the questionnaires are presented in Table 4.2. An independent samples t-test was conducted to explore gender differences in the questionnaire scores. There were no significant gender differences in the scores on any of the questionnaires, *ts* < 1.5, *ns*. The current sample included 9 participants (24%) who scored 46 or above on the

STAI-T and 4 participants (11%) who scored above 31 on the SIAS. Note that none of the participants scored above the cut-off of 46 and 15 on the STAI-S and neuroticism scale respectively. There was one outlier on the social interaction anxiety scale. Results were not affected after removing this participant from the data, thus this person was retained in the analysis.

Results from the inter-correlations between the measures of individual differences are provided in Table 4.3. As expected, the anxiety questionnaires were all positively correlated with each other (*rs* > .45, *ps* < .01). In addition, high neuroticism was positively linked to trait anxiety, $r = .72$, $p < .001$ and social anxiety $r = .65$, $p < .001$, and attentional control was positively linked to neuroticism $r = .58$, $p < .001$ and the anxiety measures (*rs* > .35, *p*s < .05). Note that high scores on the ACS indicated low attentional control.

Table 4.2.

Descriptive Statistics and Internal Consistency for the Measures of Individual Differences.

	M	*SD*	*Minimum (lower limit)*	*Maximum (upper limit)*	*Cronbach's a*
Trait Anxiety (STAI-T)	38.11	8.82	20 (20)	62 (80)	.91
State Anxiety (pre STAI-S)	34.41	6.02	26 (20)	46 (80)	.78
State Anxiety (post STAI-S)	30.38	6.29	20 (20)	45 (80)	.84
Social Interaction Anxiety (SIAS)	16.89	12.56	1 (0)	55 (76)	.94
Neuroticism (EPQ)	4.35	3.37	0 (0)	12 (12)	.84
Depression (HADS)	3.08	2.25	0 (0)	10 (21)	.46
Attentional Control (ACS)	48.03	9.01	24 (20)	66 (80)	.86

Table 4.3.

***C**orrelations between the Measures of Individual Differences, the Social Adjusmtent Measures and the Eye Movement Measures.*

	Psychometric Measures					Social Measures				Directional Errors			Saccade Latency		
Psychometric Measures	2	3	4	5	6	7	8	9	10	An	Ha	Ne	An	Ha	Ne
1. Neuroticism	.72***	.30	.65***	.46**	.29	-.37*	-.10	-.27	-.41*	.26	.06	.17	.02	-.03	.29
2.Trait Anxiety		.50**	.49**	.49**	-.07	-.43**	-.23	-.28	-.32*	-.15	-.16	-.07	-.17	-.24	.17
3.State Anxiety		-	.36*	.31	-.37*	-.31	-.39*	-.34*	-.25	-.18	-.11	-.16	-.01	.01	.13
4.Attentional Control			-	.38*	.09	-.30	-.09	-.33*	-.37*	.11	-.04	-.01	.13	.09	.23
5. Depression				-	-.13	-.21	.19	-.18	-.16	.001	-.04	.03	-.01	.05	.30
Social Measures															
6. Friendship Quality					-	-.01	.17	.10	-.14	.14	.01	.05	.38	.25	.26
7.Facial Orientation						-	.40*	.36*	.21	-.05	-.12	.002	.20	.22	.05
8.Motor Behaviour							-	.38*	.25	.06	.09	.06	.12	.12	-.07
9.Speech Clarity								-	.20	.08	.14	.34*	.002	-.10	-.18
10. Role play effectiveness									-	-.09	.31	.24	-.22	.002	-.22

Note. *** $p < .001$, ** $p < .01$, * $p < .05$

In order to assess whether anxiety would be associated with selective attention for threat (i.e. automatic saccades towards angry faces), correlations were conducted between the measures of individual differences and directional errors in each distractor condition separately (collapsed across eccentricities). The results showed that there were no significant correlations between the measures of individual differences and the error rates for any distractor condition, $r < .27$, *ns.* See table .4.3.

Further analysis was conducted to explore whether anxiety would be associated with difficulties to disengage attention from threatening stimuli, and to regulate orienting responses in the presence of threat presented in parafoveal and peripheral regions of the visual field (i.e. covert processing of threat). The six predictors (i.e. trait anxiety, state anxiety, social anxiety, neuroticism, attentional control and depression) were regressed against first saccade latencies to the target for each distractor condition separately (collapsed across eccentricities).The regression models were not significant, $R^2s < .18$, $Fs < 1.10$, *ns* and there were no significant predictors within these models $|\beta s| < .35$, $ps > .05$.

However, it was possible that links between anxiety and impaired inhibition of threat would be reflected in the RDE magnitude in the angry distractor condition. The measures of individual differences were regressed against the RDE magnitude for each distractor condition separately (collapsed across eccentricities). The regression models were non-significant for the happy and neutral distractor conditions, $R^2s <$ .21, $Fs < 1.29$, *ns*, and no significant predictors were found within these models $|\beta s| < .53$, $ps > .05$. Notably, the regression model was significant for the angry distractor condition $R^2 = .43$, $F(6, 34) = 3.45$, $p = .01$ and neuroticism was a

significant predictor within the model, β = .75, p = .002, which suggests links between neuroticism and greater interference from threatening distractors. See table 4.5.

Additional regressions were conducted to assess whether the association between neuroticism and interference from threat was evident across distractor eccentricities. Neuroticism was regressed against the RDE magnitude scores for the angry distractor condition at each distractor eccentricity separately. This would allow us to identify the exact attention mechanisms underlying impaired inhibition of threat in neuroticism (i.e. difficulties to disengage attention from central threat or inability to regulated attention in the presence of threat at all distractor eccentricities). Results showed that neuroticism was a significant predictor of the RDE magnitude in the presence of central angry distractors R^2 = .13, F (1, 35) = 7.38, p =.034 and parafoveal angry distractors R^2 = .18, F (1, 34) = 7.39, p =.010, but not in the presence of peripheral angry distractors, R^2 = .01, F < 1, *ns.* These findings suggest that threat presented at locations with high visual acuity (i.e. foveal and parafoveal vision) interfered with eye movement performance in individuals high in neuroticism.

Based on previous research suggesting a moderating effect of attentional control on attention biases for threat, it could be argued that the association between neuroticism and the RDE magnitude in the angry condition would be evident in individuals with high neuroticism and low attentional control. However, the moderation model was not significant, b = -0.02, 95% CI [-0.19, 0.16], t = -0.20, p > .05, suggesting that interference from threat occurred in all individuals with elevated neuroticism, irrespective of their attention control abilities.

Further analysis considered whether individual differences in internalising and externalising traits, and attentional control were associated with RTs. The results

showed that there were no significant associations between the measures of individual differences and RTs for any distractor condition, $r < -.25$, *ns*. See table 4.5.

Table 4.4.

Regression Analyses on the RDE Magnitude for Each Distractor Emotion.

	Angry Distractors			Happy Distractors			Neutral Distractors		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Trait Anxiety (STAI-T)	-0.49	0.39	-.35	-0.24	0.54	-.15	-0.49	0.53	-.29
State Anxiety (STAI-S)	-0.54	0.40	-.22	-0.28	0.56	-.10	0.02	0.56	.01
Social Anxiety (SIAS)	-0.13	0.25	-.12	-0.26	0.32	-.23	-0.32	0.32	-.27
Neuroticism (EPQ)	2.86	0.82	.75*	1.37	1.34	.32	1.77	1.14	.41
Attentional Control (ACS)	0.20	0.25	.13	0.30	0.34	.19	0.43	0.34	.27
Depression (HADS)	-1.28	0.89	-.23	-1.18	1.25	-.18	0.51	1.24	.08

Note. *** $p < .001$, ** $p < .01$, * $p < .05$

Table 4.5.

Correlations between the Measures of Individual Differences and RTs.

	RTs		
	An	*Ha*	*Ne*
Neuroticism (EPQ)	.09	.09	.20
Trait Anxiety (STAI-T)	-.12	-.10	.02
State Anxiety (STAI-S)	.08	.10	-.02
Attentional Control (ACS)	.09	-.03	06
Depression (RCADS)	-.07	-.02	.10

Note. *** $p < .001$, ** $p < .01$, * $p < .05$

4.3.4 Individual Differences and Attentional Processing Summary

The current analysis found that neuroticism was related to a greater RDE magnitude in the angry (but not happy and neutral) distractor condition. Specifically, saccade latencies in the angry distractor condition were delayed in the presence of angry distractors compared to the single target trials embedded in the same experimental block. Further analysis revealed that links between neuroticism and impaired inhibition of threat were evident in trials where the angry distractor was presented in the foveal and parafoveal (but not peripheral) vision. The current work found no evidence to suggest a moderating effect of attentional control in the relationship between neuroticism and impaired inhibition of threat; individuals with neurotic traits showed greater RDE magnitude in the angry distractor condition, irrespective of their scores on the attentional control scale. In addition, the current results found that trait anxiety was unrelated to performance on the RDP task.

4.3.5 Individual Differences, Attention and Social Adjustment

This analysis was conducted to test our hypothesis that anxiety would be linked to social adjustment difficulties via an attention bias towards threat. Exploratory analysis was initially conducted to consider links between the measures of individual differences and the social adjustment measures. The results showed that trait anxiety was negatively linked to self-report socio-metric status, r = -.43, p = .008. That is, trait-anxious individuals reported lower socio-metric status compared to non-anxious individuals, which is consistent with previous research suggesting that anxious individuals are generally less popular compared to non-anxious individuals (Erath, Flanagan, & Biderman, 2007). State anxiety was negatively associated with friendship quality, r = -.37, p = .026 and preference for online interaction, r = -.39, p = .020, which indicates that state-anxious individuals were more likely to report poor

quality friendships and to show less preference for online social interaction. Social anxiety r = -.36, p = .034 and depression r = -.35, p = .035 were also related to lower preference for online interaction (see table 4.6).

Correlations were also used to assess links between the measures of individual differences and social behaviour during a role play task. Trait anxiety and neuroticism were negatively related to role play effectiveness and facial orientation, rs > -.30, ps < .05. These findings suggest that trait-anxious individuals and individuals high in neuroticism were generally more uncomfortable and were less likely to look at the confederate during the role play task. In addition, state anxiety was related to increased role play anxiety, r = .43, p = .007, and decreased motor activity (i.e. increased stiffness and minimal body movement), r = -.39, p = .015 during the role play task. High state-anxious individuals showed decreased speech clarity (i.e. mumbling, voice trembling and low volume), r = -.34, p = .038 and were less talkative, r = -.44, p = .006 compared to non-anxious individuals. Finally low attentional control was associated with decreased role play effectiveness, r = -.37, p = .022 and speech clarity, r = -.33, p = .041 (see table 4.7).

Pearson's correlations between the eye movement measures, the temperamental risk factors, and the social adjustment measures were used to guide our decisions regarding the exact mediation models that would be tested. In order to test a mediation model, the mediator should be significantly correlated to the predictor and the outcome. The correlations between anxiety and the eye movement measure were not significant, r > .15, *ns*, thus it was not appropriate to run mediation analysis between anxiety and the social adjustment measures.

However, the RDE magnitude in the angry distractor condition was associated with neuroticism and with social effectiveness during the role play task. Also,

neuroticism was linked to social effectiveness. Hence, mediation analysis was conducted to assess whether it was impaired inhibition of threat in individuals with neuroticism influencing their ability to interact effectively during a real life interaction with an unfamiliar person. The mediation model was not significant, b = -.01, BCa CI [-0.0536, 0.0098], suggesting that covert processing of threat does not explain links between neuroticism and low effectiveness in social settings. Thus, the exact factors influencing the relationship between neuroticism and low effectiveness during social interaction remain unclear. It might be the case that the relationship between neuroticism and low social effectiveness is mediated by other factors such as negative self-related thoughts and interfering views related to the appraisal of the task. The current findings suggest that neuroticism and impaired inhibition of threat independently contribute to social effectiveness. A diagram of the model generated from the current results is provided below (Figure 4.3).

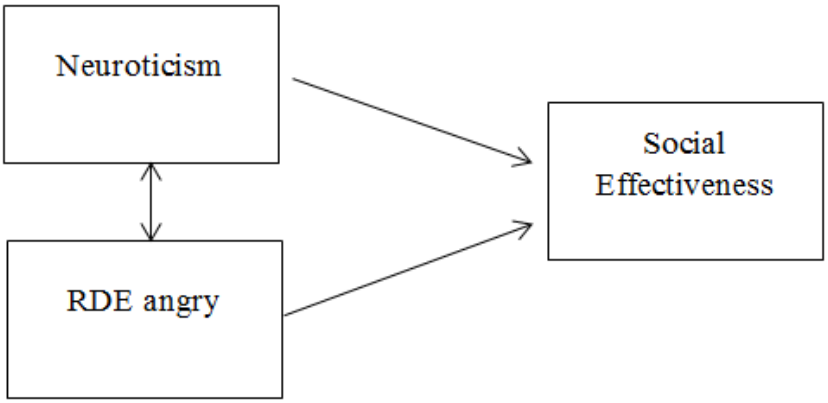


Figure 4.3. A diagram representing links between neuroticism, the RDE magnitude for the angry distractor condition and social behaviour.

Table 4.6.

Correlations between the Measures of Individual Differences and the Social Adjustment Measures.

	Friendship Quality	Friendship Quantity	Social Status	Online Interaction
Trait Anxiety (STAI-T)	-.07	.05	-.43**	-.23
State Anxiety (STAI-S)	-.37*	-.09	-.29	-.38*
Social Anxiety (SIAS)	-.04	.18	-.24	-.36*
Neuroticism (EPQ)	.29	.26	-.23	-.21
Attentional Control (ACS)	.09	.19	-.14	-.25
Depression (HADS)	-.13	.13	-.10	-.35*

Note. *** $p < .001$, ** $p < .01$, * $p < .05$

Table 4.7.

Correlations between the Measures of Individual Differences and Social Behaviour.

	Role-play Anxiety	Role-play Effectiveness	Facial Orientation	Motor Behaviour	Speech Clarity	Communicative	Talkative	Speech Latency
Trait Anxiety (STAI-T)	.29	-.32*	-.43**	-.23	-.28	-.27	-.32	.08
State Anxiety (STAI-S)	.43**	-.25	-.31	-.39*	-.34*	-.25	-.44**	.16
Social Anxiety (SIAS)	.21	-.17	-.24	-.08	-.09	-.27	-.26	.10
Neuroticism (EPQ)	.16	-.41*	-.37*	-.10	-.27	-.23	-.19	.11
Attentional Control (ACS)	.46	-.37*	-.30	-.09	-.33*	-.24	-.19	.19
Depression (HADS)	.23	-.16	-.21	.19	-.18	-.33*	.16	-.08

Note. *** $p < .001$, ** $p < .01$, * $p < .05$

4.3.6 Individual Differences, Attentional and Social Adjustment Summary

The current analysis found links between anxiety and neuroticism and social adjustment. Specifically, trait anxiety was associated with lower scores on the socio-metric status scale; trait anxious individuals consider themselves as less popular compared to non-anxious individuals. In addition, state anxiety, social anxiety and depression were associated with lower preference for online interaction. The current results also revealed links between trait anxiety and neuroticism and social performance; trait anxious individuals and individuals with neurotic traits were less effective and avoided looking at the confederate during social interaction. State anxiety was also linked to poor social performance. Specifically, increased state anxiety was associated with decreased motor movement and speech clarity during social interaction. In addition, poor attentional control was related to decreased effectiveness and speech clarity. Further analysis considered links between the eye movement measures and social adjustment. It was found that increased RDE magnitude was related to low social effectiveness. No other associations were found between the eye movement measures and the social adjustment measures.

4.4 Discussion

Previous research has established an association between anxiety and bias for threatening information. It is also well known that anxious individuals have difficulties with social relationships (e.g. low social status, fewer friends and low quality friendships). The primary aim of this study was to explore links between anxiety and social adjustment, and the mediating role of attentional biases in this relationship.

The remote distractor paradigm was used to measure distraction from task-irrelevant threatening and non-threatening faces presented at different eccentricities in the visual field. It was predicted that anxious individuals would show an attention bias towards threat (i.e. greater interference from threatening distractors compared to non-threatening distractors), and that this relationship would be moderated by attentional control. Specifically, it was expected that the presence of angry faces would lead to increased saccade latencies towards pre-specified targets and/or increased inaccurate first saccades towards angry distractors in anxious individuals with low attentional control.

Consistent with previous research using the remote distractor paradigm (Richards, Benson & Hadwin, 2012) and eye movement methodology, a reliable remote distractor effect was found in the current study, where first saccade latencies were longer in the distractor trials compared with the single target trials across all distractor conditions and eccentricities. Additionally, the remote distractor effect size increased as the distractor eccentricity decreased (i.e. greater saccade latencies in central distractor trials compared with parafoveal and peripheral distractor trials) and directional error rates increased with eccentricity.

Contrary to our predictions and previous research, there was no evidence in the current study to suggest links between trait anxiety and impaired inhibition of threat. Saccade latencies and directional errors in the angry condition were not influenced by anxiety. The lack of an association between anxiety and directional errors towards threatening faces is consistent with the idea that anxiety is unrelated to selective attention (i.e. involuntary eye movements) towards threatening stimuli (Richards, Benson and Hadwin, 2012).

However, neuroticism, a personality trait characterised by anxiety, predicted a greater remote distractor effect in the angry distractor condition. Specifically, the magnitude of the RDE in the presence of angry (but not happy and neutral) distractors increased with neuroticism, suggesting greater interference from threat in individuals high in neuroticism. Neuroticism was unrelated to the percentage of directional errors towards angry faces (inaccurate first saccades towards angry distractors), providing additional evidence for the absence of selective attention (i.e. involuntary rapid saccades) towards threat in individuals showing anxiety symptoms. In addition, no association was found between anxiety or neuroticism and RTs in the angry distractor condition.

Further analysis explored whether links between neuroticism and impaired inhibition of threat was evident across distractor eccentricities. Neuroticism predicted a greater RDE magnitude in angry central and angry parafoveal distractor trials, indicating that eye movement performance was influenced by threat presented at locations with high visual acuity. This finding is consistent with previous research suggesting links between anxiety and difficulties to regulate attention in the presence of threat presented at different eccentricities (Richards, Benson & Hadwin, 2012). Moderation analysis was used to assess whether the relationship between neuroticism and impaired inhibition of threat was moderated by attentional control. In contrast to previous work and theoretical frameworks, no moderating effects of attentional control were found, which suggests that individual high in neuroticism showed a greater RDE in the angry distractor condition irrespective of their attentional control skills.

The current study found links between the measures of individual differences and the social adjustment measures. Trait anxiety was associated with lower socio-

metric status and state anxiety was linked to low quality friendships and low preference for online interaction. Social anxiety was also related to low preference for online interaction. These findings provide additional support for the proposition that anxious individuals are more likely to experience social adjustment and friendship problems (Beidel, Turner & Morris, 1999; Erath, Flanagan, & Biderman, 2007). Results also found links between the measures of individual differences and performance in the role play task. Research looking into the association between anxiety and social behaviour focuses on social anxiety, where no evidence were found to suggest that socially anxious individuals are less socially skilled (Hatton, Hodges & Porter, 2003; Hatton, Tschernitz & Gomersall, 2005). Consistent with previous research, the current study found no association between social anxiety and performance in the role play task. However, links were found between trait anxiety and neuroticism and role play effectiveness and facial orientation. Individuals with high trait anxiety and neuroticism were less effective and found it more difficult to look at the confederate during the interaction. In addition, state anxiety was associated with increased role play anxiety and decreased speech clarity and talkativeness. As no association was found between the anxiety measures and the eye movement measures, it was not appropriate to conduct mediation analysis to assess whether impaired inhibition of threat mediated the relationship between anxiety and social adjustment difficulties.

In summary, the current study found links between anxiety and neuroticism and social adjustment difficulties. However, it remains unclear whether attentional biases towards threat have a mediating role in this relationship. The current findings contradict with previous research suggesting links between trait anxiety and greater interference from threatening stimuli (Richards, Benson & Hadwin 2012). However,

neuroticism which is defined as a personality trait characterized by high levels of anxiety, was linked to greater distraction from threatening than non-threatening faces. Although most eye movement research focuses on links between trait anxiety and impaired inhibition of threat, a few studies have reported an association between neuroticism and behavioural inhibition and attention biases towards threatening information (Lonigan et al, 2004). Contradictory to theoretical models and previous research, the current study found no evidence to suggest a moderating effect of attentional control on attention biases towards threat. The current study provides a valuable insight into the links between personality traits and threat processing, and highlights the social adjustment difficulties related to anxiety and neuroticism. Further research is recommended to explore additional factors that might be contributing to social adjustment difficulties experienced by anxious individuals.

Chapter 5: General Discussion

Previous research has shown that high anxious and aggressive individuals experience social adjustment difficulties such as poor quality friendships, low socio-metric status and peer rejection (La Greca & Stone, 1993; Morris, 2001; Laird et al., 2001). Previous findings have also highlighted links between attention (i.e. effortful control and impaired inhibition of threat) and socio-emotional development including prosocial behaviour, empathy-related responses and social competence (Checa, Rodriguez-Bailon, & Rueda, 2008; Perez-Edgar, 2011; Simonds et al., 2007). Simonds et al., (2007) for example, found that children with low attentional control had difficulties to adjust to social norms (i.e. smiling when receiving an undesired gift). In addition, a further study found that children with high effortful control showed greater sympathy (i.e. greater facial sadness) during an empathy inducing film compared to children with low effortful control (Valiente et al., 2004).

Although research in the area of attention and social adjustment is extensive, little research has explored the impact of poor attentional control and impaired inhibition of threat on peer relationships and social behaviour in individuals with internalising and externalising traits. The primary aim of the studies presented in the current thesis was to explore links between anxiety-related traits, attention, and social adjustment in children and adults. In addition, it aimed to consider the specificity of attentional and social processes to internalising symptoms to compare them with children who reported elevated symptoms of conduct-like behaviour. The experiments presented in the current thesis extend previous research by examining mediating pathways between internalising traits and social behaviour during real life interaction via impaired inhibition of threat (i.e. selective attention to and hypervigilance for threat). All three studies in the current thesis applied eye movement methodologies to

capture the attention mechanisms related to threat processing, and to explore how these may influence social adjustment in youth and adults.

Experiment 1 assessed links between temperamental risk, impaired inhibition of threat and friendship quality in children. It tested the hypothesis that temperamental risk would be associated with impaired inhibition of threat, and investigated whether this relationship was moderated by attentional control. Experiment 1 further addressed the proposition that impaired inhibition of threat would mediate links between temperamental risk and friendship quality. Experiment 2 investigated links between internalising and externalising traits and threat processing in adolescents, and the moderating role of attentional control in this relationship. It further examined associations between impaired inhibition of threat and social adjustment (i.e. friendship quality, friendship quantity, peer acceptance, preference for online interaction and social skills). Experiment 2 aimed to replicate and extend the findings from experiment 1 by assessing links between temperamental risk, attention and social behaviour in older children. Following Experiment 1, it was predicted that neuroticism would be related to difficulties to inhibit threat, where this relationship would be moderated by attentional control. The second hypothesis predicted a mediating effect of impaired inhibition of threat in the relationship between temperamental risk and social adjustment difficulties. Experiment 3 investigated links between anxiety and impaired inhibition of threat in adults. The moderating effect of attentional control in this relationship was also considered. It was expected that individuals with elevated anxiety and low attentional control would show impaired inhibition of threat. In addition, experiment 3 assessed links between anxiety and social adjustment difficulties, and the mediating effects of impaired inhibition of threat in this relationship. It was predicted that trait anxious individuals would show

social adjustment difficulties, via impaired inhibition of threat. Note that it was not possible to consider links between externalising traits, attention and social adjustment in Experiment 3 because the sample did not include any participants that scored above the norm (as reported in the EPQ manual) on the psychoticism scale.

The experiments presented in the current thesis used a modified version of the remote distractor paradigm to measure interference from task-irrelevant threatening and non-threatening distractors on task performance. This paradigm allows consideration of both hypervigilance for threat, as well as attentional capture (or failure to inhibit) for threat. Impaired inhibition of threat in this task is reflected in increased rapid involuntary saccades towards angry distractors (i.e. selective attention to threat) or increased saccade latencies towards the target in the presence of angry distractors presented at different eccentricities in the visual field (i.e. hypervigilance for threat).

The following section will summarise and discuss associations between internalising traits and attentional processes in children and adults. The discussion will then move on to address links between externalising traits and attention in adolescents. This will be followed by a section considering the role of attentional processes in social adjustment. The discussion will then consider the theoretical implications of the results from all three experiments, and will finally move on to highlight the limitations of the current work and make suggestions for future research.

5.1 Internalising Traits and Attention in Youths and Adults

Several theoretical models have been developed to explain attention biases towards threat in anxiety. They typically propose that anxiety is characterized by selective attention towards threat, where attention is automatically captured by threatening stimuli (for a review, see Williams, Watts, MacLeod, & Mathews, 1997).

However, more recent theoretical frameworks of attention in anxiety developed from eye movement research suggest that anxious individuals show hypervigilance for threat (i.e. attention is spread across the visual field to enhance threat detection; Richards et al., 2014). All three experiments presented in the current thesis applied eye movement methodologies, which allowed the exploration of both of these attentional pathways.

The findings from the experiments presented in the current thesis were not consistent with theories and research suggesting that anxiety is related to selective attention towards threatening stimuli. The current work found no evidence to suggest links between anxiety or neuroticism (i.e. a personality trait characterized by high levels of anxiety) and difficulties to inhibit exogenous saccades towards threatening distractors. In all three experiments, anxiety and neuroticism were unrelated to the proportion of directional errors (eye movements made towards angry face distractors, versus happy and neutral face distractors). In contrast, the results from the current work were more consistent with the proposition that anxious individuals are hypervigilant for threat. In all three experiments neuroticism was associated with difficulties to regulate orienting responses in the presence of threat. Specifically, Experiments 1 and 2 found that neuroticism predicted longer latencies to fixate the target in the presence of angry (but not happy or neutral) faces. Additionally, Experiment 1 revealed that this effect was stronger in trials where the angry distractor was presented in the centre of the screen, suggesting that young children with neurotic traits had greater difficulty to disengage their attention from angry faces. This is consistent with previous findings, where heightened trait anxiety was associated with increased attentional dwell-time on angry and happy (but not neutral) faces (Fox, Russo & Dutton 2002). Experiment 3 found that neuroticism was associated with a

greater remote distractor magnitude in the angry distractor condition (i.e. the difference between saccade latencies in the angry distractor trials and the single target trials embedded within the angry block was greater in individuals with high levels of neuroticism).

In support of the broadening of attention theory in anxiety, the current results suggest that attention was spread across the visual field and threat was covertly processed in individuals with neurotic traits; i.e. delayed saccade latencies in the angry distractor condition were evident across all distractor eccentricities. Hence, the presence of threatening (but not non-threatening) distractors influenced eye movement behaviour in children and adults with elevated neuroticism. The current results are therefore consistent with theoretical frameworks and previous findings that highlight an association between anxious behaviour and impaired inhibition of threat and where this attentional process delays time taken to meet task goals.

Theories and empirical findings have also suggested that attentional control moderates the relationship between temperamental risk and impaired inhibition of threat. Lonigan and Philips (2001) argued that attentional control allows individuals at risk for developing anxiety disorders to disengage and shift their attention away from threatening stimuli in the environment. Hence, anxious individuals with low attentional control find it more difficult to inhibit threatening information than anxious individuals with high attentional control. In line with this proposition, the experiments presented in the current thesis found evidence to suggest a moderating effect of attentional control in the relationship between neuroticism and impaired inhibition of threat. Experiment 1 showed that the association between neuroticism and delayed disengagement from angry distractors located in the foveal vision (but not in parafoveal and peripheral locations) was moderated by attentional control. Thus,

difficulties to disengage (shift away) attention from angry faces located in the centre of the screen were most evident in children with high neuroticism and low attentional control. These findings are consistent with previous research suggesting that attentional control has an important role in the relationship between anxious behaviour and attention biases for threat (see Derryberry & Reed, 2002; Lonigan and Philips, 2004; Muris de Jong, and Engelen, 2004).

A possible explanation for the lack of an interactive effect of neuroticism and attentional control on impaired inhibition of threat located in the parafoveal and peripheral vision is that attentional demands differed across distractor eccentricities. Specifically, trials where threat was presented in the foveal vision required increased attentional control, as participants had to first disengage their attention from threat and then initiate a saccade towards the target, whereas parafoveal and peripheral trials did not require overt attention to be released from threat prior to initiating a saccade towards the target. At least, disengagement might have been easier at those distractor locations, since attention was not fully focused on the distractor, as in the case of central distractors. In addition, trials where distractors were presented in the centre of the screen recruited additional cognitive processes given the multiple unpredictable locations of the target (i.e. parafoveal right or left and peripheral right or left) compared with the parafoveal and peripheral distrtactor trials where the target always appeared in the mirror position. The effort required in trials where the distractor was presented in foveal vision was greater compared to trials wHere the distractor was presented in parafoveal and peripheral regions of the visual field, and hence attenional control skills had an important role in central trials.

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Similarly, Experiment 2 also found that attentional control moderated the relationship between neuroticism and delayed saccade latencies towards the target in the presence of threat. Additional analysis exploring the effect of attentional control in each distractor eccentricity separately revealed that attentional control moderated links between neuroticism and delayed latencies in the angry distractor condition in all distractor eccentricities. However, the effect was stronger in trials where the angry distractor was presented in the foveal vision (i.e. the centre of the screen) than in trials where threat was located in parafoveal and peripheral regions of the visual field. This finding is consistent with the results from Experiment 1.

In contrast to the results from Experiments 1 and 2, Experiment 3 did not find any evidence to suggest a moderating effect of attentional control in the relationship between neuroticism and impaired inhibition of threat. Thus, distraction from threat was evident in all individuals with elevated neuroticism, irrespective of their scores on the attentional control scale. However, it should be noted that the number of participants with elevated neuroticism and high attentional control was low (5%) in Experiment 3. In future, in order to obtain a better understanding of the moderating effects of attentional control, the number of participants with high neuroticism and low versus high attentional control should be comparable.

Taken together, the findings from the experiments presented in the current thesis suggest that neuroticism is associated with impaired inhibition of threat; individuals with neurotic traits consistently found it more difficult to direct their attention towards the target in the presence of threatening distractors located at different eccentricities in the visual field. The current findings also indicate that impaired inhibition of threat in neuroticism resulted from an inability to regulate orienting responses in the presence of threat (i.e. to inhibit the processing of threat and

shift attention towards the target), rather than reflecting the outcome of enhanced orienting towards angry distractors (i.e. rapid involuntary saccades towards threat). In addition, the current work found evidence to support a moderating effect of attentional control in the relationship between neuroticism and impaired inhibition of threat. These findings provide further support to the existing eye tracking research that highlights an association between anxiety and biased attention towards threatening information (e.g. Deraksan et al., 2009, Richards et al., 2011; 2012). In addition, the current results fit theoretical models that propose that attentional control plays an important role in the relationship between anxiety and attention biases towards threatening information (Lonigan and Philips; 2001). The current work further extends previous research by suggesting that search strategies used by anxious adults (i.e. the broadening of attention) to facilitate threat detection are also evident in young individuals with elevated neuroticism.

5.2 Specificity of Impaired Inhibition of Threat to Internalising Traits

There is a growing body of research which has found evidence to support links between attentional biases to threat in children and adolescents with anxiety and where this is most evident for paradigms that require some element of inhibition (review by Dudeney, 2015). Previous research on attention in individuals with externalising behaviour has also found that aggressive children show an attention preference for threatening stimuli, raising the possibility that attentioanl biases represent a broad risk factor for different disorders in development. Gouze (1987) for example, found that aggressive pre-school age boys had difficulties disengaging their attention from task-irrelevant aggressive scenes, as indexed by increased latencies to shift attention away from threat and engage in another task (i.e. press a button as quickly as possible when a light came on). However, the attention mechanisms (i.e.

selective attention to threat versus hypervigilance) underlying this impaired inhibition of threat in individuals with externalising traits have not yet been fully explored across development.

The current work explored associations between externalising traits and attentional processes in children and adolescents. In the studies presented in the current thesis a subscale from the EPQ was used to masure psychotic traits. Psychotic behaviour is characterized by high agresivness, toughmindedness, hostility, recklessness and impulsivity. Individuals that score high on the psychoticism scale are more likely to express severe externalising mental disorders including psychosis and psychopathy. Individuals who score specifically high on the psychoticism scale of the EPQ exhibit some qualities commonly found among psychotics, which make them more susceptible, given certain environments, to psychosis. In contrast to previous findings, the results from the experiments presented in the current thesis found no evidence in support of the proposition that aggressive behaviour was related to an attention bias towards threat. Instead, the current results revealed that aggressive individuals were generally distracted by task-irrelevant emotional and non-emotional faces. Specifically, Experiment 1 found that aggressive behaviour was associated with increased directional errors (i.e. first saccades towards the distractor rather than the target) towards all type of distractors (angry, happy and neutral faces). Thus, children with aggressive behaviour did not selectively attend to threatening face distractors specifically, but to all task-irrelevant stimuli. The current results contradict with previous research (e.g. Chan, Rain and Lee, 2010) which suggests that aggressive behaviour is associated with enhanced processing of threatening information. Instead the current findings suggest that attention biases to threat might be specific to anxious

behaviour rather that an attentional behaviour that is also observed in individual with conduct-like difficulties.

Experiment 2 found links between aggressive behaviour and saccade latencies towards the target in all distractor conditions; aggressive youths showed delayed saccade latencies towards the target in the presence of distractors, irrespective of the distractor emotion. Hence, the results from Experiments 1 and 2 suggest that both threatening and non-threatening distractors influenced eye movement behaviour in individuals with psychotic personality traits. In addition, the results indicate that different attentional processes were evident in children versus adolescents with psychotic traits. Namely, in children, attention was automatically captured by task-irrelevant distractors whereas in adolescents distractors in the parafoveal and peripheral vision were processed by covert attention. These age group differences in attentional processing might reflect developmental changes in attention (i.e. inhibitory control improves with age and individuals become more able to supress exogenous orienting towards task-irrelevant information and focus on goal-directed behaviour (Christ, White, Mandernach & Keys, 2001). Together these findings suggest that aggressive behavioural symptoms are related to high distractibility from task-irrelevant information in general, rather than a threat related bias. The current results are in direct contrast with previous research which suggests that conduct-like problems (i.e. high agressivness) and conduct disorder are associated with enhanced attention to threatening information (see Smith & Waterman, 2004). However, a study by Linden (2007) found that conduct disorder was related to a bias for emotional faces (i.e. a greater ability to recognise angry and happy faces), which is consistent with the current results.

The current, novel, results highlight the need to further explore associations between externalising traits and attentional processes. Psychotic traits in childhood have been found to be linked to the development of conduct disorder and psychopathy in adulthood, hence it is important to understand how attentional processes including enhanced attention to threat or distraction from task-irrelevant information in general might be related to early externalisisng behavioural problems in order to prevent the development of severe externalising behaviours later in life.

5.3 Internalising Traits, Attention and Social Adjustment in Youths and Adults

Theoretical frameworks and empirical findings have highlighted an association between attentional processes and social adjustment. In addition, attention biases to threat have been previously found to mediate links between internalising traits and social adjustment difficulties across development (Checa, Rodriguez-Bailon, & Rueda, 2008; Perez-Edgar, 2011). However, there is no research to date exploring links between differential attentional processes underlying impaired inhibition of threat and social adjustment in individuals with internalising and externalising behavioural problems. The second aim of the experiments presented in the current thesis was to explore associations between internalising traits, attention and social adjustment (i.e. peer relationships and social behaviour specifically) in youths and adults, and to consider whether such links would also be evident in individuals with externalising traits.

Experiment 1 assessed links between temperamental risk (i.e. anxiety, neuroticism and aggressive behaviour), attention and friendship quality in children (aged 9-11 years). In contrast to previous research, Experiment 1 found no evidence to suggest that children with elevated anxiety or neurotic traits have lower quality friendships. However, an association was found between psychoticism (i.e. aggressive

behaviour) and friendship quality. Specifically, children with psychotic traits reported lower security and help from others within their friendships. Further analysis revealed that psychoticism was also associated with lower companionship within friendships, via impaired inhibition of threat. Namely, children with psychotic traits that showed an attention bias towards threat (i.e. increased proportion of directional errors towards angry faces) reported spending less time with their best friend, suggesting that enhanced attention to threat is a possible cognitive mechanism influencing the relationship between aggressive behaviour and friendship problems. A plausible explanation for this indirect relationship between aggressive behaviour and companionship is that perceived threat in the environment becomes a stressor for an aggressive individual that warrants immediate action, thus attention is withdrawn from ongoing tasks (i.e. interacting with friends) and is oriented towards the potentially threatening situation. Similar associations between attention and social adjustment have been previously found in individuals with internalising traits. The current results add to the existing literature by suggesting that impaired inhibition of threat also mediates links between externalising behaviour and social adjustment difficulties.

Experiment 2 aimed to replicate and extend experiment 1 by assessing links between internalising and externalising traits, attention and social relationships as well as social behaviour[8] in adolescents (12-14 years old). Consistent with the findings from Experiment 1, no relationship was found between neuroticism or anxiety and friendship quality. In addition, in experiment 2 there was no evidence to suggest that individuals with internalising or externalising traits have fewer friends or

[8] Measures of social relationships included friendship quality, friendship quantity, socio-metric status and preference for online interaction. The social indicators assessed were speech clarity, response latency, talkativeness, communicative skills, motor behaviour, facial orientation and overall social effectiveness.

are less popular (i.e. low socio-metric status) than their peers, which contradicts with the existing literature proposing that anxious and aggressive individuals are generally less well accepted than their peers. However, experiment 2 did find an association between temperamental risk (i.e. neuroticism, anxiety and psychoticism) and social behaviour; neurotic and psychotic traits and social anxiety were related to increased voice tremor and low voice volume during a role play task, where participants interacted with an unfamiliar person for a short duration.

Research examining social skills in anxious individuals focuses on social phobia, and the findings are controversial. Some empirical studies have suggested that there are clear differences on social performance (e.g. gaze behaviour, speech clarity, social effectiveness, and frequency of responses during interaction and public speaking) between socially anxious and non-anxious individuals (see Beidel, Turner & Dancu, 1985; Borkovec et al, 1974; Daley, 1978), whereas other studies have failed to find any differences between anxious individuals and controls on social performance tasks (e.g Rapee & Lim, 1992). The controversy over these findings might be explained by methodological differences between studies. Some researchers, for example, argued that anxious individuals can perform adequately well on social tasks where expectations for performance are clear, but perform worse than non-anxious individuals on tasks with vague expectations (Alden & Wallace, 1995). In support of this argument Derakshan and Eysenck (2011) suggested that clear task demands and expectations increase motivation in anxious individuals, leading to an extensive use of attention resources (i.e. greater use of effortful processing) in an attempt to override the impact of the stimulus-driven attentional system on task performance.

In the studies presented in the current thesis no expectations for performance were provided (i.e. participants were unaware of the evaluative nature of the social interaction task). Instead the task focused on participants' spontaneous reactions to social situations, which involved interacting with an unfamiliar person. However, it seems that in Experiment 2 social performance was influenced by individual differences in internalising and externalising traits. It is possible that the interaction with an unfamiliar person operated as a stressor or that the task parameters were difficult for these individuals (e.g. to imagine that these scenarios were really happening) influencing negatively their performance.

It was predicted that impaired inhibition of threat would mediate links between temperamental risk and social behaviour. However, in contrast to this prediction, the association between neuroticism and psychoticism and speech clarity was not mediated by impaired inhibition of threat (i.e. increased saccade latencies towards the target in the presence of threat), suggesting that it is not monitoring for threat, but other factors, that influence social behaviour related to speech clarity (i.e. voice trembling and voice volume) in anxious and aggressive individuals. However, Experiment 2 revealed that greater distraction from task-irrelevant information (i.e. longer latencies to initiate a saccade to the target in the presence of distractors of any type) was related to lower socio-metric status. Namely, adolescents that were generally distracted by faces (irrespective of the face emotion) rated themselves as less academically successful and well-accepted compared to their peers. These findings fit well with theoretical models and empirical research, which suggest that academic achievement and social adjustment are better understood in the context of cognition (e.g. attention and working memory; Rueda, Checa and Rothbart, 2011).

Experiment 3 explored links between internalising traits, attention and social adjustment in adults. In line with previous research, Experiment 3 found that trait anxious individuals reported lower socio-metric status compared to non-anxious individuals. However, this finding contradicts with the results from experiment 2, where no association was found between anxiety or neuroticism and socio-metric status in younger individuals. Thus, the findings from Experiments 2 and 3 indicate that anxious behaviour interferes with social relationships in adults (as reflected in lower socio-metric status and friendships quality), but not in younger groups.

In addition, Experiment 3 showed an association between neuroticism and anxiety and social performance. Individuals who scored high on the neuroticism and trait anxiety scales were generally less effective and looked away from the confederate (i.e. an unfamiliar same-sex individual) more frequently during the role play task. These findings are consistent with previous research suggesting that anxious individuals perform worse in social settings compared to non-anxious individuals (Beidel, Turner & Dancu, 1985). Notably, these results were found for trait anxiety but not for social anxiety. However, it is possible that trait anxious individuals performed worse than non-anxious individuals due to heightened state or social anxiety during the social interaction task. Poor attentional control was also related to lower effectiveness during the role play task, which is consistent with previous research (e.g. Simonds et al., 2007) suggesting that attentional processes can interfere with socio-emotional regulation, leading to social adjustment problems, including difficulties to adjust to social norms. In addition, state anxious individuals showed increased role play anxiety, reduced motor activity and unclear speech (i.e. lower voice volume and increased voice tremor) during the social interaction task, all of which indicates that heightened state anxiety may also impact social performance.

In contrast to the prediction that impaired inhibition of threat would mediate links between internalising traits and social adjustment difficulties, Experiment 3 did not find any evidence to suggest that enhanced processing of threat mediated associations between neuroticism or anxiety and social behaviour, which is consistent with the findings from Experiment 2. Hence, the results from all three experiments presented in the current thesis contradict the proposition that social adjustment difficulties (i.e. poor quality friendships, low socio-metric status and poor social performance) in anxiety can be partly explained by anxious individuals' tendency to process threatening information.

To summarize, the current work found links between anxiety and aggressiveness and social adjustment difficulties, but there was no evidence to suggest indirect links between internalising traits and social adjustment in the studies presented in the current thesis. However, Experiment 1 found that psychoticism was associated with companionship within friendships via impaired inhibition of threat (i.e. increased proportion of eye movements directed towards angry face distractors); individuals with psychotic traits who showed impaired inhibition of threat also reported spending less time with their best friend. It is important to note that although children with psychotic traits were generally distracted by task irrelevant stimuli (i.e. all face distractors delayed first saccade latencies towards the target), only distraction from threat mediated links between psychoticism and companionship. To conclude, the current findings suggest that attention biases towards threat influence social adjustment in aggressive (but not in anxious) individuals. They further highlight the unique effects of internalising and externalising traits and attention on social relationships and social behaviour, and emphasize the need for more research into the factors influencing social adjustment in anxious individuals.

5.4 Theoretical and Clinical Implications

The current work highlights the importance of applying eye movement methodologies to study the attention mechanisms underlying increased sensitivity to threat in anxious individuals. The current results provide insight into a developing conceptual framework that supports a broadening of attention in anxious individuals. This strategy may be beneficial to some extent as it facilitates threat detection, but it can also have a negative impact on daily functioning and individuals' ability to meet task goals when threat is mild or task-irrelevant, and hence should be inhibited. Previous research has argued that a broadening of the attentional beam reduces the attentional resources available for other ongoing tasks (Eysenck et al., 2007). The current results provide some evidence in support of this proposition by suggesting links between attentional processes (prolonged saccade latencies towards the target in the presence of distractors more specifically) and social performance. Specifically, individuals who processed task-irrelevant information (by covert attention) for longer duration showed poorer performance on the role play task.

Attentional control was also an important construct in the current work. The results provided additional evidence in support of existing theoretical frameworks and empirical findings (see Lonigan & Philips, 2001; Deryberry & Reed, 2002) that suggest a moderating effect of attentional control in the relationship between anxiety and attention biases to threat. The current results suggest that difficulty to disengage attention from threat is dependent on attentional control. Hence, individuals' ability to regulate attention should be considered in studies exploring associations between anxiety and impaired inhibition of threat. The current findings can be used to inform future interventions that will aim to train youths and adults with elevated anxiety to supress enhanced attention towards threatening information in the environment.

In addition, the current work extends existing research by emphasizing that temperamental risk and impairments in attentional processing (i.e. low attentional control and impaired inhibition of threat) are associated with social adjustment difficulties, including poor quality friendships and low effectiveness in social situations. Most importantly, these results highlight that internalising traits and attention also work independently, and do not interact to predict social adjustment difficulties. Conversely, the current findings also indicate that social adjustment problems in individuals with externalising behaviour might be better understood in terms of interactive effects between individual differences in self-regulation and attention.

Considering the possible impact of impaired inhibition of threat on the development and maintenance of psychopathological traits and its association with social adjustment difficulties, it is important that interventions focus on attention training that will aim to reduce enhanced processing of threat in individuals at risk for developing anxiety disorders. Attentional training techniques (ATTs) aim to reduce anxiety symptoms via training anxious individuals to inhibit threat processing and orient their attention towards neutral or positive stimuli. Attention training tasks (e.g. the dot probe paradigm) have been increasingly used to modify biased attention for threatening information in anxious individuals, and empirical findings are very promising. ATTs have been found to successfully modify attentional biases towards threat, reducing anxiety levels in clinical populations (e.g. social anxiety and GAD; see Bar-Haim, 2010; Cowart & Ollendick, 2010; MacLeod, 2010).

However, recent conceptual frameworks propose a new direction of research on attention in anxiety by suggesting links between anxiety and a broadening of attention that serves to facilitate threat detection. In line with this proposition, the

current results found evidence to suggest that anxious behaviour is characterised by a broadening of attention (i.e. attentional resources are spread across the visual field), as reflected in increased latencies to orient attention towards task-relevant stimuli in the presence of threatening distractors. These findings have important implications for attention training interventions that aim to reduce biased attention to threat in anxious individuals. Specifically, the current findings highlight the importance of taking into consideration the visual search processes underlying attention biases towards threat in the development of future therapeutic interventions that will aim to train anxious individuals to inhibit the processing of threatening information in the environment. If it is the case that anxious individuals spread their attention across the visual field to enhance threat detection, then attention training techniques should also consider the possibility of narrowing down the attentional breadth in individuals with elevated anxiety.

The current findings further revealed links between impaired inhibition of threat and social adjustment difficulties (i.e. poor quality friendships and low effectiveness during social interactions), suggesting that social adjustment may also benefit from threat bias modification techniques. However, more research is required to establish whether social adjustment difficulties are associated to specific attention mechanisms related to threat processing (i.e. selective attention versus hypervigilance). In order to develop ATTs that will aim to reduce the impact of attention biases to threat on social adjustment, it is important to first identify the exact attentional processes related to poor peer relationships and social performance.

5.5 Limitations

All three experiments reported in the current thesis used self-report questionnaires to measure anxiety, personality traits and attention. Although this is a

very common methodology to gather data in behavioural sciences, there are also some potential problems with using self-report measures. Honesty, for example, is a very important issue in research relying entirely on participants' views about themselves, as it depends on the topic of the questionnaire and the personality of the responder, and possibly the current state of the participants at the time of completing each questionnaire. Another challenge using self-report measures is the variety between participants' understanding or interpretation of some questions. This is less of an issue when measuring concrete concepts, but it can be a major problem when assessing more abstract things like personality traits. The use of additional methods of data collection (i.e. parent and teacher reports, interviews, observations etc.) would increase the reliability of the current results by allowing correlations to be made between the different tests.

Another limitation of the current work is that the statistical power in Experiment 2 was low due to the small sample size (twenty-two participants). Although the use of bootstrapping techniques was a powerful statistical tool in the current work, which allowed the testing of models in a small sample, having a bigger sample would more reliably reflect the mean of the population. In addition, the number of participants with psychotic traits was small in Experiment 2; hence additional research is required before any inferences can be made about the relationship between psychoticism, attention and social adjustment in adolescents.

The current studies also used unselected samples of individuals with neurotic and psychotic traits. It would be useful if future studies used screening procedures prior to testing to ensure that a sufficient number of participants with neurotic and psychotic traits are pre-selected to participate. In view of the large number of variables involved in the current studies and the multiple statistical tests conducted,

larger sample sizes would have provided more statistical power, hence it is important that future research replicates the current results with larger sample sizes. The use of screening procedures prior to testing would have helped to recruit more participants with elevated anxiety and psychoticism.

Theoretical frameworks and previous findings suggested that attention biases towards threat are most evident in anxious individuals with low attentional control (Lonigan et al., 2004). Experiments 1 and 2 found that attentional control moderated links between neuroticism and impaired inhibition of threat, but this effect was not evident in Experiment 3. However, in order to fully assess the moderating effects of attentional control, a sufficient number of participants with high neuroticism and high attentional control should be included in the sample. Screening participants before testing would have helped to recruit a more balanced number of anxious individuals with low versus high attentional control.

In Experiment 2, interratter reliability for the social behaviour assessment task was modest. Participants were video-recorded and videos were used to assess social behaviour at a later stage. It has been suggested that video scoring can be disadvantageous compared with live scoring as it reduces interrater consistency. It would have been useful if live sessions rather than videos were used to assess participants' social behaviour. In addition, the professional background and experience of the raters may also influence interrater reliability. In the current work, the raters had different professional backgrounds and no previous experience with scoring the social behaviour assessment task. It is important that training and experience are taken into consideration in future research that wishes to use the current task.

Finally, it should be noted that the current results are based on studies conducted with individuals from a typical population. This is a very common approach in research on anxiety, as it is argued that clinical and sub-clinical anxiety only differ quantitatively (i.e. they differ on the level of anxiety and not the symptoms). However, it would be valuable if future research replicated the current findings in a clinical population, especially if these findings are used in any way to form the basis of future rehabilitation techniques in anxiety.

5.6 Directions for Future Research

The current thesis highlights the utility of using eye movement methodologies to understand the attention mechanisms underlying impaired inhibition of threat in anxiety, and how these relate to social adjustment difficulties. It is slowly, but consistently, becoming clearer that anxiety is characterized by a broadening of attention, which facilitates threat detection. However, this work has been mainly explored in anxious adults, and not in younger populations. The current work was the first study to use the RDP task with young children, and the first to find evidence to suggest that attentional broadening is also evident in young individuals with anxiety-related traits. These findings suggest that the broadening of attention in anxiety is a visual behaviour that is adopted early in life and is maintained throughout adulthood. The current findings challenge current conceptual frameworks suggesting that anxiety is associated with selective attention for threat (i.e. attention is automatically captured by threatening stimuli), whereas they provide evidence in support of the proposition that anxiety is linked to hypervigilance for threat (see Richards et al., 2014 for a review). Thus, it is important that these novel findings are replicated before this relationship is established.

In addition, it would be interesting to determine the conditions under which a broadening of attention occurs. It is possible that attention is spread across the visual field under low attention demanding conditions, but that this may narrow down in more complex situations. Previous research, for example, found that the effects of cognitive failure (i.e. high distractibility in daily life) on distractibility during a response-competition task were reduced in settings where perceptual load was high (i.e. participants were required to search for an angular target among five angular non-target letters). Specifically, distractor interference was reduced in all subjects, irrespective of individual differences in everyday cognitive failures (Forster & Lavie, 2007). Similarly, different search strategies (i.e. broadening of attention versus scan paths) may be applied by anxious individuals to facilitate threat detection depending on perceptual load. It is of interest to explore whether anxious individuals maintain a broadening of attention in more complex settings. In a real life setting, for instance, visual scan paths (i.e. the excessive scanning of the environment with rapid eye movements) may be more beneficial for threat detection than the broadening of attention strategy. A study by Horley, Williams, Consalvez and Gordon (2004) for instance, measured scan paths to examine threat-related processing in social phobia. The authors reported that individuals with social phobia showed hyperscanning (i.e. increased scanpath length) and a reduced number of fixations on the eye region in displays with angry faces, whereas this visual behaviour was not evident in displays with happy or neutral faces.

Another important line of enquiry is whether the location or number of threat stimuli influences attentional processing in anxious children. It has been previously argued that anxious adults show an increase in processing capacity when presented with multiple threats (two angry faces presented at the same time), due to the co-

activation of threatening signals across the visual field (i.e. attention is spread and multiple threats are processed simultaneously; Richards et al., 2011). It would therefore be interesting to explore whether an increase in processing capacity is also evident in anxious children when the number of threatening stimuli is manipulated. If this is the case, then threatening signals that fall within their broad attentional window will be co-activated, and hence saccade latencies to the target in displays containing multiple threats should be comparable to those containing a single threat. This would suggest that highly efficient search strategies related to threat detection are already developed in anxious youths, highlighting the developmental aspects of attentional processing in anxiety. Another possibility is that anxious children apply different strategies in the presence of single versus multiple threats. These hypotheses remain to be empirically tested.

Research on attention in individuals with externalising traits is very sparse. Although, previous studies (e.g. Gouze, 1987; Chan, Rain and Lee (2010) have suggested that aggressive individuals show an attention bias for threat, the attention mechanisms underlying this bias are not yet known. In contrast to this proposition, the studies presented in the current thesis found no evidence to support an attention preference for threatening stimuli in aggressive individuals. Conversely, the current results suggest that externalising behaviour (i.e. aggressiveness) is characterized by a general distraction from task-irrelevant stimuli that is not always threat specific. In addition, it was found that different attention mechanisms were applied in different age groups with externalising traits. Specifically, young children showed increased exogenous saccades towards task–irrelevant distractor stimuli (increased numbers of eye movement errors towards distractors), whereas adolescents processed task-irrelevant information by covert attention (increased latencies to initiate eye

movements towards the targets). Although it remains to be confirmed, this difference might reflect age differences in the development of inhibitory control for task irrelevant distractors.

In light of these results, it would be interesting to consider whether this increased distractibility in aggressive individuals extends to other stimuli that have no social or emotional context. If young children with elevated aggressive behaviours are generally distracted by task-irrelevant information in the environment, then this should have an important impact on everyday life activities. Future studies could focus on the investigation of the attention mechanisms related to enhanced distractibility in aggressive individuals, and on the development of attention training techniques that will aim to minimise distraction and improve goal-directed behaviour. In addition, it is important that interventions aiming to improve attention in children with externalising traits, take into consideration any possible developmental differences in inhibitory control.

Previous research has found that anxious and aggressive individuals experience social adjustment difficulties, including poor quality friendships, low socio-metric status and peer rejection. In addition, research has also shown that cognitive factors (e.g. poor attentional control and attention biases towards threat, working memory) are also associated with poor social adjustment. Although the experiments in the current thesis found no evidence to suggest links between anxiety or neuroticism and poor peer relationships, previous findings are inconsistent, and hence, it is important that this area is explored more extensively and systematically, before any firm conclusions can be drawn from these findings.

Although there is substantial research suggesting links between internalising and externalising behaviour and social adjustment difficulties, research exploring the

contribution of attention in this relationship has been very limited. It is not clear, for example, whether different attention processes (e.g. exogenous versus endogenous attention) are related to unique social adjustment difficulties (i.e. poor peer relationships, social behaviour etc). Considering the current results, it seems that exogenous and endogenous attention towards threat were related to different social adjustment measures (i.e. social relationships and social behaviour respectively). Specifically, distributing attention across the visual field to facilitate threat detection was related to social behaviour, whereas narrowing attention on threat was associated with friendship problems (i.e. low security, help and companionship within friendships). Therefore, it is important that future research explores further this possibility and replicates these findings before firm conclusions and any rehabilitation implications can be considered. A further step would be to assess links between visual attention and social performance in real-life settings. Observational studies could provide valuable insight into this area of research, but initially it will be important to establish links between attentional processes and social adjustment empirically, and reliably.

5.7 Conclusion

The findings presented in the current thesis support existing theories and previous research by highlighting that attention biases to threat in anxiety can be better understood in the context of theoretical frameworks that highlight a broadening of attention in anxious individuals. The broadening of attention strategy is applied by anxious individuals when threat is anticipated in order to facilitate threat detection. A broad attentional beam allows the detection of multiple threats in the environment as threat signals can be received simultaneously from different locations in the visual field. However, it should be noted that this strategy might also have an attention cost

as it increases the possibility of distraction from threatening stimuli that are not relevant to the ongoing task. The current work further suggests an association between aggressive behaviour and greater distraction from task-irrelevant information (i.e. irrespective of the distractor emotion), where the attentional processes applied differed between age groups; children with aggressive behaviour processed task-irrelevant distractors overtly, whereas adolescents broaden their attention and processed distractors by covert attention.

In addition the current results extend previous work by suggesting links between attention and social adjustment difficulties. In line with conceptual frameworks and previous findings, the current results highlight that individual differences in attentional control and threat processing can reflect social adjustment difficulties in youths and adults. In addition, the studies presented here emphasize the independent contribution of personality traits and attention to social adjustment difficulties.

These findings can be used to inform interventions that will aim to modify attention biases to threat and improve attentional control with the purpose of facilitating social relationships and social performance in individuals with internalising and externalising traits.

However, future research is required to better understand links between externalising traits and attentional processing, as well as the effects of attention to threat on friendship quality and behaviour in social settings.

References

Acremont, M., Van der Linden, M. (2007). Memory for angry faces, impulsivity, and problematic behavior in adolescence. *Journal of Abnormal Child Psychology, 35, 313–324*.

Agarwal, N. and Agarwal, S. (2012). Subclinical Anxiety: Presence and Implications in Hypertensive Patients. *The Internet Journal of Cardiology*, 10 (2).

American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. Arlington, VA, American Psychiatric Association, 2013.

Andrews, G. (1996). Comorbidity and the general neurotic syndrome. *British Journal of Psychiatry*, 168: 30, 76–84.

Armstrong, T., & Olatunji, B. O. (2012). Eye tracking of attention in the affective disorders: a meta-analytic review and synthesis. *Clinical Psychology Review*, 32: 8, 704-723.

Asendorpf, J. B. (1993). Beyond temperament: A two-factorial coping model of the development of inhibition during childhood. In K. H. Rubin and J. B. Asendorpf (Eds.), Social withdrawal, inhibition and shyness in childhood. (pp. 265-289) New Jersey: Lawrence.

Atkins, M.S., Stoff, D.M. (1993). Instrumental and hostile aggression in childhood disruptive behavior disorders. *Journal of Abnormal Child Psychology*, 21,165–178.

Dunsmoor, J.E., Åhs, F., LaBar, K.S. (2011). Neurocognitive mechanisms of fear conditioning and vulnerability to anxiety. *Frontiers in Human Neuroscience*, 2011(5).

Erlbaum Associates. Bar-Haim, Y., Dominique, L., Pergamin, L., Bakermans-Kranenburg, M. J., Van IJzendoorn, M. H. (2007). Threat-related attentional bias on anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin*, 133:1, 1-24.

Beck, A. T. & Clark, D. A. (1997). An information processing model of anxiety: Automatic and strategic processes. *Behaviour Research and Therapy*, 35, 49-58.

Beck, A. T., Emery, G., & Greenberg, R. (1985). Anxiety disorders and phobias. A cognitive perspective. New York: Basic Books.

Beck, A. T., Emery, G., & Greenberg, R. (2005). Anxiety disorders and phobias: A cognitive perspective. (2nd ed.) Cambridge: Basic Books.

Becker, M. W. (2009). Panic search: Fear produces efficient visual search for non-threatening objects. *Psychological Science*, 20, 435–437.

Beidel, D.C., Turner, S.M., Dancu, C.V. (1985). Physiological, cognitive and behavioral aspects of social anxiety. *Behaviour Research and Therapy*, 23, 109- 117.

Beidel, D. C, Turner, S. M. (1997). At risk for anxiety: I. Psychopathology in the offspring of anxious parents. *Journal of the American Academy of Child and Adolescent Psychiatry*, 36, 918-924.

Beidel, D. C., Turner, S. M., & Morris, T. L. (1999). Psychopathology of childhood social phobia. *Journal of the American Academy of Child and Adolescent Psychiatry*, 38, 643–650.

Beidel, D.C., Turner, S.M., Morris, T. L. (2000). Behavioral treatment of childhood social phobia. *Journal of Consulting and Clinical Psychology*, 68(6),1072-1080.http://dx.doi.org/10.1037/0022-006X.68.6.1072.

Belopolsky, A. V., Zwaan, L., Theeuwes, J., & Kramer, A. F. (2007). The size of an attentional window modulates attentional capture by color singletons. *Psychonomic Bulletin and Review, 14,* 934-938.

Benjamin, R.S., Costello, E. J., Warren, M. (1990). Anxiety disorders in a pediatric sample. *Journal of Anxiety Disorders*, 4, 293–316.

Berndt, T.J. (1999). Friends' influence on students' adjustment to school. *Educational Psychologist*, 34, 15–28.

Betz, C.L. (1995). Childhood violence: A nursing concern. *Issues in Comprehensive Pediatric Nursing*, 18, 149–161.

Biederman, J., Hirshfeld-Becker, D.R., Rosenbaum, J.F., Hérot, C., Friedman, D., Snidman, N., Kagan, J., Faraone, S.V. (2001). Further evidence of association between behavioral inhibition and social anxiety in children. *American Journal of Psychiatry*, 158(10), 1673-9.

Biederman, J., Rosenbaum, J. F., Bolduc-Murphy, E. A., Faraone, S. V., Chaloff, J., Hirshfeld, D. R., & Kagan, J. (1993). A 3-year follow-up of children with and without behavioral inhibition. *Journal of the American Academy of Child and Adolescent Psychiatry*, 32, 814–821.

Biederman, J., Rosenbaum, J.F., Hirshfeld, D.R., Faraone, S.V., Bolduc, E.A., Gersten, M. et al. (1990). Psychiatric correlates of behavioral inhibition in young children of parents with and without psychiatric disorders. *Archives of General Psychiatry*, 47, 21–26.

Bishop, S., Duncan, J., Brett, M., & Lawrence, A. D. (2004). Prefrontal cortical function and anxiety: Controlling attention to threatrelated stimuli. *Nature Neuroscience*, 7, 184-188.

Borkovec, T. D., Stone, N., O'Brien, G., & Kaloupek. D. (1974). Identification and measurement of a clinical relevant target behaviour for analogue outcome research. *Behavior Therapy*, 5, 503-513.

Boyd, C. P., Kostanski, M., Gullone, E., Ollendick, T. H., & Shek, D. T. L. (2000). Prevalence of anxiety and depression in Australian adolescents: Comparisons with worldwide data. *Journal of Genetic Psychology*, 161, 479−492.

Brady, E. U., Kendall, P. C. (1992). Comorbidity of anxiety and depression in children and adolescents. *Psychological Bulletin*, 111, 244–55.

Brotman, M. A., Rich, B. A., Schmajuk, M., Reising, M., Monk, C. S., Dickstein, D. P., Mogg, K., Bradley, B. P., Pine, D. S., Leibenluft, E. (2001). Attention bias to threat faces in children with bipolar disorder and comorbid lifetime anxiety disorders. *Biological Psychiatry*, 61:6, 819-21.

Brown, B. B. (1990). Peer groups and peer cultures. In S. S. Feldman, & G. R. Elliot (Eds.), At the threshold: the developing adolescent (pp. 171–196). Cambridge, MA: Harvard University Press.

Bukowski, W. M., Hoza, B., & Boivin, M. (1994). Measuring friendship quality during pre and early adolescence: The development and psychometric properties of the Friendship Qualities Scale. *Journal of Social and Personal Relationships*, 11, 471–484.

Bukowski, W. M., Newcomb, A. F., and Hartup, W. W. (eds.) (1996). The Company They Keep: Friendship in Childhood and Adolescence. New York: Cambridge University Press.

Burstein, M., Ameli-Grillon, L., Merikangas, K.R. (2011). Shyness versus social phobia in US youth. *Pediatrics*, 128, 917–925.

Burton, C. B. Problems in Children's Peer Relations: A Broadening Perspective. In L. G. Katz. Norwood (Eds.), Current topics in early childhood education (Volume 7). NJ: Ablex, in press.

Campbell, J.C., Woods, A.B., Chouaf, K.L., & Parker, B. (2000). Reproductive health consequences of intimate partner violence: a nursing research review. *Clinical Nursing Research*, 9(3), 217-237.

Cantrell, P.J., MacIntyre, D.I., Sharkey, K.J., Thompson, V. (1995). Violence in the marital dyad as a predictor of violence in the peer relationships of older adolescents/young adults. *Violence & Victims*, 10, 35–41.

Cartwright-Hatton, S., Hodges, L., & Porter, J. (2003). Social anxiety in childhood: the relationship with self and observer rated social skills. *Journal of Child Psychology and Psychiatry*, 44(5), 737-42.

Cartwright-Hatton, S., Tschernitz, N., & Gomersall, H. (2005). Social anxiety in children: social skills deficit, or cognitive distortion? *Behavioural Research and Therapy*, 43 (1), 131-141.

Castiello, U., & Umilta, C. (1990). Size of the attentional focus and efficiency of processing. *Acta Psychologica* ,73:3, 195–209.

Cave, K. R. & Bichot, N. P. (1999). Visuospatial attention: Beyond a spotlight model. *Psychonomic Bulletin and Review, 6*, 204-223.

Checa, P., Rodriguez-Bailon, R., & Rueda, M. R. (2008). Neurocognitive and temperamental systems of self-regulation and early adolescents' school competence. *Mind, Brain and Education*, 2: 4, 177–187.

Chorpita, B. F., Yim, L., Moffi tt, C. E., Umemoto, L. A., & Francis, S. E. (2000). Assessment of symptoms of DSMIV anxiety and depression in children: A Revised Child Anxiety and Depression Scale. *Behaviour Research and Therapy*, 38, 835-855.

Chronis-Tuscano, A., Degnan, K.A., Pine, D.S., Perez-Edgar, K., Henderson, H.A., Diaz, Y., Raggi, V.L., and Fox, N.A. (2009). Stable Early Maternal Report of Behavioral Inhibition Predicts Lifetime Social Anxiety Disorder in Adolescence. *Journal of American Academy of Child and Adolescent Psychiatry*, 48(9), 928–935. doi: 10.1097/CHI.0b013e3181ae09df

Coie, J. D., Dodge, K. A., & Coppotelli, H. (1982). Dimensions and types of social status: A cross-age perspective. *Developmental Psychology*, 18, 557-570

Compas, B. E., Connor-Smith, J. K., Saltzman, H., Thomsen, A. H., & Wadsworth, M. E. (2001). Coping with stress during childhood and adolescence: Progress,

problems, and potential in theory and research. *Psychological Bulletin*, 127, 87–127.

Compton, R., Banich, M.T., Mohanty, A., Milham, M.P., Herrington, J., Miller, G.A., Scalf, P.E.,Webb, A., Heller,W., 2003. Paying attention toemotion: an fMRI investigation of cognitive and emotional Stroop tasks. *Cognitive, Affective. and Behavioural Neuroscience*, 3(2), 81– 96.

Conroy, R.L., Weener, P. (1976). The development of visual and auditory selective attention using the central-incidental paradigm. Journal of Experimental Child Psychology, 22, 400–407.

Costello, E. J., & Angold, A. (1995). Epidemiology. In J. S. March (Ed.), Anxiety disorders in children and adolescents (pp. 109–124). New York: Guilford Press.

Crick, N.R. and Grotpeter, J.K. (1995). Relational aggression, gender, and social-psychological adjustment. *Child Development*, 66, 710–722.

Criss, M.M., Pettit, G.S., Bates, J.E., Dodge, K.A., Lapp, A.L. (2002) Family adversity, positive peer relationships, and children's externalising behavior: A longitudinal perspective on risk and resilience. *Child Development*, 73: 4, 1220-1237.

Daley S. (1978). Behavioural correlates of social anxiety. *British Journal of Clinical Psychology*, 17, 117-120.

Derakshan, N. & Koster, E. H. (2010). Processing efficiency in anxiety: Evidence from eye-movements during visual search. *Behaviour Research and Therapy*, 48, 1180-1185.

Derryberry D., & Reed M.A. (2002). Anxiety related attentional biases and their regulation by attentional control , *Journal of abnormal psychology,* 111, 225-236.

Deubel, H., & Schneider, W. X. (1996). Saccade target selection and object recognition: evidence for a common attentional mechanism. Vision Res, 36:12, 1827–1837.

Dodge, K.A. (1991). The structure and function of reactive and proactive aggression. In: Pepler D, Rubin K, editors. The development and treatment of childhood aggression. Hillsdale, NJ: Erlbaum. pp. 201–218.

Dollard, J., Doob, L., Miller, N ., Mowrer, O., & Sears, R. (1939). Frustration and aggression. New Haven, CT: Yale University Press.

Donovan, C. L. & Spence, S. H. (2000). Prevention of childhood anxiety disorders. *Clinical Psychology Review,* 20, 509-531.

Dubner, A. E, Motta, R. W. (1999): Sexually and physically abused foster care children and posttraumatic stress disorder. *Journal of Consulting and Clinical Psychology*, 67, 367–373.

Dudeney, J., Sharpe, L., & Hunt, C. (2015). Attentional bias towards threatening stimuli in children with anxiety: A meta-analysis. *Clinical Psychology Review,* 40, 66-75.

Dunn, J. (2004). Children's friendships: The beginnings of intimacy. Oxford, UK: Blackwell.

Earth, S. A., Flanagan, K. S., Bierman, K. L. (2007). Social anxiety and peer relations in early adolescence: Behavioural and cognitive factors. *Journal of Abnormal Child Psychology*, 35, 405-416.

Eisenberg, N., Fabes, R. A., Nyman, M., Bernzweig, J., Pinuelas, A. (1994). The relations of emotionality and regulation to children's angerrelated reactions. *Child Development*, 65,109 -28.

Eisenberg, N., Guthrie, I. K., Fabes, R. A., Shepard, S., Losoya, S., Murphy, B., Jones, S., Poulin, R., Reiser, M. (2000). Prediction of Elementary School Children's Externalizing Problem Behaviors from Attentional and Behavioral Regulation and Negative Emotionality. *Child Development*, 71:5, 1367–1382.

Ellis ML, Weiss B, Lochman JE. 2009. Executive functions in children: Associations with aggressive behavior and appraisal processing. *Journal of Abnormal Child Psychology*, 37:7, 945–956.

Eriksen, C. W., Hoffman, J. E. (1973). The extent of processing of noise elements during selective encoding from visual displays. *Perception & Psychophysics*, 14: 1, 155–160.

Eriksen, C., & St James, J. (1986). Visual attention within and around the field of focal attention: A zoom lens model. *Perception & Psychophysics*, 40: 4, 225–240.

Essau, C. A., Aihara, F., Petermann, P., &Wiswasi, S. L. (2001). Specific phobia. In C. A. Essau & F. Petermann (Eds.), Anxiety disorders in children and adolescents. New York: Bruner Routledge.

Eysenck M. W., Derakshan, N., Santos., R., Calvo., M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion*, 7:2, 336-353.

Eysenck, H.J., & Eysenck, S. B. G. (1975). Manual of the Eysenck Personality Questionnaire. Sevenoaks: Hodder & Stoughton

Eysenck, M. W. (1992). Anxiety: The cognitive perspective. Lawrence Erlbaum Associations Ltd. Hove, England.

Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition and Emotion*, 6, 409–434.

Eysenck, M.W., Derakshan, N., Santos, R., & Calvo, M.G. (2007). Anxiety and Cognitive Performance: Attentional Control Theory. *Emotion*, 7, 336-353.

Fairchild, G., Hagan, C.C., Passamonti, L., Walsh, N.D., Goodyer, I.M., et al. (2014). Atypical neural responses during face processing in female adolescents with conduct disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, 53, 677–687.

Fan, J., McCandliss, B. D., Sommer, T., Raz, M., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience*, 14, 340–347.

Farrington, D.P. (1989). Early predictors of adolescent aggression and adult violence. *Violence and Victims,* 4, 79–100.

Farrington, D.P. (2001). Predicting adult official and self-reported violence. In: Pinard GF, Pagani L, editors. Clinical assessment of dangerousness: Empirical contributions. New York: Cambridge University Press. pp. 66–88.

Fenigstein, A., Scheier, M. F., & Buss, A. H. (1975). Public and private self-consciousness: Assessment and theory. *Journal of Consulting and Clinical Psychology*, 43, 522-527.

Feshbach, S. (1970). Aggression. In: Mussen P, editor. Carmichael's manual of child psychology. New York: Wiley. pp. 159–259.

Findlay, J. M. & Gilchrist, I. D. (2003). Active vision: The psychology of looking and seeing. Oxford: Oxford University Press.

Fowles, D. C. (1980). The three arousal model: Implications of Gray's two-factor learning theory for heart rate, electrodermal activity, and psychopathy. *Psychophysiology*, 17, 87-104.

Fox, E., Russo, R., &Dutton, K. (2002). Attentional bias for threat: Evidence for delayed disengagement from emotional faces. *Cognition and emotion*, 16: 3, 366-379.

Fox, E., Russo, R., & Dutton, K. (2002). Attentional bias for threat: Evidence for delayed disengagement from emotional faces. *Cognition & Emotion*, 16, 355–379.

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do threatening stimuli draw or hold visual attention in subclinical anxiety? *Journal of Experimental Psychology: General*, 130, 681-700.

Fyer, A. J., Mannuzza, S., Chapman, T.F., Martin, L.Y., & Klein, D.F. (1995). Specificity in familial aggregation of phobic disorders. *Archives of General Psychiatry*, 52, 564–573.

Garner, M. (2010).Assesment of attentional bias using the dot-probe task in anxious children and adolescents. In J. Hadwin & A.P Field (eds). Information Processing Biases and Anxiety: A developmental Perspective, pp.77-109. Chichester, UKL: Wiley-Blackwell.

Giancola, P.R., & Corman, M.D. (2007). Alcohol and aggression: A test of the attention-allocation model. *Psychological Science*, 18, 649–655.

Gilchrist, I. D., Brown, V., Findlay, J.M. & Clarke, M. P. (1998). Using the eye movement system to control the head. *Proceedings of the Royal Society B*, 265, 1831-1836.

Gladstone, G.L., Parker, G.B., Mitchell, P.B., Wilhelm, K.A., & Malhi, G.S. (2005). Relationship between selfreported childhood behavioral inhibition and lifetime anxiety disorders in a clinical sample. *Depression and Anxiety*, 22, 103–113.

Goie, J. D., & Kupersmidt, J. B. (1983). A behavioural analysis of emerging social status in boys' playgroups. *Child Development*, 54, 1400-1416.

Goodman, E., Adler, N. E., Kawachi, I., Frazier, A. L., Huang, B., Colditz, G. A. (2001). Adolescents' perceptions of social status: development and evaluation of a new indicator. *Pediatrics*, 108 (2), E31-E31.

Gouze, K.R. (1987). Attention and social problem solving as correlates of aggression in preschool males. *Journal of Abnormal Child Psychology*, 15, 181-197.

Gray, i. A. (1972). The psychophysiological basis of introversion-extraversion: A modification of Eysenck's theory. In V. D. Nebylitsyn & J. A. Gray (Eds.), The biological bases of individual behaviour (pp. 182-205). San Diego, CA: Academic Press.

Gray, J. A. (1978). The 1977 Myers lecture: The neuropsychology of anxiety. British *Journal of Psychology*, 69, 4 1 7 - 4 3 4.

Gray, J. A. (1981). A critique of Eysenck's theory of personality. In H. J. Eysenck (Ed.), A model for personality (pp. 246-276). Berlin: Springer-Verlag.

Gray, J. A. (1982). The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system. New York: Oxford University Press.

Gray, J. A. (1987a). Perspectives on anxiety and impulsivity: A commentary. *Journal of Research in Personality*, 21, 493 - 509.

Gray, J. A. (1987b). The psychology of fear and stress. Cambridge, England: Cambridge University Press.

Gray, J. A. (1990). Brain systems that mediate both emotion and cognition. *Cognition and Emotion*, 4, 269 - 288.

Gray, J. A., Owen, S., Davis, N., & Tsaltas, E. (1983). Psychological and physiological relations between anxiety and impulsivity. In M. Zuckerman (Ed.), Biological bases of sensation seeking, impulsivity, and anxiety (pp. 181-217). Hillsdale, NJ: Erlbaum.

Gross, C., & Hen, R. (2004). The developmental origins of anxiety. *Nature Reviews Neuroscience*, 5, 545–552.

Gruner, K., Muris, P., & Merckelbach, H. (1999). The relationship between anxious rearing behaviors and anxiety disorders symptomatology in normal children. *Journal of Behavior Therapy and Experimental Psychiatry*, 30, 27–35.

Hadley, M. (2003). Relational, indirect, adaptive, or just mean: Recent work on aggression in adolescent girls—Part I. *Studies in Gender and Sexuality*, 4, 367–394.

Hadwin, J. A., Donnelly, N., Richards, A., French, C. C., & Patel, U. (2009). Childhood anxiety and attention to emotion faces in a modified Stroop task. *British Journal of Developmental Psychology*, 27, 487-494.

Hanania, R., Smith, L.B. (2010). Selective attention and attention switching: towards a unified developmental approach. *Developmental Science*,13, 622–35.

Harter, S. (1997). The development of self-representations. In W. Damon (Series Ed.) & N. Eisenberg (Vol. Ed.), Handbook of child psychology (5th ed., Vol. III). New York: Wiley.

Hartup, W. W. (1989). Behavioral manifestations of children's friendships. In T.J. Berndt & G. W. Ladd (Eds.), Peer relations in child development (pp. 46-70). New York: Wiley.

Hayes, A.F. (2013). *Introduction to mediation, moderation, and conditional process analysis*. The Guilford Press, New York.

Hettema, J.M., Neale, M.C., Myers, J.M., et al (2006). A population-based twin study of the relationship between neuroticism and internalizing disorders. *American Journal of Psychiatry*, 163, 857–64.

Hirshfeld-Becker, D.R., Biederman, J., Henin, A., Faraone, S.V., Davis, S., Harrington, K. et al. (2007). Behavioral inhibition in preschool children at risk is a specific predictor of middle childhood social anxiety: A five-year follow-up. *Journal of Developmental and Behavioral Pediatrics*, 28, 225–233.

Hirshfeld-Becker, D.R., Rosenbaum, J.F., Biederman, J.F., Bolduc, E.A., Faraone, S.V., Snidman, N., Reznick, J.S., Kagan, J. (1992). Stable behavioral inhibition and its association with anxiety disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, 31, 103–111.

Horley, K., Williams, L., Gonsalvez, C., Gordon, E. (2004). Face to face: Visual scanpath evidence for abnormal processing of facial expressions in social phobia. *Psychiatry Research*, 127:1-2, 43–53.

James, W. (1890). The Principles of Psychology. New York: Henry Holt, Vol. 1, pp. 403-404.

Johnson, R. L. & Glass, C. R. (1989). Heterosocial anxiety and direction of attention in high school boys. *Cognitive Therapy and Research*, 13, 509-526

Jonides, J. (1983). Further toward a model of the mind's eye's movement. *Bulletin of the Psychonomic Society*, 21:4, 247-250.

Juola, I. P., Bouwhuis, D. G., Cooper, E. E. & Warner, C. B. (1991).Control of attention around the fovea. *Journal of Experimental Psychology: Human Perception and Performance*, 11, 1, 125-141.

Just, M. A., & Carpenter, P. A. (1976). Eye fixations and cognitive processes. *Gognitive Psychology*, 8, 441-480.

Kashani, J. H., Orvaschel, H. (1990). A community study of anxiety in children and adolescents. *American Journal of Psychiatry*, 147, 313–18

Kendler, K.S., Gardner, C.O., Gatz, M., & Pedersen, N.L. (2007). The sources of co-morbidity between major depression and generalized anxiety disorder in a Swedish national twin sample. *Psychological Medicine*, 37, 453–462

Kessler, R., Berglund, P., Demler, O., Jin, R., Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, 62, 593–602.

Kieras, J.E., Tobin, R.M., Graziano, W.G., Rothbart, M.K.(2005). You can't always get what you want: effortful control and children's responses to undesirable gifts. *Psychological Science*, 16(5), 391–396.

Kim, H., Somerville, L. H., Johnstone, T., Alexander, A. L., & Whalen, P. J. (2003). Inverse amygdala and medial prefrontal cortex responses to surprised faces. *NeuroReport*, 14, 2317–2322.

Klima, T., & Repetti, R. L. (2008). Children's peer relations and their psychological adjustment: Differences between close friendships and the larger peer group. *Merill-Palmer Quarterly*, 54: 2, 151-178.

La Greca, A. M. (2001). The peer group: Friends or foes? In W. K. Silverman & P. A. Treffers (Eds.), Anxiety disorders in children: Theory, research and practice. London: Cambridge University Press.

La Greca, A. M., & Harrison, H. M. (2005). Adolescent peer relations, friendships, and romantic relationships: Do they predict social anxiety and depression? *Journal of Clinical Child and Adolescent Psychology*, 34, 49–61.

La Greca, A.M., Prinstein, M.J. & Fetter, M.D. (2001). Adolescent peer crowd affiliation: Linkages with health-risk behaviors and close friendships. *Journal of Pediatric Psychology,* 26, 131-143.

Ladd, G.W., Troop-Gordon, W. (2003). The role of chronic peer difficulties in the development of children's psychological adjustment problems. *Child Development,* 74: 5, 1344-1367.

Laird, R.D., Jordan, K.Y., Dodge, K.A., Pettit, G.S., & Bates, J.E. (2001). Peer rejection in childhood, involvement with antisocial peers in early adolescence, and the development of externalizing behavior problems. *Development and Psychopathology*, 13, 337-354.

Last, C. G., Hersen, M., Kazdin, A. E, Francis, G., Grubb, H. J. (1987). Psychiatric illness in the mothers of anxious children. *American Journal of Psychiatry*, 144, 1580–83

Last, C. G., Perrin, S., Hersen, M., & Kazdin, A. E. (1996). A prospective study of childhood anxiety disorders. *Journal of the American Academy of Child & Adolescent Psychiatry,* 35, 1502−1510.

Levy-Schoen, A. (1969). Determination et latence de la reponse oculo-motrice a deux stimulus simultanes ou successifs selon leur excentricite relative. *Annee psychologique*, 69, 373-392.

Lipsitz, J. D., Martin, L. Y., Mannuzza, S., Chapman, T. F., Liebowitz, M. R., Klein, D. F., & Fyer, A. J. (1994). Childhood separation anxiety disorder in patients with adult anxiety disorders. *American Journal of Psychiatry,* 151, 927–929.

Little, L., Kantor, G.K. (2002). Using ecological theory to understand intimate partner violence and child maltreatment. *Journal of Community Health Nursing*, 19,133–145.

Lonigan, C. J., Kistner, J. A., Hooe., E. S., & David, C. (1997). An affective model of anxiety and depression in children: Evidence from a longitudinal study. Association for the Advancement of Behavior Therapy Abstracts, 4, CD-ROM Version.

Lonigan C. J., & Phillips B. M. (2001). Temperamental Influences in the development of Anxiety Disorders. In M. W Vasey, & M. R Dadds (Eds.), The developmental psychopathology of anxiety, (pp.60-91). Oxford University Press, New York.

Lonigan, C. J., Vasey, M. W., Phillips, B. M., & Hazen, R. A. (2004). Temperament, anxiety, and the processing of threat-relevant stimuli. *Journal of Clinical Child and Adolescent Psychology*, 33, 8-20.

Mallet, P., & Rodriguez-Tome, G. (1999). Social anxiety with peers in 9- to 14-year-olds. Developmental process and relations with self-consciousness and perceived peer acceptance. European Journal of Psychology of Education, 14, 387–402.

Maren, S. (2001). Neurobiology of Pavlovian fear conditioning. *Annual Review of Neuroscience*, 24, 897–931.

Martin, J. M., &Cole, D. A. (2000). Using the personal Stroop to detect children's awareness of social rejection by peers. Cognition and Emotion, 14, 241-260

Martin, M., & Jones, G. V. (1995). Integral bias in the cognitive processing of emotionally linked pictures. *British Journal of Psychology,* 86, 419–435.

Martin, M., Horder, P., & Jones, G. V. (1992). Integral bias in naming of phobia-related words. *Cognition and Emotion*, 6, 479-486

Mathews, A. & Mackintosh, B. (1998). A cognitive model of selective processing in anxiety. Cognitive Therapy and Research, 22, 539-560.

McCloskey, L.A., Lichter, E.L. (2003). The contribution of marital violence to adolescent aggression across different relationships. *Journal of Interpersonal Violence,* 18, 390–412.

McLeod, B. D, Wood, J. J, Weisz, J. R. (2007). Examining the association between parenting and childhood anxiety: A meta-analysis. *Clinical Psychology Review*, 27, 155–172.

Mendelson, M. J. & Aboud, F. (2012) . McGill Friendship Questionnaire ‘‘ Respondent's affection (MFQ-RA) . Measurement Instrument Database for the Social Science. Retrieved from www.midss.ie.

Merikangas, K.R., He, J.P., Brody D., Fisher, P.W., Bourdon, K., Koretz, D.S. (2010). Prevalence and treatment of mental disorders among US children in the 2001–2004 NHANES. Pediatrics, 125(1), 75–81.

Moffitt, T.E. (1993). Adolescence-limited and life-course-persistent antisocial behavior—A developmental taxonomy. *Psychological Review,* 100:674–701.

Mogg, K. & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy*, 36, 809-848.

Mogg, K., Holmes, A., Garner, M., & Bradley, B.P. (2008). Effects of threat cues on attentional shifting, disengagement and response slowing in anxious individuals. *Behaviour Research and Therapy*, 46, 656-667.

Moradi, A. R., Taghavi, M. R., Neshat-Doost, H. T., Yule, W., & Dalgleish, T. (1999). Performance of children and adolescents with PTSD on the Stroop colour-naming task. *Psychological Medicine*, 29, 415−419.

Morahan-Martin, J., & Schumacher, P. (2003). Loneliness and social uses of the Internet. *Computers in Human Behavior*, 19, 659–671.

Muris, P., De Jong, P.J., & Engelen, S. (2004). Relationships between neuroticism, attentional control, and anxiety disorders symptoms in non-clinical children. *Personality and Individual Differences*, 37, 789-797.

Muris, P., & Field, A.P. (2008). Distorted cognition and pathological anxiety in children and adolescents. *Cognition and Emotion*, 22, 395-421.

Muris, P., van Brakel, A., Arntz, A., Schouten, E. (2011) Behavioral inhibition as a risk factor for the development of childhood anxiety disorders: a longitudinal study. *Journal of Child and Family Studies*, 20, 157–170.

Naatanen, R. (1992). Attention and Brain Function. Lawrence Erlbaum Associates, Inc. Publishers, New Jersey.

Oldehinkel, A.J., Hartman, C.A., De Winter, A.F., Veenstra, R., & Ormel, J. (2004). Temperament profiles associated with internalizing and externalizing problems in preadolescence. *Development and Psychopathology*, 16, 421–440.

Olweus, D., (2003) Victimization by peers: Antecedents and long-term outcomes. In K. Rubin & J. Asendorf (Eds.), ‘’Social withdrawal, inhibition, and shyness in childhood.’’ Hillsdale, NJ: Erlbaum.

Ost L. G. (1987). Age of onset in different phobias. *Journal of Abnormal Psychology*, 96, 223–29.

Pedersen, S., Vitaro, F., Barker, E. D. y Borge, A.H.I. (2007). The timing of middle-childhood peer rejection and friendship: linking early behaviour to early adolescent adjustment. *Child Development*, 78:4, 1037-1051.

Pérez-Edgar, K., Bar-Haim, Y., McDermott, J. M., Chronis-Tuscano, A., Pine, D. S., & Fox, N. A. (2010). Attention biases to threat and behavioral inhibition in early childhood shape adolescent social withdrawal. *Emotion*, 10, 349–357.

Pérez-Edgar, K., Reeb-Sutherland, B.C., McDermott, J.M., White, L.K., Henderson, H.A., Degnan, K.A., Hane A.A., Pine, D.S. & Fox, N.A. (2011). Attention biases to threat link behavioral inhibition to social withdrawal over time in very young children. *Journal of Abnormal Child Psychology*, 39, 885–895.

Phelps EA, Delgado MR, Nearing KI, LeDoux JE (2004) Extinction learning in humans: role of the amygdala and vmPFC. *Neuron*, 43, 897–905

Pine, D. S., Mogg, K., Bradley, B. P., Montgomery, L., Monk, C. S., McClure, E., Guyer, A. E., Ernst, M., Charney, D. S., Kaufman, J. (2005). Attention bias to threat in maltreated children: implications for vulnerability to stress-related psychopathology. *American Journal of Psychiatry*, 162, 291–296.

Plude, D.J, Enns, J.T, Brodeur, D. 1994. The development of selective attention: a life- span overview. Special Issue: Life span changes in human performance. *Acta Psychologica,* 86: 227-72.

Posner, M. I., & Fan, J. (in press). Attention as an organ system. In J. Pomerantz (Ed.), Neurobiology of perception and communication: from Synapse to Society the IVth De Lange Conference. Cambridge, UK: Cambridge University Press.

Posner, M. I., & Rothbart, M. K. (1998). Attention, self-regulation, and consciousness.Philosophical *Transactions of the Royal Society of London B,* 353, 1915-1927.

Posner, M. I., Rothbart, M. K. (2000). Developing mechanisms of self-regulation. *Developmental Psychopathology*, 12, 427–41.

Posner, M. I., Snyder, C. R., & Davidson, B. J. (1980). Attention and the detection of signals. *Journal of Experimental Psychology: General, 109,* 160-174.

Posner, M.I., & Rothbart, M.K. (2007). Educating the human brain. Washington, DC: APA Books.

Raine, A. (2002). The role of prefrontal deficits, low autonomic arousal, and early health factors in the development of antisocial and aggressive behavior. *Journal of Child Psychology and Psychiatry,* 43, 311–326.

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy*, 35, 741–756.

Rapee, R. M., & Lim, L. (1992). Discrepancy between self- and observer ratings of performance in social phobics. *Journal of Abnormal Psychology*, 101, 728-731.

Rapee, R. M., & Melville, L. F. (1997). Retrospective recall of family factors in social phobia and panic disorder. *Depression and Anxiety*, 5, 7–11

Rapee, R. M., Schniering, C.A., Hudson, J. L. (2009). Anxiety disorders during childhood and adolescence: Origins and treatment. *Annual Review of Clinical Psychology*, 5, 311-341.

Rayner, K. (1978). Eye movements in reading and information processing. *Psychological Bulletin*, 85, 618-660.

Reynolds C.R., & Richmond B.O. (1978). A Revised Measure of Children's Manifest Anxiety. *Journal of Abnormal Child Psychology*, Vol. 6: 2, 271-280.

Richards, A., Richards, L. C., & McGeeney, A. (2000). Anxiety related Stroop interference in adolescents. *Journal of General Psychology*, 127, 327−333.

Richards, Anne, French, Christopher C., Nash, Gilly, Hadwin, Julie A. and Donnelly, Nick (2007). A comparison of selective attention and facial processing biases in typically developing children who are high and low in self-reported trait anxiety. *Development and Psycholpathology*, 19:2, 481-495.

Richards, H.J., Benson, V., Donnelly, N. & Hadwin, J.A. (2014). Exploring the Function of Selective Attention and Hypervigilance for Threat in Anxiety. *Clinical Psychology Review*, 34:1,1-13.

Richards, H. J., Benson, V., Hadwin, J. A. (2012). The attentional processes underlying impaired inhibition of threat in anxiety: The remote distractor effect. *Cognition and Emotion*, 26:5, 934-42.

Rothbart, M. K., Ahadi, S. A., & Hershey, K. L. (1994). Temperament and social behaviour in childhood. *Merrill-Palmer Quarterly*, 40, 21-39.

Rothbart, M.K., Bates, J.E. (2006). Temperament. In: Eisenberg N,(ed). Handbook of Child Psychology: Vol 3, Social, emotional, and personality development (6th ed., pp. 99-166). New York: Wiley.

Rothbart, M. K., & Jones, L. B. (1998). Temperament, self-regulation, and education. *School Psychology Review*, 27, 479-491.

Roy, A. K., Vasa, R. A., Bruck, M., Mogg K., Bradley, B. P., Sweeney, M., Bergman, L., McClure-Tone, E. B., Pine, D. S. (2008). Attention Bias Toward Threat in Pediatric Anxiety Disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*, 47:10, 1189-1196.

Rubin, K.H., Bukowski, W., & Parker, J. G. (2006). Peer interactions, relationships, and groups. In W. Damon, R. M. Lerner, & N. Eisenberg (Eds.), Handbook of child psychology: Vol. 3, Social, emotional, and personality development (6th ed., pp. 571–645). New York: Wiley.

Rubin, K., LeMare, L., Lollis, S. (1990). Social withdrawal in childhood: Developmental pathways to peer rejection. In S. Asher & J. Coie (Eds.), Peer rejection in childhood, pp. 217-249. New York: Cambridge University Press.

Rueda, M. R., Checa, P., & Rothbart, M. K. (2010). Contributions of Attentional Control to Socioemotional and Academic Development. *Early Education and Development*, 21: 5, 744-764.

Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2004). Attentional control and self-regulation. In R. F. Baumeister & K. D. Vohs (Eds.), Handbook of self regulation: Research, theory, and applications (pp. 283-300). New York: Guilford Press.

Ruff, H. A., & Rothbart, M. K. (1996). Attention in early development: Themes and variations. New York: Oxford University Press.

Salmivalli, C., Kaukiainen, A., & Lagerspetz, K (2000). Aggression and sociometric status among peers: Do gender and type of aggression matter? *Scandinavian Journal of Psychology*, 41, 17-24.

Schneider, B. H. (1999). A multimethod exploration of the friendships of children considered socially withdrawn by their school peers. *Journal of Abnormal Child Psychology*, 27, 115–123.

Searight, H.R., Rottnek, F., Abby, S.L. (2001). Conduct disorder: diagnosis and treatment in primary care. *American Family Physician*, 63(8), 1579–88.

Simonds, J., Kieras, J. E., Rueda, M., & Rothbart, M. K. (2007). Effortful control, executive attention, and emotional regulation in 7–10-year-old children. *Cognitive Development*, 22, 474–488.

Smith, P., & Waterman, M. (2004). Role of experience in processing bias for aggressive words in forensic and non-forensic populations. *Aggressive behaviour*, 30, 105-122. doi:10.1002/ab.20001.

Southam-Gerow, M. A., & Kendall, P. C. (2000). A preliminary study of the emotion understanding of youth referred for treatment of anxiety disorders. *Journal of Clinical Child Psychology*, 29, 319–327.

Spence, S. H, Donovan, C., Brechman-Toussaint, M. (1999): Social skills, social outcomes, and cognitive features of childhood social phobia. *Journal of Abnormal Psychology*, 108, 211–221.

Spielberger, C. D. (1973). Manual for the State-Trait Anxiety Inventory for Children. Palo Alto, CA: Consulting Psychologists Press.

Stein, M.B., Simmons, A.N., Feinstein, J.S., Paulus, M.P. (2007) Increased amygdala and insula activation during emotion processing in anxiety-prone subjects. *American Journal of Psychiatry*, 164, 318 –327.

Stirling, L. J., Eley, T. C., & Clark, D. M. (2006). Preliminary evidence for an association between social anxiety symptoms and avoidance of negative faces in school-age children. *Journal of Clinical Child and Adolescence Psychology*, 35, 440–445.

Stroop, J.R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18, 643–662.

Subrahmanyam, K., Reich, S. M., Waechter, N., Espinoza, G. (2008). Online and offline social networks: Use of social networking sites by emerging adults. Journal of Applied Developmental Psychology, 29,420–433.

Suveg, C., & Zeman, J. (2004). Emotion regulation in children with anxiety disorders. *Journal of Clinical Child and Adolescent Psychology*, 33, 750–759.

Tangney, J.P., Baumeister, R.F., & Boone, A.L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality*, 72, 271–322.

Taylor, S.F., Phan, K.L., Decker, L.R., Liberzon, I. (2003). Subjective rating of emotionally salient stimuli modulates neural activity. *Neuroimage*, 18, 650–9.

Telzer, E. H., Mogg, K., Bradley, B. P., Mai, X., Ernst, M., Pine, D. S., Monk, C. S. (2008). Relationship between trait anxiety, prefrontal cortex, and attention bias to angry faces in children and adolescents. *Biological Psychology*, 79, 216–222.

Tottenham, N., Tanaka, J. W., Leon, A. C., McCarry, T., Nurse, M., Hare, T. A. et al. (2009). The NimStim set of facial expressions: Judgments from untrained research participants. *Psychiatry Research,* 168, 242-249.

Turner SM, Beidel DC, Wolff PL (1996). Is behavioral inhibition related to the anxiety disorders? *Clinical Psycho1ogy Review*, 16, 157-172.

Van Brakel, A.M.L., Muris, P., Bogels, S.M., & Thomassen, C. (2006). A multifactorial model for the etiology of anxiety in non-clinical adolescents: Main and interactive effects of behavioral inhibition, attachment, and parental rearing. *Journal of Child and Family Study*, 15, 569–579.

Van der Molen, G., van den Hout, M., van Dieren, A., & Griez, E. (1989). Childhood separation anxiety and adult-onset panic disorders. *Journal of Anxiety Disorders*, 3, 97–106

Vasey, M. W., & Daleiden, E. L. (1996). Information-processing pathways to cognitive interference in childhood. In I. G. Sarason, G. Pierce, & B. Sarason

(Eds.), Cognitive interference: Theory, methods, and findings (pp. 117–138). Hillsdale, NJ: Erlbaum.

Vernberg, E. M, Abwender, D. A, Ewell, K. K., Beery, S. H. (1992). Social anxiety and peer relationships in early adolescence. A prospective analysis. *Journal of Clinical Child Psychology*, 21, 189–196.

Vuilleumier, P. (2005). How brains beware: Neural mechanisms of emotional attention. *Trends in Cognitive Sciences*, 9, 585–594.

Walker, R., Deubel, H., Schneider, W. X., Findlay, J. M. (1997). Effect of remote distractors on saccade programming: Evidence for an extended fixation zone. *Journal of Neurophysiology*, 78, 1108-1119.

Waters, A. M., Mogg, K., Bradley, B. P., Pine, D. S. (2008) Attentional bias for emotional faces in children with generalized anxiety disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, 47, 435–442.

White, L.K., McDermott, J.M., Degnan, K.A., Henderson, H.A., Fox, N.A. (2011). Behavioral inhibition and anxiety: the moderating roles of inhibitory control and attention shifting. *Journal of Abnormal Child Psychology*, 39(5), 735-47. doi: 10.1007/s10802-011-9490-x.

Wightman, F. L., Callahan, M. R., LutW, R. A., Kistler, D. J., & Oh, E. (2003). Children's detection of pure-tone signals: Informational masking with contralateral maskers. *Journal of the Acoustical Society of America*, 113: 6, 3297–3305.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathews, A. (1997). Cognitive psychology and emotional disorders. (2nd ed.). Chichester, England: Wiley.

Woodward, L.J., Fergusson, D.M. (2000). Childhood peer relationship problems and later risks of educational under-achievement and unemployment. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 41: 2, 191-201.

Zigmond, A.S., & Snaith, R.P.(1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*, 67(6), 361-70.

Appendix A: Examples of Participant Consent and Debriefing Forms

A.1 Participant Information Sheet

ATTENTION, WORRY, AND FRIENDSHIPS

Version 1, 13/05/2014)

We are hoping to work with some young people in this school on a project to find out more about how children feel about their friendships with other children.

Why are we doing this research?

We want to find out if children who worry and find it difficult to concentrate have problems making friends.

Why have I been invited to take part?

You have been invited to do this study because you are in Year 5-8. We are asking all young people in these year groups to do this study to help as find out more about children's feelings and friendships.

Do I have to take part?

No, it is up to you. Before you make this decision, you can ask the researcher to answer any questions that you might have. If you think that you might want to take part you can fill out the form at the end of this information sheet. You will be given a copy of this information sheet to keep. If you agree to take part, you can stop at any time, without giving a reason.

What will happen to me if I take part?

You will be asked to do a task on the computer to see how good you are at concentrating. Also, you will need to answer a few questions about your feelings and about your friendships with other children. You will also be asked to do another short task in which you will be asked to chat with another child. For us to be able to get all the information we need we will need to video tape your conversation while it is happening. If you decide to take part, then you should answer the questions on the next page.

Will anybody know my scores?

Nobody except me and the people who are helping me will know your answers to the questions. I won't write your name down next to your scores so if anybody working with me looks at them, they won't know that it was you who scored that.

What are the benefits of taking part?

You will help us understand if people of your age who feel worried are more or less able to concentrate and have good friendships with other children. This information will be used by other researchers to help you and other children to stop worrying so much and have good relationships with other children.

What happens when the study is finished?

When the study is finished we will look at all the scores given by all the people who took part and we will show this information to other people so other researchers can find out more about worry and children's relationships with their friends and classmates. But we will never say or write your name or any other information that will let people know who you are.

What if there's a problem or something goes wrong?

It is very unlikely that you will have any problems while you are doing this study. If you are worried about anything and you decide you want to stop that's OK.

Who has planned this study?

This study is planned through Psychology at the University of Southampton.

Who has read and approved this study?

The study has been read and approved by the ethics committee at the University of Southampton who makes sure that the research is fair - they are happy that this research is safe to do.

What happens I want to find out more?

You can ask me or your teacher any questions you have now. Also you can call Katerina Pavlou on 02380 595078 or Julie Hadwin on 023 8059 2590 and ask us anything you like.

What happens if I find some of the questions upsetting?

If you find the questions or anything else we ask you to do upsetting, you can speak to a number of different people. This could be someone you know, like your parent or guardian.

Or you can talk to your school counsellor.

You can also talk to people from outside the school by ringing a helpline, such as the Child line. People on Childline will talk to you about any worries you might have but they will not tell anyone what you said to them. You can speak to someone on Childline by calling 0800 1111. There are other ways of contacting childline. You can find out more information online at: http://www.childline.org.uk/

A.2 Participant Consent Form

ATTENTION, WORRY AND FRIENDSHIPS (Version 1, 13/05/2014)

If you are happy to help us with this study, then answer the questions below and sign your name.

Have you read about this project?	Yes/ No
Has somebody else explained this project to you?	Yes/ No
Do you understand what this project is about?	Yes/ No
Have you asked all the questions you want?	Yes/ No
Have you had your questions answered in a way you understand?	Yes/ No
Do you understand it's OK to stop taking part at any time?	Yes/ No
Are you happy to take part?	Yes/ No
Is it okay to video tape you while you are talking to another child?	Yes/ No

If you want to take part, you can write your name below

Your name _____ Date _____

Your tutor group _____

THANK YOU FOR YOUR HELP!

A.3 Participant Debriefing Form

(Version 1, 13/05/2014)

Exploring the links between anxiety, attentional control and social adjustment in young people and adults

Debriefing Statement (Version 1, 13/05/2014)

The aim of this research was to investigate links between individual differences in anxiety and the ability to ignore threatening items, and social adjustment difficulties including the

development of successful peer relationships and friendships. Cognitive models suggest that individuals with high levels of anxiety are hyper-vigilant to threat and find it difficult to inhibit the processing of threatening stimuli (Eysenck, 1992). Previous research indicates that, when asked to move their eyes towards a target in the presence of threat, anxious individuals show delayed orienting towards the target as indexed by longer latencies to look at the target (Richards, Benson & Hadwin, 2012). Further research has argued that this attentional style is important in understanding social interaction difficulties and social withdraw in children and adolescents (Perez-Edgar et al., 2010). In the current study we predict that anxiety will be associated with an inability to inhibit the processing of threatening faces; that is anxious individuals will take longer to orient towards the target when presented with an angry (vs happy and neutral faces and the oval shaped distractor), and that this attentional bias towards threatening faces will be linked to difficulties to develop high quality friendships and interact successfully with peers. The current study also aims to consider the moderating effects of attentional control. Specifically, it is expected that this bias towards angry faces and hence its effect on social adjustment difficulties in anxious individuals will be especially evident in participants who also report low levels of attentional control (i.e. difficulties in shifting and focusing their attention).

Once again results of this study will not include your name or any other identifying characteristics. The experiment did not use deception. You may have a copy of this summary if you wish and a summary of the research findings on completion of the project.

If you have any further questions please contact Katerina Pavlou at kp1c11@soton.ac.uk. Alternatively, if participation in this study has raised any issues that you wish to discuss in confidence, the University provides a confidential helpline. Phone: 023 8059 3719.

Thank you very much for your participation in this research.

Signature: ……. Date: ……..

Name: ……

If you have any questions about your rights as a participant in this research, or if you feel that you have been placed a risk, you may contact the Chair of the Ethics Committee, Department of Psychology, University of Southampton, Southampton, SO17 1BJ; Phone: (023) 8059 3995

Appendix B: Recognition of Facial Expression in Parafoveal and Peripheral Vision.

B.1 Introduction

Theoretical frameworks of visual processing suggest that the foveal vision allows the extraction of high-resolution information (Eriksen & James, 1986) and as the retinal eccentricity of a stimulus increases, visual acuity decreases (Findlay and Gilchrist, 2003). However, several studies have found that individuals are also able to covertly attend to stimuli located in the parafoveal and peripheral vision (Juola, 1991). Findings from our lab (Richards, 2011) have shown that adults are able to recognise with high accuracy the expression of faces positioned at four (97.73% accuracy) and eight (94.97% accuracy) degrees away from the centre of the screen (corresponding to parafoveal and peripheral vision, respectively). Further research suggested that anxiety moderates this processing for angry faces. Findings from visual search paradigms indicate that anxious individuals show an enhanced ability (as indicated in reaction times) to detect with less overt eye-movements (relative to non-anxious individuals) angry faces in the visual field (Richards et al., 2012). In order to explore at a later stage, similar anxiety-related processing in young people, we first need to establish that individuals between the ages of our interest (i.e. 11-14 years-old) are able to recognise the expression of faces located at parafoveal and peripheral locations.

B.2 Aim

Following Richards et al., (2010), the aim of the current study was to explore whether, using the same stimuli (angry, happy and neutral faces), individuals between 11-14 years-old are also able to identify the expression of faces in parafoveal and

peripheral locations without executing an eye movement. Participants were asked to keep their eyes focused on the centre of the computer screen while doing the task, and indicate the facial expression portrayed in each trial by pressing one of the three buttons corresponding to angry, happy and neutral faces.

B.3 Method

B.3.1 Participants

Six healthy young adolescents (11-14 years old; 4 females and 2 males) participated in this study. All participants and their guardians were provided with written information about the study and the parent provided written consent for their child to take part. In addition, every participant was asked to provide written consent prior to taking part.

B.3.2 Stimuli and Apparatus

Sixteen models (8 male and 8 female) from the NimStim face set (Tottenham et al., 2009) displaying angry, happy and neutral expressions were used. These items included European-American, African-American and Latino-American models. Additionally, two models also from the NimStim set were used as items for practice trials. Faces of each model were clipped so that only the face was on display; body parts such as neck and shoulders or the model's hair could not be seen. The size of all the faces was 165 x 256 pixels (4.2° horizontally and 6.5° vertically). Each participant viewed a block of 96 images with happy, angry and neutral faces presented in parafoveal (4°; 157.5 pixels) and peripheral (8°; 315 pixels) locations. The number of trials for each expression and eccentricity were equally divided (i.e. 32 happy, 32 angry, 32 neutral faces from which 16 were presented in parafoveal, and 16 in peripheral vision). Experiment builder software was used to create the experiment and

an Eyelink 1000 Desk Mount eye-tracking system (SR Research Ltd.) recorded participants' right-eye vertical and horizontal eye-movements. Display items were presented on a 20inch monitor (1280x1024 resolution). The task was completed at a viewing distance of 70 cm. Eye link 1000 allows pupil and corneal reflection tracking and the collection of high resolution eye-movement data (e.g. fixations and saccades). It can give information about saccades based on velocity, acceleration and motion thresholds. A saccade signal is generated if the velocity of the eye movement is greater than 30°/second or if acceleration of the eye movement exceeds 8000°/second². The motion threshold ensures that a saccade is only detected when saccade amplitude exceeds 0.1°.

B.3.3 Design

A repeated measures design was used to investigate whether facial emotion in the parafovea and periphery could be accurately recognised with covert attentional processing. The variables of interest were accuracy and errors rates and descriptive statisitcs were used to compare proportions of accuracy and errors across the different conditons of emotion and eccentricity.

B.3.4 Procedure

Participants from a convenience sample, and their guardians, were provided with written information about the study. In order to take part in the study, both children and parents were asked to provide written consent. This was followed by a detailed verbal description of the task they were asked to do. Each participant was presented with a block of 96 images of mixed angry, happy and neutral faces placed at 4° and 8° degrees from the centre of the screen. The order of displays within the block was randomized for each participant. Participants were first presented with a practice

block (12 trials) to habituate them to the task. Eye movements were recorded during the whole process. Before the presentation of both practice and experimental trials participants were asked to follow a calibration and validation process, which involved successive fixations on 9 (3x3) black dots presented in an array on a white background.

Participants were asked to indicate the facial expression displayed in each trial by pressing one of the three buttons corresponding to angry, happy and neutral faces. The buttons were counterbalanced across participants. To accommodate the main requirement of this study (i.e. that participants look at the center of the screen throughout the task) a white dot followed by a white fixation cross (presented for 800 ms), both on a black background and located in the center of the screen, were presented before each trial and participants were asked to focus their eyes on both these stimuli. Additionally, an invisible boundary was set up around the fixation cross to prevent the participant from fixating outside the desired containment area, corresponding to 1.5°x 1.5° (581 x 435 pixels) away from the center of the screen. When the fixation point exceeded 1.5°, the display would not be updated until the eyes fixated within the set boundary for 200 ms. Trial displays were presented until a response was made. A black screen presented for 1000ms marked the end of each trial.

B.3.5 Data Preparation

Eyelink Data Viewer was used to view participants' visual behaviour while completing the task and to prepare the data collected to be analyzed. Three exclusion criteria were used. Trials were removed if: 1) an error was made (i.e. the participants looked at the face) and 2) the location of the first fixation in the trial was more than one degree away from the center of the screen and 3) saccades with amplitude greater than one degree occurred.

B.4 Results

The overall percentage of errors (trials in which participants looked at the face) was 19% (114 trials across participants; see Figure 1.). The overall percentage of trials excluded for other reasons (i.e. amplitude of saccade greater than 1°, location of first fixation was more than one degree away from the centre of the screen) was 6% (32 trials across participants). Based on the exclusion criteria, 146 trials were excluded in total. From the remaining 430 trials, the 420 trials (98%) were accurate (i.e. participants pressed the right response button while looking at the centre of the screen) and 10 trials (2%) were inaccurate (i.e. participants pressed the button that corresponded with an incorrect face emotion while looking at the centre of the screen). Inaccurate responses were removed from the data set. The results revealed that the expression of faces located at 4° and 8° can be identified with high accuracy; 99% accuracy at 4° and 97% accuracy at 8° ; see Figure 2.

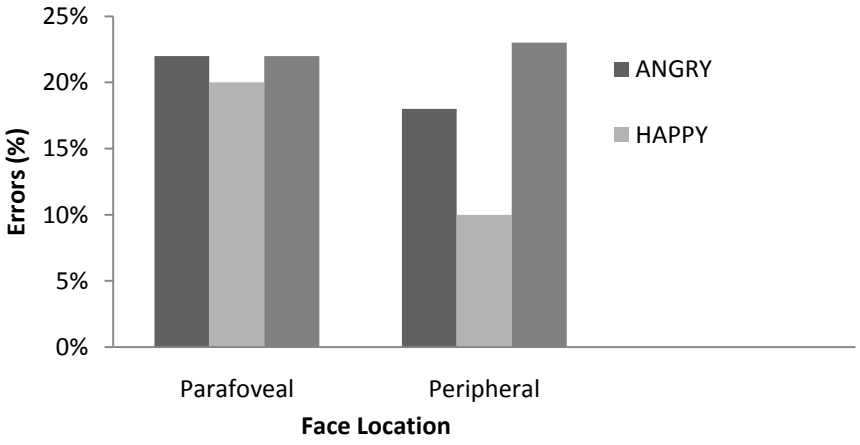


Figure B1. Percentage of errors as a function of face expression and eccentricity.

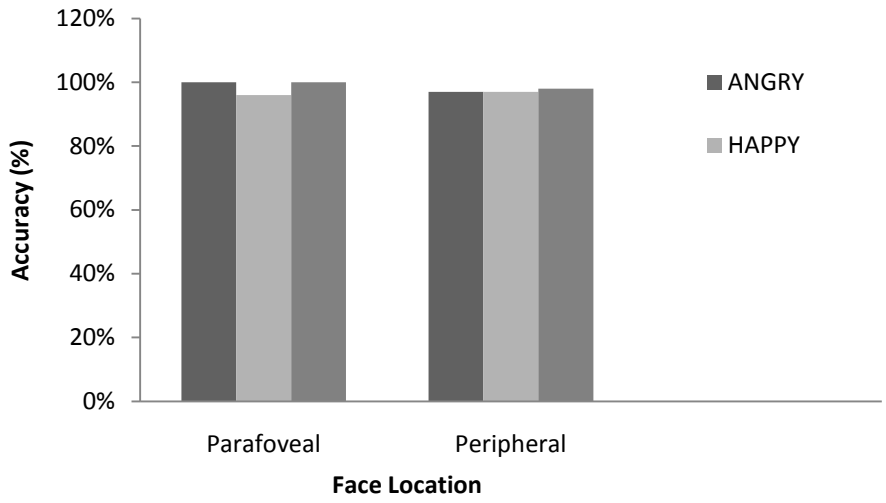


Figure B2. Percentage of accurate trials as a function of face expression and eccentricity.

B.5 Conclusions

Individuals between 11-14 years old were able to determine with high accuracy facial expressions in parafoveal and peripheral locations in the visual field; where this level of performance is comparable to that of adults. A small study conducted in our lab showed, for example, that adults could identify the expression (angry, happy or neutral) of faces in the parafovea with 97.73% (*SD* = 1.56) accuracy and the periphery with 94.97% (*SD* = 2.73) accuracy. As such, these stimuli were considered adequate for use in future experiments.

Appendix C: Questionnaire Measures

C.1 Attentional Control Scale for Adults (Derryberry & Reed, 2002)

Instructions: These questions are about how well you feel you concentrate on your work. Please answer each item, indicating how often it is true for you on the scale beside each question.

1 = Almost never 2 = Sometimes 3 = Often 4 = Always

1. It' s very hard for me to concentrate on a difficult task when there are noises around.
2. When I need to concentrate and solve a problem, I have trouble focusing my attention.
3. When I am working hard on something, I still get distracted by events around me.
4. My concentration is good even if there is music in the room around me.
5. When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me.
6. When I am reading or studying, I am easily distracted if there are people talking in the same room.
7. When trying to focus my attention on something, I have difficulty blocking out distracting thoughts.
8. I have a hard time concentrating when I am excited about something.
9. When concentrating I ignore feelings of hunger or thirst.
10. I can quickly switch from one task to another
11. It takes me a while to get really involved in a new task.
12. It is difficult to coordinate my attention between the listening and writing required when taking notes during lessons.
13. I can become interested in a new topic very quickly when I need to.
14. It is easy for me to read or write while I am also talking on the phone.
15. I have trouble carrying out two conversations at once.
16. I have a hard time coming up with new ideas quickly.
17. After being interrupted or distracted, I can easily switch my attention back to what I was doing before.
18. When a distracting thought comes to mind, it is easy for me to shift my attention away from it.
19. It is easy for me to alternate between two different tasks.
20. It is hard for me to break from one way of thinking about something and look at it from another point of view.

C.2 Friendship Questionnaire for Adults (Mendelson & Aboud, 2012)

Part A

The items on this form concern the kind of friend your best/casual same-sex friend is to you. Imagine that the blank space in each item contains your friend's name. With him or her in mind, decide how often the item applies. On the scale directly to the right of each item **circle the number** that indicates how often your friend is or does what the item says. There are no right or wrong answers because adult friendships are very different from one another. Just describe your friend as he or she really is to you.

	Never		Rarely		Once in a while		Fairly often		Always
1. ___ helps me when I need it.	0	1	2	3	4	5	6	7	8
2. ___ would make me feel comfortable in a new situation.	0	1	2	3	4	5	6	7	8
3. ___ is someone I can tell private things to.	0	1	2	3	4	5	6	7	8
4. ___ has good ideas about entertaining things to do.	0	1	2	3	4	5	6	7	8
5. ___ would want to stay my friend if we didn't see each other for a few months.	0	1	2	3	4	5	6	7	8
6. ___ makes me feel smart.	0	1	2	3	4	5	6	7	8
7. ___ makes me laugh.	0	1	2	3	4	5	6	7	8
8. ___ knows when I'm upset.	0	1	2	3	4	5	6	7	8
9. ___ helps me do things.	0	1	2	3	4	5	6	7	8
10. ___ points out things that I am good at.	0	1	2	3	4	5	6	7	8
11. ___ would be good to have around if I were frightened.	0	1	2	3	4	5	6	7	8
12. ___ would still want to be my friend even if we had a fight.	0	1	2	3	4	5	6	7	8
13. ___ lends me things that I need.	0	1	2	3	4	5	6	7	8
14. ___ would make me feel better if I were worried.	0	1	2	3	4	5	6	7	8
15. ___ is someone I can tell secrets to.	0	1	2	3	4	5	6	7	8
16. ___ would stay my friend even if other people criticized me.	0	1	2	3	4	5	6	7	8

	Never		Rarely		Once in a while		Fairly often		Always
17. ___ compliments me when I do something well.	0	1	2	3	4	5	6	7	8
18. ___ is exciting to talk to.	0	1	2	3	4	5	6	7	8
19. ___ makes me feel special.	0	1	2	3	4	5	6	7	8
20. ___ would stay my friend even if other people did not like me.	0	1	2	3	4	5	6	7	8
21. ___ knows when something bothers me.	0	1	2	3	4	5	6	7	8
22. ___ is exciting to be with.	0	1	2	3	4	5	6	7	8
23. ___ would make me feel calmer if I were nervous.	0	1	2	3	4	5	6	7	8
24. ___ helps me when I'm trying hard to finish something.	0	1	2	3	4	5	6	7	8
25. ___ makes me feel that I can do things well.	0	1	2	3	4	5	6	7	8
26. ___ would still want to stay my friend even if we argued.	0	1	2	3	4	5	6	7	8
27. ___shows me how to do things better.	0	1	2	3	4	5	6	7	8
28. ___is fun to sit and talk with.	0	1	2	3	4	5	6	7	8
29. ___makes me feel better when I’m upset.	0	1	2	3	4	5	6	7	8
30. ___is easy to talk about private things.	0	1	2	3	4	5	6	7	8

Part B

Write the initials of up to 10 people you interact with most in person, up to 10 people you interact with most on social networking sites, and up to 10 people you interact with most on instant messaging. **Individuals can be repeated across lists. <u>These people should not be a relative of yours or your partner.</u>**

In person	Social networking sites	Instant messaging
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Part C

ONLINE FRIENDS

This questionnaire should only be completed by young people who use social networks. If you do not use social networks please tick "No" and leave the rest of the questionnaire.

I use social networks: Yes ☐ No ☐

Please tick the social networks you use:

Facebook		**MySpace**		**Google+**		**Badoo**	
Bebo		**Twitter**				**Bolt.com**	

Now we want to ask some questions about your online friends. Please tell us if the sentence describes the way you think about online friends (compared to those in real life). Remember, there is no right or wrong answer.

Tick 1: If the statement is very true of your online friends (compared to those in real life)
Tick 2: If the statement is usually true of your online friends
Tick 3, if you think the statement is sometimes true and sometimes not true of your online friends
Tick 4: If you think the statement doesn't really describe your online friends
Tick 5: If it doesn't describe your online friends at all

Be sure to read carefully and answer as honestly as possible.

Compared to real life……	**1 Strongly Agree**	**2 Agree**	**3 Neither agree nor disagree**	**4 Disagree**	**5 Strongly disagree**
1. It is easier for me to make friends online					
2. I have less friends online					
3. I find it easier to communicate with friends online					
4. I can contact others when I want online					
5. My online friends understand me better					
6. It's easier to share secrets with friends online					
7. I have more fun with friends I know online					
8. I find it more difficult to communicate with friends online					
9. It is harder to make friends online					
10. I can be myself online					
11. I have more friends online					

THANK YOU FOR COMPLETING THESE QUESTIONS!

C.3 Attentional Control Scale for Children (Derryberry & Reed, 2002)

Attentional Control Scale for Children (ACS-C)

		1 Almost never	2 Sometimes	3 Often	4 Always
1.	It's very hard for me to concentrate on a difficult lesson if there is a lot of noise in the class	O	O	O	O
2.	If I have to concentrate and solve a difficult maths problem, I have trouble focusing my attention	O	O	O	O
3.	When I am working hard on something, I still get distracted by things going on around me	O	O	O	O
4.	My concentration is good, even when somebody turns the music on*	O	O	O	O
5.	When I concentrate, I do not notice what is happening in the room around me*	O	O	O	O
6.	When I am reading in the classroom, I am easily disturbed by other children talking to each other	O	O	O	O
7.	When I try to concentrate, I find it difficult not to think about other things	O	O	O	O
8.	I find it difficult to concentrate when I am excited about something	O	O	O	O
9.	When I am concentrating, I do not notice that I am hungry or thirsty*	O	O	O	O
10.	When I am doing something, I can easily stop and switch to some other task*	O	O	O	O
11.	When I have to start a new task, it takes me a while to get really involved in it	O	O	O	O
12.	When the teacher explains something, I find it difficult to understand and write it down at the same time	O	O	O	O
13.	When it is necessary, I can become interested in a new topic very quickly*	O	O	O	O
14.	It is easy for me to read or write while I am also talking to someone on the telephone*	O	O	O	O
15.	I have trouble having two conversations at the same time	O	O	O	O
16.	I find it difficult to come up with new ideas quickly.	O	O	O	O
17.	After being interrupted or distracted, I can easily shift my attention back to what I was doing before*	O	O	O	O
18.	When I am daydreaming or having distracting thoughts, it is easy for me to switch back to the work I have to do*	O	O	O	O
19.	It is easy for me to switch back and forth between two different tasks*	O	O	O	O
20.	I find it difficult to let go of my own way of thinking about something, and to look at it in a different way	O	O	O	O

C.4 Friendship Questionnaire for Children (Bukowski, 1994)

Participant number 

WHO ARE MY FRIENDS?

Tell me the names of your six best same-sex friends in your tutor group or year group.

MAKE SURE YOU RECORD THE FRIENDS' FIRST AND LAST NAME.

	FIRST NAME	**LAST NAME**
1.		
2.		
3.		
4.		
5.		
6.		

YOUR BEST FRIEND

Put the name of your very best friend here:

FIRST NAME:	**LAST NAME:**

We want to find out more information about you and the person you think of as your best friend. Please read the sentences below. Tell us for each sentence how much you think each one describes your friendship by ticking one of the boxes. Be sure to read each sentence carefully and answer as honestly as possible. Remember, there is no right or wrong answer.

Tick 1: If the statement is very true of your friendship (Strongly Agree)

Tick 2: If the statement is usually true of your friendship (Agree)

Tick 3, if you think the statement is sometimes true and sometimes not true (Neither Agree nor Disagree)

Tick 4: If you think the statement doesn't really describe your friendship (Disagree)

Tick 5: If it doesn't describe your friendship at all (Strongly Disagree)

Please think about your friend above when you answer these questions.

	1 Strongly Agree	**2 Agree**	**3 Neither Agree nor Disagree**	**4 Disagree**	**5 Strongly disagree**
1. My friend and I spend all our free time together					
2. My friend thinks of fun thinks for us to do together					
3. My friend helps me when I am having trouble with something					
4. If my friend had to move away I would miss him/her					
5. When I do something well my friend is happy for me					
6. If other kids were bothering me, my friend would help me					
7. Sometimes my friend does things for me or makes me feel special					
8. I can get into fights with my friend					
9. My friend would stick up for me if another child was causing me trouble					
10. If I have a problem at school or at home, I can talk to my friend about it					
11. My friend can annoy me even though I ask him/ her not to					
12. If I forgot my lunch or needed a					

little money my friend would lend it to me					
13. If I said I was sorry after I had a fight with my friend he/ she would still stay mad at me					
14. My friend and I go to each other's houses after school and on weekends					
15. Sometimes my friend and I just sit around and talk about things like school, sports, and other things we like					
16. My friend would help me if I needed it					
17. If there is something bothering me I can tell my friend about it even if it is something I cannot tell to other people					
18. If my friend or I do something that bothers the other one of us we can make up easily					
19. My friend and I can argue a lot					
20. My friend and I disagree about many things					
21. If my friend and I have a fight or argument we can say "I'm sorry" and everything will be alright					
22. I feel happy when I am with my friend					
23. I think about my friend even when my friend is not around					

ONLINE FRIENDS

This questionnaire should only be completed by young people who use social networks. If you do not use social networks please tick "No" and leave the rest of the questionnaire.

I use social networks: Yes ☐ No ☐

Please tick the social networks you use:

Facebook		**MySpace**		**Google+**		**Badoo**	
Bebo		**Twitter**				**Bolt.com**	

Now we want to ask some questions about your online friends. Please tell us if the sentence describes the way you think about online friends (compared to those in real life). Remember, there is no right or wrong answer.

Tick 1: If the statement is very true of your online friends (compared to those in real life)
Tick 2: If the statement is usually true of your online friends
Tick 3, if you think the statement is sometimes true and sometimes not true of your online friends
Tick 4: If you think the statement doesn't really describe your online friends
Tick 5: If it doesn't describe your online friends at all

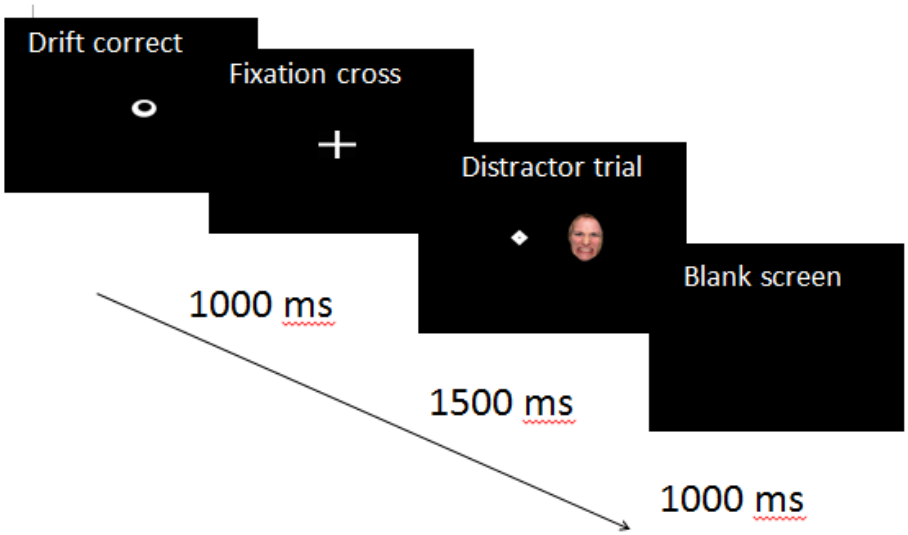
Be sure to read carefully and answer as honestly as possible.

***Compared to real life*……**	**1 Strongly Agree**	**2 Agree**	**3 Neither agree nor disagree**	**4 Disagree**	**5 Strongly disagree**
1. It is easier for me to make friends online					
2. I have less friends online					

3. I find it easier to communicate with friends online					
4. I can contact others when I want online					
5. My online friends understand me better					
6. It's easier to share secrets with friends online					
7. I have more fun with friends I know online					
8. I find it more difficult to communicate with friends online					
9. It is harder to make friends online					
10. I can be myself online					
11. I have more friends online					

THANK YOU FOR COMPLETING THESE QUESTIONS!

Appendix D: An example of the experimental procedure



Appendix E: Social Behaviour Assesment Task

E.1 Rating Form for the Social Behaviour Assesment Task

Patient Initials: _____ Patient ID#: _____
Assessment: _____ Tape #: _____
Rater Name: _____ Rater#: 1 or 2
Date: _____

Latency to First Utterance: Record the number of seconds between when the child actor finishes each line and when the target child begins to speak (**.1-10 secs**).

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Response time from Line 1:	_____	_____	_____	_____	_____
Response time from Line 2:	_____	_____	_____	_____	_____

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Number of Words Spoken (Do NOT include utterances, e.g., eh, uh, um, like)	_____	_____	_____	_____	_____

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Facial Orientation While Speaking	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

1= No eye contact or staring
2= Minimal eye contact; Less than 50% of interaction
3= Moderately appropriate eye contact; Greater than approximately 50% of interaction
4= Appropriate eye contact; Approximately 70% of the interaction

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Facial Orientation While Peer is Speaking	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

1= No eye contact or staring
2= Minimal eye contact; Less than 50% of interaction
3= Moderate eye contact; Greater than 50% of interaction
4= Appropriate eye contact; Approximately 70% of the interaction

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Motor Movement (Frequency of movement, not intensity. e.g., wringing hands; scratching self; playing with chair or other objects in sight)	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

1= Consistent throughout the entire interaction (this includes fine motor movements)
2= During most of the interaction; greater than 50% of interaction
3= During some of the interaction; less than 50% of interaction
4=Less than 50% of the interaction

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Posture-Stiffness (Stiff movements and whether lack of movement is stiff; not an all or nothing; e.g., arms crossed, seated at edge of chair)	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

1= Significantly stiff; seated at edge of chair (e.g., completely stiff, no movement)
2= Moderately stiff (completely stiff, but slight fluid movement)
3= Somewhat stiff (somewhat stiff, but some fluid movement)
4= Not stiff at all (all movement is fluid or posture is relaxed)

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Posture-Awkwardness (Seated away from other child; legs hanging over arm of chair; hand over face)	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

1= Significantly awkward; legs hanging over arm of chair
2= Moderately awkward (significantly awkward for 1 response; moderately awkward for both responses)
3= Somewhat awkward (e.g., leaning off to the side of the chair; facing somewhat away from peer)
4= No awkwardness (e.g., posture oriented towards peer)

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Voice Volume	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

(Loudness or softness)
1= Inappropriate voice volume; too loud or inaudible
2= Voice volume somewhat too loud or barely audible
3= Slightly too loud or moderately audible
4= Appropriate volume

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Vocal Fluidity	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

1= Trembling
2= Moderately trembling
3= Somewhat trembling
4= No trembling

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Vocal Inflection	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

(Vocal quality that indicates some emotion or feeling in voice)
1= Monotone; no inflection
2= Minimally appropriate inflection
3= Moderately appropriate inflection; inflection for only 1 response
4= Appropriate inflection for both responses

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Affect	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

(Degree to which the emotion displayed is appropriate to the social scenario; facial expressions; overt behavior)
1= Inappropriate affect (angry when complimenting)
2= Minimally appropriate affect
3= Moderately appropriate affect
4= Appropriate affect (smiles when displaying positive assertion, firm expression when assertive and offering help)

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Appropriateness of Response	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

(Degree to which the content of the response is effective; code response as a transcript)
1= No response to either prompt; response is not at all appropriate
2= Minimally appropriate response
3= Moderately appropriate;
4= Appropriate response; both responses are appropriate (e.g., says "thank you" when complimented; asserts oneself with a bully)

Average of All Scenes: _____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
Effort to Maintain Conversation	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

1= Did not speak at all; no response
2= Minimal response; responded to 1 prompt with minimum response (e.g., "ok")
3= Responded to both prompts with a minimal response (e.g., "ok," "ok"); elaborated on 1 response but did not respond to second prompt (e.g., "ok, that would be great," "--")
4= Effort to maintain conversation; elaborated on both responses; elaborated on 1 response and at least minimum response to other prompt (e.g., "ok, that would be great," "thanks")

Average of All Scenes:_____

	SCENE 1	SCENE 2	SCENE 3	SCENE 4	SCENE 5
	0 1	0 1	0 1	0 1	0 1

No Response to Entire Scene
0= responded to at least one prompt to a scene
1= no response to either prompt

Total (sum) number of scenes with no response_____

E.2 Inter-rater reliability analyses for the social behaviour assessment task

Inter-rater reliability

a. Categories

1. Overall

		Rater 2				Totals
		1	2	3	4	
Rater 1	1					
	2					
	3					
	4					
Totals						

2. Facial orientation (while speaking/ while peer speaking)

		Rater 2				Totals
		1	2	3	4	
Rater 1	1					
	2					
	3					
	4					
Totals						

3. Motor behaviour (movement/ stiffness/ awkwardness)

		Rater 2				Totals
		1	2	3	4	
Rater 1	1					
	2					
	3					
	4					
Totals						

4. Voice (volume/ fluidity/ inflection)

		Rater 2				Totals
		1	2	3	4	
Rater 1	1					
	2					
	3					
	4					
Totals						