An Introduction to the Study of Information Processing Biases in Childhood Anxiety: Theoretical and Methodological Issues

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Why is the Study of Information Processing Biases in Child Anxiety Important?

Anxiety is an emotion that appears early in childhood and follows a typical developmental course. Inborn fears are seen in children younger than 2 years who display transient anxieties and worries associated with separation and strangers (Kagan, Kearsley and Zelazo, 1978). Fears related to the dark and to imaginary creatures typically appear at around 5–6 years of age (Bauer, 1976) and are thought to be a function of cognitive change related to an emerging imaginative capacity (Wellman, 1990). Other fears, such as fear of failure, appear later in childhood (Muris et al., 2000; Schaefer, Watkins and Burnham, 2003) and are more likely to reflect learning processes related to distinctive aspects of a child's environment (Stevenson, Batten and Chernar, 1992). The early occurrence of anxiety in childhood is argued to play an adaptive function that facilitates the detection of threat or danger (Bowlby, 1973) and promotes the development of emotional regulation and coping (Sroufe, 1995). The development of these skills through anxiety displays initially rely on the elicitation of nurturing behaviours (e.g. increased proximity, soothing, verbal reasoning) from caregivers when children are young (Bowlby, 1969; Sroufe, 1995). As children get older, cognitive development leads to an increasing reliance on self-regulation strategies such as attention switching and positive thinking (Fox and Calkins, 2003).
Typical and atypical patterns of anxiety share core underlying features related to a distinctive profile of physical change (increased physiological arousal), cognition (worry and rumination) and behaviour (avoidance; Lang, 1985). Clinical levels of anxiety occur in around 2–15% of children and adolescents (review by Rapee, Schniering and Hudson, 2009) and are associated with atypical (i.e. developmentally inappropriate) and maladaptive behaviours (e.g. excessive crying, persistent fears and anxious apprehension) that interfere with daily routines and the development of relationships (American Psychiatric Association, 2000). The emergence of anxiety disorders follows a similar developmental pattern to anxieties seen in typical development, suggesting that children at different ages are at risk for developing specific disorders (Weems, 2008). Concerns with separation, for example, are most commonly seen early in childhood, while specific phobias, social phobia and generalized anxiety disorder occur more frequently in late childhood and early adolescence (Weiss and Last, 2001; Essau et al., 2001). Researchers have found that symptoms associated with clinical or sub-clinical levels of anxiety can be found in children as young as 3 years (Egger and Angold, 2006). Further studies have shown that these symptoms often follow a stable course from childhood through adolescence and into adulthood (Essau, Conradt and Petermann, 2002; Roza et al., 2003; review by Weems, 2008). In addition, anxiety has been found to place children at risk for academic underachievement (Ashcraft, 2002; Crozier and Hostettler, 2003; Owens et al., 2008). It is also associated with social and peer difficulties (Asendorpf, Denissen and van Aken, 2008) and the development of other mental (Lewinsohn et al., 2008; Roza et al., 2003) and physical (Beesdo et al., 2009) health problems.

Given the early occurrence of anxiety disorders and evidence for its chronic course, studies within developmental psychopathology are increasingly pursuing a research agenda that allows researchers and clinicians to understand factors that play a causal role in its development and contribute to its stability over time. Cognitive biases for the detection and processing of threat-related information are a significant feature of adult (review by Bar-Haim et al., 2007) and, increasingly, developmental models of anxiety (review by Muris and Field, 2008). Some early models did not recognize information processing biases as being causally linked to the development of anxiety (e.g. Muris and Merckelbach, 2001). Research has, however, demonstrated through longitudinal (Warren, Emde and Sroufe, 2000) and experimental studies (MacLeod et al., 2002) that they can play a causal role in its onset.

Given the increasing recognition of the importance of understanding information processing biases, we are delighted to be able to bring together a collection of papers to give a comprehensive overview of relevant theory and research related to biases in children and adolescents who experience elevated or clinical levels of anxiety. We are grateful to the contributors who have taken time to summarize the theoretical frameworks they work in and the related empirical research to provide a series of chapters that serve to establish a firm scientific basis for this area of study and to highlight important avenues for further research.

We have structured the book in two broad sections. The first section allows the reader to consider how researchers have adapted and utilized experimental
paradigms typically developed for use with adults to younger populations. Its aim is to highlight the rich canvas on which different researchers have explored diverse aspects of information processing (e.g. selective attention, inhibition, interpretation) in anxious children and adolescents through different levels of analysis (behavioural, neurophysiological and neuropsychological). Working through these chapters the reader will start to get some sense of the theoretical and empirical issues that are generic to the broader research programme on information processing biases in childhood anxiety. Section 2 aims to provide readers with an understanding of the role of information processing biases more broadly in the context of developmental psychopathology. It presents a comprehensive series of chapters that explore the origins of information processing biases in development and that draw on the microparadigms utilized in the study of development and psychopathology to consider issues related to heritability, temperament, learning and parenting (Achenbach, 1990; Cicchetti and Cohen, 1995). In addition, this section also provides an overview of the relevance of this research programme for the development of preventive methods and treatment protocols in childhood and adolescent anxiety.

**Information Processing Biases in Childhood Anxiety: Theoretical and Research Issues**

Chapters in Part One highlight that one challenge for research in information processing biases with children and adolescents is that the majority of the phenomena they test stem from theory and method utilized in adult psychopathology. Several chapters describe the experimental and practical modifications they have used when working with children and adolescents. These chapters suggest that making simple paradigm changes when working with younger populations (e.g. using picture-based stimuli rather than word-based stimuli or reducing the number of experimental trials) has been effective in allowing this area of research to develop. Researchers using the implicit association task (IAT), designed to look at the extent to which individuals automatically associate objects or events and described by Huijding, Wiers and Field (Chapter 7), for example, have made several changes to a task typically used with adults to make it accessible for children. These changes include reducing the number of trials and using specifically designed response pads or a touch screen when working with very young children. Muris (Chapter 2) outlines further modifications to investigate covariation bias (perceptions that two stimuli are consistently associated) and probability bias (increased perceptions of the likelihood of the occurrence of future negative events) in childhood anxiety. It describes a series of studies that have found that the use of emotional faces to depict negative outcomes to investigate covariation bias has been successful in demonstrating that anxious children more readily link negative stimuli to negative outcomes.

Once changes have been made to established paradigms, a further challenge for researchers is to demonstrate that the tasks they are using are reliable and valid.
Very few researchers working either with adults or with children provide details about the psychometric properties of the cognitive tasks they use. Some researchers have explored the extent to which one task that purports to measure attention to threat correlates with similar measures. For example, Chapter 3 (Nightingale, Field and Kindt) summarized recent work showing that in an emotion categorization task, the mis-categorization of faces with low levels of happiness (as angry) was correlated with increased reaction times (i.e. greater interference) to colour name threat versus neutral words in an emotional Stroop task. However, this chapter also highlights earlier work showing that interference of colour naming threat words in a Stroop task was not correlated with selective attention to similar stimuli in a dot-probe task, suggesting that these tasks tap different underlying cognitive mechanisms. Chapter 7 also reports several indices on the validity and reliability of the IAT task, highlighting moderate internal consistency and test–retest reliability. Furthermore, In-Albon and Schneider (Chapter 6) report statistics related to the psychometric properties of eye tracking tasks in children. They outline a number of studies that have found good internal consistency related to anti-saccade errors. In addition, they report good and moderate test–retest reliability for anti-saccade errors and predictive saccades, respectively. However, the general lack of information related to the psychometric properties of the tasks used to explore information processing biases in children and adults should be addressed in future work.

Other researchers raise the issue of the specificity of information biases across different anxiety disorders, and between anxiety and other internalizing (depression) or externalizing difficulties (conduct disorder). Chapter 1, for example, describes results to show that information processing biases for threat have been associated with depression and externalizing disorders. This chapter does, however, note that some progress has been made utilizing social cognitive tasks to understand how biases have been differentially associated with separation anxiety and social anxiety, as well as between anxiety and depression. Chapter 3 highlights that research has failed to demonstrate specificity of Stroop interference in children with separation anxiety disorder, generalized anxiety disorder and specific phobia for anxiety relevant words. It is evident that if researchers want to argue that information processing biases in anxiety represent a core cognitive feature of this disorder, then they need to be able to demonstrate that the bias is universal in children who experience anxiety; that it plays a causal role in its onset and that it is specific to this disorder (Happe, 1994).1

1This approach to ‘sensitivity’ (the idea that all children with anxiety should display information processing biases) and ‘specificity’ (that information processing biases for threat are largely limited to anxiety and its subtypes) is consistent with the suggestion that information processing biases can be conceptualized as endophenotypes (see Crosbie et al., 2008, p. 45) and is similar to thinking about core cognitive deficits in pervasive developmental disorders, such as autism. Other approaches to understanding cognitive deficits in psychological disorders and their treatment are quite different. The transdiagnostic approach, for example, aims to understand the extent to which cognitive or behavioural factors represent shared processes that can cause or maintain a range of psychological disorders (Mansell, 2008).
The review of this literature serves to highlight that the majority of studies exploring information processing biases have worked with typically developing children and adolescents who show some variation on self-report measures of trait anxiety or more specific anxieties. If it is accepted that anxiety represents a dimensional construct such that the boundaries between high levels of anxiety within the typical range and sub-clinical or clinical levels of anxiety are ‘fluid’ (MacLeod, 1991; Rapee, 2001), then research with typically developing children provides an effective vehicle for testing and developing models of anxiety that can be applied to a less accessible clinical population. In support of this approach, the results of studies described across the book have generally found that information processing biases using a range of tasks associated with high versus low anxiety in a typical range show similar findings with children and adolescents who have been diagnosed with an anxiety disorder. In order to support the integrity of theoretical models and research with typical populations, researchers should also be careful to test models of anxiety with clinical groups of children.

Several chapters note that very little research has considered developmental factors in the study of information processing biases, either longitudinally or cross-sectionally. It is unclear, for example, when biases become most evident in childhood anxiety, whether they show a similar developmental pattern to the emergence of anxiety disorders (e.g. do biases related to separation emerge before those linked to social factors?) and whether they follow a stable developmental course. Chapter 3 outlines what is currently the only strictly developmental theory (i.e. it predicts change over time) related to information processing biases and childhood anxiety (see Kindt and van den Hout, 2001). Kindt and van den Hout developed this framework based on research on anxiety and inhibition using the Stroop task. This framework proposes that information processing biases for negative or threat stimuli are a typical feature of development that is evident in middle childhood and that dissipates in early adolescence, except for children with elevated anxiety. The key feature of this theory is not that information processing biases place children at risk for the development of anxiety, rather that the failure to develop an ability to inhibit attention to threat makes children vulnerable. The evidence base for this proposed developmental course is, however, mixed. Chapter 3 highlights that (consistent with Kindt’s account) anxiety-related interference of threat relevant material in the Stroop and other inhibitory tasks has been reliably shown in late childhood and early adolescence, with mixed findings before this age. Few studies have, however, been able to empirically demonstrate the proposed developmental course of information processing biases outlined in Kindt and van den Hout’s (2001) framework.

Further chapters also describe work to understand links between cognitive development and information processing biases in childhood. Chapter 1, for example, outlines a series of studies which show that cognitive ability (as measured by theory of mind and conservation tasks) is linked to emotional reasoning and interpretation biases associated with physical symptoms, indicating that the emergence of this phenomenon may be linked to specific developmental stages in childhood. It reports further work highlighting that covariation bias is more evident in children aged 12 years and above versus children aged 8–11 years.
The chapter links this finding to a Piagetian change in abstract reasoning in late childhood and argues that some information processing biases may reflect a cognitive developmental shift that occurs at this time. These studies suggest that age represents a risk factor for the development of information processing biases in children and further work is needed to understand links between cognitive development and the emergence of biases across childhood.

Chapter 1 also highlighted other factors that can moderate interpretation biases including children’s perception of physical change in emotional situations. It notes that younger children use information about physical symptoms of anxiety in emotional reasoning tasks, an effect that was found to decrease with age. This developmental pattern is used to propose that emotional reasoning might represent a vulnerability factor for the development of anxiety disorders in young children. The inclusion of a physiological aspect of anxiety (either actual physiological change or an individual’s sensitivity or perception of change) in the study of information processing is notable, due to its general absence in developmental research. The lack of a systematic programme of research to understand the impact of both state and trait anxiety in the context of information processing biases in childhood and adolescence anxiety is surprising given the prominence of both aspects in adult models of anxiety (e.g. Mogg and Bradley, 1998; Williams et al., 2007). Further work is required to understand the effects of both trait and state aspects of anxiety in the emergence of information processing biases across development.

Linked to Kindt and van den Hout’s (2001) aim to understand information processing biases in the context of the development of inhibitory control, recent theoretical models related to adults (Eysenck et al., 2007) and children (Lonigan et al., 2004) propose that associations between anxiety and information processing biases can be potentially moderated by attentional or effortful control. Attentional control is conceptualized as an individual’s ability to strategically regulate attention (Derryberry and Reed, 2002). Effortful control is a similar concept and is defined as ‘the ability to inhibit a dominant response in order to activate a subdominant response, in order to plan, and to detect errors’ (Rothbart, Sheese and Posner, 2007, p. 3). These models of anxiety relate to ‘biased competition models of selective attention’ (Bishop, 2007, p. 310) and encapsulate the interplay between the proposed automatic capture of attention to threat in anxiety (reflecting activation of the amygdale and related structures) and the more fragile role of top-down processes (related to activation of the pre-frontal cortex).

Some chapters present recent evidence that effortful or attentional control in adults (Derryberry and Reed, 2002; Reinholt-Dunne, Mogg and Bradley, 2009) and children (Lonigan and Vasey, 2009) moderate the development of information processing biases. In other words, the association between biases for threat and anxiety is most clear when individuals also show poor attentional or effortful control. This programme of research is linked to further work outlined in Chapter 7 based on the dual-processing model of addiction (see Tiffany, 1990). Chapter 7 considers research which has found that links between drug (alcohol and cigarette) use in adolescence and drug-related associations in memory are moderated by working memory capacity. (These associations are clearest when working memory capacity is low.) It contrasts the dual-processing framework
with the discussion of top-down and bottom-up processing outlined in attentional control theories in anxiety (Eysenck et al., 2007) to suggest that while anxiety models focus on links between cognition and emotion, the dual process model of addiction considers the relationship between automatic associations in memory and links with behaviour more broadly.

Working within a similar conceptual framework, Donnelly, Meneer (Chapter 5) considered the use of visual search paradigms in adults and children to look at evidence for the automatic capture of threat in anxious individuals. This paradigm is often used to explore selective attention to threat in anxiety and to test the proposition featured in several adult models of anxiety (e.g. Williams et al., 2007) that threat automatically captures attention, where automatic processing is defined as being involuntary and unintentional (vs. strategic and effortful; see Wolfe, 1994).

The chapter reviews how the visual search paradigm has been used to investigate the relative role of top-down (using target searches) and bottom-up (using odd one out search) processing. It outlines the basic processes that influence visual search and discusses how research with children and adults supports the proposition that anxiety moderates search either to enhance threat detection for phobic relevant stimuli or threat stimuli or to make decisions about when to terminate search. Consistent with other chapters in the book, it proposes that this influence is likely to be a function of individual vulnerability that interacts with experience and learning, where these combine to adjust template thresholds in the visual search task for threat stimuli in relation to speed and decision-making in anxiety.

The notion of automatic processing in information processing biases is also addressed in Chapter 7. Utilizing the dual-processing framework this chapter describes a series of tasks designed to explore indirect automatic associations for threat in anxiety. The chapter argues that the use of experimental measures including the IAT, the affective priming task (APP) and the extrinsic affective Simon task (EAST) allow an exploration of the extent to which anxiety-related information in memory is automatically activated in individuals who experience anxiety. The EAST has shown some promising results with children in demonstrating how learned associations can lead to automatic (valence-relevant) processing of these stimuli. The use of these indirect measures more generally have, however, provided mixed results with childhood research. Further research is described to demonstrate the utility of this task in exploring automatic associations of rejection in adolescents with low perceived social acceptance or in negative racial attitudes in children and adolescents. This chapter also notes that these tasks can be utilized alongside more strategic tasks to consider whether automatic biases concur with explicit judgements and to tease apart implicit and explicit processing in anxiety.

Following the theme of automatic capture of threat in anxiety, Garner (Chapter 4) outlines research on information processing biases in childhood and adolescence that has used paradigms that allow some consideration of attentional capture or difficulty in disengaging from threat in anxious children. In relation to attentional capture, this chapter specifically considers evidence based on a vigilance-avoidance model of anxiety (Mogg and Bradley, 1998). It describes work with adults to show that the manipulation of stimulus exposure has allowed researchers to
demonstrate vigilance for threat in anxiety at short exposures (<500 milliseconds) and avoidance of threat at longer exposures (>1500 milliseconds). Furthermore, it outlines developmental research which has found evidence of both vigilance and avoidance to threat words and pictures across different types of anxiety and for both clinical and non-clinical anxious populations. The chapter also highlights some preliminary evidence which suggests that anxiety-related biases might work differentially between gender, with girls showing increased vigilance and boys showing increased avoidance of threat stimuli. Research related to understanding whether information processing biases operate differently between genders is sparse.

Linked to the notion of vigilance-avoidance in anxiety, Chapter 6 argues that reliance on behavioural indices of attention provide researchers with a 'snapshot' of attentional processing in anxiety. This chapter considers the benefits of using eye tracking methodology in anxiety research and highlights its utility in allowing researchers to record continuous eye movements, as well as other indices of attention (i.e. first fixation, number of fixations and time spent looking at specific stimuli). Consistent with Chapter 4, it reveals some interesting findings in relation to the time course of attentional processing in adult anxiety that are consistent with a vigilance-avoidance model of attention. It describes several studies that support the notion of initial attention to threat followed by a late avoidance of these stimuli (occurring at around 1500 milliseconds after stimulus presentation) in adults. It also outlines some preliminary results to support this attentional pattern in children with separation anxiety disorder. The exploration of attention in anxiety at different levels of analysis serves to validate the methods and findings in this area of research.

Consistent with a research agenda that moves away from a reliance on behavioural indices of attention to investigate information processing biases in anxiety, Chapter 8 (Pérez-Edgar and Bar-Haim) looks at empirical research that has used neuropsychological techniques. The chapter focuses on the two most commonly used techniques where these allow an exploration of the time course of information processing [using event-related potential (ERP)], as well as methods that give some indication of brain pathways and locations or structures utilized in the processing of threat information [through functional magnetic resonance imaging (fMRI)]. The chapter describes how neuropsychological research using the dot-probe task has been utilized to investigate early ERP components in anxiety. It outlines several papers that have found increased C1 amplitudes (a negative ERP component which occurs at around 60–90 milliseconds after stimulus presentation and which is suggested to reflect the primary visual cortex response to stimuli; Stolarova, Keil and Moratti, 2006) to threatening stimuli in anxiety. The authors use these findings to argue that the occurrence of neural activation during the early processing of threat in anxiety is likely to be mediated by amygdala activity (see also Anderson and Phelps, 2001; Bishop, 2007). This chapter also outlines a number of studies that have used fMRI and which have found associations between adolescents with generalized anxiety disorder and increased amygdala activity when presented with threat stimuli at very brief durations. The chapter discusses these findings in the context of how they complement and extend studies which have
relayed on behavioural indices of attention. It suggests that while these literatures are largely consistent, there is some evidence to suggest that neuropsychological techniques are more sensitive in the detection of information processing biases in childhood anxiety.

The Origin and Treatment of Information Processing Biases in Childhood Anxiety

Within the challenging context of developing theoretical frameworks and establishing a strong research basis in information processing biases in children and adolescents, Part Two of this book includes chapters related to understanding the origins of these biases and the implications of this broad research programme for the treatment and prevention of anxiety in children. Chapters 9–12 describe research reflecting the contribution of both genes and environment in the emergence of information processing biases and anxiety in childhood. In addition, they outline studies that have focused on identifying specific aspects of the environment that place children at risk.

Eley and Zavos (Chapter 9) consider the role of information processing biases within a genetics framework. This chapter provides an evaluation of studies that have established a genetic basis for anxiety in children and adolescents, as well as a role for the non-shared environment. It outlines further research which has found moderate heritability estimates for interpretation biases in adolescence and highlights the need for further research in this area. In addition, the chapter reviews recent studies that aim to identify whether specific genes are associated with anxiety and information processing biases in children and adults and considers how genes interact with specific aspects of the environment to place children at increased risk (e.g. Fox et al., 2005). Consistent with other researchers (e.g. Lau and Pine, 2008), the chapter suggests that future research should aim to explore links between genes and intermediate phenotypes (or endophenotypes) in anxiety. When trying to understand the role of genes in psychopathology, researchers have argued that associations between genes and dysfunction in biological or cognitive systems associated with a disorder may be easier to determine because these impairments are nearer to gene expression (Crosbie et al., 2008; Canon and Keller, 2006). Following this approach, Chapter 9 proposes two mediated pathways between genes and anxious behaviour via brain structure and function, which include attentional and interpretation information processing biases.

Consistent with the establishment of information processing biases as an endophenotype in anxiety research, Chapter 9 summarizes a number of studies which have found links between individuals who carry the SS or LG alleles of the serotonin transporter (5-HTTLPR) gene with both anxious states in childhood and with dysfunction in neural circuitry linked to the processing of threatening stimuli. Research to establish information processing biases as a cognitive endophenotype in anxiety is still in its infancy. This research programme does, however, assume an underlying conceptual profile that links to and extends several avenues of research.
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outlined across a number of chapters. For example, at a basic level this research agenda will encourage researchers to explore the extent to which tasks that measure information processing biases are valid and reliable. It will promote research to take forward the idea that these biases represent a vulnerability factor that place children at risk for the development of anxiety disorders, such that they act independently of anxiety and can be seen in the absence of anxiety symptoms. This status will also serve to encourage researchers to explore the time course of biases in childhood, its origins and to understand associated underlying biological structures and pathways (see Crosbie et al., 2008).

Linked to the exploration of the genetic underpinnings of anxiety, Chapter 10 (White, Helfinstein and Fox) explores links between information processing biases and temperament. The chapter focuses on early temperamental origins of information processing biases in children who are defined as behaviourally inhibited. The chapter highlights that these children show distinctive psychological (avoidance and fear when faced with novelty) and biological (e.g. elevated cortisol and increased heart rate) characteristics from an early age. It describes research which has found that behavioural inhibition is associated with an increased risk of developing anxiety disorders later in development. It looks at empirical evidence from studies with behaviourally inhibited children and links this work to animal models of anxiety to consider three pathways that can explain this relationship, including amygdala hyperresponsivity to threat or ambiguity, the overgeneralization of fear learning (from a learned context to other context that share some features), as well as information processing biases to threat. This chapter also discusses why some children who show this temperamental trait early in childhood do not go on to develop anxiety and it looks at the moderating role of inhibitory processes in this development. Exploring themes raised in Part One of the book, Chapter 10 highlights research which has found that inhibitory control moderates attention to threat in anxiety. It also notes that children who demonstrate high levels of inhibitory control can also have increased anxiety levels. This interesting proposition suggests that the development of inhibitory control in childhood functions like an inverted U-shaped curve\(^2\) where very low or high levels can interact with the development of information processing biases to increase anxiety in children.

While Chapter 10 considers factors intrinsic to the child as being significant in understanding the origins of information processing biases in childhood, it also explores the moderating role of the family context in this development. It presents evidence to suggest that the presence of increased negative emotion in mothers or specific types of parenting interact with temperamentally vulnerable children to place them at risk for the development of anxiety disorders, where this relationship may be mediated by information processing biases for threat.

The role of the family in the development of information processing biases is a theme that continues in Chapters 11 (Field and Lester) and 12 (Creswell, Murray

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\(^2\)This pattern is reminiscent of the Yerke–Dodson Law (Yerkes and Dodson 1908) which suggests that moderate levels of anxiety can facilitate task performance, while low and high levels are associated with lowered performance.
and Cooper). Based on models of childhood anxiety (e.g. Hudson and Rapee, 2008) Chapter 12 focuses specifically on the role of parenting in information processing biases. It argues that specific parenting styles or the presence of parental anxiety are associated with the sharing of negative cognition from parents to their children that fosters a perception of the world as a threatening place and that reduces children’s ability to cope with threat. It presents a model which highlights that parental cognition can lead to the development of information processing biases for threat in children via two mediated pathways. The first pathway links parent and child cognition via parental expectations of the child (how well they think their child can cope) and parent behaviour (e.g. over control). The second pathway shows a mediated link via parent behaviour (e.g. transfer of negative information). The chapter provides some support for the different components of this proposed model. It reviews evidence which indicates, for example, that anxious parents demonstrate information processing biases for threat when asked to interpret ambiguous situations and that they expect their child to interpret ambiguity in a similar way to themselves. In addition, it describes a series of studies which have shown that negative information processing biases in children can be modified through parent discussion leading to either the continuity of maladaptive or the emergence of more adaptive cognitive processing styles. Furthermore, it reviews studies which have demonstrated the bidirectional nature of these relationships, where parents’ perceptions of their children’s vulnerability were found to lead to changes in parenting approaches and specifically to increased parental control.

Chapter 11 also focuses on parenting behaviours to explore potential mechanisms that lead to information processing biases in children. It reviews evidence which indicates that interpretation and attentional biases for threat can be developed or trained in laboratory settings with adults and children, where training individuals to attend to threat or interpret stimuli as threatening has been found to generalize to similar but unseen stimuli, and to increase anxiety levels and emotional responses to stressors. The chapter focuses on understanding the mechanisms underpinning these effects and their relevance to real life settings. It proposes that analogous ‘training’ processes could occur in families via the transmission of negative information from parents to their children. In order to understand these mechanisms more clearly it embeds this analogy in models of associative learning. Specifically, it suggests that information processing biases develop through associative and habitual learning, where negative associations in memory are largely driven by parental reactions and behaviour in ambiguous situations that serve to direct children’s attention to threat and away from other less threatening or neutral cues. Furthermore, the chapter proposes that attentional biases can appear early in development and are underpinned by habitual learning, whereas interpretation biases emerge later in development and are argued to be dependent on the development of language and theory of mind. Furthermore, the chapter proposes that cognitive change that occurs at around 4–7 years of age places children at risk for the development of information processing biases and represents a sensitive period for their development. Taken together, Chapters 11 and 12 outline important avenues for further research to understand the extent to which information processing biases originate in the interactions between parents and their children.
The final chapter in the book provides the main impetus for this area of research. By understanding more clearly what places children at risk for the development of information processing biases and how they link to anxiety allows for the improvement and advancement of effective prevention and treatment methods in childhood anxiety. Increasingly, researchers and clinicians working with children who experience clinical levels of anxiety recognize that a focus on changing attentional processing can form an effective component of treatment (e.g. Legerstee et al., 2009). This approach to treatment is summarized in Chapter 13. The chapter reviews evidence on attention retraining in adults for the treatment of a range of anxiety disorders. It notes that more traditional treatment methods, like cognitive behavioural therapy, aim to challenge maladaptive cognitions associated with anxious thoughts and to replace these with cognitions that more accurately reflect reality. In contrast, attention retraining is suggested to facilitate an individual’s ability to strategically control their attention from threat to neutral stimuli (i.e. to selectively attend to neutral stimuli and to switch attention from threat to neutral stimuli in order to regulate their emotion). It highlights several studies which have used either therapy directed attentional training or experimental attentional training paradigms based on the dot-probe or Stroop tasks and that train anxious adults to attend to neutral rather than threat stimuli. The chapter reports findings that have shown some success in reducing attention to threat or facilitating disengagement from threat stimuli and lowering anxious symptoms and describes similar success in preliminary work with children. Chapter 13 links this approach to treatment in children in the context of the development of effortful control. Consistent with themes raised in Part One of the book, it discusses the role of effortful control in development of the regulation of emotion and behaviour and, specifically, conceptualizes information processing in anxiety as reflecting ‘under-controlled attentional processes.’ It suggests that children who are low in effortful control are specifically at risk for the development of anxiety because they are unable to direct their attention away from sources of threat.

Chapter 13 outlines evidence which has shown that effortful control can be enhanced in children aged between 4 and 6 years using training programmes. It argues that this training should form the basis of attentional control in children because it would allow them to develop strategies to regulate their attention and manage their emotions more effectively. This approach fits well with an emerging literature that has focused on training executive functions (inhibition, working memory) in young children (e.g. Thorell et al., 2009) and in children with attention-deficit hyperactivity disorder (ADHD). Previous research has highlighted significant success in training working memory skills in children with ADHD (Klinberg, Forssberg and Westerberg, 2002; Klinberg et al., 2005) and adults (Jaeggi et al., 2008). Klinberg et al. (2005), for example, found that asking children with ADHD between 7 and 12 years of age to complete a relatively short working memory training protocol (25 days of around 30–40 min of training per day over a 6-week period) led to significant improvements in working memory and related tasks (complex reasoning and response inhibition), as well as a reduction in parent report symptoms of ADHD (inattention and hyperactivity or impulsivity).
The proposition that it is possible to train attention strategies to children fits well with a goal of adjusting the proposed imbalance between top-down and bottom-up processing in anxiety (Bishop, 2007). Consistent with this approach, further research has highlighted increased activation in brain regions (frontal and parietal cortices) following working memory training (e.g. Olesen, Westerberg and Klinberg, 2004). Future research should aim to establish whether it is possible that similar effects would be found post training in children and adolescents who experience elevated levels of anxiety and who undergo attention retraining.

Summary

The chapters across Parts One and Two of this book provide a comprehensive overview of information processing biases in children and adolescents. Part One highlights that the pursuit of a research agenda that considers diverse aspects of information processing biases using different levels of analysis has started to allow researchers to develop a picture of cognitive processing in childhood anxiety that is similar to that found in adults (review by Bar-Haim et al., 2007). Importantly, it outlines a number of different avenues of research for developing the theoretical and empirical bias of this area. Along with Part Two, the chapters delineate several mechanisms to indicate why some children develop information processing biases for threat and to consider whether these place them at risk for the development of anxiety disorders. Importantly, links between these mechanisms and the development of prevention and treatment methods are addressed in the concluding chapter.

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