UNIVERSITY OF SOUTHAMPTON

Faculty of Medicine, Health and Life Sciences

School of Psychology

EXPLORING THE ROLE OF ATTENTIONAL INHIBITION IN THE DEVELOPMENT OF ANXIETY IN CHILDREN

NAIDA SOUTHALL

Doctorate in Clinical Psychology

May 2007

Word count: 19,396

Acknowledgements

I would like to thank my parents for their support and encouragement in this piece of work. In particular, Angela for her proof reading and feedback, Jo for technical support and supply of a laptop and printer cartridges and Richard for the many words of encouragement when they were most needed. All of my family have been very patient and accommodating throughout.

I would also like to thank all of my friends for their support. In particular I would like to thank Tanya, Matt and Stuart for providing connections for data collection. I would also like to thank Kevin for writing scoring programmes for the Presentation output at short notice, for the loan of a computer and for his continued help, support, encouragement and faith in all aspects of my training.

From the University of Southampton, I would like to thank Dr Jin Zhang for arranging Licenses in her own time, Luke Phillips for writing the Presentation software and Debra Morris (Hartley Library) for forwarding research articles that I had been unable to access.

It goes without saying that I would like to thank all of the young people who gave up their time to take part in this study. Without their interest and cooperation this study could not have been completed. In addition I would like to thank staff at the schools involved for giving up their time and space in order that this study could be done.

Finally I would like to thank my supervisor, Dr Julie Hadwin, for her helpful suggestions and comments on the experimental procedure and data collection, feedback on the literature review and statistical advice and guidance.

Abstract

There is strong evidence for information processing biases in attention to threat in adults who are high in anxiety (e.g., Williams, Watts, MacLeod & Matthews, 1988, 1997). Research has highlighted that attention bias appears to be of importance in the maintenance of anxious states with attention towards and away from threatening stimuli being identified as influential in processing of emotionally valent material (Mogg & Bradley, 1998; Williams et al. 1988, 1997). More recently, theorists have questioned whether it is the capture of attention or the ability to inhibit attention that plays a role in the development of anxiety disorders (Derryberry & Reed, 2002; Fox, 1993).

The first paper explores the literature to date, discussing current models in the adult literature before moving on to the emerging findings from studies of childhood anxiety. Consideration is given to the adaptive role of attention to threat and to the physiological processes underlying this. The development of effortful control used in inhibiting attentional processes is discussed in terms of neurological development over childhood. Attention is drawn to gaps in the literature and directions for future research, as well as the application of findings to clinical practice.

The second paper goes on to examine the relationship between attention control, chronological age and anxiety in a developing population. The study aimed to explore whether the relationship between anxiety and attention to threat in children is moderated by age and attentional control.

A community sample of 42 children, aged 8 to 16, completed measures of trait anxiety, attention control, state anxiety and depression. Two computer based tasks were also administered; a modified version of the emotional Stroop and a Go/Nogo task.

The main results identified were a negative relationship between attention to angry faces and state anxiety. This relationship was moderated by and facilitated by an interaction between age and attention control. The limitations of employing a correlational design and effect of task duration on children's ability to maintain concentration is discussed.

Contents

Literature Review

EMPIRICAL PAPER

Index of Tables

Literature Review

EXPLORING THE ROLE OF ATTENTIONAL INHIBITION IN THE DEVELOPMENT OF ANXIETY IN CHILDREN

Prepared as if a submission to:

Developmental Psychology

(see Appendix A for instructions for authors)

Exploring The Role Of Attentional Inhibition In The Development Of Anxiety In Children

Naida Southall

School of Psychology

University of Southampton

Address for correspondence:

Naida Southall, Doctoral Programme in Clinical Psychology, School of Psychology, University of Southampton, Highfield, Southampton, Hants. S17 1BJ. United Kingdom (tel: ++44 23 80 595321; fax: + 44 23 80 592588).

Running Header:

Attentional bias in anxiety

Abstract

Cognitive models have highlighted links between a predisposition for anxiety and information processing biases for threat in memory, attention and the interpretation of ambiguity (e.g., Williams, Watts, MacLeod & Matthews, 1988, 1997). This paper focuses on the role of attention biases in anxiety. A range of experimental paradigms have been used to investigate attentional biases and have provided robust evidence in support of cognitive models of anxiety. Research has highlighted, for example, that attention appears to be of considerable importance in the maintenance of anxious states with attention towards and away from threatening stimuli being identified as influential in processing of emotionally valent material (Mogg & Bradley, 1998; Williams et al. 1988, 1997). More recently, theorists have questioned whether it is the capture of attention or the ability to inhibit attention that plays a role in the development of anxiety disorders (Derryberry & Reed, 2002; Fox, 1993). Differences between findings in the adult and child populations have highlighted the ability to control emotional processing as key in the experience of increased levels of anxiety and the development of information processing biases. The development of ability to inhibit attentional processes around middle childhood occurs alongside the development of enhanced evaluative thinking and ability to regulate behaviour accordingly by effortful control (Derryberry & Rothbart, 1997). It is suggested that failure to develop these skills leads to increased levels of anxiety and the subsequent development of anxiety disorders (Kindt, Bierman & Brosschot, 1997).

Current models in the adult literature are examined before discussing the emerging findings from studies of childhood anxiety. Consideration is given to the adaptive role of attention to threat and to the physiological processes underlying this. The development of effortful control used in inhibiting attentional processes is discussed in terms of neurological development over childhood. Attention is drawn to gaps in the literature and directions for future research, as well as the application of findings to clinical practice.

Key words: Childhood anxiety, development, attention, selective attention, information processing, bias, attentional inhibition, effortful control.

Introduction

Anxiety is a complex interaction of cognitive, somatic, emotional, and behavioural components bought on by the anticipation of threat or potential threat (Seligman, Walker & Rosenhan, 2001). The expectation of danger causes arousal of the autonomic nervous system in preparation for 'flight or fight'. As the body prepares the organism to deal with threat, voluntary and involuntary behaviours may arise directed at escaping or avoiding the source of anxiety. Whilst this reaction is a necessary adaptive function essential to survival, when experienced in reaction to non- threatening stimuli the resulting behaviours are often maladaptive and self-maintaining (Clark, 1986). Under these circumstances anxiety can have a range of undesired effects on an individual's functioning, ranging from embarrassment caused by blushing to panic attacks and avoidance of particular stimuli or situations (Clark, 1989). The course of anxiety disorders is often chronic and can cause significant distress to the individual (National Institute for Clinical Excellence, NICE, 2004).

In the UK, anxiety disorders represent one of the leading causes of people seeking medical and mental health services (Boyd, 1986); although precise and accurate U.K. referral data for anxiety disorders are difficult to find (NICE, 2004). A survey on behalf of the Department of Health estimates 16% of

adults aged 16 to 74 to have a neurotic disorder, the most common being mixed anxiety and depressive disorder, 9%, consisting of 4% generalised anxiety disorder (GAD), 3% depressive episodes and 2% phobias, obsessive compulsive disorder (OCD) and panic disorders (Office of National Statistics, 2001). Similarly, studies in North America suggest that the incidence of all anxiety disorders in the U.S. is estimated at 17% for one-year prevalence and 25% lifetime prevalence (Kessler, McGonagle, Zhao & Nelson, 1994).

Anxiety is also a common disorder of childhood affecting between 6 and 10% of children and adolescents (Ost & Treffers, 2001), although different anxiety disorders are more common to different age groups. The content of children's anxieties is observed to change over time as a consequence of their developmental experiences and increasing cognitive abilities (Koplewicz, 1996). Typically developing infants tend to fear strangers, loud noises and unexpected objects whilst toddlers experience separation anxiety and fear of the dark (Dadds, Seinan, Roth & Harnett, 2000). Anxiety disorders such as separation anxiety disorder emerge when fears become developmentally inappropriate and excessive (American Psychiatric Association, 2000). Phobias are more prevalent in early childhood with test anxiety and school phobia emerging in middle childhood. Agoraphobia, panic disorders and social phobias are most prevalent in adolescence (Carr, 2006).

Childhood anxiety is of particular concern, due not only to its potential impact on the child's social and educational development (Kashini & Orvaschel, 1990) but also to the high degree of comorbidity it has with depression and

other forms of childhood psychopathology (Cole, Peeke, Martin, Truglio & Syrocynski, 1998), the co-occurrence of which is also linked to more severe anxiety symptoms (Strauss, Last & Hersen, 1998). In addition, the experience of anxiety in childhood is reported to increase the risk for anxiety in adulthood by two to three times (Pine, Cohen, Gurley, Brook & Ma, 1998) and is a significant risk factor for the development of other psychological disorders in adulthood (Cole et al., 1998; Orvaschel, Lewinsohn & Seeley, 1995).

Findings in the adult literature suggest that individuals with anxiety exhibit information processing biases favouring threat. Although recognition of threat and activation of the 'flight or fight' reaction is necessary to the survival of the individual and, as such, is considered a vital and healthy reaction (Beck & Clark, 1997; Mathews & Mackintosh, 1998; Mogg & Bradley, 1998), individuals with increased levels of anxiety are observed to have heightened attention to threat stimuli in the immediate surroundings. Evidence has been found for increased detection of threat in the environment and increased orientation towards threat by anxious individuals (e.g. Williams et al., 1988, 1997). Cognitive models suggest that an interaction of information processing biases favouring threat in the areas of attention, memory and the interpretation of ambiguous information distinguish anxiety from other states (Beck, Emery & Greenberg, 1985; McNally, 1994).

For instance, Beck et al.'s (1985) schema-based model of anxiety describes a three-stage sequence of information processing that may lead to the

inappropriate generation of threat-meaning assignments to stimuli. In this model, it is proposed that the first stage involves rapid and automatic detection of threatening stimuli in the environment which assigns information processing priority to life threatening stimuli or situations. Next, the body prepares for action through arousal of the autonomic nervous system and activation of automatic cognitive strategies aimed at limiting danger (such as hypervigilance and perceptual narrowing). Finally, it is suggested that more effortful and elaborative processing of the stimuli or situation takes place in which the individual evaluates their ability and the effectiveness of their resources to deal with the perceived threat. As the individual moves through the stages, processes become less automatic and more evaluative with processing in the later stages drawing on semantic information held in schemas biased towards threat (see also Beck and Clark, 1997).

There has been much interest over the years in the cognitive processes that occur in the identification of threat in the environment and in initiating a sequence of response to this threat. Researchers have been particularly interested in the degree to which these processes occur beyond conscious awareness and whether processing occurs automatically or draws upon more elaborative cognitive processes. Certainly, those parts of the brain aimed at recognising and responding to threat are believed to be evolutionarily primitive and are thought to function quite independently of other processes of the brain (Gray, 1982; Isaacson, 1982). More controlled cognitive processes capable of analysing information, making informed decisions and inhibiting behaviour lie in more recently evolved structures such as the cerebral cortex

and frontal lobes (Posner & Rothbart, 1992). It is the interaction between these structures that is of interest. To date, of the various cognitive processes involved in anxiety, studies involving the attentional processes have proved most reliable and have shown attention to be fundamental in threat recognition and response.

The importance of determining the nature of attentional biases implemented in the development of anxiety disorders has been highlighted in understanding the development of anxiety disorders (review by Hadwin, Garner & Perez-Olivas, 2006). It has been noted that facilitated capture of attention may be related to improved awareness of threat in the environment, whereas impaired attentional disengagement may be related to prolonged anxiety states and difficulties in task performance in the presence of threat (Derryberry and Reed, 2002). This highlights the importance of studying attention engagement and disengagement in anxiety as well as the conscious and subconscious mechanisms involved in information-processing in the development of anxiety disorders.

Unexpected differences in findings between adult and child research have also highlighted the need to study the development of attention in children including the development of typical and atypical experiences of anxiety (Kindt, Bierman & Brosschot, 1997). The study of anxiety in adults alone cannot be depended upon to inform reliable models of the developmental pathway of anxiety disorders; it is not possible to confidently determine the origin of the information processing biases identified and whether they are

either causative or resultant of anxiety or, indeed, whether they may have arisen merely as part of coping strategies in response to years of living with high anxiety.

The present paper intends to examine the role of inhibition of attention to threat in the development of anxiety disorders in childhood by focusing on the role of the ability to control the attentional processes involved. The emerging cognitive models of anxiety will be discussed along with the supporting evidence as observed in studies employing modifications of the paradigms typically used with adults for which a vast body of literature exists describing empirical findings related to attentional processes. The findings in the child literature will then be discussed with emphasis on how differences between the findings in adult and child studies have led to improved understanding of how anxiety disorders develop. This level of analysis will be described in relation to the development of anxiety disorders through the failure to develop an adequate system of attention inhibition in children. The neurological underpinnings of the anxiety and attention systems will also be described and related to the development of neurological structures throughout childhood and early adolescence and specifically how these structures relate to the development of the normal and abnormal processing in anxiety reactions.

Information processing bias in psychological disorders

A number of cognitive models for anxiety disorders have been suggested including panic disorder (Clark, 1986), social phobia (Stopa & Clark, 1993), obsessional disorders (Salkovskis, 1989), and GAD (Beck et al., 1985). Central to these models is the proposal that a bias for threat in the information processing areas of attention, interpretation and memory leading to the development and maintenance of anxiety disorders. For example, Clark (1986) described how anxiety can result from the individual's misperception of events as threatening. The resultant physiological responses are then, in turn, misinterpreted as a further source of stress, leading to the development of a series of 'vicious circles' that serve to maintain or exacerbate the anxiety reaction. Thus, information processing biases are proposed to be central to the development and maintenance of anxiety disorders (Beck and Clark, 1997).

Early schema-driven models of anxiety (e.g. Beck, 1976; Bower, 1981) suggested that processing biases in emotional disorders are content-specific. That is, individuals with anxiety are biased towards processing threatening stimuli, whilst individuals with depression are similarly biased towards information and materials of a depressive nature. Yet, despite the observed attentional bias for threatening material in anxious individuals (discussed

further below), no attentional bias for depressive stimuli has been identified in people with depression (e.g. Mogg, Bradley, Williams & Mathews, 1993). Conversely, individuals with depression have exhibited biases in memory and interpretation of ambiguity, whereas evidence for biases in these processes in individuals with anxiety is mixed.

Similarly, McNally, Foa and Donnell (1989) provided evidence for memory bias in panic disorder using a free recall test for previously presented anxiety and non-anxiety related words. Patients with panic disorder were observed to recall a greater number of anxiety related adjectives than non-anxiety adjectives, with the pattern being reversed in non-anxious subjects. Despite this finding, researchers have failed to find bias for anxiety related stimuli in GAD (Mathews, Mogg, May & Eysenk, 1989), social phobia (Rapee, McCallum, Melville, Ravenscroft & Rodney, 1994), or specific phobia (Watts and Coyle, 1993).

McNally (1997) observed that memory biases appear to be specific to particular disorders, namely panic disorder and posttraumatic stress disorder, although enhanced accessibility of danger related information would be influential in exacerbating proneness to anxiety in ambiguous situations. Mathews, Richards, & Eysenck (1989) identified that anxious individuals were more likely to give the threatening spellings of ambiguous homophones than individuals who were no longer anxious ("recovered") and non-anxious controls. These findings have been repeated using a range of different stimuli such as spoken comments (Amir, Beard & Bower, 2005), reading tasks

(Calvo & Castillo, 2001) and lexical decision tasks using homographs (e.g. Calvo, Eysenck, & Estevez, 1994; Hirsch & Mathews, 1997). As processing biases in memory and ambiguity have not been consistent, schema models have lost popularity with subsequent models of anxiety which have focused more centrally on attentional processes.

The suggestion that different disorders may be associated with different processing biases has led to further research to explore attentional biases in anxiety and the possibility that these may be related to preattentive processes favouring threat material rather than conscious processes that draw more on memory or elaborative biases (Williams et al., 1988, 1997).

The following sections provide an overview of the study of attentional processes and their bias for threat in anxious individuals. The review is presented chronologically in order to provide a historical background to the development of researchers' interest and understanding of attentional bias, beginning with the study of basic attention mechanisms such as selective attention and interference. Attentional bias to threat was originally studied in adult populations with a particular focus on the pre-attentive nature of processes leading on to an interest in the interaction between these automatic processes and more controlled evaluative and inhibitory processes. The subsequent study of attention biases in developing populations, aimed at exploring the origin of attention bias and the development of anxiety disorders, is then discussed in the context of theories emerging from the adult literature and the mixed findings from empirical studies with children.

Selective attention

The study of attention has spanned many decades with early researchers being particularly interested in the way attention is afforded to some stimuli in the environment over others (e.g. Broadbent, 1958; MacKay, 1973; Treisman, 1964). The attentional system must allow for selective deployment of attention for goal related processing whilst filtering out distracting stimuli. At the same time, changes outside the area of immediate focus need to be monitored in order to allow for stimuli of potential significance to intrude on the focus of attention (Perez-Edgar & Fox, 2005). Early studies identified selective attention (e.g. Cherry, 1953), divided attention (e.g. Gopher & Donchin, 1986) and attention switching (e.g. Neisser, 1967) as functions important in the three main areas of attention: orientation to sensory events, detection of signals for conscious processing and maintenance of an alert or vigilant state (Kahneman, 1973).

For example, using a listening paradigm, Cherry (1953) demonstrated that listeners were able to fully attend to a message played to one ear, whilst being aware of only superficial information, such as gender of speaker, about a second message played simultaneously to the other ear. A filter system allowing analysis of critical information, whilst ignoring other information, was initially proposed (Broadbent, 1958). It was later suggested that several channels work in parallel to perform preattentive, automatic processing that affords low level analysis of unattended information, including minimal

semantic analysis; before selecting one channel for further processing (Neisser, 1967; Norman, 1968).

In dual task experiments, it has been shown that subjects are able to apply their attention to two tasks, albeit with a loss of performance in both, signifying a limited capacity for attentional resources, the competition for which may subsequently cause interference between the two processes (Gopher & Donchin, 1986). However, processes which are highly practiced and have become automatic, such as driving or playing a musical instrument, can be performed alongside other processes without performance loss or interference (Shiffrin, 1988). Further studies of dual tasks have found that secondary stimuli are processed at an unconscious level whilst full attention is paid to a primary task. For example, Näätänen (1990) detected event-related potentials (ERP), to show that changes in sounds played to subjects giving their full attention to a reading task had been detected and resulted in measurable neurological activity despite individuals not consciously being aware of this process. This finding suggests that secondary stimuli can be analysed in a rapid, automatic process requiring few cognitive resources and is the basis for switching attention.

Competition for attention resources is observed in the well known 'Stroop' (1935) paradigm in which colour words are presented in incongruent ink colours and subjects are required to name the ink colour. In this task, the over learned skill of reading, an automatic process for the majority of adults, competes for attentional resources with the task of colour naming. The

interference effect is well documented and demonstrates not only the process of interference, but also the individual's ability to inhibit this reaction. The Stroop paradigm forms the basis of many studies looking at attentional processes due to its ability to induce competition between automatic and controlled processes (Haberlant, 1997). The task is considered an effective measure of executive functions controlled by the frontal lobes; patients with lateral lesions in the prefrontal lobes are reported to show a higher number of errors in the Stroop task compared with normal controls (Vendrell et al., 1995).

Attention to threat and its physiological basis

A system capable of detecting threat stimuli is of considerable importance to the survival of any organism and, as such, attentional bias for threat is well documented in non-anxious individuals (e.g. Fox et al. 2000). Threat stimuli are known to automatically capture attention over non-threatening stimuli, where this process affords priority to the processing of threatening stimuli in the environment and is key to the survival of the organism (e.g. Mogg et al. 2000; Wilson & MacLeod, 2003). This rapid processing of threatening stimuli is of such importance that it is suggested that attention capture by evolutionarily relevant threat stimuli is innate (Öhman, 1997). Indeed, there is evidence for neurological structures aimed solely at detecting threat in the form of movement independent of other stimuli in the visual field. This attentional movement filtering mechanism has been located in the medial

temporal region of the cortex along with specialised visual nuclei sensitive to moving objects (Livingston & Hubel, 1988).

The processing of stimuli aimed primarily at survival of the organism is known to occur in the limbic system of the brain, a relatively primitive part of the brain involved in evolutionarily older aspects of mental life and behaviour and implemented in motivation, emotion and emotional association with memory (Gray, 1982; Isaacson, 1982). This early system is shared with all other vertebrates; whereas other areas of the brain which developed later in evolutionary terms are shared with fewer vertebrates. Indeed, only mammals are believed to possess neocortex, the top layer of the cerebral cortex, which is a fairly recent evolutionary development associated with higher functions including sensory perception, generation of motor commands, conscious thought, reasoning skills, social understanding and, in humans, language (Karten, 1997).

Studies using animals have identified the amygdala, a small almond-shaped group of neurons located deep within the medial temporal lobes of the brain, as essential in fear and memory of fear (e.g. LeDoux, 2005). Early research centred on the neuroanatomy of fear conditioning, a well known phenomenon first studied by Pavlov (1927, cited in LeDoux, 2000) in which a neutral stimulus (such as a tone, or bell) is paired with a significant event (unconditioned stimuli) which can be positive or negative (e.g. food or electric shock) so that the neutral stimuli becomes 'conditioned' to illicit the same response as the unconditioned stimuli (e.g. salivation or defence behaviours).

This research has identified the amygdala as the central structure in fear conditioning by facilitating the transmission of information about the conditioned and unconditioned stimuli gained through the sensory system to the behavioural, autonomic and endocrine control systems located on the brainstem (see Aggleton, 1992).

Current understanding of the amygdala and its neurological structure and functioning is at such an advanced stage that scientists have identified 12 different regions which can be subdivided into further regions. They have identified which of these are most relevant to fear (the lateral, basal, accessory basal and central nuclei and the connections between them) and have a good understanding of the synaptic pathways into, through and out of the amygdala (see LeDoux, 2000, for a detailed summary).

As part of the limbic system the amygdala is thought to act independently of the later emerging higher cognitions. Animal studies have shown that there are two routes through which the amygdala receives sensory information about threat. One is a visual pathway from the retina, through the lateral geniculate bodies of the thalamus to the primary visual cortex for cortical visual processing. Object recognition is achieved in the inferior temporal lobe and information is conveyed to the amygdala for emotional activation. The second route is a faster, more direct route from the thalamus; for which cortical processing is not necessary (LeDoux, 2000).

In humans, functional magnetic resonance imaging (fMRI) has been used to monitor the blood-oxygen-level-dependent signals in the amygdala during fear conditioning. Findings highlight that subliminally presented conditioned stimuli activate pathways between structures not active for supraliminally presented conditioned stimuli (Morris, Öhman & Dolan, 1998). These structures (the superior colliculus and pulvinar) are thought to be part of the rapid, subcortical pathway for emotion detection in humans (Phelps & LeDoux, 2005).

Cognitive studies have also provided evidence for this crude but effective, low processing pathway. For instance, Soares and Öhman (1993) concluded that backward masking of visual threat stimuli (pictures of snakes), demonstrated that emotional information that has not been processed by the visual cortex still results in psychophysiological reaction (as measured by enhanced skin conduction), in those individuals with a fear of snakes. Cognitive models are discussed further below.

Studies using human subjects have also demonstrated greater amygdala activity in response to fear conditioning using electric shock (Furmark, Fischer, Wik, Larson, & Fredrickson, 1997; LeDoux, 1996, 2000), threatening words (Isenberg et al., 1999), aversive tastes and odours (Zald, & Pardo, 1997), and fearful verses happy faces (Morris et al., 1996).

In addition, findings from studies using patients with damage to the amygdala have demonstrated deficits in fear conditioning (Bechara et al., 1995), in the

detection of emotional tone in voices (Scott et al., 1997) and in the perception of emotional meaning in faces (Calder et al., 1996).

Selective attention to threat and anxiety

Attentional engagement / orientation to threat stimuli

Although notably a mechanism of survival, the capture of attention by threatening stimuli has been found to be stronger in those individuals with increased levels of anxiety (e.g. Mathews & Mackintosh, 1998; Mogg & Bradley, 1998). These findings have led to the suggestion that hypervigilant attention mechanisms may contribute to the heightened anxiety and the development of anxiety disorders. Specifically, it is suggested that orientation of attentional resources towards threatening information is one of the central cognitive vulnerabilities in high anxious individuals, whilst low anxious individuals are observed to orientate away from negative stimuli (Williams et al., 1988, 1997).

In an early paper, MacLeod, Matthews and Tata, (1986) demonstrated this phenomenon using the attentional deployment or dot-probe task. In their task, two words, one threatening and one non-threatening, appeared on a screen together with one above and one below the central line. When the words disappeared a dot appeared in place of one. Subjects were required to read aloud the top word of each pair and to indicate where the dot appeared on the screen by pressing a button. Patients with GAD were found to

respond more quickly when the dot was preceded by a threat related word suggesting a selective attention bias towards threat. Conversely, non-anxious controls were faster detecting the dot when it replaced a non-threatening word suggesting low anxious individuals exhibited attentional avoidance of threat stilmuli.

As previously noted, the limited capacity of the attentional system results in competition for processing resources meaning that involuntary processing of threatening word stimuli occurs at the expense of more effortful, voluntary processes resulting in an interference effect that slows performance. In a related study, Mathews and MacLeod (1986) used a dichotic listening task to demonstrate that threatening auditory stimuli were processed involuntarily by anxious individuals resulting in an interference effect during a reaction time task. Subjects were asked to press a button when directed to by a visual cue presented on a computer. At the same time, individuals shadowed stories presented on the attended channel whilst individual words, either threatening or non-threatening, were presented on the unattended channel at equal or lower volume. Results suggested that information processing resources had been diverted from the reaction time task by threatening words presented in the unattended channel. Subjects were later unable to recall these words at greater than chance; indicating that diversion of attentional resources towards the threatening stimuli had occurred at an unconscious level.

Similar interference effects have been found using modifications of the emotional Stroop paradigm. For instance, Mogg, Mathews and Weinman

(1989) found a slowing effect for individuals with GAD in naming ink colours of words which included threatening words versus non-threatening words. This result suggested that the attention of anxious individuals had been captured by the threatening meaning of the words despite their not being consciously processed. These findings have been replicated in non-clinical samples. Richards and Millwood (1989) showed that individuals with anxiety below clinical thresholds also exhibited biases in selective processing of threat stimuli through a slowing of colour naming anxiety related words as compared to neutral words matched for length.

Studies have consistently provided evidence indicating that individuals high in trait anxiety orientate towards threat stimuli, whilst individuals low in anxiety orientate away from threat (although see Mogg & Bradley, 1998, below). Cognitive models of information processing bias in anxiety therefore suggest that biased attention for threat is one of the main vulnerabilities in the development and maintenance of anxiety (e.g. Beck, Emery & Greenberg, 1985; Eysenk, 1992; Williams et al., 1988). The findings of MacLeod et al., (1986) have been replicated using different clinical groups (e.g. posttraumatic stress disorder; Bryant & Harvey, 1997), non-clinical groups (e.g. Bradley, Mogg & Miller, 2000) and different stimuli including emotion faces (e.g. Bradley, Mogg, White, Groom & de Bono, 1999) and threatening pictorial scenes (e.g. Mogg et al., 2000). In addition, the trend towards attentional engagement with threatening stimuli is found to be stronger in anxious individuals tested in stressful conditions (MacLeod & Mathews, 1988; Mogg, Bradley and Hallowell, 1994); highlighting a role of elevated state anxiety in

this process. Related research has found preattentive bias for threat and initial orientation to threat in individuals with GAD without depression, but not in those with GAD and depression suggesting that this process seems to be inhibited in individuals with depression (Bradley, Mogg, Millar & White, 1995).

Clearly, there exists a substantial body of evidence confirming the role of anxiety in orientation of attentional resources towards and away from threat. However, Mogg and Bradley (1998) question the efficacy of a system of threat monitoring in which low anxious individuals always orientate away from threat. They suggest that, in order to survive, a threshold of threat intensity must exist to which even low anxious individuals respond. Otherwise, real and apparent threat would be ignored by low anxious individuals potentially placing them at risk of harm in situations that are genuinely threatening

Evaluation of threat

Evaluative models of anxiety address the anomalies found in directional models. The cognitive motivational model (e.g. Mathews & Mackintosh, 1998; Mogg & Bradley, 1998) assumes that attention to threat is a normal and adaptive process which determines allocation of resources based on current task demand and stimulus input. It proposes that the appraisal of a stimulus as exceeding a certain threshold for threat leads to inhibition of attention to the current task and direction of attentional resources towards the novel, potentially threatening stimulus. Thus, non-anxious individuals may exhibit

increased attention to threat in an environment in which there is high threat; whereas highly anxious individuals may exhibit increased attention to threat with stimuli of low threat value. In support of this hypothesis, It has been found that individuals high in trait anxiety are more likely to interpret a stimulus of low level threat as highly threatening compared with low anxious individuals (Mogg et al., 2000; Wilson & MacLeod, 2003).

In an attempt to assess the degree of threat, Mogg et al. (2000) devised a dot probe task using pictures graded for threat valence. Their first experiment used black and white picture scene stimuli taken from a range of sources including magazines, criminology texts and video stills and rated as mild-, high- and non-threatening. Consistent with the predictions of the cognitive motivational model, the study found an increase in attention towards threat not only with level of trait anxiety, but also with increased threat valence of the stimuli. Response times indicated that the attentional resources of high anxious individuals were drawn towards highly threatening stimuli with a reduction in orientation away from stimuli in the highly threatening scenes. Mogg et al. (2000) replicated these results in a second experiment using colour pictures from a standardised set of emotion pictures for which normative data was available (International Affective Picture System; Lang, Bradley & Cuthbert, 1995).

Wilson and Macleod (2003) also used a system of varying stimulus intensity to evaluate the same models; which they termed the biased attentional direction account (e.g. Williams et al.,1988, 1997) and the shifted attentional

function account (e.g. Mogg & Bradley, 1998). They used computer software to alter the facial expression of one individual to create a continuum from a neutral to high angry face. The findings again supported the view that orientation of attentional resources towards threat stimuli increased in anxious individuals. However, they noted that this was only to a point and that mildly threatening stimuli may or may not capture attention based on evaluation. Highly threatening stimuli were observed to capture the attention of both low anxious and high anxious individuals.

Wilson and MacLeod (2003) concluded that the difference between their two groups of participants was their pattern of response to moderately threatening stimuli. However, they added that whilst the findings supported the view that more anxious individuals may view intermediately threatening stimuli as threatening than non-anxious individuals, this could not be concluded from findings due to the fact that the underlying mechanism of the subjective appraisal of threat could only be guessed at. Indeed, their study included a rating task in which subjective threat of the facial expressions used was scored; no difference was found in ratings given by low anxious and high anxious individuals.

Backward masking is a technique in which stimuli are shown only very rapidly (subliminally) and then replaced with a colour patch mask. Some researchers (e.g. Mogg & Bradley, 1999) have failed to find evidence for preattentive capture of attention using this technique with threat stimuli that are very close to awareness. This is despite consistently producing evidence

for preattentive capture of attention using threat stimuli for which awareness is more restricted. Together with the findings above, this suggests that stimuli above a certain threshold, which are perceived only momentarily, rapidly capture attention. However, it is suggested that stimuli that remain in awareness for longer are processed by more active efforts which may interfere with processing by more automatic mechanisms. Therefore, subliminally perceived threat stimuli that are closer to conscious awareness do not hold attention to the same extent as threats of more restricted awareness. These findings provide support for the survival orientated fast track route for the automatic processing of fear stimuli as well as a more complex route of processing that draws on previous experience and semantic knowledge (LeDoux, 2000).

Further evidence for this pathway is provided in neuropsychological studies of brain activity by neuroimaging during exposure to emotional faces. Results have shown that although there is concurrent activity in the amygdala, dorsal anterior cingulate and medial prefrontal, subcortical amygdala activity was relatively persistent for subliminal fear, whereas supraliminal fear showed more sustained cortical activity (Williams et al., 2006).

Attentional disengagement

Many studies of attention bias have relied on one of two paradigms, emotional modifications of the dot-probe and the Stroop. Whilst each of these has advantages in the study of selective attention, they also have their limits.

Fox (1993) presents evidence challenging the reliability of the traditional Stoop as a test of selective attention. Whilst it is a good test of interference bought about by the cognitive demands of automatic processing of two pieces of information at once, Fox (1993) argues that all information within a radius of 1^{o} of the visual field is processed and that to reliably test for selective attention the most appropriate method would be to present the to-be-attended to and distracting information in spatially separate locations. She queries whether the Stroop-like interference from threat-related stimuli identified in anxious individuals in a number of studies can be reliably interpreted as selective attraction of attention by threatening information. Yet, Fox (1993) also suggests that the dot-probe is not a good measure of ability to ignore distraction which appears outside the focus of attention as subjects' best strategy in such a task would be to constantly shift attention between the two possible locations in which the dot could appear.

Fox (1993) overcomes these difficulties by using a modified version of the Stroop task that separated target stimuli and distracting information in an attempt to more reliably explore selective attention to threat stimuli in anxious individuals. By presenting neutral or threatening words above and below colour patches, Fox (1993) demonstrated that threatening words not immediately in the area of focus distracted highly anxious individuals; suggesting that unattended information was semantically processed. However, it was also noted that highly anxious individuals were distracted by non-threatening colour-word stimuli; indicating that there may be a more generic difficulty in ignoring distracting stimuli in anxious individuals. This

increased distraction by non-threatening as well as threatening stimuli suggested that anxious individuals experienced greater distractibility by a range of stimuli, not just threatening stimuli, leading to the suggestion that inhibition of attention played a role in delayed response times in the colour naming task.

These findings add to cognitive models by considering the importance of being able to filter out irrelevant material, or disengage from it, in order to direct attention to that which is important. Disengagement of attention was a concept already accounted for in physiological models of attention at the time.

Posner and Peterson (1990) described a three stage model of attention; which proposed an initial transient shift of attention towards a stimulus, engagement with the stimulus and finally, disengagement from the stimulus. Disengaging attention from the original stimulus is necessary in order to shift attention to novel stimuli. The model is based on existing knowledge from studies with humans and monkeys that have used PET and ERP to investigate brain functioning during attentional tasks and data from studies of deficits in individuals with lesions.

Evidence shows that whilst the attentional system appears to operate throughout the brain, different areas appear to have specific functions and as such, damage to different areas of the brain can cause quite different deficits in shifting attention. For example, damage to the posterior parietal lobe causes difficulties in disengaging attention from one area of focus to another

(Posner, Walker, Friedrich & Rafal, 1984), whilst individuals with degeneration of the superior colliculus exhibit a slowed shift and a tendency to return to former target locations; usually avoided by an 'inhibition of return' mechanism which inhibits the return of visual attention to an area that has already been searched (Posner & Cohen, 1994). Finally, patients with lesions of the thalamus show difficulty engaging with new targets (Peterson, Robinson & Morris, 1987). This approach to understanding anxiety suggests two forms of attentional bias may exist and that difficulties with either could result in an anxiety disorder. The first relates to the capture of attention by threat, at the stages of shifting attention towards stimuli and then engaging with the stimuli, and the second relates to difficulties in disengaging this attention in order to shift attention to new stimuli.

In order to determine whether delayed disengagement from threat stimuli is a factor in processing biases in anxiety, Fox, Russo and Dutton (2002) used an experimental paradigm that was able to distinguish between initial orienting and differences in attentional dwell time by requiring respondents to categorise targets rather than simply respond to their location. The findings were interpreted to show that delayed disengagement from emotional face stimuli was increased in individuals with high trait anxiety. Unexpectedly, this was found to be true for both angry and happy faces although both were more effective than neutral faces suggesting that the mechanisms involved in producing enhanced dwell time may not differentiate between emotional expressions. However, in a subsequent experiment Fox et al. (2002) found that 'inhibition of return' was less when angry facial expressions were used as

opposed to both neutral and happy faces. A low 'inhibition of return' indicates delayed disengagement from distracting stimuli to a central point, which suggests attentional inhibition processes have not been not applied in time to facilitate the return.

Koster, Crombez, Verschuere, Van Damme, and Wiersema (2006) used a modified cueing task to investigate attentional engagement and disengagement from pictures, such as a man with either a knife or a hairdryer, rated for valence and arousal. Reaction times indicated disengagement of attention from pictures with a highly threatening valence was impaired in those individuals with higher trait anxiety. However, these findings were only true when presentation of stimuli was for only 100ms. On a longer presentation of 500ms, high trait individuals exhibited attentional avoidance of the highly threatening pictures, contradicting the view that impaired attentional disengagement characterises trait anxiety. In a further experiment aimed at exploring their initial findings, Koster et al. (2006) confirmed that attentional avoidance of threat stimuli was apparent after 200ms exposure of the threatening stimulus and that results differed little between presentations of 200ms and 500ms.

The fact that these results are only found in very brief presentations is consistent with the findings of Mogg and Bradley (1999) that attention biases are observed when processing subliminally presented stimuli perceived only momentarily but not when processing material that is closer to conscious awareness due to increased exposure time. These findings also link to

LeDoux's (2000) fast track model of emotional processing. Derryberry and Reed (2002) summarised the neurological processes behind this by describing attention processing in terms of Posner and Peterson's (1990) model of attention. Posner and Peterson (1990) identify the anterior system located in the frontal regions (anterior cingulated cortex) which is connected with the limbic and frontal motivational systems.

Attentional inhibition by effortful control

Derryberry and Reed (2002) described the role of the anterior attentional system in inhibiting dominant response tendencies, inhibiting dominant conceptual associations and detecting erroneous responses. Thus, the anterior system is able to inhibit the automatic processes of the posterior system (the amygdala's rapid route) in order to provide voluntary control guided by expectations and motives rather than the presence of threatening stimuli in the environment. The suggestion is that the inhibition of automatic attention to stimuli allows for the disengagement of attention to threatening stimuli. It is the ability to control this process that many researchers have cited as the source of important individual differences in children's development.

Derryberry and Rothbart (1997) suggested that 'effortful control' is a process involved in the regulation of fear and in other important processes such as delayed gratification and the development of conscience. Effortful control is believed to develop over childhood as the brain matures and as an adaptive

response to the child's environment (Rothbart, Posner & Boylan, 1990). Children are born with the limbic system almost fully developed. However, those parts of the brain involved in more complex processes continue to develop through the child's early years and into adolescence (Alderman et al., 2002; Bennett & Baird, 2006). Regulation of the brain's input and output is initially thought to be a reactive process; with reactive processes being supplemented for voluntary and more effortful forms of control as the child develops (Derryberry and Reed, 1994). Individuals low in effortful control are believed to have difficulty in inhibiting their attention to threat thereby prolonging the anxious experience and delaying disengagement. (Discussed in more detail later).

Derryberry and Reed (2002) suggested that failure to develop inhibitory processes through effortful control is critical in the development of anxiety disorders. Furthermore, they proposed that adults with high effortful control are able to disengage attention from threat in order to engage in more appropriate coping strategies. Thus, for anxious individuals, distractibility and interference by threatening stimuli in the environment is only a difficulty if the individual is low in effortful control. To test this hypothesis, Derryberry and Reed (2002) compared results on a self-report questionnaire designed to measure to ability to control attention with results on a reaction time task. The task measured disengagement from stimuli using a pre-target cue to direct attention to an area of threat. Rapid completion required participants to actively disengage their attention from the pre-target cue to a 'safe' area. They found delays in disengaging attention from threat cues were increased

in anxious individuals and that this was more apparent in those individuals with low attention control.

Selective attention and the development of anxiety

There are a number of reasons why the study of anxiety in children is important. Firstly, studies with anxious adults cannot be relied upon due to the fact that the biases found in these individuals could result from years of experiencing certain situations as fearful (Kindt, van den Hout, de Jong & Hoekzema, 2000). In this case it is difficult to determine the cause of the bias, and whether the bias has resulted in high levels of anxiety or, for example, whether anxiety itself, or the associated avoidance or coping strategies have led over time to a bias in processing.

Studying anxiety in childhood can lead to a greater understanding of the developmental pathway of typical and atypical processing of threat and the role of information processing biases. In turn, this can aid our understanding of anxiety, thus enabling clinicians to implement appropriate interventions to prevent the development of chronic anxiety problems into adulthood and the occurrence of common co-morbid disorders such as depression. Finally, studies with young populations, using experimental paradigms previously used with adults, have raised interesting results which have both supported and refuted findings in the adult literature. These require further investigation in order to relate them to existing knowledge and integrate findings into a coherent cognitive developmental model. In particular, understanding of the

differences between child and adult anxiety can help inform how typical anxiety develops into anxiety disorders.

Building on findings using adult populations, empirical investigations with children have used the dot probe paradigm to identify an attentional bias for threat words in anxious children similar to that of adults. For example, Vasey, Daleiden, Williams and Brown (1995) compared response latency to a dot-probe following threat words to probes following neutral words in 12 clinically anxious and 12 non-anxious children aged 9 to 14 years. They found that faster response latencies followed threatening words in the clinically anxious group and no difference was found for threatening and non-threatening words in the non-anxious group. These findings have been replicated in test-anxious children aged 12 to 14 years (Vasey, Elhag & Daleiden, 1996) and children and adolescents (mean age 13.56 years) with a diagnosis of GAD (Taghavi, Neshat-Doost, Moradi, Yule & Dalgleish, 1999).

Studies using other experimental paradigms have also identified attentional biases for threat stimuli in children with high anxiety including improved visual search for angry faces displayed amongst distracter faces (Hadwin et al., 2003), facilitated startle-eyeblink associated with treat words (Waters, Lipp & Cobham, 2000) and slowed reaction times to angry faces in Go/Nogo tasks (a task requiring a push button response to one specific emotional face but not to another, Ladoucer et al. 2006).

Yet, studies by other researchers have failed to identify any attentional bias in anxious children, as compared to non-anxious children, using a similar range of experimental paradigms and different sources of fear (e.g. dot probe; Waters, Lip & Spence, 2004). Still others, such as Monk, et al. (2006) have provided evidence for increased attention bias away from threat stimuli in adolescents with generalised anxiety disorder as compared to non-anxious controls.

The modified emotional Stroop, a paradigm which consistently shows attention bias for threat in the adult literature has also produced mixed results with developing populations. In an early study, Martin, Horder and Jones (1992) replicated findings in adults by identifying a similar attentional bias towards threat stimuli in spider phobic children. Martin et al. (1992) identified a delayed response to naming spider words versus other insect related control words in a card version of the emotional Stroop with children aged 8-11 who had a fear of spiders. Martin and Jones (1995) went on to replicate this finding in a further Stroop based study with spider fearful 4 to 9-year-olds, but this time using pictorial stimuli presented on a card format.

Moradi, Taghavi, Neshat-Doost, Yule, and Dalgleish (1999) also used the Stroop paradigm with children aged 9 to 17 years with a diagnosis of PTSD and found evidence for an attentional bias towards threat stimuli in anxious children (those with PTSD). Similarly, Heim-Dreger, Kohlmann, Eshenbech and Burkhardt (2006) identified a bias for threatening faces, which was

correlated with trait anxiety in an emotional Stroop task using a community sample of children aged 7 to 10 years.

However, other studies using modifications of the emotional Stroop have failed to find a difference in response time for threatening stimuli in children with anxiety as compared to those without anxiety (e.g. Kagan, Snidman, Zentner & Peterson, 1999; Kindt, Brosschot & Everaerd, 1997). Studies such as these have led to the suggestion that a bias for threat material may be general to all young children. The literature suggests a developmental model of anxiety in which a bias for threat stimuli is common to young children, remaining into adolescence in anxious children but reducing in children with low anxiety as they develop.

The findings of Martin et al. (1992) were replicated by Kindt, Bierman and Brosschot (1997) who used a computerised version of Martin et al.'s (1992) emotional Stroop in order to minimise experimenter bias. Kindt and colleagues confirmed the threat bias in children with spider phobia and replicated this heightened attention to threat stimuli with children who exhibited 'medical fear' (Kindt, Brosschot & Everaerd, 1997). In this study they found that low and high anxious children exhibited the same bias towards threatening material. This finding contradicted the results of studies with anxious adults from the adult population that bias for threat stimuli was found in anxious individuals but not in non-anxious controls (Bradley et al., 1995; Mogg et al. 1993). Interestingly, they also noted that this bias decreased in low fearful children as age increased. They suggested that this

divergence might result from the limited capacity of the cognitive system in children meaning that affording attention to anxiety was at the expense of other processes. They suggested that, from a cognitive developmental perspective, this could be reduced with age as the ability to inhibit attention to threat developed.

Kindt, van den Hout, Jong and Hoekzema (2000) later went on to confirm this, demonstrating a bias for spider words in all children, reducing with age in low anxious children but not in high anxious children. Interestingly, they found that all children aged eight exhibited a bias for spider threatenening words whether they reported themselves as spider fearful or not. However, Kindt et al. (2000) later went on to test whether non-fearful children were actually fearful by threatening exposure to a real live spider. The results suggested that these children may have responded in a socially desirable way to the standardised spider fear questionnaire, which had not previously been used with 8 year olds. The researchers reported that changes in children's behaviour in response to the belief they would meet a real spider confirmed their enhanced fear over low spider anxious children. However, it is not clear from the paper how the possible exposure to a real spider was presented to the children and it could be argued that this late addition to the experimental design may have served to build up the children's fears beyond that experienced in a more natural environment.

A closer inspection at the work of Kindt and colleagues reveals a number of anomalies in the methodology. For example, the spider anxious 8-year old

group consisted of only five children who were compared to groups of 14, 19 and 17 nine, ten and eleven year olds respectively. Kindt et al. (2000) do refer to this fact in their paper saying their findings were "spurious" (Kindt et al., 2000, p. 216); although they appear to neglect this point in their conclusion, as they go on to report that a "bias for spider words is a normal characteristic of children aged 8" (Kindt et al., 2000, p. 218).

Kindt, Bogels and Morren (2003) produced similar findings (i.e. no evidence of an attention bias for threat) in an equally limited study. In this study, despite their own recognition of age dependent changes in processing biases, they failed to separate age groups and were unable to do this post-hoc due to the small sample sizes. The group concluded that no attentional bias was identifiable in anxious children with either GAD or a specific phobia, compared with non-anxious controls. Recognising the sample size did not permit analysis of age differences, Kindt et al. (2003) also noted that the mean age of their sample (12.2 years) which was higher than the age at which they had previously observed the general bias for spider threat (7 to 9 years).

However, Kindt and collegues are not alone in identifying a general bias for threat in younger children. Waters, Lipp and Spence (2004) also found a bias for fear related pictures in a comparison of 23 clinically anxious and non-anxious children aged between 9 and 12 years. Their study using the dot probe paradigm and fear pictures such as vicious dogs, aimed guns and sharks found a bias towards threatening picture versus pleasant pictures that

was not significantly different for anxious and non-anxious children. The researchers suggest that their findings extend those of Kindt, Brierman and Brosschot (1997) and Kindt, Brosschot and Everaerd (1997) by identifying an attentional bias towards fear-related information which is common to all children up to the age of about twelve years. However, Waters, Lipp and Spence (2004) did not include a group of older children in their study with whom comparisons could be made. It cannot be determined therefore whether their results were particular to the under twelve age group or whether older children would also exhibit a general bias for the threat stimuli used in this particular study. Indeed, as the researchers observed, models generated in adults studies suggest adults low in anxiety will also show a marked attention bias towards threatening stimuli if it appears to be above a certain threshold (e.g. Mogg & Bradley, 1998).

A more recent study by Hadwin, Donnelly, Richards, French and Patel (submitted) attempts to extend the age range typically used in studies of childhood attention in an modified emotional Stroop task investigating bias for threat in schematic faces in socially anxious children. Hadwin et al. (submitted) found evidence for attention bias for threat in schematic faces in socially anxious children. Similar to findings in the adult literature (e.g. Bryne & Eysenk, 1995; Mogg, Millar & Bradley, 2000) the results suggested that children with high social anxiety had increased reaction times when responding to angry faces as compared to neutral or happy faces. However, the observed attention bias was not effected by age suggesting, contrary to the findings of Kindt, Brierman and Brosschot (1997), Kindt, Brosschot and

Everaerd (1997) and Waters et al. (2004), that attention bias for threat, in the form of decreased ability to inhibit attention to threat, was associated with social anxiety in children as young as six years.

As noted earlier, inhibition of attention to threat stimuli is believed to be an effective cognitive strategy in removing attention from the threatening stimuli and onto more adaptive strategies. Failure to disengage from the stimuli prolongs the experience of anxiety in anxious individuals (Derryberry & Reed, 2002). Stirling, Eley and Clark (2006) used a dot probe task to investigate the relationship between children's self-report social anxiety and attention bias for emotion faces shown for a relatively long duration (1000ms). They identified avoidance of negative stimuli, namely anger and fearful faces, at long exposure rather than vigilance, a finding that could result from the use of attentional disengagement in response to threatening stimuli as a means of regulating fear.

Along with the handful of findings from Stroop studies that have found a significant interference effect for threat, this observation supports models of anxiety which consider the role of attention control and inhibition to threat as described by Derryberry and colleagues. Derryberry and Reed (2002) considered anxiety in the terms of Posner and Peterson's (1990) three stage model of attention. Derryberry and Rothbart (1997) described the development of effortful control, implicated in the ability to inhibit attention to threat. In neurological terms, the motivational system is believed to guide the child's behaviour through instinctive physical desire and defensive needs.

Cortical synapses provide feedback about events leading to the formation over time of cognitive representations that enhance the child's ability to evaluate complex situations and regulate behaviour accordingly (Cicchetti & Tucker, 1994).

This process involves considerable plasticity in the early years of development and connections within the cortex are initially extensive. However, with exposure to the environment, cortical synapses become progressively more stable, with the more active synapses having strengthened and the remainder appearing to regress (Cicchetti & Tucker, 1994). As the pathways of the cortex develop children become progressively more able to respond to the finer distinctions of events including relating events to the context of the environment and predicting outcome (Derryberry & Rothbart, 1997). This development also allows for more abstract analysis in terms of concepts of self and others as the child grows older. Whilst the fear system remains primarily reactive, cortical development allows for increase in the child's capacity to perform more voluntary and effortful forms of control. Indeed, fMRI studies suggest development of the brain continues through to late adolescence and even into early adulthood (Alderman et al., 2002; Bennett & Baird, 2006). Thus in a typically developing child, the amygdala receives direct sensory input from the thalamus, whilst thalamic pathways also deliver sensory information to the cortex which allows for a more complex analysis as the child develops. The results of this are fed back to determine what action to take, overriding the drives of the limbic system if necessary by means of effortful control.

Derryberry and Rothbart (1997) described how the child's temperament directs experience which in turn leads to the organisation of the described systems. They describe the motivation system with strong approach tendencies, as guiding the child to seek out new and stimulating experiences whereas more fearful children will prefer a more stable and calm environment. They add that the preferences of the child will also influence the behaviour of adults around the child, for example, there may be a tendency to protect the fearful child, thus failing to allow exposure to feedback information that may provide the learning experience that fears are unwarranted. However, it is also possible for the anxious child to develop representations of sources of safety that can help them to cope with threat.

Schwartz, Snidman and Kagan (1996) provided evidence for anxiety bias in adolescents using a Stroop task with threatening words. In this study, subjects had been assessed previously for behavioural inhibition at the age of either 21 or 31 months of age using observations of their engagement with an unfamiliar child or adult. From the observed bias for threatening words in those children previously classified as anxious, Schwartz et al. (1996) concluded that inhibited youngsters could be placed at risk for later anxiety disorder which may result from an underlying physiological vulnerability.

Indeed, structural differences in the amygdala of anxious children have been observed and may result from the organisational processes taking place between synapses during these formative experiences. Thomas et al. (2001)

have used fMRI to investigate amygdala functioning in anxious and non anxious children while viewing photographs of fearful and angry faces. Their findings highlighted functional differences in the amygdala of anxious children which correlated with scores on a self-report measure of anxiety symptoms. Some of the same children were also subject to a morphometric MRI study which reported the right amygdala to be of greater volume in children and adolescents with anxiety compared to non anxious children and suggesting a relationship between structure and function (De Bellis et al., 2000).

This would also suggest that biases for anxiety stimuli could result from increased exposure to an anxiety provoking environment; thus suggesting biases could be part of an adaptive mechanism to children exposed to high levels of threat or anxiety such as those growing up in an environment in which they are subject to traumatic experience or physical abuse. In one study, Moradi, Neshat-Doost, Taghavi, Yule and Dalgleish (1999) found evidence for increased Stroop interference in children of adults with PTSD as compared to control children of adults who were asymptomatic. This was despite the children of adults with PTSD not experiencing symptoms of PTSD or differing from control children in self-report measures of depression or anxiety. Although they did consider that the self-report of children in the experimental group may not accurately reflect the children's mood, the researchers also suggested that the increased attention to threat could have arisen from greater 'expertise' for threat-related stimuli gained from living in a household with a traumatised member. In another study considering traumatising environments, Pine et al. (2005) investigated information

processing biases in maltreated children, and found a tendency to avoid, or divert attention away from, angry facial stimuli (photographs of actors' faces) in a visual probe task. The researchers cite their study as a first step in examining the relationship between anxiety and underlying brain functioning, laying the groundwork for clinical studies of the effects of traumatised upbringing on the dysfunctional patterns of these children's later social lives.

This view of anxiety development serves to fill in the gaps of some of the purely cognitive models. McNally (1998) recognised the need for theorists from cognitive and neuropsychological orientations to come together in determining the nature of human emotion. Findings such as those described above stress the importance of understanding the processes underlying development in the formative years.

Unlike the study of Hadwin et al. (submitted) few recent studies have explored the relationship between age, anxiety and attention bias. Those that have, such as that of Reid, Salmon and Lovibond (2006), which did identify a bias for threatening stimuli in anxious children using a dot-probe task, have failed to identify anything but weak trends for age despite being well designed and including a thorough analysis of developmental effects and interactions of age, anxiety symptoms, depression, aggression and gender. This implies that researchers are failing to pick up an interesting phenomenon which should be not only be explored further in order to increase theoretical understanding but should be taken into account in studies of the anxiety bias in developing populations in general.

Despite an apparent lack of significant results, the literature suggests that it is important for researchers to continue investigate developmental effects on information processing and biases in attention. Significant changes in the organisation of the brain occur throughout childhood, and we have yet to understand the significance of such changes in the development of anxiety. Furthermore, it is evident that childhood anxiety is not only problematic to those children who are affected by it but may also be a precursor to disorders in adulthood. These issues make it imperative that the search for a developmental account for anxiety is not sidelined as a result of failures to find support in studies that may have been hampered by methodological flaws. Recent progress in integrating models emphasizes the need for future studies to take a much more systematic approach, limiting variables and using larger sample sizes, in order to help clarify related effects in high and low anxious children. Only then can we start to build a fully coherent cognitive model of anxiety taking into consideration the child's developmental experiences.

Summary and Conclusion

Findings in the adult literature clearly show that adults who have high levels of anxiety exhibit information processing biases favouring threat stimuli by the attentional system. Using a range of subject groups from both clinical and non-clinical populations, empirical studies have consistently found that anxious individuals direct attention towards threatening material that has been processed in a rapid, pre-attentive process (e.g. Bradley, Mogg, & Miller, 2000; Bradley, et al. 1999; Bryant & Harvey, 1997; MacLeod, et al. 1986; Williams et al., 1988). However, some studies have suggested that difficulties in disengaging attention from threat stimuli could prolong and increase the experience of anxiety, thereby contributing to the development and maintenance of anxiety disorders (e.g. Fox, 1993). The initial capture of attention, engagement with the stimuli for processing and subsequent disengagement of attention are considered to be essential stages in shifting attention around the environment (Posner & Peterson, 1990). Failure to disengage attention results in inability to engage with other, less threatening stimuli, and to utilise adaptive coping strategies (Derryberry & Reed, 2002).

Studies of the human brain have identified two areas which are highly active in the experience of anxiety. The primitive defensive systems of the amygdala, which process information with the prime aim of survival, are

activated by stimuli perceived as threatening in a rapid processing allowing only low level semantic processing (LeDoux, 2000). However, a more complex analysis of stimuli along with context and knowledge from past experiences is executed within the frontal lobes and fed back to the limbic system via the anterior cingulate system allowing inhibition of processing by the amygdala and activation of more adaptive processes by the process of effortful control (Derryberry & Rothbart, 1997).

In investigating the origin of information processing biases, researchers have highlighted that studies using adults should be interpreted with caution due to the uncertainty around whether attentional biases were themselves developed as part of a cognitive coping strategy in response to many years of living with anxiety (Kindt et al., 2000). Therefore, many of the studies that had provided such reliable results with adults have been repeated with younger populations. Although some studies were able to replicate the finding in the adult literature (e.g. Vasey et al., 1995), others failed to find a bias for threatening stimuli in children with anxiety (e.g. Kindt, Bierman & Brosschot, 1997).

In an effort to find empirical evidence to support a cognitive developmental theoretical model, researchers have produced a quite confusing and contradictory body of literature. Some studies have been interpreted with much more power than they really have (see Kindt et al., 2000). At the same time, studies of questionable methodology have yielded results that have

been influential in leading to the rejection certain hypotheses that might otherwise have proven sound, notably around the interaction of age and anxiety on attention bias. However, influences from concurrent work looking at the development of children's temperament, an increased understanding of neuropsychological models and review of experimental methods for use with developing populations has led to the production of more reliable and robust theories with some supportive data.

Despite the emergence of a handful of well-designed studies which adequately allow for analysis of age affects, the findings remain mixed. Although some studies have identified attentional bias in anxious children similar to those of adults others suggest that younger children with anxiety fail to demonstrate an attentional bias that differs from that of non-anxious children (e.g. Waters et al., 2004). The studies that report that until a certain point in development young children may not differ in their attention bias towards threat stimulus, regardless of level of anxiety suggest that attentional bias towards threat stimuli is usual in young children. This, in turn, supports a cognitive developmental model of anxiety disorders. In line with adult studies, the failure to develop inhibitory skills is suggested as a cause of the difference in findings between non-anxious and anxious older children (e.g. Hadwin et al. submitted) and this proposition is supported by neuropsychological evidence. The development of effortful control through childhood and adolescence is proposed to be crucial in learning to inhibit

attention to threat and failure to do this adequately will lead to an increased attentional dwell time on threatening stimuli (Derryberry and Rothbart, 1997).

Interestingly, findings from 'bottom up' research on children's development and temperament (e.g. Derryberry & Reed, 1994) appears to have achieved some degree of congruence with those of cognitive researchers working 'top down' on the same concepts. The joining of these two paradigms in psychological research offers increased opportunity of working towards an accurate cognitive developmental model of anxiety that incorporates the child's social, emotional and physiological experiences. The re-focusing of researcher attention on the development of anxiety disorders in children will be crucial in directing interventions especially given the emerging finding regarding plasticity in the developing brain (see Derryberry & Rothbart, 1997).

However, it is important that the rejection of earlier findings from inadequate studies does not lead to some important and relevant hypotheses becoming overlooked or lost. Exploration suggests it may be necessary to review and re-evaluate the body of evidence and that this may help the progress towards the greater integration of models. Future studies using larger sample sizes across several age ranges are needed in order to help further develop the emerging developmental model.

References

Alderman, N. E., Menon, V., Blasey, C. M., White, C. D., Warsofsky, I. S., Glover, G. H. and Reiss, A. L. (2002). A developmental fMRI Study of the Stroop Colour-word Task. *Neuroimage, 16,* 61 – 75.

Aggleton, J. P. (Ed.) (1992). The Amygdala: Neurobiological aspects of emotion, memory and mental dysfunction. New York: Wiley-Liss.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders. (4th ed, revised).* Washington: Author.

Amir, N., Beard. C. and Bower, E. (2005). Interpretation bias and social anxiety. *Cognitive Therapy and Research, 29, 4*, 433 – 443.

Bechara, A., Tranel, D., Damasio, H., Adolphs, R., Rockland, C. and Damasio, A.R. (1995). Double dissociation of conditioning and declarative knowledge relative to the Amygdala and hippocampus in humans. *Science, 269, 5227*, 1115-1118.

Beck, A. T. (1976). *Cognitive Therapy and the Emotional Disorders.* New York: International Universities Press.

Beck, A. T. and Clark, D. A. (1997). An information processing model of anxiety: Automatic and strategic processes. *Behaviour Research and Therapy, 35, 1,* 49 – 58.

Beck, A. T., Emery, G. and Greenberg, R. L. (1985). *Anxiety Disorders and Phobias: A Cognitive Perspective.* New York: Basic Books.

Bennett, C. M. and Baird, A. A. (2006). Anatomical changes in the emerging

adult brain: A voxel-based morphometry study. *Human Brain Mapping, 27, 9*, 766 – 777.

Bower, G. H. (1981). Mood and memory. *American Psychologist, 36*, 129 – 148.

Boyd, J. H. (1986). Use of mental health services for the treatment of panic disorder. *American Journal of Psychiatry, 143*, 1569 – 1574.

Bradley, B. P., Mogg, K. and Millar, N. H. (2000). Covert and overt orienting of attention to emotional faces in anxiety. *Cognition and emotion, 14, 6,* 789 – 808.

Bradley, B. P., Mogg, K., Millar, N. and White, J. (1995). Selective processing of negative information: Effects of clinical anxiety, concurrent depression and awareness. *Journal of Abnormal Psychology, 104, 3*, 532 – 536.

Bradley, B. P., Mogg, K., White, J., Groom, C. and de Bono, J. (1999). Attentional bias for emotional faces in generalised anxiety disorder *British Journal of Clinical Psychology, 38,* 267-278.

Broadbent, D.E. (1958). *Perception and Communication*. London: Pergamon.

Bryant, R. A. and Harvey, A. G. (1997). Attentional bias in posttraumatic stress disorder. *Journal of Traumatic Stress, 10*, 635–644.

Bryne, A. and Eysenk, M. W. (1995) Trait anxiety, anxious mood and threat detection. *Cognition and Emotion, 9,* 549 -562.

Calder, A. J., Young, A. W., Rowland, D., Perrett, D. I., Hodges, J. R. and Etcoff, N. L. (1996). Facial emotion recognition after bilateral amygdala damage: Differentially severe impairment of fear. *Cognitive*

Neuropsychology, 13, 699 – 745.

Calvo, M. G. and Castillo, M. D. (2001). Selective interpretation in anxiety: uncertainty for threatening events. *Cognition and Emotion, 15, 3,* 299 – 320.

Calvo, M. G., Eysenck, M. W. and Estevez, A. (1994). Ego-treat interpretive bias in test anxiety: Online inferences. *Cognition and Emotion, 8,* 127 – 146.

Carr, A. (2006). *The Handbook of Child and Adolescent Clinical Psychology.* London: Routledge.

Cherry, E. C. (1953). Some experiments in the recognition of speech, with one and two ears. *Journal of the Acoustical Society of America, 25,* 975-979.

Cicchetti, D. and Tucker, D. (1994). Development and self-regulatory structures of the mind. *Development and Psychopathology, 6,* 533 – 549.

Clark, D. M. (1986). A cognitive approach to panic. *Behaviour Research and Therapy, 24,* 461 – 470.

Clark, D. M. (1989). Anxiety states: Panic and generalised anxiety. In Hawton, K., Salkovskis, P. M. and Clark, D. M. (eds) *Cognitive Behaviour Therapy for Psychiatric Problems.* Oxford: Oxford Medical.

Cole, D. A., Peeke, L. G., Martin, J. M., Truglio, R. and Serocynski, A. (1998). A longitudinal look at the relationship between depression and anxiety in children and adolescents. *Journal of Consulting Clinical Psychology, 66,* 451 – 460.

Dadds, M., Seinen, A., Roth, J. and Harnett, P. (2000). *Early intervention for anxiety disorders in children and adolescents.* Queensland: Austalian Early Intervention Network for Mental Health in Young People.

De Bellis, M. D., Casey, B. J., Dahl, R., Birmaher, B., Williamson, D. E., Thomas, K. M., Axelson, D. A., Frustaci, K., Boring, A. M., Hall, J. and Ryan, N. D., (2000). A pilot study of amygdala volume in pediatric generalised anxiety disorder. *Biological Psychiatry, 48*, 51 – 57.

Derryberry, D. and Reed, M. (1994). Temperament and the self-organization of personality. *Development and Psychopathology, 6,* 653 – 676.

Derryberry, D. and Reed, M. A. (2002). Anxiety-related attentional biases and their regulation by attentional control. *Journal of Abnormal Psychology, 111, 2*, 225 – 236.

Derryberry, D. and Rothbart, M. K. (1997). Reactive and effortful processes on the organization of temperament. *Development and Psychopathology, 9,* 633 – 652.

Fox, E. (1993). Attentional bias in anxiety: Selective or not? *Behaviour Research and Therapy, 31, 5*, 487 – 493.

Fox, E., Lester, V., Russo, R., Bowles, R. J., Pichler, A. and Dutton, K. (2000). Facial expressions of emotion: Are angry faces detected more efficiently? *Cognition and emotion, 14,* 61 – 92.

Fox, E., Russo, R. and Dutton, K. (2002). Attentional bias for threat: Evidence for delayed disengagement from emotional faces. *Cognition and Emotion, 16, 3*, 355 – 379.

Furmark, T., Fischer, H., Wik, G., Larsson, M. and Fredrikson, M. (1997). The

amygdala and individual differences in human fear conditioning. *Neuroreport, 8, 18*, 3957-3960.

Gray, J. A. (1982). *The Neuropsychology of Anxiety.* Oxford, U.K.: Oxford University Press.

Gopher, D. and Donchin, E. (1986). Workload – An examination of the concept. In K. R. Boff, L. Kaufmand & J. P. Thomas (Eds.), *Handbook of perception and human performance.* New York: Wiley.

Haberlandt, K. (1997). *Cognitive psychology* (2nd ed.). Boston: Allyn and Bacon.

Hadwin, J. A., Donnelly, N., French, C. C., Richards, A., Watts, A. and Daley, D. (2003). The influence of children's self-report trait anxiety and depression on visual search for emotional faces. *Journal of Child Psychology and Psychiatry, 44,* 432 – 444.

Hadwin, J. A., Garner, M., and Perez-Olivas, G. (2006). The development of information processing biases in childhood anxiety: A review and exploration of its origins in parenting. *Clinical Psychology Review, 26,* 876 – 894.

Hadwin, A, A., Donnelly, N., Richards, A., French, C. C. and Patel, U. (submitted). Childhood anxiety and attention to emotion faces in a modified emotion Stroop task. British Journal of Developmental Psychology, re-submitted March 1997.

Heim-Drager, U., Kohlmann, C. W., Eschenbeck, H. and Burkhardt, U. (2006). Attentional bias for threatening faces in children: Vigilant and avoidant processes. *Emotion, 6,* 2, 320 – 325.

Hirsch, C. and Mathews, A. (1997). Interpretative inferences when reading about emotional events. *Behaviour Research and Therapy, 35,* 12, 1123 – 1132.

Isaacson, R. L. (1982). *The Limbic System.* New York: Plenum.

Isenberg, N., Silbersweig, D., Engelien, A., Emmerich, S., Malavade, K., Beattie, B., Leon, A.C. and Stern, E. (1999). Linguistic threat activates the human amygdala. *Proceedings of the National Academy of Sciences of the United States of America, 96, 18*, 10456-10459.

Kagan, J., Snidman, N., Zentner, M. and Peterson, E. (1999). Infant temperament and anxious symptoms in school age children. *Development and Psychopathology, 11,* 209 – 224.

Kahneman, D. (1973). *Attention and Effort.* Englewood Cliffs, NJ: Prentice-Hall.

Karten, H. J. (1997) Evolutionary developmental biology meets the brain: the origins of mammalian neocortex. *Proceedings of the National Academy of Sciences (USA),* 94, 2800 – 2804.

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

Kessler, R. C., McGonagle, K. A., Zhao, S. and Nelson, C. B. (1994). Life-time and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: Results from the National Comorbidity Study. *Archives of General Psychiatry, 51, 1*, 8-19.

Kindt, M., Bierman, D., and Brosschot, J. F. (1997). Cognitive bias in spider fear and control children: assessment of emotional interference by a

card format and a single-trial format of the Stroop task. *Journal of Experimental Child Psychology, 66,* 163 – 179.

Kindt, M., Bögels, S. M, and Morren, M. (2003). Processing bias in children with separation anxiety, social phobia and generalised anxiety disorder. *Behavior Change, 20,* 143-150.

Kindt, M., Brosschot, J. F., and Everaerd, W. (1997). Cognitive processing bias of children in a real life stress situation and a neutral situation. *Journal of Experimental Child Psychology, 64*, 79 – 97.

Kindt, M. and van den Hout, M. (2001). Selective attention and anxiety: A perspective on developmental issues and he causal status. *Journal of Psychopathology and Behavioral Assessment, 23, 3,* 193 – 202.

Kindt, M., van den Hout, M., de Jong, P., and Hoekzema, B. (2000). Cognitive bias for pictorial and linguistic threat cues in children. *Journal of Psychopathology and Behavioral assessment*, *22*, 201–219.

Koplewicz, H. (1996). Childhood phobia. In C. Lindemann (Ed.) *Handbook of the treatment of anxiety disorders,* (pp. 173-178). New Jersey: Jason Aronson Inc.

Koster, E. H., Crombez, G., Verschuere, B., Van Damme, S. and Wiersema, J. RG. (2006). Components of attentional bias to threat in high trait anxiety: Facilitated engagement, impaired disengagement, and attentional avoidance. *Behaviour Research and Therapy, 44, 12*, 1757 – 1771.

Ladouceur, C. F., Dahl, R. E., Williamson, D. E., Birmaher, B., Axelson, D. A., Ryan, N. D. and Casey, B. J. (2006). Processing emotional facial

expressions influences performance on a go/nogo task in pediatric anxiety and depression. *Journal of Child Psychology and Psychiatry, 47,* 11, 1107 – 1115.

Lang, P.J., Bradley, M. M. and Cuthbert, B. N. (1995). International affective picture system: Technical manual and affective ratings. Grainsville, FL: University of Florida.

LeDoux, J. E. (2000). Emotion circuits in the brain. *Annual Review of Neuroscience, 23,* 155 – 184.

LeDoux, J. (1996). *The Emotional Brain.* New York: Simon and Schuster.

Le Doux, J. E. (2005). Contributions of the amygdala to emotion processing: From animal models to human behaviour. *Neuron, 48,* 175 – 187.

Livingston, M. and Hubel, D. (1988). Segregation of form, color, movement and depth: Anatomy, physiology and perception. *Science, 240,* 740 – 749.

MacLeod, C. and Mathews, A. (1988). Anxiety and the allocation of attention to threat. *Quarterly Journal of Experimental Psychology, 40a*, 653 – 670.

MacLeod, C., Matthews, A. and Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*, 15 – 20.

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

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

Mathews, A. and Mackintosh, B. (1998). A cognitive model of selective processing in anxiety. *Cognitive Therapy and Research, 22, 6*, 539 – 560.

Mathews, A. and MacLeod, C. (1986). Discrimination of threat cues without awareness in anxiety states. *Journal of Abnormal Psychology. 95, 2*, 131-138.

Mathews, A., Mogg, K., May, J. and Eysenk, M. W. (1989). Implicit and explicit memory bias in anxiety. *Journal of Abnormal Psychology, 98*, 236 – 240.

Mathews, A., Richards, A., and Eysenck, M. (1989). Interpretation of homophones related to threat in anxiety states. *Journal of Abnormal Psychology, 98*, 31-34.

MacKay, D. G. (1973). Aspects of a theory of comprehension, memory and attention. *Quarterly Journal of Experimental Psychology, 25,* 22 – 40.

McNally, R. J. (1994). *Panic disorder: A critical analysis.* New Yourk: Guilford Press.

McNally, R. J. (1997). Memory and anxiety disorders. *Transactions: Biological Sciences, 352, 1362*, 1755 – 1759.

McNally, R. J. (1998). Information-processing abnormalities in anxiety disorders: Implications for cognitive neuroscience. *Cognition and Emotion, 12, 3,* 479 – 495.

McNally, R. J., Foa, E. B. and Donnell, C. D. (1989). Memory bias for anxiety information in patients with panic disorder. *Cognitive Emotion, 3*, 27 – 44.

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

Mogg, K. and Bradley, B. P. (1999). Orienting of attention to threatening facial expressions presented under conditions of restricted awareness. *Cognition and Emotion, 13, 6,* 713 – 740.

Mogg, K., Bradley, B. P., and Hallowell, N. (1994). Attentional bias to threat: Roles of trait anxiety, stressful events, and awareness. *Quarterly Journal of Experimental Psychology, 47A,* 841–864.

Mogg, K., Bradley, B. P., Williams, R. and Mathews, A. (1993). Subliminal processing of emotional information in anxiety and depression. *Journal of Abnormal Psychology, 102, 2*, 304 – 311.

Mogg, K., Mathews, A. and Weinman, J. (1989). Selective processing of threat cues in anxiety states: a replication. *Behaviour Research and Therapy, 27*, 317-323.

Mogg, K., McNamara, J., Powys, M, Rawlinson, H., Seiffer, A. and Bradley, B. P. (2000). Selective attention to threat: A test of two cognitive models of anxiety. *Cognition and Emotion 14 ,3,* 375 – 399.

Mogg, K., Millar, N. and Bradley, B. P. (2000). Biases in eye movements to threatening facial expressions in generalised anxiety disorder and depressive disorder. *Journal of Abnormal Psychology, 109,* 695 – 704.

Monk, C. S., Nelson, E. E., McClure, E. B., Mogg, K., Bradley, B. P., Leibenluft, E. et al. (2006). Ventrolateral prefrontal cortex activation and attentional bias in response to angry faces in adolescents with generalised anxiety disorder. *American Journal of Psychiatry, 163*,

1093 – 1097.

Moradi, A. R., Neshat-Doost, H. T, Taghavi, M. R., Yule, W. and Dalgleish, T. (1999). Performance of children of adults with PTSD on the Stroop color-naming task: A preliminary study. *Journal of Traumatic Stress, 12, 4,* 663 – 671.

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

Morris, J.S., Frith, C.D., Perrett, D.I., Rowland, D., Young, A.W., Calder, A.J. and Dolan, R.J. (1996). A differential neural response in the human amygdala to fearful and happy facial expressions. *Nature, 383*, 812-815.

Morris, J. S., Öhman, A. and Dolan, R. J. (1998). Conscious and unconscious emotional learning in the human amygdala. *Nature, 393*, 467 – 470.

Näätänen, R. (1990). The role of attention in auditory information processing as revealed by event-related potentials and other brain measures of cognitive function. *Behavioral and Brain Sciences, 13,* 201 – 288.

National Institute of Clinical Excellence. (2004). *Anxiety: Management of anxiety (panic disorder with or without agoraphobia, and generalised anxiety disorder) in adults in primary, secondary and community care. Clinical Guideline 22.* London: Author.

Neisser, U. (1967). *Cognitive Psychology.* New York: Appleton-Century-Crofts.

Norman, D. A. (1968). Towards a theory of memory and attention. *Psychological Review, 75,* 522 – 536.

Office of National Statistics. (2001). *First release: Psychiatric Morbidity Among Adults living in private households, 2000.* London: National Statistics.

Ohman, A. (1997). As fast as the blink of an eye: Preattentive processing and evolutionary facilitation of attention. In P. J. Lang, M. Balaban and R. F. Simons (Eds.), *Attention and motivation: Cognitive Perspectives from Psychophysiology, Reflexology, and Neuroscience.* Hillsdale, NJ: Erlbaum.

Orvaschel, H., Lewinsohn, P. M. and Seeley, J. R. (1995) Continuity of Psychopathology in a Community Sample of Adolescents, *Journal of the American Academy of Child and Adolescent Psychiatry, 34*, 1525 – 1535.

Ost, L. G. and Treffers, P. D. A. (2001). Onset, course and outcome for anxiety disorders in children. In W.K. Silverman & P.A. Treffers (Eds.), *Anxiety disorders in children and adolescents: Research, assessment and intervention* (pp. 293–212). Cambridge: Cambridge University Press.

Perez-Edgar, K. and Fox, E. (2005). Temperament and anxiety disorders. *Child and Adolescent Psychiatric Clinics of North America, 14,* 681 – 706.

Peterson, S. E., Robinson, D. L. and Morris, J. D. (1987). Contributions of

the pulvinar to visual spatial attention. *Neuropsychology, 25,* 97 – 105.

Phelps, E. A. and LeDoux, J. E. (2005). Contributions of the amygdala to emotion processing: From animal models to human behavior. *Neuron, 48,* 175 – 187.

Pine, D. S., Cohen, P., Gurley, D., Brook, J. and Ma, Y. (1998). The risk for early-adulthood anxiety and depressive disorders in adolescents with anxiety and depressive disorders. *Archives of General Psychiatry, 55,* 56 – 64.

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

Posner, M. I. and Cohen, Y. (1984). Components of visual orienting. In H. Bouma and D. Bowhuis, (Eds.). *Attention and Performance X.* Hove: Lawrence Erlbaum

Posner, M. I. and Peterson, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience, 13,* 25 – 42.

Posner, M. I. and Rothbart, M. K. (1992). *Attentional mechanisms and conscious experience.* In D. Milner and M. Ruggs (Eds.), The Neuropsychology of Consciousness. San Diego, CA: Academic Press.

Posner, M. I., Walker, J. A., Friedrich, F. J. and Rafel, R. D. (1984). Effects of parietal lobe injury on covert orienting of visual attention. *Journal of Neuroscience, 4,* 1863 – 1874.

Rapee, R. M., McCallum, S.L., Melville, L. F., Ravenscroft, H. and Rodney, J. M. (1994). Memory bias in social phobia. *Behaviour Research and Therapy, 32*, 89 – 99.

Reid, S. C., Salmon, K. and Lovibond, P. F. (2006). Cognitive biases in childhood anxiety, depression and aggression: Are they pervasive or specific? *Cognitive Therapy and Research, 30,* 531 – 549.

Richards, A. and Millwood, B. (1989). Colour-identification of differentially valenced words in anxiety. *Cognition and Emotion, 3*, 171-176.

Rothbart, M. K., Posner, M. I., and Boylan, A. (1990). Regulatory mechanisms in infant development. In J. T. Enns (Ed.), *The development of attention: Research and theory.* New York: Elsevier Science.

Salkovskis, P. M. (1989). Cognitive-behavioural factors and the persistence of intrusive thoughts in obsessional patients. *Behaviour Research and Therapy, 27*, 677 – 682.

Schwartz, C. E., Snidman, N. and Kagan, J. (1996). Early temperamental predictors of Stroop interference to threatening information at adolescence. *Journal of Anxiety Disorders, 10, 2,* 89 – 96.

Scott, S. K., Young, A. W., Calder, A. J., Hellawell, D. J., Aggleton, J. P. and Johnson, M. (1997). Impaired auditory recognition of fear and anger following bilateral amygdala lesions. *Nature, 385,* 254 – 257.

Seligman, M. E. P., Walker, E. F. and Rosenhan, D. L. (2001). *Abnormal Psychology* (4th Ed.). New York: Norton.

Shiffrin, R. M. (1988). Attention. InR. C. Atkinson, R. J. Hernstein, G. Linzey

and R. D. Luce. (Eds.), *Stevens' handbook of experimental psychology.* New York: Wiley.

Soares, J. J. F., and Öhman, A. (1993). Backward masking and skin conductance responses after conditioning to non-feared but fear relevant stimuli in fearful subjects. Psychophysiology, 30, 460 – 466.

Stirling, L. J., Eley, T. C and Clark, D. M. (2006). Preliminary evidence for an association between social anxiety symptoms and avoidance of negative faces in school aged children. *Journal of Clinical Child and Adolescent Psychology, 35,* 3, 440 – 445.

Stopa, L. and Clark, D. M. (1993). Cognitive processes in social phobia. *Behaviour Research and Therapy, 31*, 255 – 267.

Strauss, C. C., Last, C. G. and Hersen, M. (1998). Association between anxiety and depression in children and adolescents with anxiety disorders. *Journal of Abnormal Child Psychology, 16,* 57 – 68.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. Journal of *Experimental Psychology, 225*, 643-662.

Taghavi, M., Neshat-Doost, H. T., Moradi, A. R., Yule, W. and Dalgleish, T. (1999). Biases in visual attention in children and adolescents with clinical anxiety and mixed anxiety-depression. *Journal of Abnormal Child Psychology*, 27, 3, 215 – 223.

Thomas, K. M., Drevets, W. C., Dahl, R. E., Ryan, N. D., Birmaher, B., Eccard, C. H., Axelson, D., Whalen, P. J. and Casey, B. J. (2001). Amygdala response to fearful faces in anxious and depressed children. *Archives of General Psychiatry, 58*, 1057 – 1063.

Treisman, A. M. (1964). Selective attention in man. *British Medical Bulletin, 20,* 12 – 16.

Vasey, M. W., Daleiden, E. L., Williams, L. L., and Brown, L. (1995). Biased attention in childhood anxiety disorders: A preliminary study. *Journal of Abnormal Child Psychology, 23*, 267-279.

Vasey, M. W., Elhag, N. and Daleiden, E. L. (1996). Anxiety and the processing of emotionally-threatening stimuli: Distinctive patterns of selective attention among high- and low-anxious children. *Child Development, 67*, 1173-1185.

Vendrell, P., Junque, C., Pujol, J., Jurado, M. A., Molets, J and Grafman, J. (1995). The role of prefrontal regions in the Stroop task. *Neuropsychology, 33, 3,* 341 – 352.

Waters, A. M., Lipp. O. V. and Cobham, V. E. (2000). Investigation of threat-related Attentional bias in anxious children using the startle eyeblink modification paradigm. Journal of Psychophysiology, 14, 3, 142 – 150.

Waters, A. M., Lipp. O. V. and Spence, S. H. (2004). Attentional bias toward fear-related stimuli: An investigation with non-selected children and adults with anxiety disorders. *Journal of Experimental Child Psychology, 89,* 320 – 337.

Watts, F. N. and Coyle, K. (1993). Phobics show poor recall of anxiety words. *British Journal of Clinical Psychology, 36*, 21 – 31.

Williams, L. M., Liddell, B. J., Kemp, A. H., Bryant, R. A., Mearey, R. A., Peduto, A. S. and Gordon, E. (2006). Amygdala-prefrontal dissociation of subliminal and supraliminal fear. *Human Brain*

Mapping, 27, 8, 652 – 661.

Williams, J. M. G., Watts, F. N., Mathews, A. and MacLeod, C. (1988). *Cognitive Psychology and Emotional Disorders*. Chichester: Wiley.

Williams, J. M. G., Watts, F. N., Mathews, A. and MacLeod, C. (1997). *Cognitive Psychology and Emotional Disorders (2nd Ed).* Chichester: Wiley.

Wilson, E. and MacLeod, C. (2003), Contrasting Two Accounts of Anxiety-Linked Attentional Bias: Selective Attention to Varying Levels of Stimulus Threat Intensity . *Journal of Abnormal Psychology, 112, 2*, 212 – 218.

Zald, D.H. and Pardo, J.V. (1997). Emotion, olfaction, and the human amygdala: Amygdala activation during aversive olfactory stimulation. *Proceedings of The National Academy of Sciences of The United States of America, 94, 8*, 4119-4124.

Empirical Paper

INTERACTION OF ATTENTION CONTROL, AGE AND ANXIETY IN ATTENTION TO THREAT IN A MODIFIED EMOTIONAL STROOP AND GO/NOGO TASK.

Prepared as if a submission to:

Cognition and Emotion

(see Appendix B for instructions for authors)

Interaction of attention control, age and anxiety in attention to threat in a modified emotional Stroop and Go/Nogo task.

Naida Southall

School of Psychology

University of Southampton

Address for correspondence:

Naida Southall, Doctoral Programme in Clinical Psychology, School of Psychology, University of Southampton, Highfield, Southampton, Hants. S)17 1BJ. United Kingdom (tel: ++44 23 80 595321; fax: + 44 23 80 592588

Running Header:

Attention inhibition and childhood anxiety

Abstract

There is strong evidence for information processing biases in attention to threat in adults who are high in anxiety (e.g., Williams, Watts, MacLeod & Matthews, 1988, 1997). This relationship has been implicated in the development and maintenance of anxiety disorders with delays in releasing attention (i.e., poor attentional control) from threatening stimuli being proposed as prolonging the anxious experience and preventing the use of coping strategies (Derryberry & Reed, 2002). The purpose of this study was to examine the relationship between attentional control, age, anxiety and attention to threat faces in a developing population. Specifically, the study aimed to explore whether the relationship between anxiety and attention to threat in children is moderated by age and attentional control.

A community sample of 42 children, aged 8 to 16, completed measures of trait and state anxiety and attention control. Two computer based tasks were also administered; a modified version of the emotional Stroop and a Go/Nogo task. The results found a negative relationship between attention to angry faces and state anxiety. This relationship was moderated by and facilitated by an interaction between age and attention control. The limitations of employing a correlational design and effect of task duration on children's ability to maintain concentration is discussed.

Key words: Effortful control, inhibition, cognitive development, anxiety, emotion, faces.

Introduction

Attention bias in anxiety

Studies have consistently provided evidence for increased capture of attention of anxious adults by stimuli interpreted as threatening (e.g. Mogg & Bradley, 1998; Williams et al., 1988, 1997). For example, a number of studies document a faster response to probes replacing threat related words suggesting individuals high in anxiety orientate towards threat whereas low anxious individuals are found to orientate away from threatening stimuli (e.g. Williams, Watts, MacLeod & Matthews, 1988). Cognitive studies and neuropsychological investigations have provided some evidence that this capture of attention occurs at a preconscious automatic stage in processing and is more prevalent in stimuli presented subliminally (e.g. Mogg & Bradley; 1999; Williams et al., 2006). These findings provide support for a fast track route, via the amygdala, for low level processing of fear bypassing more elaborative processing routes, that has been identified in magnetic resonance imaging (MRI) studies (LeDoux, 2000).

Evaluative models (e.g. Mogg, McNamara, Powys, Rawlinson, Seiffer & Bradley, 2000; Wilson & Macleod, 2003) suggest that the capture of attention by threatening stimuli is an adaptive survival mechanism necessary for the

detection and avoidance of danger. They further propose that this mechanism is activated in low anxious individuals, when stimuli appear above a particular threshold. More recently, it has been suggested that it is not the capture of attention by threatening stimuli per se, but the delayed release of this attention that leads to the development of anxiety disorders (Fox, Russo & Dutton, 2002). Delayed release of attention is maladaptive as it prolongs the experience of anxiety (Derryberry & Reed, 2002), reduces attentional availability to search the rest of the environment (Posner & Peterson, 1990) and limits the individual's ability to relocate attention on safe or relieving stimuli that aid coping (Derryberry & Reed, 2002).

Derryberry and Rothbart (1997) suggest that attention to threat may be inhibited by effortful control, a skill developed throughout childhood coinciding with the strengthening of synapses in neural networks of the brain's frontal regions. They suggest that the development of effortful control increases a child's capacity for strategic voluntary forms of control allowing evaluative information about the current situation, past experiences and predictions for the future to be fed back to the limbic system during the processing of threatening stimuli. They further suggest that failure to develop adequate effortful control has implication for the development of a range of childhood disorders, including problems with aggression, anxiety and attention control.

Yiend and Mathews (2001) measured attentional disengagement from non-threatening and threatening pictures in adults using a cueing paradigm in which

the pictures either predicted or did not predict the target location. On those trials which accurately predicted the target location they were able to measure attentional engagement whereas those which failed to predict target location allowed for measurement of attentional disengagement. Results showed that although low and high anxious adults were slower to respond to targets that were invalidly cued, high anxious individuals demonstrated a relatively slower response to invalidly cued targets following threatening pictures as compared to non-threatening pictures. These findings support the suggestion that ease of disengagement from threat cues in anxious individuals contributes to attentional information processing biases in anxiety disorders.

Using a similar cueing task, Koster, Crombez, Verschuere, Van Damm and Wiersema (2006) replicated the findings of Yiend and Mathews (2001) providing support for the delayed disengagement of attention in high trait anxious adults at rapid presentation (100ms). However, they did not find this at longer presentations nor did they find an effect for low anxious individuals in response to highly threatening stimuli, as would be predicted by evaluative models. Their findings contrasted with Yiend and Mathews' (2001) findings at longer stimulus presentation. Although Koster et al. (2006) cite methodological differences as a possible explanation for this difference, their results did support previous cognitive studies which identified a bias for subliminally presented threat stimuli (Mogg & Bradley, 1999; Williams et al., 2006).

Derryberry and Reed (2002) tested the theory that adults with high anxiety may have delayed disengagement from threat stimuli due to poorly developed effortful control, a mechanism thought to be used to inhibit attention to irrelevant threatening stimuli enabling attention to be redirected towards the appropriate use of coping strategies. Consistent with the findings of Koster et al. (2006) and Yiend and Mathews (2001), Derryberry and Reed identified delayed disengagement from threat stimuli in anxious individuals using a cueing task. However, the researchers also measured ability to control attentional processes using their own self-report measure, the Attentional Control Scale. They found that anxious adults with poor attentional control responded more slowly to uncued targets suggesting delayed disengagement of attention. Conversely, those anxious individuals with good attention control were quicker at shifting attention from threatening stimuli.

Stroop studies

Use of the Stroop

Another experimental paradigm used in the study of attention is 'Stroop' task. First used over 70 years ago, the traditional Stroop demonstrates interference in naming the ink colour of contrasting colour words (e.g. the word 'red' printed in green ink). The task of colour naming is slowed by the more automatic process of reading the colour word, a response that must be inhibited in order to give the required ink colour (Stroop, 1935). The task is considered a reliable measure of executive functions and inhibition controlled by the frontal lobes (MacLeod,

1991); patients with lateral lesions in the prefrontal lobes are reported to show a higher number of errors in the Stroop task compared with normal controls (Vendrell et al., 1995).

Over 400 studies have explored the theoretical basis of the processes underlying the Stroop effect, providing support for a number of dominant theories which remain subject to debate. These include the Relative Speed of Processing account (e.g. Morton & Chamber, 1973) whereby the two stimuli are processed in parallel and with interference occurring at the limited capacity response stage, the Automaticity account (e.g. Shiffrin & Schneider, 1977) whereby processing of stimuli requiring greater attentional resources compromised by processing of alternative stimuli requiring less attentional resources and the Perceptual Encoding account (e.g.Hock & Egeth, 1970), an 'early selection' model in which the encoding process is slowed owing to incompatibilities of stimuli colour as opposed to a neutral control (for a review and evaluation see MacLeod, 1991).

Despite the uncertainty over the underlying processes of the Stroop phenomenon, many hundreds of studies have emerged over the years that apply the 'Stroop Task' to exploration of attentional processes leading to a greater understanding of the effects of interference occurring when two stimuli presented in the same location compete for attention. Studies in developing populations have found an early rise and fall in interference effects due to undeveloped reading skills in younger children. Interference peaks around age

7 or 8 years, as reading ability improves, before then declining into adulthood (Dash & Dash, 1982). This hypothesis is supported by findings from older children with poor reading ability who also exhibit minimal interference for colour words in ink colour naming (Ehri, 1976). Difficulties with screening out interfering information are then seen to increase again as the individual approaches advanced age (Cohn, Dustman & Bradford, 1984).

Over the years the form of the Stroop task has evolved for use in studying attentional processes in anxiety and has produced consistent findings in studies of attentional bias spanning over 25 years. Beginning initially with exam related words and students preparing for an important examination (Ray, 1979) researchers have gone on to identify a Stroop effect in a range of disorders including obsessive-compulsive disorder (e.g. Foa, Ilai, McCarthy, Shoyer & Murdock, 1993), social phobia (Hope, Rapee, Heimberg & Dombeck, 1990), spider phobia, (e.g. Lavy, Van Den Hout & Arntz, 1993), panic disorder (McNally, Riemann & Kim, 1990), generalised anxiety disorder (Mathews & MacLeod, 1985) and posttraumatic stress disorder (e.g. Thrasher, Dalgleish & Yule, 1994). The biases identified in emotional Stroop studies have been recognised as preconscious processes as evidenced in Stroop investigations using backward masking of stimuli (e.g. van den Hout, Tenney, Huygens & de Jong, 1997).

Stroop stimuli

Mogg, Mathews and Weinman (1989) demonstrated that the Stroop effect was specific for stimuli congruent with the anxious subjects' worries. In addition, it is suggested that some stimuli, such as spiders and snakes, are of such evolutionary importance that they are viewed as innately threatening (Őhman, 1993). Whilst some researchers (e.g. Vasey, El-Hag & Daleiden, 1996) have raised concerns over the effectiveness of word stimuli with children whose reading may not be well developed, word stimuli used in the Stroop have been shown to be equally effective as pictures in young subjects despite being rated as less aversive (e.g. Kindt, Bierman & Brosschot, 1997; Kindt, van den Hout, de Jong & Hoekzema, 2000). This suggests that magnitude of threat is not relevant in gaining attentional resources provided a minimal relevance or threshold value is achieved (Cohen, Dunbar & McClelland, 1990; LeDoux, 2000).

Derryberry and Rothbart (1997) describe the environmental and temperamental influences on the development of neurological structures implicated in effortful control. They describe young children's motivation to approach new situations in order to experience and learn. It is possible that, amongst neutral stimuli, other stimuli perceived as threatening by the researcher may indeed capture the child's attention but due to unusual interest or novelty rather than

threat valence. Therefore, the validity of stimuli such as dogs, guns and sharks (e.g. Waters, Lipp and Spence, 2004) could be questioned.

Stimuli such as faces however are less open to interpretation. Children are born with an innate interest in faces which helps the formation of an attachment with the primary carer and aids language acquisition, emotional and social development (Őhman, 2002). Recognition of angry faces is of particular importance due to the benefit of being able to assess mood of others, particularly if that mood represents a threat to the individual (Őhman, 2002). Indeed, a number of studies have found evidence for automatic, preconscious processing of angry and fearful stimuli by the amygdala (e.g. Williams et al., 2006). In addition, cognitive and fMRI studies have suggested an attention bias favouring angry faces in visual search with adults quickly identifying angry faces amongst a 'crowd' of positive (Eastwood, Smilek & Merikle, 2001; Őhman, Lundqvist & Esteves, 2001) and neutral faces (Fox et al. 2000).

These findings have been replicated with young populations. Hadwin et al. (2003) provides empirical evidence in the form of a visual search task confirming that children aged 7 to 10 years are also able to pick out angry faces from amongst other distracter faces. Meanwhile, Thomas et al. (2006) provide neuropsychological evidence from fMRI studies of children for a heightened amygdala response to threatening versus neutral faces whilst viewing photographs of faces which also correlated with self-report anxiety.

Findings in child studies

Attentional bias in anxious children

A number of studies have identified an attentional bias for threatening stimuli in anxious children using paradigms such as the dot-probe (e.g. Vasey, El-Hag & Daleidine, 1996), startle reflex (e.g. Miller & Patrick, 2000; Waters, Lipp & Cobham, 2000) and visual search (Hadwin et al., 2003). However, other researchers have failed to identify any attentional bias in anxious children using a range of experimental paradigms and different sources of fear (e.g. dot probe; Waters, Lip & Spence, 2004). Others, such as Monk, et al. (2006), have provided evidence for increased attention bias away from threat stimuli in adolescents with generalised anxiety disorder compared with non-anxious controls using the dot-probe (see also Stirling, Eley & Clark, 2006). Further evidence exists suggesting that bias away from threat stimuli may have an adaptive function for children living in highly stressful environments (e.g. Pine et al. 2005; Moradi, Neshat-Doost, Taghavi, Yule, & Dalgleish, 1999).

However, these empirical approaches do not assess the self-control mechanisms required in processing two stimuli competing for attention whilst occupying the same space and are therefore not appropriate for the study of the role of inhibition in the developmental of childhood anxiety disorders. Despite the small size of the child literature examining attention bias in anxiety that use it, the Stroop would appear to be a more effective measure of the interference and inhibitory effects taking place.

Child studies using the Stroop

Despite consistent results found in adult studies using the emotional Stroop, studies with children have not produced reliable results in the search for a relationship between anxiety and attentional biases for threat. A number of studies have reported an observed interaction between anxiety and interference effects of threat stimuli in modifications of the emotional Stroop with developing populations. Evidence from investigations using a variety of stimuli and anxiety disorders suggest an attentional bias in high anxious children, as compared to low anxious children, that is similar to that of adult populations; for example, Martin, Horder & Jones (1992) and Martin and Jones (1995) studying children with spider phobia, Moradi, Taghavi, Neshat-Doost, Yule, and Dalgleish (1999) studying children with a diagnosis of PTSD and Heim-Dreger, Kohlmann, Eshenbech and Burkhardt (2006) comparing bias for threatening faces and state and trait anxiety in a community sample of children.

However, many of the studies reported suffer methodological flaws which mean their findings may not be as promising as first thought. For example, Richards, Richards and McGeeney (2000) found a delay in colour naming threatening words in a Stroop with high-anxious adolescents aged 16 to 18, as identified using the Beck Anxiety Inventory (Beck & Steer, 1990). The relationship between anxiety and interference was shown to be linear and consistent with findings from adult Stroop studies. Unfortunately, as with many of the previous studies cited, their stimuli did not include positive or happy stimuli. This means a

bias for threat can only be identified in relation to neutral stimuli and the bias in relation to any other emotions is unclear. This is particularly important when making use of the emerging findings as the child's environment contains a mixture of differently valenced stimuli and is rarely limited to threat or neutral.

Schwartz, Snidman and Kagan (1996) tested 74 children (mean age 13), classified previously as either 'inhibited' or 'uninhibited', using an emotional Stroop paradigm with threatening, positive and neutral word stimuli. Although they conclude that inhibited children had more threatening word stimuli amongst their longest latencies as compared to uninhibited children, on examining their results it is seen that mean response latency for threatening words was actually shorter than that of positive words, although not significantly. A post-hoc analysis in which the researchers compared only the top quartile of subjects' scores did produce results supporting their research hypothesis that adolescents who had been classified as inhibited 11 years earlier would display bias for threat related words. However, the validity of selecting scores for analysis which fit with the expected outcome is highly questionable.

Still, further studies have found unexpected findings in developing populations that appear to contradict findings in the adult literature. For instance, Kindt and collegues (Kindt, Bierman & Brosschot, 1997; Kindt et al., 2000) found a general bias for threat stimuli in 8 year old children using a Stroop task with spider words. This bias was observed to reduce with age in low anxious children but

remained in children with higher levels of anxiety; although the distribution of participant ages in these studies was considerably uneven.

Other studies that have not found a difference in magnitude of bias for threat for low and high anxious children have failed to examine effects of increasing age. For example, Kindt, Bogels and Morren (2003) failed to identify an attentional bias for threat in anxious children with either GAD or a specific phobia, compared with non-anxious controls but commented that their participant numbers did not allow for an analysis of developmental effects.

Waters, Lipp and Spence (2004) also found a bias for fear related pictures in a comparison of 23 clinically anxious and non-anxious children aged between 9 and 12 years, this time using the dot probe paradigm. However, they did not include a group of older children in their study with whom comparisons could be made. It cannot be determined therefore whether their results were particular to the under-twelves age group or whether older children would also exhibit a general bias for the threat stimuli used in this particular study.

A more recent study by Hadwin, Donnelly, Richards, French and Patel (submitted) attempts not only to investigate age effects but also to extend the age range typically used in studies of childhood attention in order to assess for developmental effects. The study identified a delay in colour matching angry schematic faces in socially anxious children but this bias was not found to be affected by age. That is, attention bias for threat, in the form of decreased ability

to inhibit attention to threat, was associated with social anxiety in children as young as six years but not in their low anxious peers.

The interesting but contradictory findings in the child literature present a confusing picture of information processing biases in childhood anxiety. Yet the emergence of significant differences between findings in the adult and child literatures suggest developmental effects on biases in attention that could be related to developing skills in effortful control. The Stroop task is particularly apt for investigating the inhibitory skills utilised in responding to stimuli which compete for attentional resources. Evidence from functional-MRI Imaging studies shows age-related increases in the ability to engage self-regulatory control through increased use of the frontostriatal systems and increased de-activation of the subgenual anterior cingulate and posterior cingulate during the Stroop task (Marsh et al., 2006, studying individuals aged 7 to 57).

Despite sound developmental theory and evidence from developmental neurological studies, the findings from cognitive studies have not yet provided reliable support for a moderating effect of effortful control in the development of anxiety disorders and the age related effects of voluntary control and inhibition of attention to threat stimuli.

The present study

This present study aimed to examine the role of inhibition to threat in the development of anxiety in children. It aimed to test the hypothesis that children's ability to inhibit attention to threat increases with chronological age and that children with high levels of anxiety are less able to inhibit their attention to threat than children with low levels of anxiety. The study used a modified version of the emotional Stroop paradigm to test the hypothesis that children with high levels of anxiety and low attention control would exhibit an increased reaction time in colour matching angry and fearful schematic faces, as compared to neutral and happy faces. A Go/Nogo task was also used in order to provide a measure of inhibitory skills along with a standardised questionnaire measure of attention control. Symptoms of anxiety were assessed using standardised self-report measures. It was expected that children with low attention control would respond with a greater number of false alarms to trials which required response inhibition and that this effect would be greatest for negative face stimuli. A correlation analysis was used to identify links between anxiety and inhibition to threat. Hierarchical regression analyses were used to identify the moderating affects of attentional control and chronological age on performance in the Stroop and Go/Nogo tasks.

Method

Design

The study used a correlation design to test the hypothesis that children's ability to inhibit attention to threat increases with chronological age and that children with high levels of anxiety are less able to inhibit their attention to threat than children with low levels of anxiety. Self report measures were used to measure anxiety, depression and attention control. Attention bias to threatening faces was assessed using a modified emotional Stroop and response inhibition was assessed using a Go/Nogo task. Correlations were run to explore the relationship between the chronological age, attention control score, state anxiety and trait anxiety. Findings from the Stroop and Go/Nogo tasks were analysed using hierarchical multiple regression analyses run to examine the relationship between the age, attention control, anxiety and the interaction between age and attention control.

Participants

Participants were an opportunity sample of 42 typically developing children (25 males and 17 females) from primary schools and secondary schools in the community. The mean age was 12 years 2 months (range 8 years 2 months to 16 years 2 months). As the aim was to provide a representative sample that

reflected developmental changes, participants were recruited from years four (n=11), six (n=11), eight (n=8) and 10 (n=12) in order to spread the age range evenly. Mean ages for children from years four, six, eight and ten were 9:3, 11:0, 13:1 and 15:1 (years:months) respectively. Schools were contacted in writing to seek permission to involve their pupils in the study (Appendix C). Letters were then sent to parents asking for written consent for their children to participate in the study (Appendix D). Informed written assent was also obtained in writing from the children on the day of testing after going through the briefing statement with the experimenter (Appendix E).

Measures and materials

Questionnaire measures

Revised Child Anxiety and Depression Scale (RCADS; Chorpita, Yim, Moffitt Umemoto & Francis, 2000). The RCADS (Appendix F, with author's permission to use in Appendix G) is a self-report measure recommended for the assessment of trait anxiety and depression in both research and clinical settings. A revision of the Spence Children's Anxiety Scale (Spence, 1994), the scale is structured to have relevance to the childhood anxiety and depressive disorders described in the Diagnostic and Statistical Manual, making it clinically relevant as well as an effective research tool (Chorpita et al. 2000). The measure benefits from being able to generate a total score for anxiety with symptoms that

overlap with depression removed. In addition, normative data exists for male and female children aged 6 to 17 years.

The scale consists of 47 items, each describing a symptom in the first person (e.g. "I worry about being away from my parents"). Respondents circle a response, from 'never', 'sometimes', 'often' and 'always', to indicate how often these things happen to them. Items are scored on a 4-point scale ranging from 0 to 3. T-scores are calculated using the RCADS Scoring Programme (Chorpita et. al, 2000). A number of scores are generated by the measure; five are from the anxiety subscales (separation anxiety, generalised anxiety, panic disorder, social anxiety and obsessive compulsive disorder) and one from the depression subscale. The five anxiety scores are averaged to give a total anxiety score whilst the mean of all six subscales represent the total RCADS score. T-scores from 65 to 70 are considered to be in the borderline range and scores above 70 are considered to be in the clinical range. The RCADS has been shown to have good psychometric properties including good internal consistency (alpha co-efficient of .73 to .82), good test-retest reliability (.71 to .81) and good convergent and discriminate validity. See Chorpita et. al (2000) for a detailed review of each of the subscales.

Attention Control Scale (ACS; Derryberry & Reed, 2002). The ACS (Appendix H) is a self-report measure designed to assess an individual's capacity to self-regulate their attention under a wide variety of contexts and environmental influences. The scale consists of twenty statements such as "I have a hard time

concentrating when I am excited about something". Responses are made on a 4-point scale from 'almost never' to 'always'. Although used primarily with adult populations, for which there is analytic support, the ACS has been used more recently with children and adolescents (e.g. Phillips, 2003). As the study aims to examine the role of effortful control in the development of childhood anxiety, this measure is included to provide a measure of children's perceived attention control in addition to the measured attention control assessed using the computerised Go/Nogo task.

Derryberry & Reed (2002) report that the measure has good internal consistency (α = .88) and is positively related to indices of positive emotionality such as extraversion (r = .40) and inversely proportional to anxiety (r = -.55). They state that factor analysis indicates the scale measures a general capacity for attentional control with correlated subfactors related to the ability to focus attention, shift attention and flexibly control thought (Derryberry & Reed, 2002).

State Anxiety Scale of the State Trait Anxiety Inventory for Children (STAI-C; Spielberger, Edwards, Montouri & Lushene, 1973). The State-Anxiety scale of the STAI-C (permission to use copyrighted material in Appendix I) is designed to measure transitory anxiety states in children and was included to determine anxiety levels during the assessment procedure. Normative data is available for children aged 8 to 12 years (Spielberger et al., 1973) and it is considered more appropriate for use in adolescent populations than the adult version due difficulties experienced by young people with the vocabulary of the adult scale

(Hoehn-Saric et al., 1987). The State Anxiety scale of the STAI-C consists of 20 statements beginning "I feel..." describing feelings the child may have at that particular moment in time, for example, 'calm', 'nervous', 'happy' and 'sure'. Responses are made on a 3-point scale (e.g. 'very calm', 'calm', 'not calm') designed to identify subjective, consciously perceived feelings of apprehension, tension and worry. Together with the Trait-Anxiety Scale, these two measures make up the STAI-C which is based on the well known State Trait Anxiety Inventory (Spielberger, Gorsuch & Lushene, 1970) used to differentiate between state and trait anxiety in adults. The measure has good construct validity and good internal consistency with Cronbach α reliability coefficients for the State Anxiety subscale ranging from .71 to .76 in children aged 8 to 12 years (Papay & Spielberger, 1986) and .87 to .89 in adolescents aged 12 to 18 years (Kirisci & Clark, 1996). The scale correlates well with other measures of childhood anxiety including the Childhood Manifest Anxiety Scale and the General Anxiety Scale for Children (see Kirisci and Clark, 1996, for a review).

Computer tasks

The emotional Stroop and the Go/NoGo task were programmed and presented using Presentation software package version 11 (Neurobehavioural Systems, 2006) on a Hewitt Packard "Pavillion" laptop computer with a widescreen, colour, LCD screen, size 34cm. Responses in the emotional Stroop task were made on a Superlab 4-key response box with four coloured keys. Responses on the Go/NoGo were made using the spacebar of the computer keyboard. The Presentation software provides a sensitive measure of reaction times

(Neurobehavioural Systems, 2006). Output data from the emotional Stroop and Go/NoGo were collated by the Presentation programme and displayed using spreadsheets in Microsoft Excel. Each response was recorded as correct or incorrect with a response time recorded in milliseconds.

Modified Emotional Stroop task. A modified emotional Stroop task was used to measure inhibition of attention to threat. The Stroop, widely used in studies of attention bias, is considered to be a reliable measure of attention and is particularly suitable for this study owing to the requirement to inhibit attention to the given emotion in order to match stimuli colour. Stimuli in the emotional Stroop condition consisted of schematic faces, 232 x 238 pixels, made up of a pair of eyes, a pair of eyebrows and a mouth. The features were arranged to convey angry, happy, fearful and neutral faces. Facial features were shown in white and were enclosed by a coloured circle, in red, blue, green or yellow, forming the outline of the face, all on a black background (see Appendix J). The faces stimuli have been used previously by Hadwin, et al., (submitted) and are based on those used by Hadwin et. al, (2003). Fours blocks of emotion faces (happy, fearful, angry and neutral) were presented each with 32 trials; 16 emotional faces and 16 inverted faces.

Children were asked to match the colour of each face outline to a button in front of them. Button responses were made on a four button response box displaying the colour choice – blue, red, green and yellow from left to right. Faces appeared on the screen until a response button was pressed and were

preceded by a fixation point (a white cross, 63 x 63) shown for a duration of 200ms. The order of the four blocks was randomised across subjects and the order of trials was randomised within each block. A series of 16 practice trials preceded the experimental blocks. In these, coloured circle outlines appeared on screen without enclosing facial features. The practice block was separated from the experimental blocks by a second instructional screen bearing the text "Ready....?" Instructions for the task appeared on the screen, in white letters on a black background, prior to the practice session (see Appendix K) and read "You will see a coloured circle on the screen. You have to match the colour of the circle to one of the four coloured buttons in front of you. Let's have a practice..... Press the spacebar to start". These were read aloud to the participant and opportunity for questions was given prior to commencing the practice block.

Go/NoGo Task. The Emotional Go/NoGo task (Hare, Tottenham, Davidson, Glover and Casey, 2005) is a modified version of the Probability Go/NoGo task (Casey et al., 2001) designed to examine the role of cognitive control processes in emotional information processing. Participants were required to respond to a particular emotional facial expression (angry, fearful, sad, happy) (Go trials) and not respond (NoGo trials) to a neutral facial expression or vice versa. Stimuli are presented at a ratio such that a 'habit' of responding to the 'go' condition is acquired. This response must be inhibited by effortful control in order to withhold responses to the 'nogo' condition and thus, the number of 'false alarms' provides a measure of failure to inhibit the response. The same schematic

faces stimuli (anger, fearful, sad, happy and neutral, encircled in red, yellow, green or blue) were used as in the emotional Stroop described above. Faces were presented sequentially in the middle of the screen on a black background. The task comprised 6 blocks of 100 trials each for a total of 600 trials. The following 6 blocks were presented: Angry Go/Neutral NoGo, Neutral Go/Angry NoGo; Fear Go/Neutral NoGo, Neutral Go/Fear NoGo; Happy Go/Neutral NoGo, Neutral Go/Happy NoGo. The order of the 6 blocks was randomized across subjects and the order of the trials was randomized within each block. The frequency of occurrence of the Go trials was 75%. Stimulus duration was 500 ms and inter-stimulus interval was 1000 ms.

Generic instructions for the task were given on the screen in white letters on a black background (see Appendix L). They were read aloud to the participant and said "You are going to see some faces, one at a time, on the screen. You will be asked to press the spacebar when you see a specific face. Only press the spacebar when you see this face. Do you have any questions? Press spacebar to begin.....". An additional instructional page proceeded each presentation block illustrating which of the two stimuli to be displayed would require the spacebar response (for an example see Appendix L).

Procedure

Appropriate ethical approval was obtained for this study (Appendix M). Children were introduced to the task by reading through the consent form and signing to

indicate their agreement to continue. Instructions for the computer tasks appeared on the laptop screen prior to each scenario and the opportunity to ask questions was given. The emotional Stroop task was completed first followed by the Go/Nogo task. The examiner then immediately administered the S-Anxiety of the STAIC by reading through the given instructions and statements whist the child circled their answers on their own copy. Clarification to the meaning of words was given when requested. The child was returned to their classroom but later attended the investigation room again in a small group (2 to 4 children). At this point the ACS was verbally administered followed by the RCADS. Again, children responded to the statements on their own questionnaires and were able to ask if they did not understand any of the questions. On completion of the RCADS, children were debriefed and thanked for their involvement in the study. Each child received their own copy of a word processed debriefing statement (Appendix N) as well as an animal sticker.

Data Analysis

The RCADS was scored using the RCADS Scoring Programme supplied by the author (Chorpita et. al, 2000). Seven RCADS T-scores were generated; six from the subscales (general anxiety, separation anxiety, phobia, social phobia, obsessions and compulsions and depression) and a total anxiety score representing the total score for trait anxiety with depression removed. The ACS was scored in accordance with the direction of Derryberry and Reed (2002). The STAI-C was scored following directions given in the accompanying manual

(Spielberger et al., 1973). In order to maintain confidentiality, children's names were removed from all stored data and replaced with numbers in order that data collected could be traced to individual subjects.

Data was collated and displayed using Microsoft Excel and then transferred to SPSS v14 (SPSS Inc., 2005) for analysis. One complete data set was removed from the analysis as self-report responses indicated the respondent had not discriminated between answers, consistently selecting the extreme response option regardless of question. One set of data was removed from the Stroop analysis owing to the number of correct responses being close to chance, suggesting the respondent may have difficulty differentiating colour. Two additional subsets of data from the Go/Nogo task were removed from the overall data set because the responses recorded indicated the instructions had been misunderstood. A further three Go/Nogo subsets were removed because they were incomplete. In cases where only part of the data was removed, the remainder of the data set was retained and used in the analysis. P-p plots performed using SPSS confirmed that all remaining data met the assumptions for a normal distribution and further analysis was undertaken to investigate the relationships between variables.

Preliminary data analysis, including correlations and t-tests, preceded the main analysis in order to ascertain the reliability of the measures used. ANOVAs were used to examine the differences between emotion conditions, included to ensure that reaction times and response rates across variables were similar in

all conditions, in order to determine that one emotion condition was not 'harder' in general (thus permitting further analysis of moderating affects of anxiety, attention control and age). Once satisfied with the reliability of the data, correlations were run in order to determine the order of entry of variables into hierarchical multiple regressions for Stroop and Go/Nogo outcomes.

Results

Table one below shows the distribution of respondents' gender along with mean scores for attention control (ACS score), trait anxiety (RCADS total anxiety T-score) and state anxiety (STAI-C State Anxiety Subscale score) for the different genders.

Table 1:

Percentage of male and female respondents and mean ACS, trait anxiety and state anxiety scores (standard deviation in parenthesis).

Gender	Percentage (*n*)	Mean Scores		
		Attention Control	Trait Anxiety	State Anxiety
Male	58.5 (24)	50.33 (6.20)	43.71 (9.23)	29.29 (4.66)
Female	41.5 (17)	49.88 (6.02)	54.59 (11.31)	29.35 (4.69)

Independent samples t-tests were carried out for attention control, trait anxiety and state anxiety for male and female respondents. Results showed there was no significant difference between males' and females' self-report attention control ($t_{(39)} = .23$, $p > .05$) or self-report state anxiety (and $t_{(39)} = .04$, $p > .05$). A significant difference between mean scores for trait anxiety was identified with females reporting more symptoms of anxiety than males ($t_{(39)} = 3.39$, $p < .01$).

Table two below shows the range, mean and standard deviation of all scores obtained using self report measures (ACS, STAI-C State Anxiety and RCADS). The table includes the 'Total Anxiety' score as measured using the RCADS (with depression removed) as well as the scores for the RCADS subscales of Separation Anxiety, General Anxiety, Phobia, Social Phobia, Obsessions and Compulsions and Depression.

Table 2:

Summary of data from standardised questionnaire measures.

	Range	Mean (Standard deviation)
Total Anxiety	32 - 73	48.22 (11.39)
Separation Anxiety	39 – 93	52.51 (14.07)
General Anxiety	29 – 67	45.55 (9.57)
Phobia	36 – 89	52.44 (11.63)
Social Phobia	25 – 64	45.66 (10.08)
Obsessions and Compulsions	33 – 65	49.24 (9.72)
Depression	33 – 83	51.54 (11.62)
State Anxiety	21 – 44	29.32 (4.61)
Attention Control	38 - 62	50.15 (6.05)

Comparisons with the norms

Scores from the RCADS are given as standardised T-scores, with a score of 50 representing the population mean. As can be seen in the table above, scores for Total (trait) Anxiety and the RCADS subscales all fall within one standard deviation (10 points) of the mean suggesting that the experimental sample reported symptoms of anxiety at a similar level to that of the normal population. Normative data for the Attention Control Scale is not available for non-adult samples.

Correlations between measures

Pearson correlations were conducted on the data set to investigate the relationship between the subscales of the RCADS and the Total Anxiety score obtained using the measure in order to determine the reliability of the scale. All subscales of the RCADS were found to correlate positively with one another, and with RCADS Total Anxiety, and all correlations were found to be statistically significant at $p < .05$ (see table 3 overleaf).

Further Pearson correlations were conducted on the data set to investigate the relationship between chronological age, attention control, trait anxiety and state anxiety (also included in table 3 overleaf).

Table 3:

Correlations between measures

Scale	1	2	3	4	5	6	7	8	9	10
1. RCADS Total Anxiety	_	.689**	.790**	.810**	.863**	.825**	.652**	-.276	-.097	-.117
2. Separation Anxiety		_	.379*	.365*	.509**	.493**	.504**	-.185	-.214	-.041
3. General Anxiety			_	.607**	.596**	.682**	.428**	-.238	.070	-.237
4. Phobia				_	.634**	.563**	.531**	-.260	-.178	.018
5. Social Phobia					_	.619**	.614**	-.201	.030	-.123
6. Obsessions & Compulsions						_	.468**	-.228	-.067	-.129
7. Depression							_	.165	-.155	-.142
8. State Anxiety								_	-.344*	.256†
9. Attention Control									_	-.417**
10. Chronological Age										_

† $p < .1$, * $p < .05$, ** $p < .01$

A significant negative relationship was found between chronological age and scores on the ACS (r = -.42, df = 39, p < .01). This suggests that ability to control attention is related to age. High scores on the ACS suggest poor ability to control attention therefore the findings suggest that as age increases children are more able to control their attention. The results significantly support the view that attention control increases with age.

Scores on the ACS were also found to have a significant negative correlation with scores of state anxiety (r = -.344, df = 39, p < .05). This finding suggests children high in state anxiety are low in attention control and supports the

hypothesis that low ability to control attention is associated with high levels or anxiety.

No significant relationships were identified between scores on the RCADS and either state anxiety, attention control or age. No further significant relationships were identified for state anxiety, chronological age or attention control

Stroop results

For the purposes of the Stroop task only, one data set was removed from the analysis as the number of correct responses was close to chance suggesting that the respondent may have had difficulty differentiating colour.

Following Ratcliffe (1993), the harmonic mean of reaction time data was used in the analysis. This is a measure of central tendency which gives a smaller standard deviation than the arithmetic mean, median or trimmed mean and thereby allows for a higher power of statistical analysis in hypothesis testing.

Preliminary Analysis

Table four below gives the harmonic mean response times in milliseconds for correct responses in each emotion face condition along with the mean number of errors (i.e. when a colour was incorrectly matched) in each condition.

Table 4:

Harmonic mean response times for correct responses, and mean number of errors, in colour matching angry, fearful, happy and neutral faces in the emotional Stroop task (standard deviation in parenthesis).

	Harmonic mean response times (ms)	Mean number of errors
Angry	783.52 (179.40)	.98 (1.23)
Fearful	800.64 (200.76)	.83 (.87)
Happy	786.51 (169.60)	1.03 (1.03)
Neutral	778.80 (184.82)	1.08 (1.53)

Two ANOVAs were run in order to assess for differences between mean response times and mean number of errors for each of the four emotion conditions. These did not identify any significant differences for emotion condition in mean reaction time ($F_{3, 120} = 1.157$, $p > .05$) or mean number of errors ($F_{3, 120} = .394$, $p > .05$).

Attention bias

The harmonic mean was used to calculate attention bias scores by subtracting means from that of the neutral face for each emotion condition. Positive bias scores indicate an increased response time suggesting increased interference whereas negative bias scores indicate a faster response time suggesting less

interference from the emotion face. Three types of emotion bias scores were generated; Angry (mean = 4.72, *SD* = 87.74), Fearful (mean = 21.84, *SD* = 76.45) and Happy (mean = 7.72, *SD* = 78.04). A repeated measures ANOVA, with the three emotion conditions (angry, fearful and happy) entered as the within subjects factor did not find and significant differences between the attentional bias scores ($F_{(2,78)} = .866$, $p > .05$).

Regression Analysis

Pearson's correlations were carried out to examine the relationship between chronological age, trait anxiety, state anxiety and attention control with the angry, happy and fearful bias scores (see table 5 overleaf). This analysis showed a positive trend between state anxiety and angry bias scores ($r = .27$, $p = .085$) and a negative trend between trait anxiety and happy bias scores ($r = -.28$, $p = .078$) There were no other significant correlations between any of the dependent variables and the emotion bias scores.

In order to explore whether the positive relationship between state anxiety and angry bias was moderated by chronological age, trait anxiety and attention control, three regression analyses were run using standardised versions of the variables (z scores generated in SPSS). Product terms were created (by multiplying the two predictor terms together) to form interaction variables for state anxiety and trait anxiety (SA x TA), state anxiety and attention control (SA

x AC) and state anxiety and chronological age (SA x CA). The interaction terms were entered into separate hierarchical regression analyses to examine the modifying role of these terms on angry bias. These analyses did not produce a significant regression equation for the interactions of state anxiety with trait anxiety ($F_{(1,40)}$ = 2.71, p > .05, β = .255, p > .05), attention control ($F_{(1,40)}$ = .779, p > .05, β = -.140, p > .05) or chronological age ($F_{(1,40)}$ = .027, p > .05, β = .027, p> .05) on anger bias.

Table 5:

Correlations between self-report measures and Stroop emotion bias scores

Variable	1	2	3	4	5	6	7
1. Chronological Age	_	-.417**	.265	-.117	-.165	-.168	.000
2. Attention Control		_	-.344*	-.097	.107	-.123	-.126
3. State Anxiety			_	-.276†	.272†	.071	.173
4. Trait Anxiety				_	-.252	-.043	-.278†
5. Anger Bias					_	.288†	.587**
6. Fearful Bias						_	.348*
7. Happy Bias							_

† p < .1, * p < .05, ** p < .01

The three regressions were repeated to explore whether the negative relationship between trait anxiety and happy bias was moderated by chronological age, state anxiety and attention control. The analysis did not

produce any significant regression equations for the moderating effect of state anxiety ($F_{(1,40)}$ = 1.05, p > .05, β = .162, p > .05), attention control ($F_{(1,40)}$ = 1.70, p > .05, β = .205, p > .05) or chronological age ($F_{(1,40)}$ = .602, p > .05, β = .123, p > .05) with trait anxiety on happy bias.

Regression analysis looking at the moderating role of age, trait anxiety and attention control did not identify any significant results suggesting that the relationships between state anxiety and anger bias and between trait anxiety and happy bias are not moderated by these variables.

GoNogo results

For each of the three emotion conditions there were two Go/Nogo tasks; one with the emotion condition as the 'go' trial and neutral face as the 'no go' trial and the other with the neutral face as the 'go' trial and the emotion condition as the 'no go' trial.

Scores were generated for the number of correct responses to 'go' trials and number of false alarms to 'no go' trials (i.e. those in which a response was given to a 'no go' trial). Mean number of correct responses for 'go' and false alarms for 'no go' trials in each of the six conditions can be found in table six below.

Table 6:

Mean number of correct responses to 'go' (/75) and false alarms (/25) to 'no go' trials (standard deviation in parenthesis).

Trial Condition	Emotion	Mean number of correct responses for 'go' trials	Mean no. of false alarms for 'no go'
Emotion 'go' (neutral 'no go')	Angry	73.73 (2.82)	10.23 (4.43)
	Fearful	72.24 (8.67)	9.42 (4.57)
	Happy	73.13 (3.41)	10.37 (4.77)
Emotion 'no go' (neutral 'go')	Angry	74.18 (2.95)	9.66 (4.39)
	Fearful	73.36 (4.06)	8.89 (4.23)
	Happy	73.19 (4.07)	10.32 (3.81)

Preliminary analysis

Mean response times for 'go' trials were analysed in two separate repeated measures ANOVAs for emotion 'go' and emotion 'no go' tasks, with the three emotion conditions (angry, fearful and happy) entered as the within subjects factor. A further two repeated measures ANOVAs were used to explore mean number of false alarms.

For the emotion 'no go' condition, results showed a significant effect on reaction time for the three emotion conditions at the .1 alpha level ($F_{2, 70} = 2.51$, $p = .08$). The mean number of correct responses to the neutral faces in the 'go' condition

for 'no go's of angry, fearful and happy were 74.18, 73.36 and 73.19 respectively. None of the three emotion conditions differed from one another with related t-tests when a Bonferroni adjustment was made for number of comparisons. For all other ANOVAs run, $p > .1$.

Regression Analysis

Pearson's correlations were carried out to examine the relationship between chronological age, trait anxiety, state anxiety and attention control with the number of false alarms (FA) in each of the 6 conditions (angry 'go', angry 'nogo', fearful 'go', fearful 'nogo', happy 'go', happy 'nogo'.). This analysis showed a significant relationship between score for state anxiety and false alarms in the angry go condition (See table 7 overleaf, $r = .33$, $p < .05$).

A hierarchical regression analysis was run the examine the moderating effects of trait anxiety, chronological age and attentional control on the positive relationship between angry 'go' false alarms and state anxiety using the standardised interaction variables generated for state anxiety and trait anxiety (SA x TA), state anxiety and attention control (SA x AC) and state anxiety and chronological age (SA x CA).

Table 7:

Correlations between self-report measures and Go/Nogo False Alarms (FA)

Measure	1	2	3	4	5	6	7	8	9	10
1. Chronological Age	_	-.097	.252	-.420**	.161	-.090	.048	-.065	-.201	-.033
2. Trait Anxiety		_	-.252	-.100	-.108	-.007	-.084	.050	.126	-.137
3. State Anxiety			_	-.348*	.333*	.149	-.013	-.040	.010	.152
4. Attention Control				_	-.153	-.069	-.083	-.216	-.213	-.197
5. Angry 'go' FA					_	.502**	.486**	.368*	.350*	.572**
6. Fearful 'go' FA						_	.477**	.469**	.347*	.614**
7. Happy 'go' FA							_	.554**	.356*	.607**
8. Angry 'nogo' FA								_	.520**	.566**
9. Fearful 'nogo' FA									_	.539**
10. Happy 'nogo' FA										_

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

As shown in table 8, this analysis produced a significant regression equation for the moderating effect of chronological age on state anxiety ($F_{(1,36)} = 4.259$, $p < .05$, $\beta = .329$, $p < .05$) accounting for 11% of the variance in the number of angry 'go' false alarms.

Table 8:

Hierarchical multiple regression of predictors of angry 'go' false alarms

Variable	B	SEB	β
Step 1			
SA X CA	1.46	.71	.329

Note. R^2 for Step 1 = .11

The analysis did not produce any significant regression equations for the moderating affect of trait anxiety ($F_{(1,36)} = 2.36$, $p > .05$, $\beta = -.252$, $p > .05$) or attention control ($F_{(1,36)} = .372$, $p > .05$, $\beta = .103$, $p > .05$).

The results show that there was an interaction between age and state anxiety affecting number of false alarms in the angry 'go' condition. To examine the moderating influence of age, two regression analyses were run; one for under-twelves and one for over-twelves. As can be seen in table 9, the analysis produced a significant regression equation in for older children with age as a moderating factor on state anxiety ($F_{(1,14)} = 13.21$, $p < .05$, $\beta = .71$, $p < .05$). No significant moderating effect was found for age in younger children ($F_{(1,21)} = .057$, $p > .05$, $\beta = -.054$, $p > .05$) accounting for 50% of the variance in angry 'go' false alarms.

Table 9:

Hierarchical multiple regression of predictors of angry 'go' false alarms in children over 12 years

Variable	B	SEB	β
Step 1			
SA X CA	2.66	.73	.710

Note. R^2 for Step 1 = .50

This result highlights that an ability to inhibit the push-button response to neutral faces when presented amongst angry face stimuli was related to level of self-reported state anxiety and moderated by chronological age such that only children aged over twelve showed this effect.

Discussion

This study aimed to explore the role of inhibition to threat in the development of anxiety in children. It used the modified emotional Stroop paradigm to explore the relationship between children's ability to inhibit attention to threat, chronological age and experience of anxiety. More specifically, it aimed to test the hypothesis that children with high levels of anxiety and low attention control would exhibit an increased reaction time in colour matching angry and fearful schematic faces, as compared to neutral and happy faces. A Go/Nogo task was also used in order to provide a measure of inhibitory skills along with a standardised questionnaire measure of attention control.

Analysis of scores from the self-report questionnaire measures found correlations between attention control and chronological age and between state anxiety and attention control. These findings support the view of Derryberry and Rothbart (1997) that there is a relationship between ability to inhibit attention by effortful control and that ability to do this increases with age. It also supports the view of Derryberry and Reed (2002) that poor skills in attention control are related to heightened levels of anxiety.

Correlations of the independent variables of chronological age, attention control, state anxiety and trait anxiety and Stroop reaction times found a positive trend between state anxiety and reaction times in the angry Stroop condition. This

finding suggests that children with high state anxiety were less able to inhibit their attention to angry face (threat) stimuli resulting in a delayed response time as compared to neutral face stimuli in the Stroop colour matching task. A negative trend was identified between state anxiety and happy-bias score suggesting attention away from happy face stimuli apparent in children with low state anxiety. These relationships were found to hold regardless of chronological age, self-reported ability to control attention and level of self-report trait anxiety suggesting that these variables were not moderating factors in response time to colour match emotion faces.

Findings from the Go/Nogo task indicated that an effect for emotion was observable in the number of correct 'go' responses to the emotion 'no go' condition only. Although the effect was not powerful, the alpha level was adequate for an exploratory study (Cohen, 1992). However, none of the emotional conditions were found to differ significantly and no significant effect was found for number of errors in the emotion 'go' or 'no go' conditions. The findings suggest a possible relationship between attention to differently valenced emotional faces and speed of reaction to respond to stimuli (as opposed to inhibiting the response to the stimuli) that would benefit from further investigation.

Finally, an analysis of response time for the Go/Nogo task found a significant positive relationship between state anxiety and number of false alarms in the angry 'go' condition of the Go/Nogo task. This finding suggests that children high in state anxiety were less able to inhibit button-press responses to the neutral

face stimuli when paired with angry face stimuli. Further analysis using hierarchical regression indicated that chronological age had a significant moderating affect on this relationship and highlighted that this relationship was clearer for children older than 12 years of age.

The findings of the present study did not support the experimental hypothesis that children with high levels of state anxiety and low attention control would exhibit an increased reaction time in colour matching angry schematic faces. However, findings from the Go/Nogo task supported the hypothesis that children who were low in attention control would commit to more 'false alarms' in the angry 'go' condition suggesting attention towards the treat stimuli that interfered with the ability to withhold the response. Unexpectedly, an attention bias away from happy faces was also identified. As predicted, atentional bias was moderated by an interaction between state anxiety and chronological.

The results are consistent with the findings of Kindt, Bierman and Brosschot (1997) and Kindt et al. (2000) who found a general bias for threat stimuli in younger children which reduced in low anxious children with age but remained in older children with high levels of anxiety. The findings also lend support to the view of Derryberry and Reed (2002) that poor ability to inhibit attention to threat by effortful control is related to increased levels of anxiety and therefore suggests a developmental aspect to the experience of anxiety. The present findings add to previous studies in extending the age range generally used in studies exploring childhood anxiety and attentional bias for threat. The present study

also differed from previous studies in having an experimental measure of inhibition (the Go/Nogo task) in addition to a self-report measure exploring attention control.

Being a correlational study the present findings do not imply causation and therefore the mechanism leading to the outcomes measured can only be speculated upon. One of the questions being asked by theorists is whether anxiety leads to attention biases for negative stimuli or whether it is the bias itself that leads to the development of anxiety disorders. Certainly, the theories of Derryberry and Rothbart (1997) would suggest that problems in developing ability in effortful control have a role in how stimuli in the environment are perceived by younger children. This appears to be a circular process in which the child develops effortful control through experience and feedback then affects subsequent explorative behaviours. However, gaining a greater understanding of the development of anxiety disorders will help inform preventative work, early interventions and later treatment strategies, In particular, attention training, part of the emerging 'third wave' cognitive therapies, may prove beneficial to children with anxiety disorders. In addition, it is important to note that adults experiencing heightened anxiety may have developed their difficulties may years before presenting at services for help.

Finally, the methodological difficulties encountered in the processes of administering the current research, and their possible affect on the results should be considered. Most notably, children were observed to tire very quickly

during the computer based tasks. This was generally during the Go/Nogo task which took around 20 minutes to complete in which time the child would have responded to many hundreds of schematic faces. This is likely to have affected response times and the number of false alarms although it is hoped that the randomisation of condition would reduce this confounding variable to a certain degree. Across the entire group of children there should have been an even spread for each emotion condition appearing either early (prior to children tiring) or late in the presentation. The use of shorter computer tasks, or tasks designed to appear more game-like might help to maintain children's attention across the assessment period. Analysis of stimuli presentation blocks by serial position would also help to reduce the affects of tiring over time.

It was also observed that negative responses to the STAI-C anxiety assessment used to measure state anxiety appeared more frequently to questions that may also measure depression, such as 'I feel .....pleasant' although this observation was not assessed statistically. However, it is possible that an alternative measure which assesses pure symptoms of anxiety may produce more reliable findings.

Conclusion

This study explored the developmental role of attentional inhibition to threat in childhood anxiety across the age range. As an exploratory study, it identified a bias for angry faces which was related to state anxiety and the interaction between age and attention control. Other studies may build on this by comparing findings from a range of individual age groups in order to identify any changes across the age range that may indicate a critical period in the development of inhibitory skills in relation to anxiety. In such a study, a significant number of participants in each age group would be crucial if reported results were to be interpreted with confidence.

References

Beck, A. T., Steer, R. A. (1990). Manual for the Beck Anxiety Inventory. San Antonio, TX: Psychological Corporation

Carr, A. (2006). *The Handbook of Child and Adolescent Clinical Psychology.* London: Routledge.

Casey, B. J., Forman, S. D., Franzen, P., Berkowitz, A., Nystrom, L. E., et al. (2001). Sensitivity of prefrontal cortext to changes in target probability: A functional MRI study. *Human Brain Mapping, 13,* 26 – 33.

Chorpita, B. F., Yim, L., Moffitt, C., Umemoto, L. A., and Francis, S. E. (2000). Assessment of symptoms of DSM-IV anxiety and depression in children: A revised child anxiety and depression scale. *Behaviour Research and Therapy, 38,* 835–855.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112, 1,* 155-159.

Cohen, J. D., Dunbar, K. and McCelland, J. L. (1990). On the control of automatic processes: A parallel distributed processing account of the Stroop effect. *Psychological Review , 97,* 332 – 361.

Cohn, N. B., Dustman, R. E., & Bradford, D. C. 0984). Age-related decrements in Stroop Color Test performance. *Journal of Clinical Psychology, 40,* 1244-1250.

Dash, J., and Dash, A. S. (1982). Cognitive developmental studies of the Stroop phenomena: Cross-sectional and longitudinal data. *Indian*

Psychologist, 1, 24-33. (From *Psychological Abstracts,* 1984, *71, Ab*stract No. 9134).

Derryberry, D. and Reed, M. A. (2002). Anxiety-related attentional biases and their regulation by attentional control. *Journal of Abnormal Psychology, 111, 2,* 225 – 236.

Derryberry, D. and Rothbart, M. K. (1997). Reactive and effortful processes on the organization of temperament. *Development and Psychopathology, 9,* 633 – 652.

Eastwood, J. D., Smilek, D. and Merikle, P. M. (2001). Differential attentional guidance by unattended faces expressing positive and negative emotion. *Perception and Psychophysics, 63,* 6, 1004-1013.

Ehri, L. C. (1976). Do words really interfere in naming pictures? *Child Development, 47,* 502-505.

Foa, E. B., Ilai, D., McCarthy, P. R., Shoyer, B. and Murdock, T. (1993). Information processing in obsessive-compulsive disorder. *Cognitive Therapy and Research, 17, 2* 173 – 189.

Fox, E., Russo, R. and Dutton, K. (2002). Attentional bias for threat: Evidence for delayed disengagement from emotional faces. *Cognition and Emotion, 16, 3,* 355 – 379.

Fox, E., Lester, V., Russo, R., Bowles, R. J., Pichler, A. and Dutton, K. (2000). Facial expressions of emotion: Are angry faces detected more efficiently? *Cognition and emotion, 14,* 61 – 92.

Hadwin, J. A., Donnelly, N., French, C. C., Richards, A., Watts, A. and Daley,

D. (2003). The influence of children's self-report trait anxiety and depression on visual search for emotional faces. *Journal of Child Psychology and Psychiatry, 44,* 432 – 444.

Hadwin, J, A., Donnelly, N., Richards, A., French, C. C. and Patel, U. (submitted). Childhood anxiety and attention to emotion faces in a modified emotion Stroop task. British Journal of Developmental Psychology, re-submitted March 1997.

Hare, T. A., Tottenham, N., Davidson, M. C., Glover, G. H. and Casey, B. J. (2005). Contributions of the □mygdale and striatal activity in emotion regulation. *Biological Psychiatry, 57,* 624 – 632.

Heim-Drager, U., Kohlmann, C. W., Eschenbeck, H. and Burkhardt, U. (2006). Attentional bias for threatening faces in children: Vigilant and avoidant processes. *Emotion, 6,* 2, 320 – 325.

Hock, H. S. and Egeth, H. (1970). Verbal interference with encoding in a perceptual classification task. *Journal of Experimental Psychology, 83,* 299-303.

Hope, D. A., Rapee, R. M., Heimberg, R. G. and Dombeck, M. J. (1990). Representations of the self in social phobia: Vulnerability to social threat. *Cognitive Therapy and Research, 14, 2,* 177 – 189.

Kindt, M., Bierman, D., and Brosschot, J. F. (1997). Cognitive bias in spider fear and control children: assessment of emotional interference by a card format and a single-trial format of the Stroop task. *Journal of Experimental Child Psychology, 66,* 163 – 179.

Kindt, M., Bögels, S. M, and Morren, M. (2003). Processing bias in children with separation anxiety, social phobia and generalised anxiety disorder. *Behavior Change, 20,* 143-150.

Kindt, M., Brosschot, J. F., and Everaerd, W. (1997). Cognitive processing bias of children in a real life stress situation and a neutral situation. *Journal of Experimental Child Psychology, 64*, 79 – 97.

Kindt, M., van den Hout, M., de Jong, P., and Hoekzema, B. (2000). Cognitive bias for pictorial and linguistic threat cues in children. *Journal of Psychopathology and Behavioral assessment*, *22*, 201–219.

Kirisci, L. and Clark, D. B. (1999). Reliability and Validity of the State-Trait Anxiety Inventory for Children in an Adolescent Sample: Confirmatory Factor Analysis and Item Response Theory. *Paper presented at the Annual Meeting of the American Educational Research Association* (New York, NY, April 8-12, 1996).

Koster, E. H., Crombez, G., Verschuere, B., Van Damme, S. and Wiersema, J. R. G. (2006). Components of attentional bias to threat in high trait anxiety: Facilitated engagement, impaired disengagement, and attentional avoidance. *Behaviour Research and Therapy, 44, 12*, 1757 – 1771.

Lavy, E. H., van den Hout, M. A., and Arntz, A. (1993). Attentional bias and spider phobia: Conceptual and clinical issues. *Behaviour Research and Therapy, 31,* 17-24.

LeDoux, J. E. (2000). Emotion circuits in the brain. *Annual Review of*

Neuroscience, 23, 155 – 184.

MacLeod, C. M. (1991). Half a century of research on the Stroop effect: An integrative review. Psychological Bulletin, 109, 2, 163 – 203.

Marsh, R., Zhu, H, Schultz, R. T., Quackenbush, G., Royal, J., Skudlarski, P. and Peterson, B. S. (2006). A developmental fMRI study of self-regulatory control. Human Brain Mapping, 27, 848–863.

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

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

Mathews, A. and MacLeod, C. (1985). Selective processing of threat cues in anxiety states. *Behaviour Research and Therapy, 23,* 5, 563 – 569.

McNally, R. J., Reimann, B. C. and Kim, E. (1990). Selective processing of threat cues in panic disorder. *Behaviour Research and therapy, 28*, 407 – 412.

Miller, M. W. and Patrick, C. J. (2000). Trait differences in affective and attentional responding to threat revealed by emotional Stroop interference and startle reflex modulation. *Behaviour Therapy, 31*, 4, 757 – 776.

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

Mogg, K. and Bradley, B. P. (1999). Orienting of attention to threatening

facial expressions presented under conditions of restricted awareness. *Cognition and Emotion, 13, 6,* 713 – 740.

Mogg, K., Mathews, A. and Weinman, J. (1989). Selective processing of threat cues in anxiety states: a replication. *Behaviour Research and Therapy, 27,* 317-323.

Mogg, K., McNamara, J., Powys, M, Rawlinson, H., Seiffer, A. and Bradley, B. P. (2000). Selective attention to threat: A test of two cognitive models of anxiety. *Cognition and Emotion 14 ,3,* 375 – 399.

Monk, C. S., Nelson, E. E., McClure, E. B., Mogg, K., Bradley, B. P., Leibenluft, E. et al. (2006). Ventrolateral prefrontal cortex activation and attentional bias in response to angry faces in adolescents with generalized anxiety disorder. *American Journal of Psychiatry, 163,* 1093 – 1097.

Moradi, A. R., Neshat-Doost, H. T, Taghavi, M. R., Yule, W. and Dalgleish, T. (1999). Performance of children of adults with PTSD on the Stroop color-naming task: A preliminary study. *Journal of Traumatic Stress, 12, 4,* 663 – 671.

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

Morton, J. and Chambers, S. M. (1973). Selective attention to words and colours. *Quarterly Journal of Experimental Psychology, 25,* 387-397

Neurobehavioral Systems (2006). Presentation (Version 11). Albany, C.A.:

Author.

Őhman, A., Lundqvist, D. and Esteves, F. (2001). The face in the crowd revisited: A threat advantage with schematic stimuli. *Journal of Personality and Social Psychology, 80,* 3, 381-396.

Papay, J. P. and Spielberger, C. D. (1986). Assessment of anxiety and achievement in kindergarten and first-and second-grade children. Journal of Abnormal Child Psychology, 14, 2, 279 – 286.

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

Posner, M. I. and Peterson, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience, 13*, 25 – 42.

Ratcliffe, R. (1993). Methods for dealing with reaction time outliers. *Psychological Bulletin, 114,* 3, 510 – 532.

Ray, C. (1979). Examination stress and performance on a color-word interference test. *Perception and Motor Skills, 49*, 2, 400 – 402.

Richards, A., Richard, L., and McGeeney, A. (2000). Anxiety-related Stroop interference in adolescents. The Journal of General Psychology, 127, 327 - 233.

Schwartz, C. E., Snidman, N. and Kagan, J. (1996). Early temperamental predictors of Stroop interference to threatening information at

adolescence. *Journal of Anxiety Disorders, 10, 2,* 89 – 96.

Shiffrin, R. M. and Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending and a general theory. *Psychological Review, 84,* 127-190.

Soares, J. J. F., and Öhman, A. (1993). Backward masking and skin conductance responses after conditioning to non-feared but fear relevant stimuli in fearful subjects. Psychophysiology, 30, 460 – 466.

Spielberger, C. D., Edwards, J., Montouri, R. and Luschene. (1973). State-Trait Anxiety Inventory for Children. Palo Alto, C. A.: Consulting Psychologists Press.

Spielberger, C. D., Gorsuch, R. L. and Lushene, R. E. (1970). *Manual for the Stait-Traite Anxiety Inventory.* Palo Alto, CA: Consulting Psychologists Press.

SPSS Inc (1995). *Statistics for Psychology and Social Sciences* (Version 14). Chicargo: Author.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. Journal of *Experimental Psychology, 225*, 643-662.

Thrasher, S. M., Dalgleish, T. and Yule, W. (1994). Information processing in post-traumatic stress disorder. Behaviour Research and Therapy, 32, 2, 247 – 254.

Thomas, K. M., Drevets, W. C., Dahl, R. E., Ryan, N. D., Birmaher, B., Eccard, C. H., Axelson, D., Whalen, P. J. and Casey, B. J. (2001). Amygdala response to fearful faces in anxious and depressed children.

Archives of General Psychiatry, 58, 1057 – 1063.

Van Den Hout, M., Tenney, W., Huygens, K. and de Jong, P. (1997). Preconscious processing bias in specific phobia. *Behaviour Research and therapy. 35,* 1, 29 – 37.

Vasey, M. W., Elhag, N. and Daleiden, E. L. (1996). Anxiety and the processing of emotionally-threatening stimuli: Distinctive patterns of selective attention among high- and low-anxious children. *Child Development, 67*, 1173-1185.

Vendrell, P., Junque, C., Pujol, J., Jurado, M. A., Molets, J and Grafman, J. (1995). The role of prefrontal regions in the Stroop task. *Neuropsychology, 33, 3,* 341 – 352.

Waters, A. M., Lipp. O. V. and Cobham, V. E. (2000). Investigation of threat-related Attentional bias in anxious children using the startle eyeblink modification paradigm. *Journal of Psychophysiology, 14, 3,* 142 – 150.

Waters, A. M., Lipp. O. V. and Spence, S. H. (2004). Attentional bias toward fear-related stimuli: An investigation with non-selected children and adults with anxiety disorders. *Journal of Experimental Child Psychology, 89,* 320 – 337.

Williams, L. M., Liddell, B. J., Kemp, A. H., Bryant, R. A., Mearey, R. A., Peduto, A. S. and Gordon, E. (2006). Amygdala-prefrontal dissociation of subliminal and supraliminal fear. *Human Brain Mapping, 27, 8*, 652 – 661.

Williams, J. M. G., Watts, F. N., Mathews, A. and MacLeod, C. (1988).

Cognitive Psychology and Emotional Disorders. Chichester: Wiley.

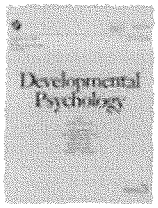
Williams, J. M. G., Watts, F. N., Mathews, A. and MacLeod, C. (1997). *Cognitive Psychology and Emotional Disorders (2nd Ed).* Chichester: Wiley.

Wilson, E. and MacLeod, C. (2003), Contrasting Two Accounts of Anxiety-Linked Attentional Bias: Selective Attention to Varying Levels of Stimulus Threat Intensity . *Journal of Abnormal Psychology, 112, 2,* 212 – 218.

Yeind, J. and Mathews, A. (2001). Anxiety and attention to threatening pictures. The Quarterly Journal of Experimental Psychology, 54A, 3, 665 – 681.

List of Appendices

Appendix A



Developmental Psychology

Editor: Cynthia García Coll
ISSN: 0012-1649
Published Bimonthly, beginning in January

Instructions to Authors

Submissions

Submit manuscripts electronically via the Manuscript Submission Portal, and mail one copy of the manuscript and any other correspondence to the Editor:

Cynthia García Coll
Developmental Psychology
Center for the Study of Human Development
Brown University
Box 1831
133 Waterman Street
Providence, Rhode Island 02912

Submission Portal Entrance

General correspondence may be directed to the Editor's Office.

Length

Manuscripts must not exceed 10,500 words (approximately 35 double-spaced pages in 12-point Times New Roman font), not including references, tables, and figures. Manuscripts that exceed this limit will not be considered.

Supplemental Materials

APA can now place supplementary materials online (e.g., questionnaires, more detailed procedures, pilot studies, videos), which will be available to readers via the published article in the PsycARTICLES database. To submit such materials, please see Supplementing Your Article With Online Material for details.

Brief Reports

Brief Reports consisting of 1,200–3,600 words (approximately 4–12 double-spaced pages in 12-point Times New Roman font) may be submitted for consideration.

Manuscript Preparation and APA Style

Authors should prepare manuscripts according to the *Publication Manual of the American Psychological Association* (5th ed.). Typing instructions (all copy must be double spaced) and instructions on the preparation of tables, figures, references, metrics, and abstracts appear in the *Publication Manual*. All manuscripts are copyedited for bias-free language (see chap. 2 of the *Publication Manual*). Manuscripts will not be considered if they do not conform to APA style. Please see APA's Checklist for Manuscript

Submission, which outlines APA style and formatting.

Abstract and Keywords
All manuscripts must include an abstract containing a maximum of 180 words typed on a separate page. After the abstract, please supply up to five keywords or brief phrases.

References
References should be listed in alphabetical order. Each listed reference should be cited in text, and each text citation should be listed in the References. Basic formats for journal, book, and book chapter are as follows:

> Cohen, D., & Strayer, J. (1996). Empathy in conduct-disordered and comparison youth. *Developmental Psychology, 32,* 988–998.
>
> Kagan, J., & Lamb, S. (1987). *The emergence of morality in young children.* Chicago: University of Chicago Press.
>
> Fivush, R. (1997). Event memory in early childhood. In C. Nelson (Ed.), *The development of memory in childhood* (pp. 139–161). Hillsdale, NJ: Erlbaum.

Figures
Graphics files are welcome if supplied as Tiff, EPS, or PowerPoint. The minimum line weight for line art is 0.5 point for optimal printing. When possible, please place symbol legends below the figure image instead of to the side. Original color figures can be printed in color at the editor's and publisher's discretion provided the author agrees to pay $255 for one figure, $425 for two figures, $575 for three figures, $675 for four figures, and $55 for each additional figure.

Permissions

Authors are required to obtain and provide to the editor on final acceptance all necessary permissions to reproduce in print and electronic form any copyrighted work, including, for example, test materials (or portions thereof) and photographs of people.

Facilitating Manuscript Review

In addition to E-mail addresses, authors should supply mailing addresses, phone numbers, and fax numbers. Most correspondence will be handled by E-mail. Authors should keep a copy of the manuscript to guard against loss.

Masked Review Policy

This journal uses masked review for all submissions. Every effort should be made to see that the manuscript itself contains no clues to the authors' identity. The submission letter should indicate the title of the manuscript, the authors' names and institutional affiliations, and the date the manuscript is submitted. The first page of the manuscript should omit the authors' names and affiliations but should include the title of the manuscript and the date it is submitted. Author notes, acknowledgments, and footnotes containing information pertaining to the authors' identity or affiliations may be added on acceptance.

Publication Policies

APA policy prohibits an author from submitting the same manuscript for concurrent consideration by two or more publications. APA's policy regarding

posting articles on the Internet may be found at Posting Articles on the Internet. In addition, it is a violation of APA Ethical Principles to publish "as original data, data that have been previously published" (Standard 8.13).

As this journal is a primary journal that publishes original material only, APA policy prohibits as well publication of any manuscript that has already been published in whole or substantial part elsewhere. Authors have an obligation to consult journal editors concerning prior publication of any data upon which their article depends. In addition, APA Ethical Principles specify that "after research results are published, psychologists do not withhold the data on which their conclusions are based from other competent professionals who seek to verify the substantive claims through reanalysis and who intend to use such data only for that purpose, provided that the confidentiality of the participants can be protected and unless legal rights concerning proprietary data preclude their release" (Standard 8.14). APA expects authors submitting to this journal to adhere to these standards. Specifically, authors of manuscripts submitted to APA journals are expected to have their data available throughout the review process and for at least 5 years after the date of publication.

If Accepted for Publication in *Developmental Psychology*

Ethical Standards

Authors will be required to state in writing that they have complied with APA ethical standards in the treatment of their sample, human or animal, or to describe the details of treatment. A copy of the APA Ethical Principles may be obtained from the APA Ethics Office web site or by writing the APA Ethics Office, 750 First Street, NE, Washington, DC 20002-4242.

Conflict of Interest

APA requires authors to reveal any possible conflict of interest in the conduct and reporting of research (e.g., financial interests in a test procedure, funding by pharmaceutical companies for drug research).

Copyright

Authors of accepted manuscripts will be required to transfer copyright of their article to APA. The necessary forms for complying with these requirements may be viewed at APA's Author's Corner.

Methodology

Description of Sample

Authors should be sure to report the procedures for sample selection and recruitment. Major demographic characteristics should be reported, such as sex, age, socioeconomic status, race/ethnicity, and, when possible and appropriate, disability status and sexual orientation. Even when such demographic characteristics are not analytic variables, they provide a more complete understanding of the sample and of the generalizability of the findings and are useful in future meta-analytic studies.

Significance

For all study results, measures of both practical and statistical significance should be reported. The latter can involve either a standard error or an appropriate confidence interval. Practical significance can be reported using an effect size, a standardized regression coefficient, a factor loading, or an odds ratio.

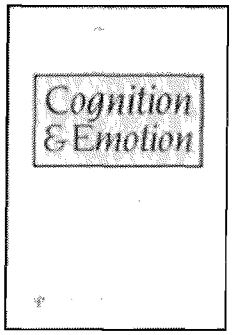
Reliability

Manuscripts should include information regarding the establishment of interrater reliability when relevant, including the mechanisms used to establish reliability and the statistical verification of rater agreement and excluding the names of the trainers and the amount of personal contact with such individuals.

APA Service Center
750 First Street, NE • Washington, DC • 20002-4242
Phone: 800-374-2721 • 202-336-5510 • TDD/TTY: 202-336-6123
Fax: 202-336-5502 • E-mail

Appendix B

Journal Details



Cognition & Emotion

20% more pages in 2007
Impact Factor: 1.623
(Journal Citation Reports 2007, published by Thomson Scientific)

Published By: Psychology Press
Volume Number: 22
Frequency: 8 issues per year
Print ISSN: 0269-9931
Online ISSN: 1464-0600

Instructions for Authors

- Cognition and Emotion

Note to Authors:** please make sure your contact address information is clearly visible on the **outside** of all packages you are sending to Editors.

Submission of Manuscripts:

Authors are encouraged to submit papers electronically to expedite the peer review process. Please email your paper, saved in a standard document format type such as Word or PDF, to

Duncan.nicholas@psypress.co.uk. You may also contact the Editorial Assistant by phone on (0)2070 177730.

List the following information in the body of your email: full contact details, the title of your article, the abstract, and whether you wish to submit the manuscript for publication as a regular article or as a brief report.

You should also confirm that the manuscript is not currently under consideration for publication elsewhere.

Manuscripts that describe only one experiment should typically be submitted as a brief report. The main text of a brief report (including footnotes) should contain no more than 4000 words. Brief reports should include a maximum of two tables or figures and 25 references.

All manuscripts should be submitted in American Psychological Association (APA) format following the latest edition of Publication Manual of the APA (currently 5th edition).

FORMAT

Typescripts. The style and format of the typescripts should conform to the specifications given in the *Publication Manual of the American Psychological Association* (5th edition).

Typescripts should be **double spaced** on **one side** only of A4 paper, with adequate margins, and numbered throughout. The title page of an article should contain only:
(1) the title of the paper, the name(s) and address (es) of the author(s);
(2) a short title not exceeding 40 letters and spaces, which will be used for page headlines;
(3) name and address of the author to whom correspondence and proofs should be sent;
(4) your telephone, fax and e-mail numbers, as this helps speed of processing considerably.

Abstract. An abstract of 100-150 words should follow the title page on a separate sheet.

Headings. Indicate headings and subheadings for different sections of the paper clearly. Do not number headings.

Acknowledgements. These should be as brief as possible and typed on a separate sheet at the beginning of the text.

Permission to quote. Any direct quotation, regardless of length, must be accompanied by a reference citation that includes a page number. Any quote over six manuscript lines should have formal written permission to quote from the copyright owner. It is the author's responsibility to determine whether permission is required from the copyright owner and, if so, to obtain it. (See the bottom of the page for a template of a letter seeking copyright permission.)

Footnotes. These should be avoided unless absolutely necessary. Essential footnotes should be indicated by superscript figures in the text and collected on a separate sheet at the end of the manuscript.

Reference citations within the text. Use authors' last names, with the year of publication in parentheses after the last author's name, e.g., "Jones and Smith (1987)"; alternatively, "(Brown, 1982; Jones & Smith, 1987; White, Johnson, & Thomas, 1990)". On first citation of references with three to six authors, give all names in full, thereafter use first author "et al.". If more than one article by the same author(s) in the same year is cited, the letters a, b, c, etc. should follow the year.

Reference list. A full list of references quoted in the text should be given at the end of the paper in alphabetical order of authors' surnames (or chronologically for a group of references by the same authors), commencing as a new sheet, typed double spaced. Titles of journals and books should be given in full, e.g.:

Books:

> Baddeley, A. D. (1999). *Essentials of human memory*. Hove, UK: Psychology Press.

Chapter in edited book:

> Plomin, R., & Dale, P. S. (2000). Genetics and early language development: A UK study of twins. In D. V. M. Bishop & L. B. Leonard (Eds.), *Speech and language impairments in children: Causes, characteristics, intervention and outcome* (pp. 35-51). Hove, UK: Psychology Press.

Journal article:

> Schwartz, M. F., & Hodgson, C. (2002). A new multiword naming deficit: Evidence and interpretation. *Cognitive Neuropsychology, 19*, 263-288.

Tables. These should be kept to the minimum. Each table should be typed double spaced on a separate sheet, giving the heading, e.g., "Table 2", in Arabic numerals, followed by the legend, followed by the table. Make sure that appropriate units are given. Instructions for placing the table should be given in parentheses in the text, e.g., "(Table 2 about here)".

Figures. Figures should only be used when essential. The same data should not be presented both as a figure and in a table. Where possible, related diagrams should be grouped together to form a single figure. Figures should be drawn to professional standards and it is recommended that the linear dimensions of figures be approximately twice those intended for the final printed version. Each of these should be on a separate page, not integrated with the text. Figures will be reproduced directly from originals supplied by the author(s). These must be of good quality, clearly and completely lettered. Make sure that axes of graphs are properly labelled, and that appropriate units are given. Photocopies will reproduce poorly, as will pale or broken originals. Dense tones should be avoided, and never combined with lettering. Half-tone figures should be clear, highly-contrasted black and white glossy prints.

Black and white figures are included free of charge. Colour figures are not normally acceptable for publication in print -- however, it may be

possible both to **print** in black and white and to **publish online** in colour. Colour figures will only be printed by prior arrangement between the editor(s), publisher and author(s); and authors may be asked to share the costs of inclusion of such figures.

The figure captions should be typed in a separate section, headed, e.g., "Figure 2", in Arabic numerals. Instructions for placing the figure should be given in parentheses in the text, e.g., "(Figure 2 about here)". More detailed Guidelines for the Preparation of Figure Artwork are available from the publisher: Psychology Press Ltd, 27 Church Road, Hove, East Sussex BN3 2FA, UK (Email: authorqueries@tandf.co.uk).

Statistics. Results of statistical tests should be given in the following form:

"... results showed an effect of group, $F(2, 21) = 13.74$, $MSE = 451.98$, $p < .001$, but there was no effect of repeated trials, $F(5, 105) = 1.44$, $MSE = 17.70$, and no interaction, $F(10, 105) = 1.34$, $MSE = 17.70$."

Other tests should be reported in a similar manner to the above example of an F -ratio. For a fuller explanation of statistical presentation, see pages 136-147 of the *APA Publication Manual* (5th ed.). For guidelines on presenting statistical significance, see pages 24-25.

Abbreviations. Abbreviations that are specific to a particular manuscript or to a very specific area of research should be avoided, and authors will be asked to spell out in full any such abbreviations throughout the text. Standard abbreviations such as RT for reaction time, SOA for stimulus onset asynchrony or other standard abbreviations that will be readily understood by readers of the journal are acceptable. Experimental conditions should be named in full, except in tables and figures.

AFTER ACCEPTANCE OF PUBLICATION IN THE JOURNAL

Proofs. Page proofs will be emailed to the

corresponding author as a PDF attachment to check for typesetting accuracy. No changes to the original typescript will be permitted at this stage. A list of queries raised by the copy editor will also be emailed. Proofs should be returned promptly **with the original copy-edited manuscript and query sheet.**

Free article access. Corresponding authors will receive free online access to their article through our website (www.informaworld.com) and a complimentary copy of the issue containing their article. Reprints of articles published in this journal can be purchased through Rightslink® when proofs are received. If you have any queries, please contact our reprints department at reprints@tandf.co.uk

COPYRIGHT PERMISSION

Contributors are required to secure permission for the reproduction of any figure, table, or extensive (more than six manuscript lines) extract from the text, from a source which is copyrighted -- or owned -- by a party other than Psychology Press or the contributor.

This applies both to direct reproduction or "derivative reproduction" -- when the contributor has created a new figure or table which derives **substantially** from a copyrighted source.

The following form of words can be used in seeking permission:

> Dear [COPYRIGHT HOLDER]
>
> I/we are preparing for publication an article entitled
> [STATE TITLE]
> to be published by Psychology Press in ***Cognition and Emotion***.
>
> I/we should be grateful if you would grant us permission to include the following materials:
> [STATE FIGURE NUMBER AND ORIGINAL SOURCE]
> We are requesting non-exclusive rights in

this edition and in all forms. It is understood, of course, that full acknowledgement will be given to the source.

Please note that Psychology Press are signatories of and respect the spirit of the STM Agreement regarding the free sharing and dissemination of scholarly information.

Your prompt consideration of this request would be greatly appreciated.

Yours faithfully

Volume contents and author index. The list of contents and the author index for the whole of the year's issues are published in the last issue of the year of each journal. For ***Cognition and Emotion***, this is issue 8 (November).

About this Journal
Aims & Scope
Abstracting & Indexing
Editorial Board
Related Journals
Related Websites
Forthcoming Special Issues

For Contributors
Copyright Assignment
Instructions for Authors

eJournal
Free Sample Copy
i*First* Content
Online Contents

↑ top

Appendix C

Dear [Head teacher's name],

Re: "Exploring the role of attentional control in childhood anxiety and attention to threat" Research Project.

My name is Naida Southall, I am a postgraduate student on the Taught Doctorate in Clinical Psychology at Southampton University. As part of my course I am required to conduct a study employing psychological theory.

I intend to examine the role attention control in the development of anxiety. To do this I hope to recruit a sample of at least fifteen 8 to 9 year olds (year 4), fifteen 10 to 11 year olds (year 6), fifteen 12 to 13 year olds (year 8) and fifteen 15 to 16 year olds (year 10).

Pupils will be required to complete three short questionnaires which will be read aloud to them as a group. The first two are about worries and feelings (for example, 'I would feel afraid of being on my own at home') and the third asks about how easily they are distracted by things (for example, 'It is easy for me to read or write whilst I'm also talking on the phone'). They will then be asked individually to undertake a short computerised assessment in which they will use a coloured keypad to respond to happy ☺, sad ☹, angry 😠 and neutral 😐 schematic faces presented on the screen. The questionnaires should take around twenty minutes and the computer task between ten and twenty. In order that the participating children also gain from their involvement in the study, I would like to return to the school to give a short presentation on the findings of the study during the summer term.

The investigation is supervised by Dr Julie Hadwin, a lecturer in child development at the University of Southampton. This project has met with the standards of the University of Southampton's ethics committee and also meets the ethical requirements of the British Psychological Society. In order to comply with these standards, permission will be sought from all participants and participants' parents prior to data collection, all data collected will remain confidential and participants have the right to withdraw from the investigation at anytime. No participant or establishment will be identifiable through the research or the written research report.

I would value the opportunity to collect data from pupils at your school and would like to contact you by telephone to discuss this possibility further.

Yours faithfully,

Naida Southall
Doctoral Programme in Clinical Psychology
Southampton University

Dr Julie Hadwin
Director of the Undergraduate Programme Board; Chair and Departmental Representative on the board for Educational Psychology; Member of the developmental research group (Developmental Brain-Behaviour Unit)

Appendix D

Printed on school's own headed paper

Dear Parent/Guardian

My name is Naida Southall. I am a postgraduate student on the Taught Doctorate in Clinical Psychology at the University of Southampton. As part of my course I am doing a study under the supervision of Dr Julie Hadwin, a lecturer in child development at Southampton University. Your Head Teacher has kindly agreed to let us approach you to take part in our research project. This project involves working with children in years 4, 6, 8 and 10.

The aim of the project is to understand how anxiety affects children's ability to pay attention to things.

Children will let us know what worries them by responding either 'never', 'almost never', 'almost always' or 'always' to statements in a questionnaire like, "I would feel afraid of being on my own at home". We will find out how much they are able to pay attention to things using another questionnaire with statements like, "It is easy for me to read or write whilst I'm also talking on the phone'. Again, children will be asked to respond either 'never', 'almost never', 'almost always' or 'always'.

Children will be also asked to complete two brief computer tasks that measure attention. In the first, children will match colours on a computer key pad to the colour of faces on a screen. The faces are similar to 'smilies' - ☺ ☹ 😐 and the study will look at whether the facial expressions shown affect how long it takes children to match the colours. In the second, children will have to press a button when they see a specific facial expression but not when they see another.

The tasks will take around 30 minutes in total.

The project has full ethical approval and all the information gathered will be strictly confidential.

We will not work with your child unless we have your written permission. If you are willing to let your child take part in this project please return the consent slip to the school office by _____.

We hope this project will give some understanding into the effects of worry and the ability to pay attention. We also hope that the experience will be enjoyable for the children and all of their questions will be answered on the day. Children will be fully briefed before taking part in the study and will be told about the study and the findings afterwards. We will be pleased to answer any of your questions about this study before or after it has taken place.

Yours sincerely

Naida Southall
Doctoral Programme in Clinical Psychology
Southampton University

Reply Slip

Attention control and anxiety in children

Statement of Consent

I _____ have read the above informed consent letter.

(Circle Yes or No)
I give consent for my child to participate in the above study. Yes No

Child's name _____ Child's date of birth _____

Your
name_____

Your signature _____ Date
_____

I understand that if I have any questions about my rights as a participant in this research, or I feel that my child has been placed at risk, I can contact the Chair of Ethics Committee, Department of Psychology, University of Southampton, Southampton. Hampshire. SO17 1BJ. Phone (023) 80 593995.

Participation is entirely voluntary and all pupils are free to withdraw at any time and ask for their results to be destroyed. All results will be kept strictly confidential and will be available only to members of the research team. Under no circumstances will any names be included in the final research reports. School marks will not be affected by your child's decision to take part or not take part in the study.

Appendix E

I am looking at the different ways young people like you feel about things and how that affects the ability to pay attention to things.

I need your help to do this project.

There are five tasks to do.

There are two computer tasks. One where you have to match coloured faces to buttons on a keypad and another where you have to press a button when you see a particular face.

Then there are three questionnaires to do. You will do one straight after the computer task and the other two a bit later. I will read the questions to you and you will say if it is true for you 'never', 'almost never', 'almost always' or 'always'.

There are no right or wrong answers to the questions.

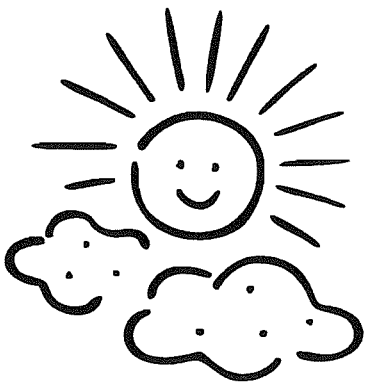
Nobody else, except me, will see any of the answers that you give me.

It is up to you whether you want to take part or not. I would understand if you decided not to. Also, if you decided you wanted to stop at any time you can.

Thank you very much

If you agree to take part please sign below:

Signature .....



Appendix F

RCADS

lease put a circle around the word that shows how often each of these things happen to you. There are o right or wrong answers.

. I worry about things	Never	Sometimes	Often	Always
. I feel sad or empty	Never	Sometimes	Often	Always
. When I have a problem, I get a funny feeling in my stomach	Never	Sometimes	Often	Always
. I worry when I think I have done poorly at something	Never	Sometimes	Often	Always
. I would feel afraid of being on my own at home	Never	Sometimes	Often	Always
. Nothing is much fun anymore	Never	Sometimes	Often	Always
. I feel scared when I have to take a test	Never	Sometimes	Often	Always
. I feel worried when I think someone is angry with me	Never	Sometimes	Often	Always
. I worry about being away from my parents	Never	Sometimes	Often	Always
0. I get bothered by bad or silly thoughts or pictures in my mind	Never	Sometimes	Often	Always
1. I have trouble sleeping	Never	Sometimes	Often	Always
2. I worry that I will do badly at my school work ..	Never	Sometimes	Often	Always
3. I worry that something awful will happen to someone in my family	Never	Sometimes	Often	Always
4. I suddenly feel as if I can't breathe when there is no reason for this	Never	Sometimes	Often	Always
5. I have problems with my appetite	Never	Sometimes	Often	Always
6. I have to keep checking that I have done things right (like the switch is off, or the door is locked)	Never	Sometimes	Often	Always
7. I feel scared if I have to sleep on my own.	Never	Sometimes	Often	Always

8. I have trouble going to school in the mornings because I feel nervous or afraid	Never	Sometimes	Often	Always
9. I have no energy for things	Never	Sometimes	Often	Always
0. I worry I might look foolish	Never	Sometimes	Often	Always
1. I am tired a lot	Never	Sometimes	Often	Always
2. I worry that bad things will happen to me	Never	Sometimes	Often	Always
3. I can't seem to get bad or silly thoughts out of my head.	Never	Sometimes	Often	Always
4. When I have a problem, my heart beats really fast	Never	Sometimes	Often	Always
5. I cannot think clearly	Never	Sometimes	Often	Always
6. I suddenly start to tremble or shake when there is no reason for this	Never	Sometimes	Often	Always
7. I worry that something bad will happen to me . .	Never	Sometimes	Often	Always
8. When I have a problem, I feel shaky	Never	Sometimes	Often	Always
9. I feel worthless	Never	Sometimes	Often	Always
0. I worry about making mistakes	Never	Sometimes	Often	Always
1. I have to think of special thoughts (like numbers or words) to stop bad things from happening. . .	Never	Sometimes	Often	Always
2. I worry what other people think of me	Never	Sometimes	Often	Always
3. I am afraid of being in crowded places (like shopping centers, the movies, buses, busy playgrounds)	Never	Sometimes	Often	Always
4. All of a sudden I feel really scared for no reason at all	Never	Sometimes	Often	Always
5. I worry about what is going to happen	Never	Sometimes	Often	Always
6. I suddenly become dizzy or faint when there is no reason for this	Never	Sometimes	Often	Always
7. I think about death	Never	Sometimes	Often	Always
8. I feel afraid if I have to talk in front of my class	Never	Sometimes	Often	Always

9. My heart suddenly starts to beat too quickly for no reason	Never	Sometimes	Often	Always
0. I feel like I don't want to move	Never	Sometimes	Often	Always
1. I worry that I will suddenly get a scared feeling when there is nothing to be afraid of	Never	Sometimes	Often	Always
2. I have to do some things over and over again (like washing my hands, cleaning or putting things in a certain order)	Never	Sometimes	Often	Always
3. I feel afraid that I will make a fool of myself in front of people	Never	Sometimes	Often	Always
4. I have to do some things in just the right way to stop bad things from happening	Never	Sometimes	Often	Always
5. I worry when I go to bed at night	Never	Sometimes	Often	Always
6. I would feel scared if I had to stay away from home overnight	Never	Sometimes	Often	Always
7. I feel restless	Never	Sometimes	Often	Always

Appendix G

Date: Wed, 31 May 2006 08:19:39 -1000
From: "Bruce F. Chorpita" <chorpita@hawaii.edu>
To: ns404@soton.ac.uk
Subject: RE: Revised Child Anxiety and Depression Scale
Part(s):

2 RCADS Scoring Program.xls	application/vnd.ms-excel	50.29 KB	
3 RCADS.doc	application/msword	57.87 KB	
4 RCADS.pdf	application/pdf	248.75 KB	

Here you go. Feel free to use. Good luck with your work!

Bruce

-----Original Message-----
From: ns404@soton.ac.uk [mailto:ns404@soton.ac.uk]
Sent: Wednesday, May 31, 2006 3:39 AM
To: chorpita@hawaii.edu
Subject: Revised Child Anxiety and Depression Scale

Dear Dr Chorpita,

I am a second-year student on the Doctoral Programme in Clinical Psychology at Southampton University, England. I am currently putting together a proposal for my research dissertation which will be investigating developmental differences in childhood anxiety and depression and inhibition to threat. I have come across your paper on the Revised Child Anxiety and Depression Scale and would be interested in using this in my study. Could you tell me if the scale has been published and where I could find it?

Thank you in anticipation,

Naida Southall

Appendix H

Name ..... **DoB / age** .....

School ..... **Class**.....

1. It is very hard for me to concentrate on a difficult task when there are noises around.

1	2	3	4
almost never	**sometimes**	**often**	**always**

2. When I need to concentrate and solve a problem, I have trouble focusing my attention.

1	2	3	4
almost never	**sometimes**	**often**	**always**

3. When I am working hard on something, I still get distracted by events around me.

1	2	3	4
almost never	**sometimes**	**often**	**always**

4. My concentration is good even if there is music in the room around me.

1	2	3	4
almost never	**sometimes**	**often**	**always**

5. When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me.

1	2	3	4
almost never	**sometimes**	**often**	**always**

6. When I'm reading or studying, I am easily distracted if there are people talking in the same room.

1	2	3	4
almost never	**sometimes**	**often**	**always**

7. When trying to focus my attention on something, I have difficulty blocking out distracting thoughts.

1	2	3	4
almost never	**sometimes**	**often**	**always**

8. I have a hard time concentrating when I'm excited about something.

1	2	3	4
almost never	**sometimes**	**often**	**always**

9. When concentrating I ignore feelings of hunger or thirst.

1	2	3	4
almost never	**sometimes**	**often**	**always**

10. I can quickly switch from one task to another.

1	2	3	4
almost never	**sometimes**	**often**	**always**

11. It takes me a while to get really involved in a new task.

1	2	3	4
almost never	**sometimes**	**often**	**always**

12. It is difficult for me to coordinate my attention between listening and writing when taking notes during lectures (or at school).

1	2	3	4
almost never	**sometimes**	**often**	**always**

13. I can become interested in a new topic very quickly when I need to.

1	2	3	4
almost never	**sometimes**	**often**	**always**

14. It is easy for me to read or write whilst I'm also talking on the phone.

1	2	3	4
almost never	**sometimes**	**often**	**always**

15. I have trouble carrying on two conversations at once.

1	2	3	4
almost never	**sometimes**	**often**	**always**

16. I have a hard time coming up with new ideas quickly.

1	2	3	4
almost never	**sometimes**	**often**	**always**

17. After being interrupted or distracted, I can easily shift my attention back to what I was doing before.

1	2	3	4
almost never	**sometimes**	**often**	**always**

18. When a distracting thought comes to mind, it is easy for me to shift my attention away from it.

1	2	3	4
almost never	**sometimes**	**often**	**always**

19. It is easy for me to alternate between two different tasks.

1	2	3	4
almost never	**sometimes**	**often**	**always**

20. It is hard for me to break away from one way of thinking about something and look at it from another point of view.

1	2	3	4
almost never	**sometimes**	**often**	**always**

---END---

Appendix I

State-Trait Anxiety Inventory for Children

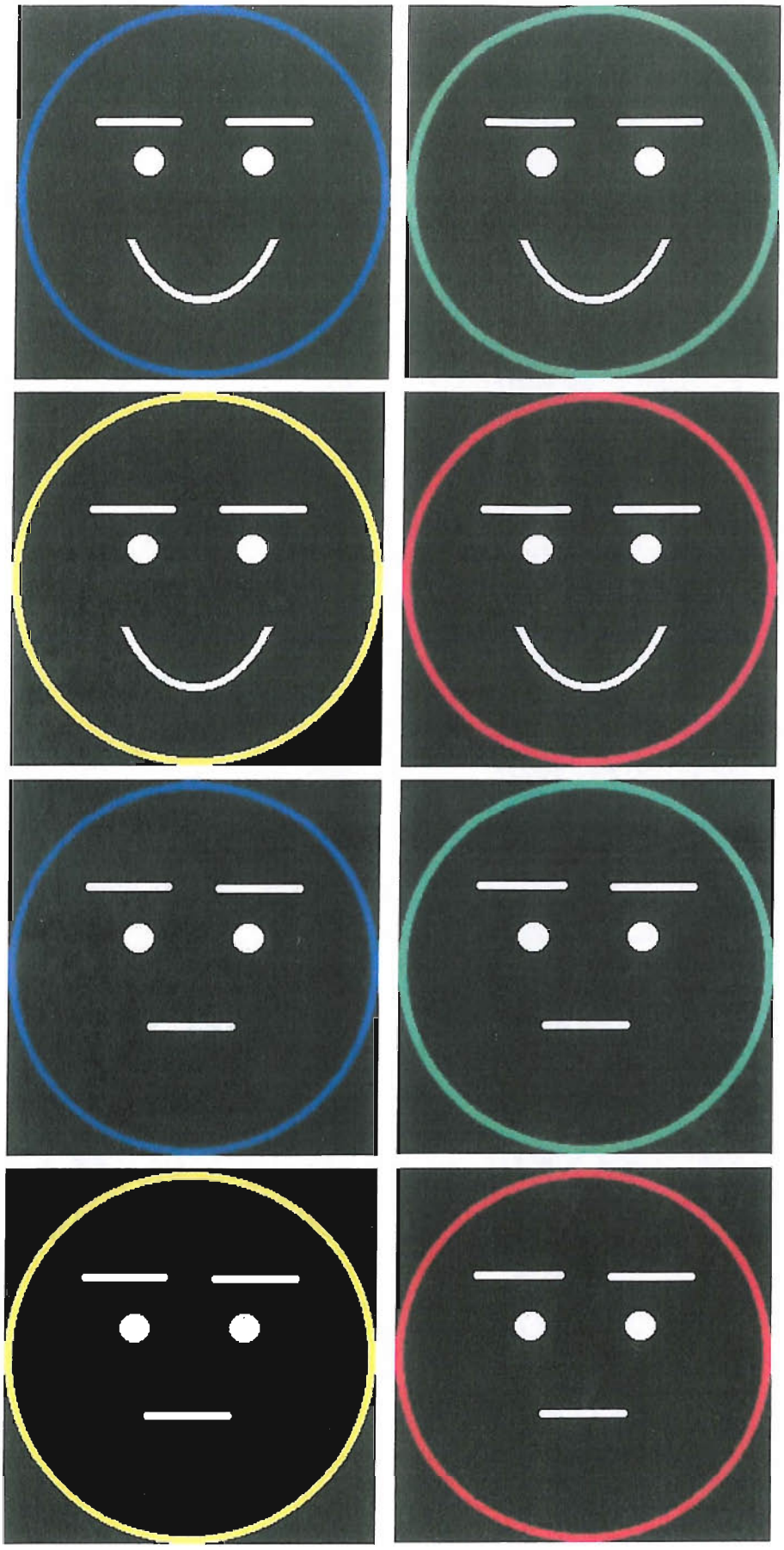
Permission to reproduce 200 copies in one year from date of purchase

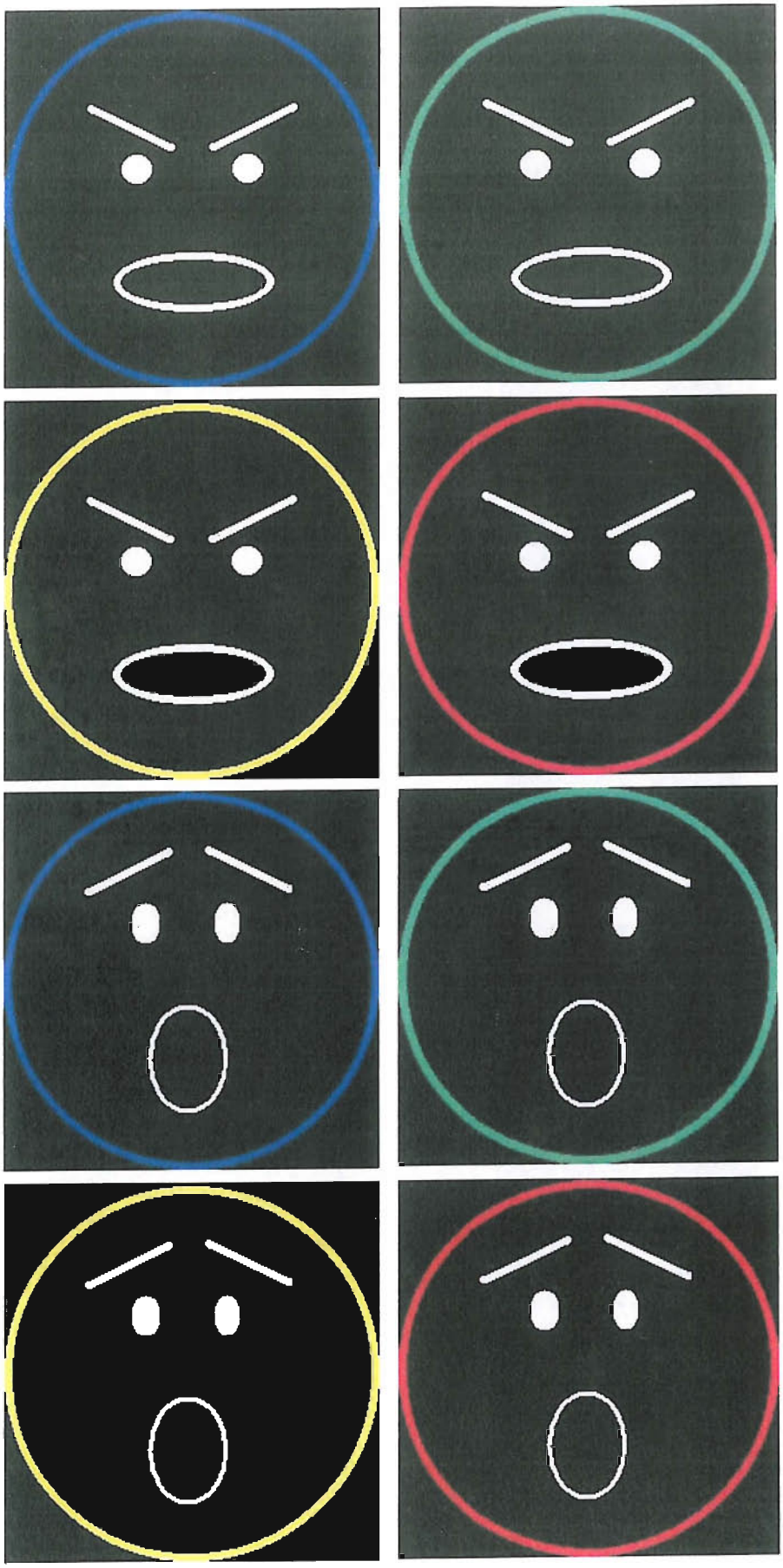
Developed by Charles D. Spielberger, Ph.D.
in collaboration with R.L. Gorsuch, R. Lushene, P.R. Vagg, and G.A. Jacobs

Distributed by Mind Garden, Inc.

info@mindgarden.com
www.mindgarden.com

Appendix J





Appendix K

You will see a coloured circle on the screen.

You have to match the colour of the circle to one of the four coloured buttons in front of you.

Let's have a practice.....

Press the spacebar to start

Ready.....?

Appendix L

You are going to see some faces, one at a time, on the screen.

You will be asked to press the spacebar when you see a specific face.

Only press the spacebar when you see this face.

Do you have any questions?

Press the spacebar to begin.....

There are two faces below.

Press the spacebar as quickly as you can when you see the face with "press button" written beside it.

Do not press the spacebar when you see the face with "don't press button" written beside it.

If you are ready, then press the spacebar to continue.....

Press button 

 Don't press button

Appendix M

Date: Mon, 27 Nov 2006 11:51:33 -0000
From: "Smith K.M." <K.M.Smith@soton.ac.uk>
To: ns404@soton.ac.uk
Cc: l.rankin@soton.ac.uk
Subject: Ethics Application

Dear Naida

Re: Exploring the role of attentional control in childhood anxiety and attention to threat

The above titled application was approved by the School of Psychology Ethics Committee on 23 November 2006.

Should you require any further information, please do not hesitate in contacting me. Please quote reference CLIN/04/32.

Best wishes,

Kathryn

Miss Kathryn Smith
Secretary to the Ethics Committee
School of Psychology
University of Southampton
Highfield
Southampton SO17 1BJ
Tel: 023 8059 3995 Fax: 023 8059 2606
Email: kms@soton.ac.uk

Appendix N

Thank you for agreeing to take part in this study today.

The study is about how much people are able to control whether they pay attention to things or not and whether people are less able to control their attention when they are worried about things.

This study was looking at whether a cross face makes people feel more worried than a happy face and whether seeing a cross face will distract them from matching the colours of the faces to the buttons.

Your scores will be kept private and no one will be able to see them other than the research team. This means that neither your teachers, your friends nor anyone who cares for you, will be able to see any of your answers or how fast you did in the colour test.

If you decide either today or afterwards that you don't want your results to be used in the study you can let me know at any time by emailing me at ns404@soton.ac.uk, by telephoning the university on 02380 353353 or by asking a teacher, friend or parent to contact me for you.

If taking part in this study has made you worry about anything you can also contact me in the same way or talk to a teacher, parent or your school nurse.

If you are interested in knowing what I have found out from this study you can contact me in the same way and I will let you know once the report is finished.

Thank you once again for your time.

Naida Southall
Doctoral Programme in Clinical Psychology
Southampton University
34 Bassett Crescent East
Highfield
Southampton
Tel. 02380 595321