Cognitive bias and the development of anxiety in children

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door

Mattijn Morren

Alice looked round her in great surprise. 'Why do I believe we've been under this tree all the time! Everything is just as it was!'

'Of course it is,' said the Queen: 'what would you have it?'

'Well, in our *country,' said Alice, still panting a little, 'you'd generally get somewhere else – if you ran very fast for a long time, as we've been doing.'*

'A slow sort of country!' said the Queen. 'Now, here, *you see, it takes all the running* you *can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!'*

Lewis Carroll, *Through the Looking-Glass, and What Alice Found There*, 1896.

Contents

Chapter 1

General Introduction

1.1 Introduction

The present thesis offers a critical examination of the role of information processing abnormalities in the development of childhood anxiety. The approach taken to guide this inquiry relies on methodological as well as conceptual considerations. The methodological approach was anchored in the realisation that only two types of evidence are admissible for establishing that selective processing of threatening information (i.e., cognitive biases) contributes to the aetiology of anxiety. First, studies with an experimental design should be able to demonstrate that manipulation of the cognitive bias produces changes in subsequent anxiety levels. Alternative to laboratory-based investigations, a more naturalistic approach can be employed. This type of study, which examines the relationship between anxiety and cognitive bias in real life, ideally has a prospective design and can establish at least one of the following: (1) the presence of the cognitive bias predicts anxiety later in time; (2) the presence of the cognitive bias predicts increases in anxiety over time; and (3) increases in the severity of the cognitive bias predict subsequent increases in the level anxiety. For practical and ethical reasons, as well as because evidence from laboratory studies does not necessarily generalise to everyday life, the research presented in the current thesis employs a naturalistic approach. More specifically, two studies examine whether anxiety is prospectively predicted by cognitive bias in the attention to and interpretation of threatening information (i.e., attentional bias and interpretation bias).

The second, conceptual approach zooms in on the only theoretical account of the role of cognitive processing abnormalities in childhood anxiety yet, the cognitive inhibition hypothesis. The hypothesis was put forward by Kindt, Bierman, and Brosschot (1997a) to explain the pattern of attentional bias they obtained with anxious and non-anxious children of different ages. They observed that at younger ages all children exhibited an attentional bias, but that this bias decreased with age in the normal, non-anxious children. In anxious children, however, the bias persisted. On the basis of these findings, Kindt and colleagues proposed that the development of anxiety pathology is associated with an *in*ability to learn to refrain from processing idiosyncratic threat-related information. As young children lack this ability, they exhibit an attentional bias. This ability to inhibit the processing of threat normally develops with age, and will result in a gradual decrease of the attentional bias. However, when children fail to achieve such inhibitory competency, this would allow their attentional bias to persist or even to increase, which puts them at risk for developing an anxiety disorder. Obviously, it would be most desirable to be able to identify those children that are most vulnerable to develop an anxiety disorder later in life before they in fact did. If poor childhood inhibitory skills prove to be a good predictor of later anxiety disorder, children at risk might be identified through their inhibitory profile. These children could then enrol in a therapeutic training program aiming to improve of inhibitory skills.

Although preliminary evidence with adults suggests that it is possible to modify cognitive processing biases (for a review see Mohlman, 2004), the scientific evidence to implement such programs in children is still meagre. Our understanding of the dynamics of the relationship between cognitive biases and anxiety in children is poor, and prospective evidence of this connection is almost completely lacking. To fill in this gap, the five studies presented in subsequent chapters of this thesis were carried out. The

purpose of these studies was to further explore the cognitive inhibition hypothesis and the prospective relationship between anxiety and cognitive processing in children. Towards the end of this chapter, the research questions will be elaborated in more detail.

The remainder of this introduction is dedicated to the theoretical and empirical backgrounds of childhood anxiety, and of how cognitive malfunction may lead to anxiety problems. Sections 2 to 4 provide some background information of anxiety in children concerning the definition and epidemiology of anxiety in children. Next, the theory of childhood cognition and information processing is explained in section 5, followed in 6 by a description of the information-processing abnormalities (i.e., cognitive biases) that presumably contribute to the development and maintenance of anxiety pathology. Three classes of cognitive biases are distinguished, namely attentional bias, interpretation bias, and memory bias. The evidence obtained from the studies that addressed the connection between these biases and childhood anxiety is discussed respectively in sections 7 and 8. This introductory chapter concludes with the research questions of this thesis, and an outline of subsequent chapters.

1.2 Normal fears in childhood

Fear is a normal response to stimuli or situations with a potential to inflict harm on the organism. The adaptive significance of fear rests in its ability to avert potential hazards through a collection of protective responses such as escape, avoidance, aggressive defence, immobility and freezing, submission, and various aspects of human attachment behaviour (Marks, 1987; Russell, 1979). As children grow up, they normally experience a range of fears that wax and wane following a predictive pattern, but that vary in frequency, duration, and intensity between children (e.g., Gullone, 2000; Muris & Merckelbach, 2001). It is assumed that this so-called ontogenetic parade of normal fears (Marks, 1987) serves to protect children from the dangers they are confronted with during the different stages of their development. For example, fear of heights seems to come about when children start crawling around to explore their environment. Thus, the ontogenetic fear parade seems to be closely linked to children's developing physical and cognitive capabilities. When children encounter potentially dangerous aspects of their environment (e.g., heights), insufficient maturation of their cognitive skills may prevent them to grasp what they are faced with (e.g., knowing that heights can make you fall, and that you should go around them). Fear helps children to deal with these situations safely because it would trigger the appropriate protective response (e.g., stop crawling and go back). Once children's cognitive skills allow them to understand these situations and learn to control them, the fear usually subsides (Ollendick, Yule, & Ollier, 1991).

Which fears constitute the ontogenetic parade? A full account would go beyond the scope of this chapter, but the following will give a good impression. Newborns show little apprehension until they are 6 months old, whereupon fears to immediate and concrete threats arise, like loud noises, loss of physical support, and separation from the mother (Craske, 1997). A little earlier, as infants gradually become able to tell apart familiar and unfamiliar faces, they slowly reduce their smiling to strangers from the 3rd month of their life. This develops into stranger fear around 7-9 months (Bronson, 1968; 1972), which persists until children are 5 or 6 years old (Ollendick, Matson, &

Helsel, 1985). In their first year still, infants develop a fear of heights as soon as they start to crawl (Scarr & Salapatek, 1970). As toddlers, children get scared of darkness and of being alone between age 2 and 4 years (Marks, 1987). This fear is replaced around age 4 with fear of imaginary creatures – ghosts, monsters, and the bogeyman – and is believed to coincide with the magical thinking of toddlers (Bauer, 1976; King, Hamilton, & Ollendick, 1988). Fears of animals seem to be linked to the increasing mobility of the child; they crop up around age 6 but rapidly disappear between age 9 and 12 (Marks, 1987). When they reach the age of 7 years, children become capable of making cause-effect inferences, which allows them to anticipate potential negative outcomes (Muris & Merckelbach, 2001). This paves the way for a large range of other fears, such as of blood and injury, and natural events (King et al., 1988; Gullone, 2000; Smith, 1979). Later, on the verge of adolescence, as children's performance in social situations becomes more and more important, fears of social situations rise gradually between age 9 and 18 years (Angelino, Dollins, & Mech, 1956), and peak in the mid-teens.

The fears that are typical of youth form an integral part of development. Some 90% of all children experience at least one specific fear between the 2nd and 14th year of their life (e.g., Craske, 1997; Marks, 1987). A noted above, these fears may endow children with a set of defensive responses that ward off potential threats they cannot cope with yet, because their cognitive proficiency falls short. When children's cognitive skills reach sufficient sophistication to control such situations, the fear usually subsides. Nevertheless, as Muris, Merckelbach, Mayer, and Prins (2000d) put it, "childhood fears reflect serious anxiety problems which interfere with children's daily routine". It is, therefore, not surprising that sometimes the fears fail to subside and develop into full-blown phobia. In fact, childhood fears may reflect significant anxiety disorders in as much as 20% of children (Muris et al., 2000d). Unlike normal fears, phobic anxiety (1) is disproportionate to the requirements of the situation or stimulus, (2) cannot be reasoned away, (3) cannot be intentionally controlled, (4) leads to avoidance of the feared object, and (5) persists over an extended period of time (Marks, 1969; Ollendick, King, & Muris, 2002). Several factors have been proposed to contribute to this undesirable conversion of normal fears into phobic anxiety. The present thesis concentrates on one of these factors, namely disturbances in the information processing of fear-evoking stimuli. The theory of human information processing, and the cognitive biases that contribute to the development of anxiety in children will be discussed at length below. First, however, the following section will describe childhood phobia in a nutshell.

1.3 Childhood phobia: a definition

According to the fourth edition of the Diagnostic and Statistical manual of mental disorders (DSM-IV) of the American Psychiatric Association (APA, 1994), an anxiety disorder is characterised by an internal process of excessive worry, apprehensive expectation, and/or rumination about possible negative outcomes. The DSM-IV distinguishes one anxiety disorder that is exclusively diagnosed with children: separation anxiety disorder (SAD), which is characterised by a developmentally inappropriate and excessive fear of being separated from persons to whom the child is attached. In addition, most anxiety disorders that have been defined for adults can also affect children. Be-

cause it is recognised that children may manifest anxiety differently than adults, the diagnostic criteria for children have been mitigated.

This applies to the following anxiety disorders. Specific phobia (SpP) is characterised by disproportionate, unreasonable fear of circumscribed objects, such as flying, heights, animals, receiving an injection, or seeing blood. In the case of social phobia (SP), the fear concerns social or performance situations in which embarrassment may occur. Rather than focused on a specific object or situation, generalised anxiety disorder (GAD) concerns intense anxiety and worry about a number of events or activities such as school and spots performance or catastrophic events (e.g., a terrorist attack). Post-traumatic stress disorder (PTSD) may develop after a horrifying event that involves confrontation with (the threat of) death or serious injury. It is associated with intrusive re-experiencing of the trauma, increased physical arousal, and emotional numbness. Finally, children with obsessive-compulsive disorder (OCD) engage in obsessions and/or compulsions for a considerable amount of time each day. The obsessions involve frequent thoughts, impulses or images that cause marked anxiety or distress, and go beyond excessive worries about daily problems. The child tries to ignore or suppress the obsessions, or to neutralise them with repetitive behaviours or mental acts known as compulsions.

1.4 Epidemiology of childhood phobia

The age of onset of anxiety disorders seems to coincide with sensitive periods during which the prevalence of corresponding normal childhood fear is high (see above). In support of this, research has shown that the approximate onset age is 6 years for animal phobia and injection phobia, 8 years for blood phobia, and 16 years for SP (Öst, 1987; 1995), 7½ to 10 years for SAD (Bernstein, Borchardt, & Perwien, 1996), 10 years for OCD, and in adolescence for GAD (APA, 1994). PTSD, of course, may develop at any age, depending on the occurrence of trauma. It is estimated that about 30% of children who experience a traumatic event will develop PTSD (Perry & Azad, 1999).

Bell-Dolan, Last, and Strauss (1990) administered a semi-structured psychiatric interview to 62 children with no history of psychiatric illness aged 5-18 years. They found subclinical phobias among 10.7% to 22.6% of the children, and reported that fear of heights and public speaking, somatic complaints, and turning away from social contacts reached subclinical or clinical levels in about 20% of the children in their study. Epidemiological studies investigating the prevalence of anxiety disorders in children and adolescents report that about 5.7 and 17.7% in the general population are affected (e.g., Costello & Angold, 1995).

However, different prevalence rates are reported for different anxiety disorders, and figures range from 0.5% to 6.1% for SAD, from 0.6% to 5.1 for SP, from 0.3% to 9.1% for SpP, and 2.4% to 10.8% for GAD. Only a few studies have reported prevalence rates for OCD, panic disorder, and agoraphobia among children and adolescents, and these rates are generally reported to lie below 2% (Bernstein et al., 1996; Costello & Angold, 1995; Jalenques & Coudert, 1993; Mackinaw-Koons & Vasey, 2000; Masi, Mucci, & Millepiedi, 2001; Verhulst, 2001). The relatively high variability of prevalence rates reported in different studies can probably be contributed to differences in how anxiety is assessed (i.e., by questionnaire or clinical evaluation), the demographic make-up of the sample, and source of information (i.e., parent or child). For instance, consistently

higher prevalence rates of anxiety disorders in childhood and adolescence are obtained by child-report compared to parent-report (Costello & Angold, 1995).

The distribution of the anxiety disorders varies across socio-demographic categories. In general, a higher frequency of anxiety disorders is reported for girls than for boys (Costello & Angold, 1995; Mackinaw-Koons & Vasey, 2000; Verhulst, 2001). An exception is OCD, which seems to attain higher prevalence in boys compared to girls (Jalenques & Coudert, 1993). In addition, inconsistent or negligible gender differences were reported for GAD in children and SP in adolescents (Mackinaw-Koons & Vasey, 2000). Age differences have also been reported, with SAD being more prevalent in children than in adolescents, whereas the opposite pattern appears for SP (Verhulst, 2001). In addition, anxiety seems to be a relatively stable phenomenon in children and adolescents (Craske, 1997).

1.5 Childhood information processing theory

The premise of the information-processing theory is that cognitive processes can give rise to pathological anxiety. The theory has already successfully been applied to explain the aetiology, maintenance and treatment of anxiety in adults (e.g., Beck, Emery, & Greenberg, 1985; Williams, Watts, MacLeod, & Mathews, 1997), and is now increasingly applied to childhood anxiety. It may help explain how childhood anxiety pathology develops, and serve as a heuristic for further research in this field (Bijttebier, Vasey, & Braet, 2003). It is important to note that information-processing theory does not deny the importance of non-cognitive factors, such as traumatic experiences, heritability, and parenting behaviour (cf. Manassis, 2000; Ollendick et al., 2002) in the development and maintenance of phobic anxiety; it just has nothing to say about them. In the following paragraphs, some general principles of information-processing theory are outlined. It will be explained how cognitive biases may arise and contribute to the maintenance and development of anxiety. Subsequently, the available evidence on the role of these cognitive biases in childhood anxiety is reviewed.

According to information-processing theory, the human organism can be looked upon as an information-processing system that responds primarily to cognitive representations of and experiences with its environment. Four aspects of the information-processing system are distinguished (Kendall, 1985). *Cognitive content* is the actual information that is stored in the system. Not only does the system include descriptive information about the physical characteristics of the stimulus (e.g., what a spider looks like) and its function or behaviour (e.g., spiders will attack you and bite), it also comprises appropriate ways to respond (e.g., avoid or run away from spiders). *Cognitive structure* refers to the representation of this information in memory, how it is organised. Thus, spiders may be classified under animals, but also simultaneously under 'dangerous things'. This structure has also been described as a collection of associative networks (Bower, 1981; 1987) or schemas (Beck, 1976; Beck et al., 1986). Furthermore, the system holds a collection of procedures at its disposal, i.e., *cognitive processes*, which can be employed for the processing of information (e.g., be vigilant of spiders). The system's output, the *cognitive products*, is a resultant of the interplay of cognitive structure, cognitive content, and cognitive processes. Problems in any of these areas may lead children to resort to selective cognitive processing (i.e., cognitive bias), which may in turn give rise to psychopathology like phobia (Kendall, 1985). How cognitive

biases can emerge from each aspect of the information processing apparatus will be explained below.

The information-processing paradigm posits that the handling and execution of cognitive tasks or operations (i.e., the cognitive process) must adhere to three fundamental principles (Bijttebier et al., 2003). The first principle holds that before incoming information can generate a response (i.e., cognitive products) it must pass through a series of stages. The output of early stages dictates at least partly the outcome of later stages. The following stages of information-processing are distinguished: (1) the encoding of internal and external cues, (2) their interpretation and mental representation in memory, (3) the selection of a desired goal or purpose of the response, (4) and the selection of the appropriate response, (5) construction of that response, and (6) behavioural enactment of this response (Crick & Dodge, 1994; Daleiden & Vasey, 1997). Originally, these stages were conceptualised as a rigid sequence of steps that had to be completed one after the other (cf. Bijttebier et al., 2003). Later, this aspect of the theory was reformulated to allow simultaneous processing at all stages. However, although individuals continually process information in each of the steps simultaneously, each stimulus cue is processed serially according to the order of the successive stages (Crick & Dodge, 1994). Biased cognitive operations may arise at each of these stages due to failing or flawed processing of certain information. Processing biases occurring in early stages have repercussions for later stages, and produce maladaptive or dysfunctional thoughts and behaviours on encounter with the stimuli that served as input (Kendall, 1985). When the processing of information in the anxiety domain is affected, and specifically involves threat-related stimuli, anxiety problems may arise. Of course, processing problems may also strike in other domains, but this is only relevant for other disorders.

Thus, one source of cognitive bias is cognitive processing itself, which can be flawed. However, bias can also arise in a different way, which relates to the second principle of information processing. This second principle stipulates the limited capacity of the information-processing apparatus (i.e., the cognitive structure). The execution of cognitive operations does not occur without effort, but takes up a portion of the system's cognitive resources. Once dedicated to a certain task, resources cannot be employed for other processing operations. As long as the sum effort required for a given number of operations in progress does not exceed the capacity of the human mainframe, task handling will be optimal. However, when effort *does* exceed capacity and resources fall short, tasks will compete for available workspace. In an environment as saturated with information as the human niche, competition is the rule rather than the exception, and leads to selective processing. Thus, in order for the organism to thrive, fast and accurate assignment of processing priorities in favour of critical tasks is crucial to ensure efficient dispatch of the operations in queue. Tasks of higher importance must be activated with preference at the expense of more trivial tasks, for which processing must then be inhibited (cf. Mathews & Mackintosh, 1998; Wood, Mathews, & Dalgleish, 2001).[1] Cognitive biases may arise from interference of competing tasks due to improper prioritisation or inhibition of these tasks.

[1] Note that the term 'preferential activation' was used intentionally, because the appraisal of priority tasks is established subjectively by the human information processing system. However, the behavioural enactment that results from the preceding processing may be objectively undesirable because it enhances, for example, anxiety pathology.

The final cornerstone of the information-processing paradigm concerns the distinction between *automatic* and *strategic* information processing. Automatic processing is held to be involuntary and requires neither mental effort nor consciousness. Task processing proceeds very rapidly, but is inflexible because tasks are always executed in the same way. Strategic processes, on the other hand, are comparatively slow, require conscious attention, and consume cognitive resources. The individual can voluntarily control strategic processes, and processing is flexible and can be tailored to individual circumstances (cf. Bijttebier et al., 2003; McNally, 1995). Note, however, that attributes of automaticity (i.e. capacity-free, unconscious, involuntary) do not all apply to selective processing of threat associated with anxiety. These biases are supposed to be automatic in the sense of being involuntary (and sometimes unconscious), but not in the sense of being capacity-free (McNally, 1995). Accordingly, cognitive biases can arise when certain schemas (i.e., cognitive structures) are constantly held active to ensure that processing of certain stimuli is prioritised. When schema-congruent information is encountered, it is involuntarily processed right away, and interferes with other tasks because processing capacity is limited. Such interference may produce cognitive bias at any of the processing stages.

1.6 Cognitive biases in childhood anxiety

According to the information-processing framework, people have limited processing resources. Moreover, the effort required for executing a given task is unavailable for other tasks, whereas, of course, excess resources can be deployed to other tasks. As long as the sum effort of active tasks does not exceed the processing capacity of the human mainframe, task handling will be optimal. However, when the active tasks require more resources than the system can provide, as is usually the case, task priorities must be assigned. The term cognitive bias, then, denotes the situation wherein certain information or a certain task is preferentially processed at the expense of another task or other information. In childhood anxiety, this preferential processing is assumed to result from overactive danger schemas, which lead to a persistent and automatic focus of processing resources on threat-relevant information. This gives rise to selective cognitive processing, or *cognitive biases*, which in turn produce maladaptive or dysfunctional thoughts and behaviours (Kendall, 1985). In this way, cognitive biases enhance the perception of threat and thereby contribute to the maintenance of anxiety (Clark, 1999). Because of this chronic hyperactivity of danger schemas, anxious children involuntarily divert their processing resources to stimuli pertinent to their anxiety. Three types of cognitive bias are deemed relevant to the development and maintenance of anxiety disorders: attentional bias, interpretation bias, and memory bias.

Attentional bias refers to the tendency of anxious individuals to direct their attention to threatening information that is related to their predominant fear. It is measured by presenting anxious individuals with a combination of anxiety-related and neutral stimuli, instructing them to respond as fast as possible to a neutral target. Because anxious individuals are unable to ignore threat, anxiety-related stimuli affect their response latency. Attentional bias is quantified as the degree to which the speed of responding is compromised by the presence of threat. Obviously, normal individuals, who do not share the anxious person's fear, do not perceive the anxiety-related stimuli as threatening, and respond to those stimuli as if they were neutral. Accordingly, anx-

ious individuals show a significant attentional bias whereas non-anxious individuals do not. In addition, the magnitude of this bias is significantly larger in anxious compared to non-anxious individuals (in whom bias may be absent or too small to reach significance). This pattern of attentional bias across anxiety groups will be referred to as the *differential attentional bias effect*. In general, this requires that (1) the anxiety group shows a significant bias, (2) the control group does not show a significant bias, and (3) bias in the anxiety group is significantly larger than bias in the control group. A large body of evidence confirms that anxious adults prioritise relevant threatening information (e.g., Logan & Goetsch, 1993; MacLeod & Mathews, 1991b; Williams, Mathews, & MacLeod, 1996).

Interpretation bias can be described as the tendency to interpret information or attribute intentions in such a way as to confirm that the object of one's fear poses a threat. Usually, this information is derived from the physical context, but people may also overestimate the probability they will encounter threat or will be harmed, or misperceive their own or other people's emotional reaction in the presence of threat. Typically, the stimulus material used to measure interpretation bias is ambiguous or degraded in the sense that it is indecisive whether it denotes threat or not. Then again, sometimes individuals are presented with clearly neutral or threatening stimuli to examine their perception of these stimuli or the consequences they attach to encountering them. Interpretation bias is considered present when these ambiguous stimuli are appraised as threatening relatively frequently (relative to non-threatening appraisals), or with exaggerated intensity. As anxious individuals have a tendency to view their surroundings as threatening, they are characterised by interpretation bias. As with attentional bias, a differential interpretation bias exist when there is a significant difference in interpretation bias between anxious participants (who show a significant bias) and non-anxious controls (who do not show a significant bias).

The third category of bias that has been associated with anxiety is memory bias: the tendency to preferentially store, recognise, and/or retrieve information which is related to the person's dominant fear. It is measured by cataloguing the accuracy of participants' recognition or recall of stimulus material they were confronted with some time earlier. A distinction can be made between tasks that target explicit or implicit memory functioning. Explicit memory refers to conscious and intentional retrieval of previously learned stimuli, and is tested by asking participants to recall or recognise these stimuli. Implicit memory involves retrieval of material that has been stored accidentally, and is examined indirectly while leaving participants unaware that they are required to search their memory (Coles & Heimberg, 2002). In addition, the focus of memory tasks may target different stimulus aspects, such as its perceptual appearance (i.e., what the stimulus looks like) or conceptual content (i.e., the stimulus' meaning). Memory bias is apparent when threatening stimuli are more accurately recognised or reproduced than neutral stimuli. As anxious individuals have extensive, continually activated threat schemas, they will be better able to assimilate threat-related information in their memory and have better access to memory representation of this threatening information, and display a memory bias. Again, to show that anxious individuals have an enhanced memory for relevant threat, a *differential memory bias* must be demonstrated.

The focus of this thesis is limited to attentional and interpretation bias. In the remainder of this section, an overview is presented of the available evidence on these two anxiety-related cognitive biases in children and adolescents. The studies pertaining to

attentional bias will be considered first (7.), followed by those on interpretation bias (8.). The purpose of this exercise is that it will help to establish to what extent these biases play a role in childhood anxiety, and whether they contribute to the development and maintenance of anxiety pathology.

1.7 Attentional bias

This section provides a review of the available evidence on the role of attentional bias in the development and maintenance of anxiety in children and adolescents. Since the first of these studies was published in 1992, nearly 50 studies have been dedicated to this relationship. These studies vary largely in sample age and in type and seriousness of the anxiety complaints. However, two experimental techniques for the measurement of attentional bias have dominated this research, namely the emotional Stroop task and the visual dot probe task (VDP). In 7.2 and 7.3, the evidence obtained with these respective methods is presented. It is aimed to examine whether anxiety in children is associated with the presence of an attentional bias, and under which circumstances it can best be observed. First, however, both experimental tasks will briefly be explained.

1.7.1 The measurement of attentional bias

The emotional Stroop task (Ray, 1979) is based on the classic colour-word task developed by Stroop (1935). Participants are presented with anxiety-related and neutral words that are printed in different colours, and have to name the colour of each word as fast as possible. The rationale behind the Stroop task is that the meaning of each word, which is processed automatically, interferes with the target task, namely naming the colour of this word. In the emotional Stroop task, the threatening content of the anxiety-related words distracts anxious individuals, which affects their colour naming performance. This is not the case for neutral words, which carry no threatening connotations. Attentional bias is demonstrated when individuals are slower to colour-name threatening words compared to neutral words. In the context of the emotional Stroop task, attentional bias is sometimes referred to as Stroop interference, which is expected to be larger in anxious individuals than in non-anxious individuals, who do not perceive anxiety-related words as threatening. In early Stroop tasks, for each stimulus category one card was created on which all words of that category were printed several times in each of the colours. The time required to name the colours of all words was recorded. From the 1980s, technological developments made it possible to present the stimuli trial by trial on a computer monitor. Consequently, the blocked presentation mode of the card Stroop was departed, and stimuli of different word categories could be mixed up (i.e., the single-trial method). Stimuli in a Stroop task can be both linguistic and pictorial. In addition, the target that participants must respond to (i.e., the colour), can vary in degree of perceptual integration with the stimulus content (i.e., the meaning of the word or the subject of the picture). Thus, Stroop stimuli can be integrated (e.g., words printed with coloured letters), or non-integrated (e.g., words printed on a coloured background). It is assumed that it is more difficult to ignore irrelevant information as it is more integrated with the target stimulus (MacLeod, 1991).

The visual dot probe task (VDP; MacLeod, Mathews, & Tata, 1986) concurrently presents pairs of words on a computer screen for a short moment (i.e., 1500 millisec-

onds), one above or next to the other. The emotional content of the words is systematically varied such that target trials present a threatening and a neutral word, while the remaining filler trials present two neutral words. Immediately after the screen is cleared, a dot probe appears on the location of one of the words. Participants must indicate the presence of the dot as fast as they can by pressing a response button. The rationale of this procedure is as follows. Both words compete to catch the participant's attention, but people can only attend to one spatial location at the same time. In addition, it takes time to change the focus of attention from one location to another. Thus, probe detection latencies will be shorter for dots emerging on the same location as the attended word as compared to dots that appear on the alternate location. Attentional bias towards anxiety-related threatening information is observed when on target trials, individuals respond faster to dots replacing threatening words compared to dots replacing neutral words. This effect is usually found in anxious individuals. In contrast to the emotional Stroop task, the VDP also allows measuring attention away from threat stimuli. This occurs when individuals respond slower to dots replacing threatening words compared to dots replacing neutral words, and is characteristic on normal, non-anxious individuals (cf. MacLeod & Mathews, 1988; Vasey, Daleiden, Williams, & Brown, 1995). In addition, like the Stroop the VDP permits the use of pictorial stimuli instead of word stimuli. However, VDP stimuli are never integrated since the target (i.e., the dot) is presented after the word or picture with emotional content.

1.7.2 Studies with the emotional Stroop task

This section describes the evidence on anxiety-related attentional bias that has been obtained by use of the emotional Stroop task. On the basis of the sample under investigation, two types of studies are distinguished. Participants of the first type of study are children diagnosed with a DSM-defined anxiety disorder, who are contrasted with a control group of children without anxiety disorders. Such studies are important because clinical levels of anxiety can be linked to the presence of attentional bias, and may contribute to the maintenance and exacerbation of clinical anxiety. However, if it is assumed that attentional bias plays a role in the aetiology of anxiety this type of studies is inadequate. It should be possible to demonstrate that attentional bias is present in children before they develop anxiety disorders, i.e. normal children. Thus, the second type of study is carried out among normal children, and groups of high and low anxious children are usually devised on the basis of self-reported anxiety. We start with studies of clinical samples.

With regard to studies of children with anxiety disorders, PTSD has received most attention. Moradi, Taghavi, Neshat-Doost, Yule, and Dalgleish (1999b) sampled 23 children who developed PTSD after facing a traffic accident or experienced personal violence (not domestic or abuse-related) and an equal number of non-anxious control children, all aged 9-17 years. A differential attentional bias was obtained, indicating that the PTSD group, but not the control group, showed slower colour-naming performance on trauma words compared to neutral words. These authors administered the same Stroop task to 39 children in the same age range, 18 had parents with PTSD and 21 had normal parents (Moradi, Neshat-Doost, Taghavi, Yule, and Dalgleish, 1999a). They obtained a similar differential bias effect, but now only the contrast between threat and neutral words attained significance. In both studies, the magnitude of attentional bias was not associated with age.

Two additional studies investigated the relationship between attentional bias and PTSD in abused children and adolescents. In a study by Freeman and Beck (2000), sexually abused girls with (n = 20) and without (n = 13) PTSD, and 20 non-abused girls completed a single-trial Stroop (age = 8-19). The results indicated that all youths showed an attentional bias for sexual abuse words (relative to general threat, developmentally relevant, neutral and positive words), and for general threat words (relative to positive words). Unfortunately, the amount of Stroop interference of both groups was not compared. Dubner and Motta (1999) examined Stroop performance of 32 foster care children and adolescents who had experienced sexual abuse and were diagnosed with PTSD. These children completed a linguistic card Stroop, and it was found that they responded slower to sexual abuse words than to neutral, positive, and OCD-related words. Thus, it is clear that sexually abused youths who are diagnosed with PTSD selectively attend to information related to sexual abuse. Unfortunately, it is not clear whether this bias results from the abuse *per se*, or from the PTSD.

The Stroop task of Moradi et al. (1999ab) was also employed in two other studies by the same research group. Taghavi, Dalgleish, Moradi, Neshat-Doost, and Yule (2003) compared the colour-naming latencies of 19 adolescents with GAD (age = 13.5±3.2 years) and 19 controls (age = 14.5±1.0 years). Evidence was found for differential attentional bias for a combination of threat and trauma words. The GAD group, but not the control group, showed significant Stroop interference, and both groups differed significantly as to the magnitude of this effect. In contrast, Dalgleish et al., (2003) failed to uncover differential bias, comparing 7-18 year old children and adolescents with GAD (n = 24), PTSD (n = 24), and major depression (n = 19) with controls (n = 26). There were no significant group differences in Stroop interference for threat- and depression-related material. However, it should be noted that no information was provided as to whether the interference of each group differed significantly from zero. Kindt, Bögels, and Morren (2003) obtained highly similar results with 40 anxiety-disordered youths and 14 controls in the same age range. Children and adolescents with DSM-IV-defined GAD, SP, and SAD did not show an attentional bias for disorder-relevant information, and no general bias effect emerged.

To summarise, among anxiety-disordered children the evidence for the presence of an attentional bias is mixed. The strongest indication for an anxiety-dependent bias was found in children with PTSD (Dubner & Motta, 1999; Moradi et al., 1999ab) and GAD (Taghavi et al., 2003). Nevertheless, three studies failed to uncover this effect (Dalgleish et al., 2003; Freeman & Beck, 2000; Kindt et al., 2003); SAD and SP could not be linked to the presence of an attentional bias (Kindt et al., 2003). On the basis of these findings, it seems reasonable to assume that attentional bias is not very reliable in children with anxiety disorders. Perhaps the wide age range of the samples was responsible for this; as will be explained below, it is not uncommon for children age 12 years and younger to display attentional bias even when their anxiety is low. Alternatively, the emotional Stroop task may lack sensitivity for the detection of attentional bias among youths; the VDP may prove a better instrument (see 7.3 below). To be certain about that, however, the Stroop findings obtained with normal children will be considered first.

The first study that used the emotional Stroop to examine the relationship between anxiety and attentional bias was carried out among normal children. It dates back to 1992, and was carried out by Martin, Horder, and Jones. A card version of the Stroop

was administered to 24 spider fearful and 24 control children who were evenly divided over three age groups of 6-7, 9-10, and 12-13 years. Spider fear was assessed by asking children whether they liked spiders and would pick up a spider. If children responded negatively to these questions, they were assigned to the spider fearful group, if they responded positively they were assigned to the control group. Spider fearful children demonstrated an attentional bias to spider words, whereas control children did not. No attentional bias differences emerged between the three age groups.

Two later studies similarly found that anxious children responded slower to threatening stimuli than to neutral stimuli, while responses of non-anxious controls to both stimulus categories were equal. Richards, Richards, and McGeeney (2000) obtained these results using a linguistic card Stroop, which they administered to a convenience sample of 30 adolescents (aged 16-18 years). The high and a low trait anxiety group were created by means of a median split procedure on self-reported anxiety scores. In a second experiment by Martin and Jones (1995), 71 spider fearful and 72 control children completed a pictorial version of the card Stroop. These children were selected from a sample of 169 using the same questions as in 1992, and the children were again divided in three age groups: 4-5, 6-7, and 8-9 years (but no age differences in attentional bias emerged).

Kindt et al. (1997a) compared performance on a card version and a single-trial version of the emotional Stroop task in elementary schoolchildren aged 9-12 years. From a group of 921 children, the 10% who scored highest on the Spider Phobia Questionnaire for Children (SPQ-C; Kindt, Brosschot, & Muris, 1996) and said "no" to Martin et al.'s (1992) questions were assigned to the spider fear group (n = 72). The 10% with the lowest SPQ-C score who answered the two questions with a "yes" were assigned to the control fear group (n = 73). Contrary to the authors' expectations, both spider fearful and control children exhibited attentional bias for spider-related information, and the degree of bias did not differ. Although the differential bias was absent in both Stroop versions, the magnitude of attentional bias was significantly larger with the card version than with the single-trial version. In addition, findings obtained with the single-trial Stroop indicated that bias increased with age in the spider fear group but not in the control group.

To examine whether stress would affect children's attentional performance, Kindt, Brosschot, and Everaerd (1997b) carried out two experiments with 8- and 9-year-old children. In both experiments, children in the stressful condition completed the emotional Stroop task while they anticipated receiving an inoculation. In the neutral condition, children completed the Stroop task in a familiar environment, at their school. The anxiety group consisted of high trait anxious children who reported a large number of specific fears, and were scared of physical harm and medical situations, specifically injections; control children were hardly troubled by these fears. In both experiments, each group comprised approximately 5% of the total sample of over 575 normal children (see Table 1.1). The Stroop counted four word categories of neutral and threatening words that were either related to the forthcoming inoculation and pertained to a medical situation, or were unrelated to this concern. It was expected that a differential attentional bias for threatening information would be elicited under stress, but not in a neutral situation. However, this was not the case: all children, irrespective of their anxiety level, showed an attentional bias in the neutral condition, while in the stressful condition only an attentional bias for medical words emerged.

In another study by Kindt and Brosschot (1999), the Stroop task consisted of both pictures and words. The words were either non-integrated like the pictures (i.e., superimposed on coloured circles) or integrated (i.e., written with coloured letters). These stimuli were presented to 28 spider fearful and 30 control girls aged 8 to 12 years who were selected on the basis of SPQ-C cut-off scores from a larger sample (n = 335). After the Stroop, children completed a behavioural test (Arntz, 1993) that required them to try to approach a life spider as closely as they dared. The children displayed a differential bias when the stimulus words were in non-integrated format, but when they were integrated an attentional bias was found in both anxious and control children, as in Kindt et al.'s previous studies (which also used integrated words). In addition, stimulus words produced more Stroop interference in integrated format than in non-integrated format. No attentional bias was found for the pictorial stimuli, even though they were shown in non-integrated format.

Kindt, Van den Hout, De Jong, and Hoekzema (2000) further explored children's Stroop performance with non-integrated pictorial and linguistic stimuli. Fifty-five high spider fearful and 58 low fearful control girls aged 8-11 years were selected from 720 normal schoolchildren by using SPQ-C cut-offs. The children were told that half of them would face a life spider after the Stroop, which in fact was not the case. It was found that both Stroop formats did not differentiate between high and low fearful children, this time because attentional bias was absent in both groups. However, further analyses of the word stimuli revealed that attentional bias increased with age in spider fearful children whereas it decreased with age in controls (cf. Kindt et al., 1997a). The authors also observed a reversed attentional bias in 8-year-olds, who responded significantly slower to control words than to spider words. This surprising effect was followed-up in a second experiment, which only employed the linguistic stimuli. This time, half of the children were actually confronted with a life spider after finishing the Stroop. Three fear groups were composed from 422 girls: there were 44 high spider fearful girls, 36 non-fearful control children, and an intermediate group of 41 girls. The spurious reversed bias could not be replicated, but as in previous studies, there were no differences in attentional bias between the groups. Bias was present irrespective of the level of fear of the children.

Eschenbeck, Kohlmann, Heim-Dreger, Koller, and Leser (2004) further explored the conditions leading to the absence of differential attentional bias in normal children aged 7-10 years. They employed a non-integrated Stroop task with line drawings of positive (i.e., happy), and negative (i.e., angry) faces. Children whose anxiety score fell in the top and bottom quartiles were classified as high and low anxious, respectively; the remaining children as medium anxious. In experiment 1, the contrast groups were composed on the basis of trait anxiety. In experiment 2, this was done on the basis of two aspects of state anxiety, namely worry (i.e., negative preoccupation with performance) and emotionality (i.e., specific physiologic and somatic reactions). The reaction time analyses showed that in experiment 1 children exhibited attentional bias irrespective of their anxiety level; in experiment 2, high emotional children generally responded slower than the other groups (there were no other effects). The analyses of error rates revealed a differential bias in both experiments: children high on trait anxiety and worry (not emotionality) had a significant bias, the other children had not. These findings indicate that children below age 12 in general selectively attend to threat, especially under conditions of high emotionality. When they are high trait anx-

ious as well and have a tendency to worry, these children are error prone with respect to the task they have to perform.

Two additional studies investigated attentional bias with children who were divided into contrasting groups based on their temperament. The first of these studies by Schwartz, Snidman, and Kagan (1996), involved children with a mean age of 13 years. Eleven years earlier, these children had been classified as behaviourally inhibited (n = 41) or uninhibited (n = 33). The emotional Stroop task that was employed involved threatening, positive, and neutral words presented in integrated format; the start of each trial was controlled by the experimenter. This is unlike single-trial Stroop tasks in other studies, which use a fixed inter-trial-interval that programmed into the computer. Analysis of the quartile of slowest responses showed that in behaviourally inhibited adolescents, this quartile contained significantly more threatening words than positive words. This was not the case in the uninhibited adolescents, who had more positive than threatening words in this quartile. Note that this way of analysing Stroop data is a highly unusual, which makes comparison with other findings difficult.

In the second study, Kagan, Snidman, Zentner, and Peterson (1999) subjected 111 children aged 6-8 years to a pictorial Stroop task. The temperament of these children had been characterised as high or low reactive when they were 4-months-old infants by presenting them with visual, auditory, and olfactory cues in a standard testing procedure. High reactive infants (n = 51) responded to these cues with strong motor activity and frequent fretting and crying, whereas low reactive infants (n = 60) did not. Between 5 and 7 years, mothers reported whether their children exhibited anxiety symptoms. The results indicated that all children showed an attentional bias, irrespective of mother-reported anxiety or reactivity.

Taken together, the evidence of Stroop studies with non-clinical children shows that anxious children are characterised by an attentional bias. However, attentional bias does appear to differentiate consistently between high and low anxious children. Most studies found an attentional bias irrespective of children's anxiety: a general attentional bias effect (Eschenbeck et al., 2004; Kagan et al., 1999; Kindt & Brosschot, 1999; Kindt et al., 1997ab; 2000). More importantly, two studies found evidence that attentional bias gradually decreased with age in non-anxious control children, but persisted or even increased in anxious children (Kindt et al., 1997a, 2000). Kindt et al. (1997a) proposed the cognitive inhibition hypothesis to explain these findings. The hypothesis holds that young children have not yet developed the ability to inhibit the processing of threat. Their attention is involuntarily drawn towards threat, and so all children exhibit attentional bias. It is further assumed that inhibitory abilities normally develop with age, allowing their bias to subside, but that anxious children fail to master inhibitory proficiency such that their attentional bias can persist. The support for this notion was rather weak, however, because in Kindt et al.'s (1997a, 2000) studies the numbers of children per age group were small. The studies presented in chapter 2 and 3 further examined this prediction of the cognitive inhibition hypothesis with a larger numbers of children.

1.7.3 Studies with the visual dot probe task

Vasey et al. (1995) were the first to use the visual dot probe task (VDP) to examine the relationship between anxiety and attentional bias in children. For this purpose, they adjusted MacLeod et al.'s (1986) task for children, and then administered it to 24 children and adolescents aged 9-14 years. Half of the children was clinically anxious, and

they were matched on age, school grade, socio-economic status, vocabulary knowledge, and reading skills with non-anxious control children. It was expected that the anxious children would respond faster to dots that appeared at the same spatial location as threatening words, but slower when they appeared at the opposite spatial location. As expected, the anxious group showed an attentional bias toward threatening stimuli, indicating that they preferentially allocated their processing resources toward anxiety-related information. The non-anxious children attended equally to both threatening and neutral words.

How children with anxiety disorders focus their attention in the face of threat was the subject of five additional enquiries. Four of these studies were carried out by the same research group, and the same version of the VDP was employed to assess the occurrence of attentional bias. Besides neutral words, this VDP comprised three categories of emotional words: social threat words, physical threat words, and depression words. By contrasting response latencies or the emotional words with the neutral words, three threat indices were obtained; in addition, a general threat index was obtained by taking social and physical threat words together. These words were selected from a corpus of emotional stimuli previously compiled by asking 221 normal children aged 11-14 years to produce as many words as they knew in a given emotional category (Neshat-Doost, Moradi, Taghavi, Yule, & Dalgleish, 1999).

In the first study, 24 clinically anxious, 19 mixed anxious-depressive, and 24 control children and adolescents between 9 and 18 years of age completed the VDP (Taghavi, Neshat-Doost, Moradi, Yule, & Dalgleish, 1999). Compared to controls, the clinically anxious group showed more bias than the control group. In addition, the anxious children displayed significantly higher levels of attentional bias for threat words than for depression words. However, no relationship between the magnitude of bias and age was found. The same pattern of results was obtained by Dalgleish et al. (2003) in 7-18 year old children with GAD or PTSD (both *n*s = 24) and a control group (n = 26). In addition, these authors reported that the GAD group had a significant bias toward threatening words, whereas a significant bias away from depression-related words was found in the PTSD group. Dalgleish, Moradi, Taghavi, Neshat-Doost, and Yule (2001) obtained similar results in 24 children and adolescents who had developed PTSD after experiencing a traffic accident or personal violence (not abuse), comparing them with 24 healthy controls (age 9-17 years). The PTSD group showed a greater attentional bias towards social threat words than the control group, but not towards physical threat words. Although these studies indicate that children with anxiety disorders direct their attention to threat-related information relative to controls, no information was provided as to whether the bias itself was significant.

If the tendency to selectively attend to threatening information contributes specifically to the development or maintenance of childhood anxiety, attentional bias should be a domain-specific phenomenon. This implies that such a bias should characterise the information processing of children and adolescents with anxiety complaints, but not of those with other emotional problems. A small number of studies have examined whether attentional bias is specific to anxiety as compared to depression. In the study by Dalgleish et al. (2001), the degree of attentional avoidance of depression words of the clinically anxious children and adolescents exceeded that of controls. In addition, Taghavi et al. (1999) reported that their anxiety group did not exhibit an attentional bias for depression-related material. Finally, several studies examined whether depressive youths would preferentially attend to depression- and anxiety-related material. No

evidence for this relationship could be obtained, even when attentional bias was linked to the anxiety level of these depressive youths (Dalgleish et al., 2003; Taghavi et al., 1999; see also Neshat-Doost, Moradi, Taghavi, Yule, and Dalgleish, 2000). Together, these VDP findings indicate that attentional bias is characteristic of children and adolescents with anxiety disorders, but not of depressive youths.

As with the Stroop, the VDP has also been used with children and adolescents without anxiety disorders. It is important to examine attentional bias among normal children as well. If bias exists before an anxiety disorder arises, the possibility that attentional bias contributes to the development of anxiety pathology becomes real. This was first examined by Vasey, El-Hag, and Daleiden (1996), who administered the VDP to 20 test-anxious and 20 control youths aged 12 to 14 years. Their VDP contained a combination of social and physical threat words, as well as neutral words. The test anxious group showed an attentional bias towards threatening stimuli, whereas the non-anxious group did not. In addition, it was found that non-anxious boys, but not girls, showed an attentional bias away from threatening stimuli. However, these authors did not find that attentional bias was associated with elevated levels of state anxiety. In contrast, they reported a trend towards a negative correlation between attentional bias and state anxiety.

Although this negative relationship was unexpected, recent evidence in 14- to 18-year olds suggests it is reliable. Using a regression approach, Vasey and Schippell (cited in Vasey & MacLeod, 2001) found a significant negative relationship between state anxiety and attentional bias. This may indicate that state anxiety suppresses attentional bias, because the intensity of children's apprehension makes it impossible for them to direct their attention at VDP stimuli at all. This would result in a bias to both threatening and neutral stimuli, and the suppression effect would arguably be larger with more intense state anxiety. Apart from state anxiety, Vasey and Schippell also examined the effect of trait anxiety on attentional bias. They found that higher trait anxiety levels were linked to faster dot detection latencies when confronted with threatening words. Again using regressing, this positive relationship was replicated in a younger sample, aged 12-14 years, by Schippell, Vasey, Cravens-Brown, and Bretveld (2003). These results with normal children indicate that an anxiety-related attentional bias can also be found when anxiety is high, but has not reached clinical proportions. What's more, two of these studies suggest that there may be a dose-response relationship between anxiety and bias, with higher anxiety concurring with more bias. Such a connection was also obtained for state anxiety, but now higher anxiety was associated with *less* attentional bias.

Unfortunately, the relationship between anxiety and attentional bias seems to be more complicated. In a study of Bijttebier (1998), normal schoolchildren (mean age 10.8 years) divided in high and low trait anxiety groups completed a linguistic VDP. Evidence for an anxiety-related bias in trait anxious children only emerged under stressful circumstances, when the children awaited a medical examination. Indeed, high anxious children not only detected dots faster when they were presented after threat words than after neutral words (i.e., a bias toward threat), low anxious children showed the opposite response pattern (i.e., a bias away from threat). Under non-stressful conditions, however, *all* children exhibited an attentional bias to threat.

This was the first time that a general attentional bias effect, which seemed so common when using the Stroop task, was obtained with the VDP. But was it an exception as well? Subsequent evidence from two studies indicates that this is not the case. Inter-

estingly, both of these studies were carried out with younger children, aged 12 and younger. Thus, this seems to confirm the suggestion made on the basis of the Stroop findings, that attentional bias is a normal phenomenon in young children. The first of the studies demonstrating a general attentional bias effect remained unpublished, and was carried out by Ehrenreich (1999). She administered a slightly modified version of Vasey et al.'s (1995) VDP to 61 primary schoolchildren aged 9-11 years who varied in their degree of trait anxiety. In this study, a regression approach was used to examine anxiety-related differences in attentional bias to threat between children. However, after controlling for gender and depression, no significant relationship emerged. Instead, evidence was found that all children exhibited a threat bias when dot probes appeared in the upper position. Further analysis indicated that this effect could be attributed to the responding of the girls (Ehrenreich, 1999; cf. Ehrenreich & Gross, 2002).

The second study that obtained a general attentional bias is one of two that used a pictorial VDP variant. Waters, Lipp, and Spence (2004) completed two experiments to examine attentional bias in normal and anxiety disordered children aged 9-12 years. In experiment 1, 105 non-selected primary schoolchildren exhibited an attentional bias toward both fear-related and pleasant pictures. Contrary to previous findings by Vasey and colleagues, attentional bias was unrelated to anxiety. In addition, the bias was significantly stronger for fear-related pictures than for pleasant pictures, and seemed to be present only in girls, but not in boys (as post-hoc analysis attested). In experiment 2, 23 of the non-selected children were matched for gender and age with 23 clinically anxious children (aged 9-12) diagnosed with GAD, SAD, SP, and SpP. In both groups, the magnitude of the attentional bias was larger for fear-related than for pleasant pictures, although anxious children showed a larger bias overall. More importantly, however, both anxious and non-selected children showed an attentional bias for fear-related material. No gender differences were observed.

The last VDP-study described here, by Pine et al. (2005), also administered a pictorial VDP to 29 maltreated children who had PTSD with 17 control children who had no psychopathology (age range 7-13 years). The pictures were 64 pairs of different faces (half male, half female), one with a neutral and one with a threatening/angry expression. Apart from 64 critical trials presenting two dissimilarly valenced faces side by side, there were 16 filler trials depicting two neutral faces. After the trial, a dot replaced the picture presented on the left or that on the right, and children indicated as fast and accurate as possible the location of the dot by pressing one of two corresponding buttons. It was found that the PTSD showed a significant attentional bias away from threat; this attentional avoidance was significantly larger than that of the control group. In addition, younger children showed more avoidance of threat as well.

1.8 Interpretation bias

Unlike attentional bias, interpretation bias is considered a much slower process that concerns the content rather than the speed and accuracy of information processing. Consequently, the paradigms used to examine interpretation bias not so much rely on response latency, but on self-report of how certain stimuli and situations are perceived. This is achieved by presenting children with ambiguous or degraded material and asking them to interpret this material in terms of what it signifies or how they would deal

with it. This material can consist of single stimuli (i.e., words or pictures), but also of brief narratives (i.e., sentences or anecdotes). In the latter case, the information can be presented at once as a single unit (i.e., story paradigms), but also in separated pieces that are unveiled step by step (i.e., script paradigms). Most research on interpretation bias in childhood anxiety made use of some variation of the story paradigm. Children's interpretation of ambiguous hypothetical situations is considered first (8.2), followed by threat perception bias (8.3). This section concludes with emotional reasoning (8.4), a type of interpretation bias that will receive further scrutiny in two chapters of this thesis. However, 8.1 starts with the most uncomplicated form of interpretation bias, which uses single stimuli.

1.8.1 Homophones and homographs

Hadwin, Frost, French, and Richards (1997) examined whether high trait anxiety would be related to children's interpretation of ambiguous stimuli. Forty children aged 7 and 9 years listened to a number of homophones: words with two clearly different meanings that are phonetically identical. (e.g., dye and die). For the purpose of the study, homophones were selected with both a threatening and a neutral meaning, and the children were instructed to indicate the meaning of the homophone by pointing to an equivalent picture. Hadwin et al. found that high trait anxiety was accompanied by a higher number of threatening interpretations of the homophones.

Using a variation of the homophone task, Taghavi, Moradi, Neshat-Doost, Yule, and Dalgleish (2000) used homographs to examine the interpretations of 17 anxiety disordered and 40 healthy control children and adolescents (aged 8-17 years). Homographs are words with two distinctly different meanings that have identical spelling, and 19 homographs were used with both a threatening and a neutral meaning (i.e., arms or growth). Seven neutral homographs were used as filler trials, and children were asked to produce a sentence in which the homograph was used. On the basis of the unanimous decision of three adult raters, it was determined whether the meaning of the homograph in each sentence was threatening or neutral. Next, a threat index was calculated by subtracting the number of neutral interpretations from the number of threat interpretations (after removal of alternative interpretations of homographs). In contrast to control children, anxious children displayed a significant interpretation bias. That is, their threat index was significantly greater than zero,[1] indicating that they produced significantly more sentences with threatening interpretations than with neutral interpretations. In addition, compared to controls, anxious children were significantly more likely to produce threatening interpretations of the homographs. Levels of interpretation bias did not vary with age.

In sum, these studies confirm that anxious children and adolescents tend to give threatening interpretations of ambiguous word stimuli. However, it might be argued that the ecological validity of these single stimuli is limited, and is not very representative for everyday life. The studies presented below attempted to eliminate this limitation by presenting their participants to narratives designed to reflect situations children normally might encounter.

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[1] This was not reported explicitly in the study, but could be calculated on the basis of the mean scores, standard deviations, and sample size.

1.8.2 Interpretation of ambiguous stories

In what appears to be one of the first studies that addressed anxiety-related interpretation bias of children, the narrative was presented as a videotaped vignette (Bell-Dolan, 1995). Fifty-two high trait anxious and 38 low trait anxious children watched six of these vignettes with a length of 15 to 20 seconds each. Each vignette depicted two children playing; one of the children, the provocateur, engaged in behaviour that had adverse consequences for the other child. The intent of the provocateur's behaviour could be hostile, non-hostile, or ambiguous, and was varied evenly across the vignettes. After watching a vignette, the children were asked whether they thought the provocateur acted intentionally or not, and why this was the case. They were also asked to indicate how they would respond if the provocation would have been directed at them. High anxious children were as accurate in identifying hostile intent as low anxious children, but were more likely to provide hostile interpretations of non-hostile vignettes. Both groups were equally likely to interpret the ambiguous peer interaction as hostile. In addition, when asked how they would react in the given situations, high trait anxious children – especially girls – more often proposed maladaptive strategies and less often adaptive strategies to deal with the negative consequences than low trait anxious children. These findings indicate that anxious children are well able to recognise realistic or probable threat, but fail to accept that a neutral situation is safe.

Barrett, Rapee, Dadds, and Ryan (1996) compared the reactions of three groups of children (aged 7 to 14 years) to 12 brief hypothetical stories of ambiguous situations referring to social or physical threats. There were 152 children with an anxiety disorder, 27 with an oppositional defiant disorder, and 26 control children. After each story, children were first invited to tell in their own words what they thought was going on. Next, they were asked which of two possible outcomes, threatening or neutral, they thought was most likely to occur. For the free- and fixed-choice question alike, not only anxious children, but also oppositional children more often interpreted ambiguous situations as threatening compared to control children. In addition, when asked how they would react upon encounter with the situations, anxious children indicated they would resolve the situation by using avoidant strategies (especially those with social phobia), whereas oppositional children preferred aggressive strategies. In addition, children with social phobia and separation anxiety disorder were more avoidant of social situations than of physical situations, whereas the opposite pattern was found for children with specific phobia. Using an adaptation of Barrett et al.'s stories, Chorpita, Albano, and Barlow (1996) similarly found that anxious children aged 9-13 years (n = 12) tended to give threatening interpretations and propose avoidant solutions. These children were encouraged to generate as many ideas as they could about what could happen in the given situation, and what they would do.

Bögels and Zigterman (2000) examined the responses of three groups of 15 children and adolescents aged 9 to 18 years to 9 ambiguous stories around themes of GAD, SAD, and SP. The groups consisted of children with anxiety disorders (GAD, SAD, or SP), externalising disorders (e.g., conduct disorder), and non-clinical controls, and they were asked to express freely what they thought what was happening in the situations. Clinically anxious children interpreted the situations more negatively than the other children did, but this difference was only significant in comparison with the externalising group. There were no group differences in the number of positive interpretations or the tendency to overestimate the dangerousness of the situations. However, anxious children underestimated their own ability to cope with the situations relative

to externalising and control children. Children also responded to a fixed-choice condition, which produced similar, but stronger effects. Bögels, Van Dongen, and Muris (2003) also administered these stories (free-choice condition only) to 25 children with the same anxiety-disorders. They found that anxiety correlated significantly with negative interpretations, but did not affect whether children proposed active or avoidant coping strategies.

Again using the same stories, Bögels, Snieder, and Kindt (2003) examined the specificity of interpretation among 55 children with high self-reported GAD, SAD, or SP, and 41 children with low scores. They found that anxious children more frequently reported negative thoughts, and judged the situations as more dangerous, threatening, and unpleasant compared to control children. In addition, anxious children reported relatively more intense negative emotions, but did not propose more avoidant strategies to cope with the situations than controls. The study also examined whether interpretation bias was content-specific, that is, only present when information is relevant to the children's anxiety type, but not for other information (which may be related to other types of anxiety). Although no evidence for this was found for each of the three disorders separately, a content-specific interpretation bias seemed to exist for SAD and SP together, as opposed to GAD.

If interpretation bias is a characteristic of anxiety in children and adolescents, it should disappear when the anxiety subsides, for instance after successful treatment. This treatment effect was addressed by Creswell, Schniering, and Rapee (2005), in a sample of 27 children with various anxiety disorders (aged 7-15 years). The children were confronted with 12 scenarios depicting ambiguous situations (based on Barrett et al., 1996) to examine their interpretation bias. They clearly showed a significant interpretation bias compared to a group of 33 control children. More importantly, after the nine-session treatment, which involved the child and a parent, threat interpretations of the clinical group dropped significantly.

A disadvantage of the studies presented above is that interpretation bias is assessed in hypothetical situations, which limits the ecological validity of this methodology. This issue was considered in a study by Rusinek, Hautekeete, Danes, Deregnaucourt, and Lemmen (2002), who a real-life ambiguous event to examine interpretation bias in 10-11-year old French children, shortly after they had transferred from elementary school to college. They confronted 79 low trait anxious and 80 high trait anxious children with a speech that was held in the classroom by their school director. The speech was about the children's school results, and was constructed to be ambiguous, though it turned out to be somewhat more negative than positive. One week after the speech, the children were asked to write down how they felt about the speech with respect to the emotional tone, intensity, and sharpness of the speech, how often they talked about the speech with their parents and friends, and the frequency of ruminations about the event. It was found that the high trait anxious children remembered the speech as having a more negative emotional tone and being more intense, and ruminated more frequently about the event compared to low trait anxious children. There were no group differences in the frequency of sharing the speech with parents of peers. These findings indicate that anxious children do not only exhibit interpretation bias in response to hypothetical situations, but also show this tendency in real life.

To summarise, the results of these studies indicate that anxious children overestimate the presence of threat. They also wrongly believe they are unable to cope with situations they perceive as dangerous, and tend to avoid them. Consequently, they fail

to experience that a situation may be harmless while they did not expect it to be, so their anxiety can persevere. This seems to be the case not only when these children respond to hypothetical situations, but also in real-life.

1.8.3 Script paradigms: the case of threat perception bias

In their review on cognitive biases that may arise in different stages of information processing, Daleiden and Vasey (1997) proposed that in anxious children even the slightest hint of threat might trigger subsequent processing that results in an anxious response. They further argued that anxious children "[...] may be acutely vigilant for signals of potential threat but, once they have encoded such a signal, they may quickly move through the interpretation stage and conclude the situation is dangerous even though a search for further information would show it is not. For example, upon seeing a dog, dog-phobic children may quickly jump to the conclusion that they are in danger and, because they have ceased encoding further information, they may fail to notice that the dog is on a leash or that the dog is behaving in a friendly manner" (pp. 411-412). In a recent series of studies, Muris and colleagues scrutinised the relationship between this threat perception bias and anxiety in children (Muris, Jacques, & Mayer, 2003b; Muris, Kindt, Bögels, Merckelbach, Gadet, & Moulaert, 2000a; Muris, Luermans, Merckelbach, & Mayer, 2000b; Muris, Meesters, Smulders, & Mayer, 2005b; Muris, Merckelbach, & Damsma, 2000c; Muris, Merckelbach, Schepers, & Meesters, 2003d; Muris, Rapee, Meesters, Schouten, & Geers, 2003e; Muris & Van Doorn, 2003). Threat perception bias refers to the tendency of anxious children to decide that a stimulus or situation is dangerous based on minor and incomplete information (Muris et al., 2000c); or as Muris et al. (2000b) put it, anxious children seem to act as if "danger is lurking everywhere" (p. 134).

In a typical study on threat perception bias, children are presented with ambiguous scripts (i.e., sets of coherent rules or sentences) that sketch situations relating to the anxiety type under investigation. Children are told that some of the scripts are scary, and will have a bad end, whereas other scripts are not scary and will have a happy end. They are instructed to discover as quickly as possible whether a script is scary or not scary. Each script is read aloud sentence-by-sentence, and children are asked to predict after each sentence how they think the story will end (i.e., scary or not scary). From each script, the following five indices of threat perception can be derived: (1) *threat threshold*: the first sentence children believed the script was going to be threatening; (2) *threat perception frequency*: the number of times children indicated after a sentence that the script would have a threatening ending; (3) *threat intensity*: the average rating of how threatening children thought the story would be after each sentence; (4) *threat appraisal*: children's appraisal of what would happen in the given situation after they heard the script a second time without interruptions; and (5) *feelings and cognitions ratings*: the sum of children's ratings about the degree to which they would be scary, shy, unsure what to do, and worry about a bad ending (cf. Muris et al., 2000b).

In the first study of threat perception by Muris' group (2000c), 252 primary schoolchildren aged 8 to 13 years completed 7 scripts pertaining to social anxiety situations; 28 of these children had social phobia. As expected, both in clinical and normal children, social anxiety was significantly related to a lower threat threshold, more frequently and intensely perceived threat, were more inclined to appraise the scripts as threatening, and reported more negative feelings and cognitions. This pattern of re-

sults has been replicated in subsequent studies by Muris' group of children's threat perception bias with a variety of anxiety problems, as can be seen in Table 1.2 (Muris & Van Doorn, 2003; Muris et al., 2000ab; 2003acde; 2005b). These findings show that children with anxiety problems see the world as a threatening place. Because anxious children combine this low threshold for perceiving threat with a tendency to avoid situations they find threatening (see 8.2, Barrett et al., 1996; Chorpita et al., 1996), they do not learn how they can deal with threat. This may explain why they feel unable to cope with threatening situations, which may in turn enhance their anxiety and contribute to its maintenance (Vasey et al., 1996; Mogg & Bradley, 1998). For this assertion to hold, threat perception bias should be specific to anxiety only, but not to other emotional problems (i.e., domain-specific). And in addition, it should only occur in situations that are relevant to the dominant anxiety problems, not if the content of this anxiety irrelevant (i.e., content-specific).

The content-specificity of threat perception bias was examined by Muris et al. (2000a), who tested whether threat perception would be specifically related to social anxiety, separation anxiety, and generalised anxiety, or be characteristic of anxiety in general. They presented 105 normal schoolchildren aged 8-13 years with scripts of the pertinent situations, and administered self-reported measures of the corresponding anxiety disorders symptoms and general anxiety. However, specific anxiety symptoms did not correlate more strongly with scripts of matching situations than with scripts depicting situations pertaining to the other two anxiety types. Instead, the presence of threat perception distortions of any content appeared to be determined primarily by children's general anxiety level (i.e., trait anxiety). In contrast, Muris et al. (2000b) found that threat perception bias is content-specific to social anxiety. They read 6 scripts of social situations to 76 normal schoolchildren aged 8-13 years. Half were ambiguous and could be interpreted as threatening, and half were evidently neutral (i.e., non-threatening). The content-specificity effect was derived from the finding that the correlation between trait anxiety and threat perception disappeared when social anxiety was partialled out, while the correlation between social anxiety and threat perception persisted after the effect of trait anxiety was removed.

Muris et al. (2000b) also examined the domain-specificity of threat perception bias, in relation to symptoms of depression. The results indicated that this bias is not specific to the anxiety domain, because it correlated significantly with both trait anxiety and depression. Moreover, the correlation with depression remained significant when the effect of anxiety was eliminated (although this attenuated the correlation considerably). A similar pattern of correlations was obtained by Muris et al. (2005b), who confronted 157 schoolchildren aged 8-12 years with 1 threatening script and 6 ambiguous scripts pertaining to anxiety-relevant situation. The children also filled out a questionnaire that assessed clinical symptoms of anxiety, depression, and aggression. Threat perception bias correlated significantly with anxiety as well as depression and aggression. However, when the relative contribution the three types of psychopathology to threat perception was examined using regression, only anxiety turned out to be a significant predictor. In sum, these findings suggest that it is yet undecided whether threat perception is content-specific to anxiety. However, there is some indication that threat perception is domain-specific, although the evidence is rather weak.

Muris et al. (2005b) also examined the prospective relationship between threat perception bias and anxiety disorder symptoms with an 8-week interval. They were unable to obtain evidence for such a relationship, although the temporal stability was high.

The latter was also the case in the study by Muris et al. (2003a), using a shorter, 4-week test-retest interval. In addition, these authors did find evidence that threat perception was predictive of later anxiety disorder symptoms in a sample of 113 primary schoolchildren aged 9-13 years. These children completed 6 ambiguous (2 SAD, 2SP, and 2 GAD), and 2 evidently threatening stories purporting to enhance the credibility of the instruction. The pattern of correlations between anxiety and threat perception was as expected, and the threat perception indices were moderately stable. Moreover, even though the temporal analyses did not reveal a *direct* prospective relationship between threat perception and anxiety, the results of the analyses indicated that this relationship was *indirect*. That is, threat perception bias led to threat perception bias 4 weeks later, which in turn generated anxiety concurrently. This indicates that this bias is self-supportive, and once present enhance children's anxiety, which in turn increases these abnormalities. As such, it appears to contribute to the maintenance of anxiety. However, it is not clear how threat perception bias arises, and whether it only emerges after anxiety has been instated, or whether a third factor is responsible.

State anxiety is a candidate for this. The studies on threat perception bias described thus far all examined anxiety as a stable phenomenon, which is relatively resistant to the effect of specific circumstances. Since each child was interviewed individually by an unfamiliar adult, it is possible that this procedure elicited state anxiety (Muris et al., 2003e). It might be argued that this state anxiety, rather than more trait-like anxiety problems, was responsible for the threat perception bias. The authors examined this possibility in 299 elementary school children aged 8-13 years, who indicated their anxiety state just before the interview started. Unexpectedly, state anxiety was linked to anxiety in the same way as trait anxiety and anxiety disorders symptoms. Furthermore, regression analyses showed that state and trait anxiety both accounted for a unique proportion of variance in threat perception bias, although the effect of trait anxiety was considerably stronger. More importantly, there was no evidence that threat perception bias resulted from the combined influence of trait and state anxiety. Thus, it can be concluded that threat perception bias is independently related to both state and trait anxiety. In addition, although the relationship between threat perception and trait anxiety seems stronger, it does not outshine the relationship between threat perception and state anxiety.

But what if threat perception bias is an artefact of the study method used, and reflects the tendency to give affirmative responses instead of anxiety? Muris and Van Doorn (2003) addressed this issue in a study among 8- to 13-year old primary school children (n = 138). However, their primary purpose was to test whether threat perception bias would also emerge in the absence of verbal information provided with scripts. The disadvantage of scripts is that they contain words and phrases that high anxious children may easily perceive as threatening, because they are sensitive to threat cues. When this occurs, these children may consider non-threatening scripts as threatening, as in Muris et al.'s (2000bc) studies, which compromises the evidence. Therefore, the children were confronted with 12 pictures, taken from projective test material, that were divided in 5 pieces like a jigsaw puzzle. Analogous to the 5 sentences in the scripts, each picture was presented to the children part by part. Half of the pictures were used for a threat condition, which required children to indicate after each piece of the puzzle whether the picture would depict a scary or a non-scary situation. The other half of the pictures was used for the non-threat condition, in which children were instructed to indicate as quickly as possible whether the picture would display a child or

not. The results showed that anxiety was accompanied by threat perception bias when pictorial scripts were used, although this connection seemed to be weaker than with the linguistic scripts. In addition, no correlation emerged between anxiety and the frequency and tendency of perceiving a child on the picture, indicating that anxiety was not associated with giving affirmative responses. In sum, it seems unlikely that the relationship between anxiety and threat perception bias is an artefact.

1.8.4 Emotional reasoning

Emotional reasoning refers to the tendency to appraise objects or situations on the basis of how one feels at that particular moment. Beck et al. (1985) first observed the phenomenon in anxiety patients who reasoned: "I'll be anxious when I ask for the date so their must be something to fear'" (p. 198). This marks the beginning of a vicious circle, because when they realise that there is something to fear, they will conclude they are in danger which in turn further exacerbates their anxious feelings, and so on. Thus, anxiety patients not only use objective information to determine the dangerousness of a situation, but also rely on information from their own anxiety response. Emotional reasoning was first examined in relation to anxiety by Arntz, Rauner, and Van den Hout (1995). They were able to demonstrate that spider phobics, panic patients, social phobics, and patients with other anxiety disorders inferred danger from their own anxiety responses. Similar findings were obtained with PTSD patients, who in addition showed a tendency to use their intrusions as a basis for their threat appraisals (Engelhard, Macklin, McNally, Van den Hout, & Arntz, 2001; Engelhard, Van den Hout, Arntz, & McNally, 2002). Therefore, it seems fair to conclude that anxious individuals, adults at least, live by the motto: "If I feel anxious, there must be danger".

In the first of two studies investigating emotional reasoning in children, Muris et al. (2003d) used an extension of their threat perception paradigm in children aged 8-13 years. In addition to 3 regular ambiguous stories, they administered an ambiguous story that also contained anxiety-response information. Evidence for emotional reasoning was found, as ambiguous stories with anxiety response information elicited a stronger threat perception bias than those without anxiety-response information. In other words, the children needed less information to decide that stories with anxiety-response information were threatening, perceived them as threatening more frequently, provided higher threat ratings, more threatening appraisals, and reported higher levels of negative feeling and cognitions. Both high and low anxious children displayed emotional reasoning, although this effect was marginally larger in high anxious compared to low anxious children.

A more systematic examination of emotional reasoning in children was provided by Muris, Merckelbach, and Van Spauwen (2003c), who adapted Arntz et al.'s (1995) paradigm for use with children. The authors confronted 101 normal primary schoolchildren with 3 scenarios that were written around themes of generalised anxiety, separation anxiety, and social anxiety. In each scenario, objective danger and objective safety were systematically combined with the presence or absence of subjective anxiety-response information. Thus, from each scenario four different stories could be derived, such that children were presented with 12 stories. Children were encouraged to identify with the main character of the story and imagine they would actually be in the situation that was portrayed. For example, one story sketched the child giving a presentation in front of the class. In the neutral condition, the class carefully listens to the talk, whereas in the threatening condition, they laugh and make jokes. In the neu-

tral-response condition, then, the main character carries on speaking unflappably, showing no sign of an emotional response, and finishes the presentation. In the anxiety response condition, however, the main character feels embarrassed and starts sweating while he stammers on. For each story, children rated to what degree they considered it threatening. The results indicated that a general emotional reasoning effect was present. That is, all children rated objective *safety* scenarios as more dangerous when anxiety-response information was present as compared to when this information was absent. In addition, only in the case of objective safety scenarios, the tendency to use emotional reasoning was associated with higher levels of trait anxiety and anxiety sensitivity.

Even though only two studies examined emotional reasoning in children, the effect seems quite robust. For that reason, it holds great promise as a mechanism that can shed further light on the maintenance and development of anxiety. Phobic children respond to confrontation with the object of their fear with intense anxiety. If this anxiety leads them to conclude that danger is in fact present (i.e., emotional reasoning), this will strengthen their belief that the object of their fear is dangerous and threatens their safety. It will also bring them to avoid the 'threat', which prevents them to experience that there is nothing to fear, and help maintain the phobic anxiety. It is also not hard to see that emotional reasoning can contribute to the development of anxiety. Everybody feels fearful at times. If children attribute their fear to certain stimuli, they may conclude that these stimuli are dangerous, at which point the stimulus attains phobogeneity. Chapter 5 and 6 of this thesis are dedicated to emotional reasoning. In chapter 5, replication of Muris et al.'s (2003c) study was sought, and the domain- and content-specificity of emotional reasoning was examined. In chapter 6, it was examined whether the presence of emotional reasoning at a certain time can predict later anxiety, to assess whether it has aetiological potential.

1.9 Research questions

The picture that arises from this overview of studies on the relationship between information processing biases and anxiety in children is complicated. Consequently, it is difficult to draw unequivocal conclusions about the role of these biases in the development and maintenance of childhood anxiety problems. An important reason for this is the considerable variation between the studies. With respect to attentional bias, this mainly relates to the diversity of sample characteristics, anxiety measurements, and variation in the task characteristics. If anything, the evidence seems mildly supportive of the idea that children exhibit an attentional bias irrespective of their anxiety at younger ages (≤12), but later in adolescence only anxious children aged 13-18 years show attentional bias. However, there are many ifs and buts. A more consistent picture arises from the interpretation bias studies, which generally support the idea that anxious children perceive their environment as threatening. In addition, these children appear to have a low threshold for the perception of threat, but have little confidence in their own coping skills and are inclined to avoid threat if they perceive it.

The rationale behind the empirical investigations presented in this thesis is, however, not grounded in the apparent fragmentation of previous research. Two problems are more fundamental to explaining the role of cognitive biases in the development of anxiety in children. The first of these problems is the striking paucity of prospective

research: the only two in this respect studies examined whether threat perception bias would be stable and predicted later anxiety (Muris et al., 2003b, 2005b). Prospective research is essential for several reasons. Firstly, anxiety problems do not arise overnight, but take time to develop. This is reflected in the diagnostic criteria of anxiety disorders, which prescribe that the anxiety must have been present for a certain period. Secondly, for the processes that lead to anxiety to take effect, their presence should be persistent. Third and finally, cross-sectional findings merely indicate that there is an association between cognitive bias and anxiety, but remain silent as to whether bias causes anxiety or is its accidental by-product. This brings us back to the beginning of this introduction, where it was argued that in order to verify that a cognitive bias contributes to the development of anxiety evidence, experimental manipulation of this bias should bring about changes in anxiety. In addition, it should be established that this effect generalises to everyday life, but to saddle people with anxiety would be unethical. In the naturalistic setting, the evidence that cognitive bias leads to anxiety should be obtained with prospective research. These studies should investigate whether (1) the presence of cognitive bias predicts later anxiety, (2) increases in anxiety, or (3) increases in the degree of cognitive bias are linked with higher anxiety levels. On the basis of the joint venture of experimental and naturalistic evidence, it is eventually possible to conclude that anxiety pathology can originate in cognitive bias. As for today, this is still science fiction.

But we are getting there. Evidence is now emerging that experimental manipulation of cognitive bias indeed produces anxiety in adults for attentional bias (Fulcher, Mathews, Mackintosh, & Law, 2001; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002) and interpretation bias (Mathews & Mackintosh, 2000; Wilson, MacLeod, Mathews, & Rutherford, 2006; Yiend, Mackintosh, & Mathews, 2005). The investigation of such effects in children traditionally lags behind the investigation of these effects in adults, and so far, no studies on this topic have been published. However, the prospective relationship between cognitive bias and childhood anxiety has in fact been addressed in two studies (Muris et al., 2003b; 2005b).The present thesis sought evidence for the role of attentional bias and emotional reasoning in the development of anxiety. For this purpose, the cross-sectional connection between these biases and anxiety is assessed in chapter 2 and 3 for attentional bias, and in chapter 5 for emotional reasoning and the related concept of parent-based reasoning (i.e., the tendency to infer danger from the anxiety response of a parent). More importantly, this connection was examined prospectively in chapter 4 and 6 for attentional bias as well as emotional and parent-based reasoning, respectively.

The second problem with previous research is that it almost completely ignores cognitive-developmental differences between children (of different ages). Adult theories of anxiety-related cognition are simply transferred to children, and the purpose of many studies seems restricted to an attempt to see whether the same cognitive biases that are observed with adults also occur in children. This is done in total disregard of the established fact that the ontological parade of childhood fears is closely linked to children's developmentally appropriate cognitive competence. Although several studies on childhood anxiety-related biases considered age differences, there usually was no theoretical reason to do this. Unfortunately, the theoretical implications of developmental variation in children's cognitive capacities on the presence of cognitive biases have largely been ignored.

One line of research on cognitive bias in childhood anxiety, however, did consider the cognitive development of children in predicting attentional bias. More specifically, in 1997 Kindt and colleagues proposed the cognitive inhibition hypothesis, which seems particularly helpful in explaining the pattern of attentional bias that was observed in relation to anxiety in children (Kindt et al., 1997a). The cognitive inhibition hypothesis was adapted from cognitive-developmental theory (Harnishfeger, 1995; Lane & Pearson, 1982), and is inspired upon the notion that anxiety-related attentional bias occurs because of an inability to control the focus of attention, and direct it away from threat (MacLeod & Mathews, 1991b). The hypothesis holds that young children are unable to ignore stimuli with emotional content, and thus prioritise the processing of emotional information at the expense of neutral information. Consequently, children of up to about 11 years show an attentional bias for threat irrespective of their anxiety level. Normally, children increasingly acquire the ability to inhibit processing emotional information as they mature, causing a gradual decline of their attentional bias until it has disappeared completely around age 11. However, anxious children fail to attain inhibitory competency; hence, their attentional bias persists or even increases as children get older. Several studies provided supportive evidence for the cognitive inhibition hypothesis (Eschenbeck et al., 2004; Kagan et al., 1999; Kindt et al., 1997ab, 2000; Waters et al., 2004).

In sum then, the aim of the current thesis is twofold. Firstly, the utility of the cognitive inhibition hypothesis in explaining anxiety-dependent differences in attentional bias of children was tested. In addition, there was a focus on the role developmental differences mediating this relationship. Secondly, it is examined whether cognitive bias would predict later anxiety. In sum, the following research questions will be investigated:

1. Does attentional bias predict the development of anxiety in children?
2. Do emotional reasoning, and the related concept of parent-based reasoning, predict the development of anxiety in children?
3. Do children exhibit attentional bias irrespective of their anxiety, as is predicted by the cognitive inhibition hypothesis? and finally,
4. Does attentional bias decrease as children get older in normal schoolchildren but persist in anxious children, as the cognitive inhibition hypothesis predicts?

1.10 Thesis outline

This thesis contains seven chapters, five of which are empirical studies. The purpose of this introductory chapter was to give the reader a broader perspective on the role of information processing and cognitive bias in childhood anxiety. The chapter starts by emphasising the importance of healthy fears that characterise the normal development of children. The distinction between normal childhood fears and phobic anxiety is explained, followed by the theory of information processing in children. If information processing goes awry, this can give rise to cognitive bias that play a role in the development and maintenance of anxiety problems. The evidence for two of these biases, attentional bias and interpretation bias, is reviewed. Chapter 1 concludes with the research questions that guided the studies reported in chapter 2 to 6.

Chapter 2 investigated the pattern of attentional bias predicted by the cognitive inhibition hypothesis in a large sample of primary school children. Children were selected from 3564 on the basis of self-reported high or low spider fear. Specifically, it was examined whether (1) the children would exhibit an attentional bias irrespective of their level of spider fear, i.e. a general attentional bias effect; and (2) whether the course of this bias would show a gradual decrease in low spider fearful children, but persist in high spider fearful children. It is also known that it is more difficult to ignore an irrelevant stimulus aspect when it is more perceptually integrated with other stimulus aspects. If children gradually develop inhibitory abilities, it can be hypothesised that (3) a bias can be observed at a younger age for non-integrated Stroop stimuli than integrated stimuli. The results were amazing.

Given the surprising results of chapter 2, chapter 3 again examined whether children show an attentional bias effect, and whether this bias differs between high and low spider fearful children depending on age. An additional purpose of this chapter was to investigate whether attentional control – the ability to strategically direct one's attention – would mediate the relationship between anxiety and attentional bias. More precisely, it was tested whether children with high attentional control would be characterised by an absence of attentional bias irrespective of their level of fear, whereas children with low attentional control would show attentional bias only if their anxiety is high.

The purpose of chapter 4 was twofold. First, several models of the prospective connection between attentional bias and anxiety were tested. It was examined whether attentional bias would predict later anxiety directly or indirectly, via later attentional bias. Alternatively, the opposite pattern was considered, whether anxiety would predict later attentional bias directly or indirectly, via later anxiety. The second purpose of the study was to examine the cognitive inhibition hypothesis. In addition to the regular cross-sectional analyses that were also carried out in the two preceding chapters, temporal analyses were carried out. It was hypothesised that increases or persistence of attentional bias would be associated with elevated anxiety, and that high attentional bias would be associated with a persistence or increase of anxiety.

Chapter 5 examined whether children would show emotional and parent-based reasoning, and whether higher anxiety and depression scores were associated with these phenomena. The domain-specificity of emotional reasoning in relation to depression, and its content-specificity with respect to generalised anxiety, separation anxiety, and social anxiety were considered as well. Furthermore, previous evidence indicated that with emotional reasoning the same developmental pattern could be observed as with attentional bias. Thus, it was examined whether emotional reasoning would persist with age in anxious children, but would drop off in non-anxious children.

In chapter 6, the prospective relationship between anxiety, on the one hand, and emotional and parent-based reasoning on the other were investigated. As in chapter 4, several models of how anxiety was linked to both types of reasoning were considered.

Chapter 7 recapitulates the results of chapter 2 to 6. The findings are discussed in terms of the information processing theory of anxiety in children. It is considered whether attentional bias, emotional reasoning, and parent-based reasoning may be seen as vulnerability factors for anxiety. The methodological considerations and clinical implications of this thesis are discussed.

Table 1.1: Studies on attentional bias

Study	Sample Characteristics				Task characteristics		
	Type	*N*	Groups	Age	Paradigm	Length	Stimuli
Bijttebier (1998)	N	88	45 stress+ 43 stress−	11.3±2.2 12.1±2.0	VDP (V) • linguistic	128	32 hospital 96 non-hospital
Dalgleish, Moradi et al. (2001)	AD	48	24A 24C	12.8±2.9 12.8±1.8 r = 9-17	VDP (V) • linguistic	196	48 emotional: • social threat • physical threat • depression 148 neutral
Dalgleish, Taghavi et al. (2003)	AD	93	24 GAD 24 PTSD 19 MDD 26C	13.6±3.2 12.8±2.9 15.6±1.6 15.2±1.4 r = 7-18	VDP (V) • linguistic Stroop (I) • linguistic • single-trial	196 120	48 emotional: • social threat • physical threat • depression 148 neutral 12 threat 12 trauma 12 happy 12 neutral 12 depression
Dubner & Motta (1999)	AD	50	32A 18C	13.4±3.3 r ≈ 8-19	Stroop (I) • linguistic • card	200	5 sexual abuse 5 neutral 5 positive 5 OCD
Ehrenreich (1999)	N	74	61*	r = 9-11	VDP (V) • linguistic	160	64 probed trials: 32 threat-neutral 32 neutral-neutral 96 non-probed trials: 32 neutral-neutral filler
Eschenbeck, Kohlmann et al. (2004, exp 1.)	N	92	16A 51m 25C	7.6±0.5 r = 7-8	Stroop (I) • pictorial • card	80	4 happy face 4 angry face
Eschenbeck, Kohlmann et al. (2004, exp 2.)	N	63	Emotionality 15A, 36m, 12C Worry 17A, 34m, 12C	8.0±0.7 r = 7-10	Stroop (I) • pictorial • card	80	4 happy face 4 angry face
Freeman & Beck (2000)	AD		20A 33C	r = 11-17	Stroop (I) • linguistic • single-trial	150	10 threat/abuse 10 general threat 10 positive 10 neutral 10 development
Kagan, Snidman et al. (1999)	N	111	42A 69C	7.3 r = 6-8	Stroop (I) • pictorial • single-trial	40	10 fearful 10 pleasant 10 neutral 10 aggressive

Study	Anxiety type	Measure	Results
Bijttebier (1998)	Trait anxiety	Q	High stress: A > C • A: bias towards threat • C: bias away from threat Low stress: A = C A+C: bias towards threat
Dalgleish, Moradi et al. (2001)	PTSD (traffic accident, no abuse)	D	social: A > C physical: A = C depression: A < C
Dalgleish, Taghavi et al. (2003)	GAD, PTSD	D	VDP: MDD, C: no AB GAD/PTSD: • AB, GAD/PTSD > MDD, C • AB threat > AB depression • GAD = PTSD PTSD: d-bias away threat GAD: bias towards threat Stroop: no group differences
Dubner & Motta (1999)	PTSD (sexual abuse)	Q+D	AB: RT sexual abuse > RT other words
Ehrenreich (1999)	Trait anxiety	Q	All AB (upper probes only); attributable to girls. Anxiety did not predict AB, after controlling for gender and depression.
Eschenbeck, Kohlmann et al. (2004, exp 1.)	Trait anxiety	Q	RTs: all AB, A = m = C Errors: all AB, A > (m = C)
Eschenbeck, Kohlmann et al. (2004, exp 2.)	State anxiety • emotionality • worry	Q	Emotionality: RTs: A > (m = C), no AB Errors: no effects Worry: RTs: no effects Errors: A: AB, A > (m = C)
Freeman & Beck (2000)	PTSD (sexual abuse)	D	All AB: RT abuse-related threat slower than RT of either developmentally relevant, general threat, positive, and neutral words. RT general threat slower than RT positive words
Kagan, Snidman et al. (1999)	Anxiety symptoms	Q	All AB, A = C

Table 1.1 – continued

Study	Sample characteristics				Task characteristics		
	Type	*N*	Groups	Age	Paradigm	Length	Stimuli
Kindt & Brosschot (1999)	N	335	28A 30C	9.8±1.1 9.5±1.2 r = 8-12	Stroop • linguistic (I) • linguistic (NI) • pictorial (NI) • single-trial	48	Each format: • 6 spider • 6 neutral
Kindt, Bierman et al. (1997a)	N	921	72A 73C	r = 8-12	Stroop • linguistic (I) • card • single-trial • blocked	40	Each format: • 5 spider • 5 neutral
Kindt, Bögels et al. (2003)	AD	54	40A 14C	12.2±2.9 r = 7-18	Stroop (I) • linguistic • single-trial	120	5 separation anxiety 5 social anxiety 5 general threat 15 neutral
Kindt, Brosschot et al. (1997b, exp. 1)	N	589	25A 22C 61/589	r = 8-9	Stroop (I) • linguistic • single-trial	64	4 medical/threat 4 medical/no threat 4 not medical/threat 4 not medical/no threat
Kindt, Brosschot et al. (1997b, exp. 2)	N	579	26A 24C	r = 8-9	Stroop (I) • linguistic • single-trial	64	4 medical/threat 4 medical/no threat 4 not medical/threat 4 not medical/no threat
Kindt, Van den Hout et al. (2000, exp. 1)	N	720	55A 58C	9.9±1.0 9.6±1.0 r = 8-11	Stroop • linguistic (NI) • pictorial (NI) • single-trial	48	Each format: • 6 spider • 6 neutral
Kindt, Van den Hout et al. (2000, exp. 2)	N	422	44A 41 36C	r = 8	Stroop (NI) • linguistic • single-trial	48	6 spider 6 neutral
Martin & Jones (1995, exp.1)	N	169	71A 72C	r = 4-9	Stroop (I) • pictorial • card	120	5 spider 5 house 5 filler
Martin, Horder et al. (1992)	N	48	24A 24C	r = 6-13	Stroop (NI) • linguistic • card	74	5 spider 5 control
Moradi, Neshat-Doost et al. (1999a)	N	39	18A 21C	12.9±2.1 13.0±2.0 r = 9-17	Stroop (I) • linguistic • single-trial	120	12 threat 12 happy 12 neutral 12 trauma 12 depression
Moradi, Taghavi et al. (1999c)	AD	26	23A 23C	12.9±2.9 13.6±1.9 r = 9-17	Stroop (I) • linguistic • single-trial	120	12 threat 12 trauma 12 happy 12 neutral 12 depression

Study	Anxiety type	Measure	Results
Kindt & Brosschot (1999)	Spider fear	Q	Pictures: no AB, A = C I words: all AB, A = C NI words: A > C AB NI: words > pictures AB words: I > NI in A and C
Kindt, Bierman et al. (1997a)	Spider fear	Q	Both formats: all AB, A = C. Single-trial: • A: AB ↑ age • C: AB ↔ age • AB: card > single-trial
Kindt, Bögels et al. (2003)	GAD, SAD, SP	D	No AB, A = C No domain-specificity
Kindt, Brosschot et al. (1997b, exp. 1)	Medical fear	Q	RTmed+ > RTmed-, A = C No AB, A = C.
Kindt, Brosschot et al. (1997b, exp. 2)	Medical fear	Q	RTmed+ = RTmed-, A = C AB, A = C
Kindt, Van den Hout et al. (2000, exp. 1)	Spider fear	Q	Linguistic: • No AB, A = C • A: bias ↑ with age • C: bias ↓ with age • age 8: A < C; 11: A > C Pictorial: • No AB, A = C
Kindt, Van den Hout et al. (2000, exp. 2)	Spider fear	Q	All AB, A = C
Martin & Jones (1995, exp.1)	Spider fear	Q	A > C No age effects Age↑: RT↑, errors↓
Martin, Horder et al. (1992)	Spider fear	Q	A > C No age effects Age↑: RT↑
Moradi, Neshat-Doost et al. (1999a)	Parental PTSD	D	A: AB (threat), C: no AB A: threat > neutral C: depression < neutral No AB-age correlation
Moradi, Taghavi et al. (1999c)	PTSD (violence or traffic accident; no abuse)	D	A: AB (trauma), C: no AB No AB-age correlation

Table 1.1 – continued

Study	Sample characteristics				Task characteristics		
	Type	*N*	Groups	Age	Paradigm	Length	Stimuli
Pine, Mogg et al. (2005)	AD	55	29A 17C	10.3±1.8 9.9±1.8 r = 7-13	VDP (H) • pictorial	128	32 threatening faces 32 happy faces 64 neutral faces *n* = 80 trials
Richards, Richards et al. (2000)	N	30	15A 15C	16.5±? r = 16-18	Stroop (I) • linguistic • card	96	8 threat 8 neutral
Schippell, Vasey et al. (2003)	N	96	n/a*	12.9±1.0 r = 11-17	VDP (V) • linguistic	160	40 threat 120 neutral
Schwartz, Snidman et al. (1996)	N	79	41A 33C	13.0±0.5 r = 12-14	Stroop (I) • linguistic • single-trial	162	18 threat 18 positive 18 neutral
Taghavi, Dalgleish et al. (2003)	AD	38	19A 19C	13.5±3.2 14.5±1.0	Stroop (I) • linguistic • single-trial	120	12 threat 12 trauma 12 happy 12 neutral 12 depression
Taghavi, Neshat-Doost et al. (1999)	AD	67	24A 19AD 24C	13.6±3.1 14.8±2.5 13.2±1.9 r = 9-18	VDP (V) • linguistic	196	48 emotional: - social threat - physical threat - depression 48 neutral 148 filler
Vasey & Schippell (cited in Vasey & MacLeod, 2001)	N		n/a*	r = 14-18	VDP • linguistic		
Vasey, Daleiden et al. (1995)	AD	24	12A 12C	11.9±1.3 11.8±1.3 r = 9-14	VDP (V) • linguistic	220	44 threatening 44 × 4 neutral
Vasey, El-Hag et al. (1996)	N	40	20A 20C	r = 12-14	VDP (V) • linguistic	160	40 threatening 40 × 3 neutral
Waters, Lipp et al. (2004, exp. 1)	N	105	Non-selected	r = 9-12	VDP (H) • pictorial	180	20 fear-related 20 pleasant 20 neutral
Waters, Lipp et al. (2004, exp. 2)	AD	26	23A 23C	r = 9-12	VDP (H) • pictorial	180	20 fear-related 20 pleasant 20 neutral

Abbreviations (alphabetic): A = anxiety group; AB = attentional bias; AD = anxiety disordered children; BI = behavioural inhibition; C = control group; D = diagnostic interview or clinical assessment; GAD = generalised anxiety; H = horizontal alignment of stimuli; I = integrated stimuli; m = intermediate anxiety group (between A and C); MDD = major depressive disorder; n/a not applicable; N = normal children; NI = non-integrated stimuli; OCD = obsessive-compulsive disorder; PTSD = post-traumatic stress disorder; Q = questionnaire, self- or parent-report; r = range; SAD = separation anxiety; SP = social phobia; SpP = specific phobia; Stroop = emotional Stroop task; V = vertical alignment of stimuli; VDP = visual dot probe task. Empty cells indicate that the information was not reported. *Data were analysed by means of regression, therefore no anxious and control group were defined.

Study	Anxiety type	Measure	Results
Pine, Mogg et al. (2005)	PTSD (abuse)	D	Threat bias: C > A Neg. correlation between threat bias and severity of physical maltreatment
Richards, Richards et al. (2000)	Trait anxiety	Q	A: AB, C: no AB AB-anxiety: $r = 0.43$
Schippell, Vasey et al. (2003)	Trait anxiety	Q	*r*+ between social threat bias and trait anxiety. *r*+ between physical threat bias and internalising (closely related to trait anxiety).
Schwartz, Snidman et al. (1996)	BI	n/a	All AB, A = C (both positive and threat words) A < C positive words in top quartile
Taghavi, Dalgleish et al. (2003)	GAD	D	Threat vs. neutral words, A: AB, C: no AB
Taghavi, Neshat-Doost et al. (1999)	GAD	D	A > C (threat-neutral) A = A-D (threat-neutral) No effects for threat-depression. No AB-age correlation in either group.
Vasey & Schippell (cited in Vasey & MacLeod, 2001)	Trait anxiety, State anxiety	Q	*r*+ between threat bias and trait anxiety. *r*- between threat bias and state anxiey.
Vasey, Daleiden et al. (1995)	Various	D	A: bias, C: no bias, A > C (only lower probe position)
Vasey, El-Hag et al. (1996)	Test anxiety, State anxiety	Q	A: AB, C: no AB C boys: AB away from threat Marginal –correlation between threat bias and state anxiety.
Waters, Lipp et al. (2004, exp. 1)	Anxiety disorders symptoms	Q	AB: overall significant, fear > pleasant Boys: AB fear = AB pleasant Girls: AB fear > AB pleasant
Waters, Lipp et al. (2004, exp. 2)	9 GAD, 6 SAD, 6 SP, 2 SpP	D	AB: overall significant, A > C No differential bias AB fear-related > AB pleasant

Table 1.2: Studies on interpretation bias

Study	Sample characteristics				Task characteristics	
	Type	*N*	Groups	Age	Paradigm	Method
Barrett, Rapee et al. (1996)	AD	205	37 SAD 57 GAD 27 SpP 31 SP 27 ODD 26 C	9.0±2.4 9.6±2.1 9.5±1.7 9.4±2.4 10.0±2.3 10.2±2.3 r = 7-14	Threat interpretation	Ambiguous scenarios • 6 social threat • 6 physical threat
Bell-Dolan (1995)	N	252	52A 38C	Grade 4-5 (USA)	Threat interpretation	Videotaped vignettes (n = 6)
Bögels & Zigterman (2000)	AD	45	15A 15cC 15C	12.2±3.1 13.5±2.8 11.9±3.0 r = 9-18	Threat interpretation	Ambiguous situations • 3 GAD • 3 SAD • 3 SP
Bögels, Snieder et al. (2003)	N	537	55A 41C	9.9±1.5 10.0±1.2 r = 7-12	Threat interpretation	Ambiguous situations • 3 GAD • 3 SAD • 3 SP
Bögels, Van Dongen et al. (2003)	AD	25	6A 19C	combined: 12.2±2.9 r = 8-17	Threat interpretation	Ambiguous situations • 3 GAD • 3 SAD • 3 SP
Chorpita, Albano et al. (1996)	N	12	4A 8C	combined: 11.3±1.8 r = 9-13	Threat interpretation	Ambiguous situations (n = 12)
Creswell, Schniering et al. (2005)	AD	60	27A 33C	11.1±2.3 10.8±2.4 r = 7-15	Threat interpretation	Ambiguous scripts (n = 12)
Hadwin, Frost et al. (1997)	N	40		7, 9	Homophones	Spoken words
Muris & Van Doorn (2003)	N	138		10.5±1.2 r = 8-13	Threat perception (ASQ-C)	Jigsaw puzzle
Muris, Jacques et al. (2003a)	N	113		10.1±1.0 r = 9-13	Threat perception	Scripts: • 2 GAD • 2 SAD • 2 SP • 2 threatening

Study	Anxiety type	Measure	Results
Barrett, Rapee et al. (1996)	GAD SpP SP SAD	D	IB: (A = ODD) > C Coping strategies: • ODD > (A = C): aggressive • (A = C) > ODD: avoidant • SP and GAD: more to social than to physical threat • SpP: more to physical than to social.
Bell-Dolan (1995)	Trait	Q	IB: • A = C: identify hostile intent • A > C: Hostile interpretation of non-hostile vignettes. Coping strategies: • A > C: maladaptive
Bögels & Zigterman (2000)	GAD SAD SP	D	IB: • A > C: negative interpretation • A = C: threat interpretation A underestimated their own coping ability relative to C
Bögels, Snieder et al. (2003)	GAD SAD SP	Q	IB: • A > C: negative thoughts • A > C: situations dangerous • A > C: situations threatening • A > C: situations unpleasant Coping strategy: • A = C: avoidant solutions Content-specificity • {SAD, SP} vs. {GAD}
Bögels, Van Dongen et al. (2003)	GAD SAD SP	D Q	IB: • positive association anxiety and negative interpretation; • no association anxiety and avoidant/active coping.
Chorpita, Albano et al. (1996)	Trait	D	IB: A > C. Coping strategy: • A > C: avoidant.
Creswell, Schniering et al. (2005)	Various	D	IB: A > C. Treatment: A: IB-post < IB-pre.
Hadwin, Frost et al. (1997)	GAD SpP SP SAD	D	Anxiety associated with threatening interpretation of homophones
Muris & Van Doorn (2003)	Trait	Q	Positive correlation anxiety and TP. No tendency for affirmative responding.
Muris, Jacques et al. (2003a)	Anxiety disorders symptoms	Q	Evidence for indirect connection between TP and anxiety: TP1→TP2→A2. No evidence for indirect connection.

Table 1.2 – continued

Study	Sample characteristics				Task characteristics	
	Type	N	Groups	Age	Paradigm	Method
Muris, Kindt et al. (2000a)	N	299		9.8±1.2 r = 8-13	Threat perception	Scripts: • 2 GAD • 2 SAD • 2 SP
Muris, Luermans et al. (2000b)	N	323	80A 19C *n*=159/323	r = 10-11	Real life situation	Ambiguous sermon
Muris, Meesters et al. (2005b)	AD	57	17A 40C	13.7±3.3 13.3±1.9 r = 8-17	Homographs	Written words (*n* = 19)
Muris, Merckelbach et al. (2000c)	N	299		9.8±1.2 r = 8-13	Threat perception	Scripts: • 2 GAD • 2 SAD • 2 SP
Muris, Merckelbach et al. (2003b)	N	323	80A 19C *n*=159/323	r = 10-11	Real life situation	Ambiguous sermon
Muris, Merckelbach et al. (2003c)	AD	57	17A 40C	13.7±3.3 13.3±1.9 r = 8-17	Homographs	Written words (*n* = 19)
Muris, Rapee et al. (2003d)	N	299		9.8±1.2 r = 8-13	Threat perception	Scripts: • 2 GAD • 2 SAD • 2 SP
Rusinek, Hautekeete et al. (2002)	N	323	80A 19C *n*=159/323	r = 10-11	Real life situation	Ambiguous sermon
Taghavi, Moradi et al. (2000)	AD	57	17A 40C	13.7±3.3 13.3±1.9 r = 8-17	Homographs	Written words (*n* = 19)

Abbreviations (alphabetic): A = anxiety group; AB = attentional bias; AD = anxiety disordered children; BI = behavioural inhibition; C = control group; D = diagnostic interview or clinical assessment; GAD = generalised anxiety (including overanxious disorder); IB = interpretation bias; n/a not applicable; N = normal children; Q = questionnaire, self- or parent-report; r = range; SAD = separation anxiety; SP = social phobia; SpP = specific phobia; TP = threat perception bias. Empty cells indicate that the information was not reported.

Study	Anxiety type	Measure	Results
Muris, Kindt et al. (2000a)	Anxiety disorders (symptoms) Trait	D Q	IB: A > C Content-specificity: • {trait) vs. {SP}
Muris, Luermans et al. (2000b)	SP	Q	IB: A > C (in ambiguous and neutral scripts. Domain-specificity: • {anxiety} vs. {depression, aggression}
Muris, Meesters et al. (2005b)	Anxiety disorders symptoms	Q	Positive correlation between: • anxiety and TP • aggression and TP • depression and TP Only anxiety significant predictor of TP No evidence prospective relationship with 8-week interval.
Muris, Merckelbach et al. (2000c)	SP	D Q	IB: A > C
Muris, Merckelbach et al. (2003b)	Anxiety disorders symptoms	Q	ER in all children in safety situations but not in threatening situations
Muris, Merckelbach et al. (2003c)	Anxiety disorders symptoms Trait Anxiety sensitivity	Q	Threat perception: • IB: A > C (in ambiguous and neutral scripts. Emotional reasoning: • all IB • A > C
Muris, Rapee et al. (2003d)	Anxiety disorders (symptoms) Trait	D Q	Positive correlation of both trait and state anxiety with TP. No combined effect of trait and state anxiety on TP.
Rusinek, Hautekeete et al. (2002)	SP	Q	A > C tonality interpretation A > C intensity interpretation A > C rumination A = C sharpness A = C emotional sharing with parents and friends
Taghavi, Moradi et al. (2000)	Anxiety disorders symptoms	Q	A > C: sentences with threatening meaning A > C: threatening interpretations

Chapter 2

Anxiety and the processing of threat in children: Further examination of the cognitive inhibition hypothesis

Abstract

The present study examined the cognitive inhibition hypothesis (Kindt, Bierman, & Brosschot, 1997a. *Journal of Experimental Child Psychology, 66,* 163-179), which asserts that young children lack the ability to inhibit the processing of threat, but develop this with age. To examine this issue, high spider fearful children (N = 170) and low spider fearful children (N = 215) aged 7 to 11 years were tested by means of an emotional Stroop task. It was hypothesised that a processing bias for spider-related stimuli would be present in all 8- and 9-year-old children. That is, it was expected that responses to spider words would be slower compared to responses to control words. Furthermore, it was hypothesised that this processing bias would decrease with age in low fearful children, whereas it would persist in high fearful children. No support was found for these hypotheses. Instead of the predicted processing bias, data showed the reverse pattern: that is, children responded faster to spider words compared to control words. It is proposed that the reverse bias results from avoidance. More precisely, children may evade the processing of spider stimuli through fast responding.

Morren, M., Kindt, M., Van den Hout, M., & Van Kasteren, H. (2003). Anxiety and the processing of threat in children aged 7-11: Further examination of the cognitive inhibition hypothesis. *Behaviour Change, 20,* 131-4142.

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2.1 Introduction

The role of cognitive processes in the aetiology and maintenance of emotional disorders has been studied extensively. This research has shown that anxious adults prioritise the processing of threat-related information, while non-anxious adults do not (for reviews, see Kindt & Van den Hout, 2001; Logan & Goetsch, 1993; Williams, Mathews, & MacLeod, 1996). This processing bias appears to be involved in the maintenance of phobic anxiety. Anxiety disorders, especially specific phobias, often begin in childhood (American Psychiatric Association, 1994; Öst, 1987), and it has been assumed that processing bias contributes to the aetiology of these disorders. If this assumption is correct, it can be expected that processing bias should also be present in anxious children.

Studies investigating the relationship between processing bias and anxiety in children have yielded mixed results. Consistent with adult literature, some studies have shown that anxious children exhibit a processing bias to threatening information, whereas such bias is absent in non-anxious children (Dalgleish, Moradi, Taghavi, Neshat-Doost, & Yule, 2001; Martin, Horder, & Jones, 1992; Moradi, Neshat-Doost, Taghavi, Yule, & Dalgleish, 1999a; Moradi, Taghavi, Neshat-Doost, Yule, & Dalgleish, 1999b; Richards, Richards, & McGeeney, 2000; Taghavi, Neshat-Doost, Moradi, Yule, & Dalgleish, 1999; Vasey, Daleiden, Williams, & Brown, 1995; Vasey, El-Hag, & Daleiden, 1996). However, a series of studies by Kindt and colleagues (Kindt & Brosschot, 1999; Kindt, Bierman, & Brosschot, 1997a; Kindt, Brosschot, & Everaerd, 1997b; Kindt, Van den Hout, De Jong, & Hoekzema, 2000) have found evidence to suggest that this processing bias is not only present in high anxious children, but also in *non-anxious* children. The results from these studies were explained by a deficiency in inhibitory control of processing threatening information. It is known from cognitive developmental theory that as children become older, they gradually attain the ability to selectively attend to relevant information in the context of distracting information (Harnishfeger, 1995; Lane & Pearson, 1982). Hence, the presence of processing bias in both anxious and non-anxious children suggests that both groups are unable to inhibit the processing of threatening information. According to the cognitive inhibition hypothesis (Kindt et al., 1997a), non-anxious children gradually develop inhibitory capacities between age 7 and 11, whereas anxious children fail to do so. As a result, processing bias wanes in non-anxious children, but persists in anxious children (Kindt et al., 1997a; 2000). Interestingly, the cognitive inhibition hypothesis fits with the idea that attentional bias in adults results from an inability to control the assignment of processing resources (MacLeod & Mathews, 1991a).

In contrast to the findings of Kindt and colleagues, several other studies did report differential attentional bias effects between anxious and non-anxious children using the emotional Stroop task. In this Stroop task, threatening and neutral words are presented sequentially in different colours. Participants have to name the colour of each word as fast as possible, meanwhile ignoring the meaning of the words. Attentional bias is defined as the delay in colour naming latency on threatening compared to neutral words. This Stroop effect has been documented in spider fearful children (Martin et al., 1992), children with PTSD (Moradi et al., 1999b), children of adults with PTSD (Moradi et al., 1999a), and generally high anxious children (Richards et al., 2000), but not in controls. In addition, attentional bias has been investigated via another experi-

mental paradigm, namely the dot probe task. In this task, one threatening and one neutral word are simultaneously shown on a computer screen, after which the screen is cleared and a dot replaces one of the words. Participants are instructed to indicate the location of the dot as fast as possible by means of pressing one of two response buttons that match the spatial location of the words. Faster responses to dots replacing threatening compared to neutral words are taken as evidence for attentional bias. Using the dot probe task, attentional bias was found in children with clinical anxiety (Taghavi et al., 1999; Vasey et al., 1995), test anxiety (Vasey et al., 1996), and post-traumatic stress disorder (Dalgleish et al., 2001), as opposed to control children. The results from the studies described in this paragraph seem to disagree with the cognitive inhibition hypothesis.

Thus, while some studies reported a differential bias between anxious and non-anxious children, findings from other studies have demonstrated a processing bias irrespective of anxiety levels. These divergent findings may be explained as follows (cf. Kindt & Van den Hout, 2001; Vasey & MacLeod, 2001). The age of the children in the studies that did reveal a differential bias was higher (i.e., 8 to 18 years) than that of children in studies reporting *no* differential bias (i.e., 7 to 12 years), a pattern of results that seems to harmonise with the cognitive inhibition hypothesis. According to this hypothesis, non-anxious children develop inhibitory capacities with age, around 10-11 years, while anxious children fail to do so. As a result, processing bias will disappear in non-anxious but not in anxious children, and so a differential bias will only emerge in early adolescence.

An alternative explanation for the divergent findings relates to characteristics of the task that is used (cf. Vasey & MacLeod, 2001). More specifically, the level of perceptual integration of different stimulus features may influence performance on an emotional Stroop task. MacLeod (1991) has argued that it is more difficult to ignore distracting information which is integrated in a target stimulus than distracting information which is not integrated. Thus, it would require more cognitive effort to distract from target information of integrated compared to non-integrated stimuli. This corresponds with the finding that in the Stroop task, integrated words (i.e., words that have coloured letters) delivered more bias than non-integrated words (i.e., words that are printed on a coloured background) in both spider phobic adults (Kindt & Brosschot, 1997) and children (Kindt & Brosschot, 1999). Additionally, integrated words yielded equal Stroop interference in high and low fearful children, whereas non-integrated words yielded more interference in high fearful compared to low fearful children (Kindt & Brosschot, 1999). Since inhibitory capacities develop gradually in young children, non-integrated stimuli would allow better differentiation between high and low anxious children. Thus, it can be hypothesised that a differential bias between anxious and non-anxious children will emerge at a younger age for non-integrated than for integrated stimuli.

The present study examined the development of processing bias in children, thus replicating the findings of Kindt and colleagues (Kindt et al., 1997a; 2000), who found that younger children showed a processing bias irrespective of anxiety, and that this bias decreased in non-anxious but not in anxious children. Processing bias was examined in a large sample of high and low spider fearful children aged 7 to 11 years, using integrated and non-integrated stimuli in an emotional Stroop task. More specifically, it was investigated (1) whether both high and low spider fearful children show a processing bias for integrated as well as non-integrated spider words, (2) whether the magni-

tude of processing bias decreases with age in low fearful children, whereas it remains fairly stable in high fearful children, and (3) whether the resulting difference in processing bias between high and low fearful emerges at a younger age for non-integrated stimuli than for integrated stimuli.

2.2 Methods

2.2.1 Participants

Children were recruited from 46 elementary schools in the Southern part of the Netherlands. Parents or other caretakers signed a written informed consent form, which explicitly stated that the child was allowed to and wanted to participate in the study. In total, 3564 normal children aged 6 to 13 were screened, which was approximately 50% of those who were invited (initial non-responders had been contacted for a second time). Children were assigned to the high fearful group if they scored 16 or higher on the *Spider Phobia Questionnaire for Children* (SPQ-C; Kindt, Brosschot, & Muris, 1996), and to the low fear group if they scored 3 or lower on this measure. In this way, 280 spider fearful and 300 non-fearful control children were selected: there were 7 children aged 6, 97 children aged 7, 127 children aged 8, 109 children aged 9, 125 children aged 10, 200 children aged 11, and 14 children aged 12 years.

Prior to the Stroop task, 3 to 20 weeks after the initial assessment, children completed the SPQ-C for a second time in order to ensure that they still met the criteria of the fear group to which they had been assigned. Although the test-retest reliability was high ($r = 0.97$, $p < 0.001$), 165 children (28.4%) did no longer meet the criteria of their fear group, and were removed from further analyses. Children aged 6 and 12 years were removed from the analyses as well, because the number of children in these age groups was too small. This procedure yielded a final sample of 170 high spider fearful children (154 girls and 16 boys) and 215 low spider fearful children (175 girls and 40 boys). Girls and boys did not significantly differ in age, $t(383) < 1$. There were relatively more girls and fewer boys in the high fear group, $\chi^2(1) = 6.5$, $p < 0.05$.[1]

2.2.2 Materials

Subjective fear of spiders was assessed with the *SPQ-C*, a self-report questionnaire which consists of 29 statements that children have to answer with *true* or *false* (e.g., "I stop reading a story if it is about spiders"). Kindt et al. (1996) have demonstrated that the SPQ-C predicts children's fear behaviour on a behavioural approach test, which requires children to approach a life spider in a number of predefined steps. During screening, a pencil-and-paper version of the SPQ-C was employed. Prior to the Stroop, children completed the SPQ-C on a computer. This second administration of the SPQ-C confirmed children's group status (see above), but also served to prime children's fear schema (Lundh & Czyzykow-Czarnocka, 2001).

The *spider Stroop task* that was used in the present study contained two types of word stimuli: integrated and non-integrated. Integrated stimuli comprised coloured letters on a black background. Non-integrated words were printed in black letters and superimposed on a coloured circle with a diameter of 145 mm. All words were printed

[1] Because boys and girls were unevenly distributed across the fear groups, all analyses reported in the Methods section were repeated only using the data of girls. This revealed a highly similar pattern of results.

in 8-mm high lowercase letters. There were nine spider words: *spider*, *web*, *hairy*, *creep*, *cobweb*, *itching*, *legs*, *house spider*, and *cross spider* and nine control words that were derived from one semantic category: *stool*, *table*, *sit*, *back*, *armrest*, *couch*, *chairs*, *armchair*, and *dinner table*. Spider and control words were matched for average word length and number of syllables in Dutch. Words were presented in red, green, yellow, and blue, and this was true for integrated and non-integrated stimuli. Each word was presented eight times, resulting in 144 experimental stimuli, which were presented in two blocks of equal length that were divided by a short break. Each block started with three filler trials to allow children to acquaint with the task.

Table 2.1: Mean SPQ-C scores (SDs) for high and low fearful children

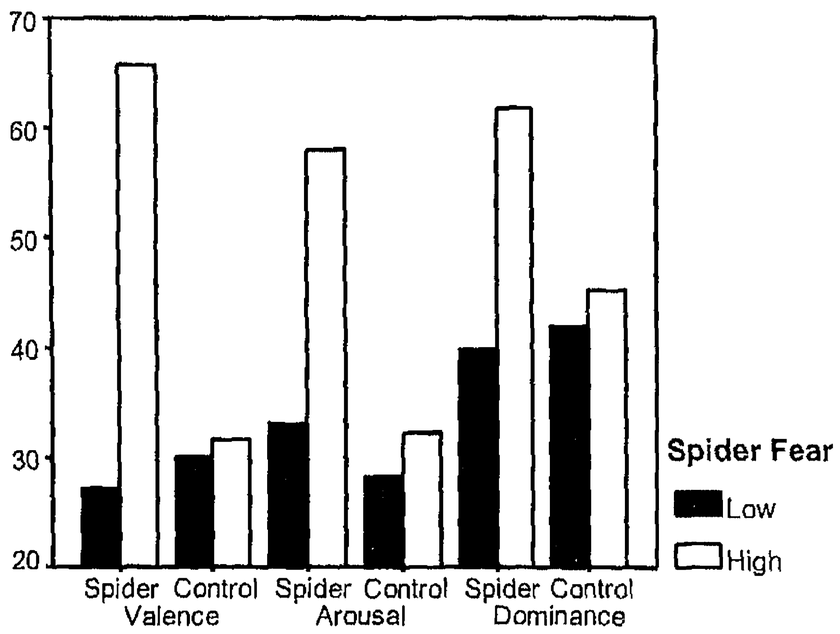
Age	Low Fearful	N	High Fearful	N
7	1.5 (1.0)	28	20.3 (3.1)	15
8	1.8 (0.9)	53	21.0 (3.2)	30
9	1.1 (0.9)	39	20.4 (2.8)	46
10	1.2 (1.0)	42	21.2 (2.7)	40
11	1.4 (1.0)	53	19.6 (2.6)	39
Total	1.4 (1.0)	215	20.5 (2.9)	170

As a manipulation check, the stimulus words of the Stroop task were evaluated with the *Self-Assessment Manikin* (SAM; Lang, 1980; Bradley & Lang, 1994), which was administered by means of a computer. The SAM is a pictorial assessment technique that can be used to measure an individual's affective evaluation of stimuli on three dimensions: valence, arousal, and controllability. Each dimension consists of five pictures in a row, ranging between the two poles of the dimension. Children were instructed to click the mouse on the picture that best reflected how they felt about each word, or to click between two adjoining pictures when they were unable to decide between the two. This produced a 9-point scale, with higher scores reflecting stimulus evaluations as more negative, arousing, and uncontrollable. It has been shown that the SAM is a suitable instrument for children to evaluate stimuli (Kindt & Brosschot, 1999).

2.2.3 Apparatus

The Stroop, the second administration of the SPQ-C, and the SAM were presented to the children on an IBM-compatible 486 MHz computer controlled by MEL software (Schneider, 1996). A microphone connected to a voice key was used to assess response times during the Stroop, which were recorded with millisecond (ms) accuracy. Stimuli were presented on a 15-inch SVGA colour monitor. Before the experiment started, a voice test was carried out to adjust the microphone sensitivity

Figure 2.1: Mean scores on the SAM for high and low spider fearful children on spider and control words



to the voice level of the child. This test involved naming each of the four colours twice, and thus served as a test for colour-blindness as well. Each trial started with a blank screen for 500 ms followed by a fixation cross which after 500 ms was replaced by the stimulus word. The stimulus word was presented until the child's response was detected, after which it was removed from the screen. If after 3000 ms no response was given, the next trial began and a missing value was recorded.

2.2.4 Procedure

Children were tested at school on two separate occasions. During the first session, children completed the SPQ-C in a classroom session. The children that were selected on the basis of these SPQ-C scores were tested individually in a separate room 3-20 weeks later. During this second session, children were seated approximately 50 cm from the monitor of the computer. First, the SPQ-C was completed, which took 5-10 min. Next, the Stroop task was administered, which required children to hold the microphone 10 to 15 cm from their mouth. Stimuli were presented in a fixed random order, with the restriction that no more than three words of the same stimulus format, word type, or colour were presented consecutively, and that the same word did not appear twice in a row. Children received the instruction to ignore the word and to name the colour that accompanied the word as quickly as possible into the microphone, without making errors. The experimenter was seated next to the child and registered errors on a response sheet. The total Stroop task took about 15-20 min. At the end of the second session, the SAM was administered, which took about 10 min.

2.3 Results

2.3.1 General findings

2.3.1.1 Spider fear

An analysis of variance (ANOVA) confirmed that the spider fearful group displayed higher levels of spider fear on the second SPQ-C (M = 20.5, SD = 2.9) than the non-fearful group (M = 1.4, SD = 1.0), $F(1, 375) = 7642.7$, $p < 0.001$. This difference was present at all ages (see Table 2.1).

Table 2.2: Mean reaction times in milliseconds (SDs) for high and low fearful children aged 7-11 years on integrated and non-integrated stimuli (N = 385)

		Integrated		Non-Integrated	
Age	Word	Low Fear	High Fear	Low Fear	High Fear
7	Control	1146 (204)	1203 (271)	1027 (162)	1077 (231)
	Spider	1109 (203)	1221 (255)	979 (160)	1010 (215)
8	Control	1068 (208)	1093 (204)	984 (187)	1021 (191)
	Spider	1062 (208)	1060 (196)	921 (172)	953 (180)
9	Control	972 (172)	991 (212)	894 (163)	911 (191)
	Spider	948 (176)	963 (209)	840 (158)	865 (183)
10	Control	875 (141)	934 (204)	806 (135)	868 (178)
	Spider	857 (144)	930 (205)	776 (121)	852 (188)
11	Control	782 (150)	834 (119)	734 (143)	786 (143)
	Spider	782 (173)	838 (125)	712 (140)	749 (105)

2.3.1.2 *Affective evaluation of stimuli*

For the affective ratings (SAM data), there were main effects of Word and Group, which were qualified by Word × Group interactions [all *F*s(1, 375) > 80.0, *p*s < 0.001]. As Figure 2.1 shows, follow-up paired *t*-tests showed that the high fearful children rated spider words considerably more negative, arousing, and uncontrollable than control words [all *t*s > 13.0; *p*s < 0.001]. Low fearful children, however, also rated spider words as more arousing, but as less negative and more controllable than control words [all *t*s > 3.0, *p*s < 0.005], but the magnitude of these differences was relatively small.

2.3.2 General processing bias effects

Mean colour-naming latencies for integrated and non-integrated stimuli are presented in Table 2.2. The computer did not record reaction times above 3000 ms. For each format and word type separately, outliers greater than three standard deviations above and below the mean were removed from the analyses. Next, reaction times below 300 ms were also deleted. Percentages of discarded data were 9.1% for integrated trials and 7.9% for non-integrated trials.

The first aim of the present study was to investigate whether children show a processing bias irrespective of their level of fear. Table 2.3 shows the results from the ANOVAs on integrated and non-integrated stimuli separately. For both stimulus formats, main effects of Group and Age indicated that high fearful and younger children responded slower than low fearful and older children, respectively. Moreover, for both stimulus formats there was a main effect of Word. As can be seen in Table 2.2, children generally responded *faster* to spider words compared to control words, a finding which is precisely opposite to the predicted processing bias effect.

2.3.3 Effects of fear and age on the processing of threat

The second purpose of the study was to examine whether processing bias decreases with age in low fearful children, but remains stable in high fearful children For both integrated and non-integrated stimuli, the expected Word × Group × Age interaction did not attain significance (see Table 2.3). For non-integrated stimuli, a significant Word × Age interaction emerged. No other relevant interactions were found.

In sum, these results do not confirm the hypotheses that both high and low spider fearful children show processing bias. Instead, evidence was found for a reversed pat-

Table 2.3: Results from the analyses investigating the effect of fear and age on processing bias for integrated and non-integrated stimuli (*N* = 385)

	Integrated		Non-integrated	
	F	*p*	*F*	*p*
Word	9.30	< 0.01	146.36	< 0.001
Group	5.57	< 0.05	5.64	< 0.05
Age	37.60	< 0.001	31.04	< 0.001
Word × Group	0.99	0.32	0.20	0.66
Word × Age	1.58	0.18	5.45	< 0.001
Group × Age	0.48	0.75	0.25	0.91
Word × Group × Age	1.99	0.10	0.76	0.55

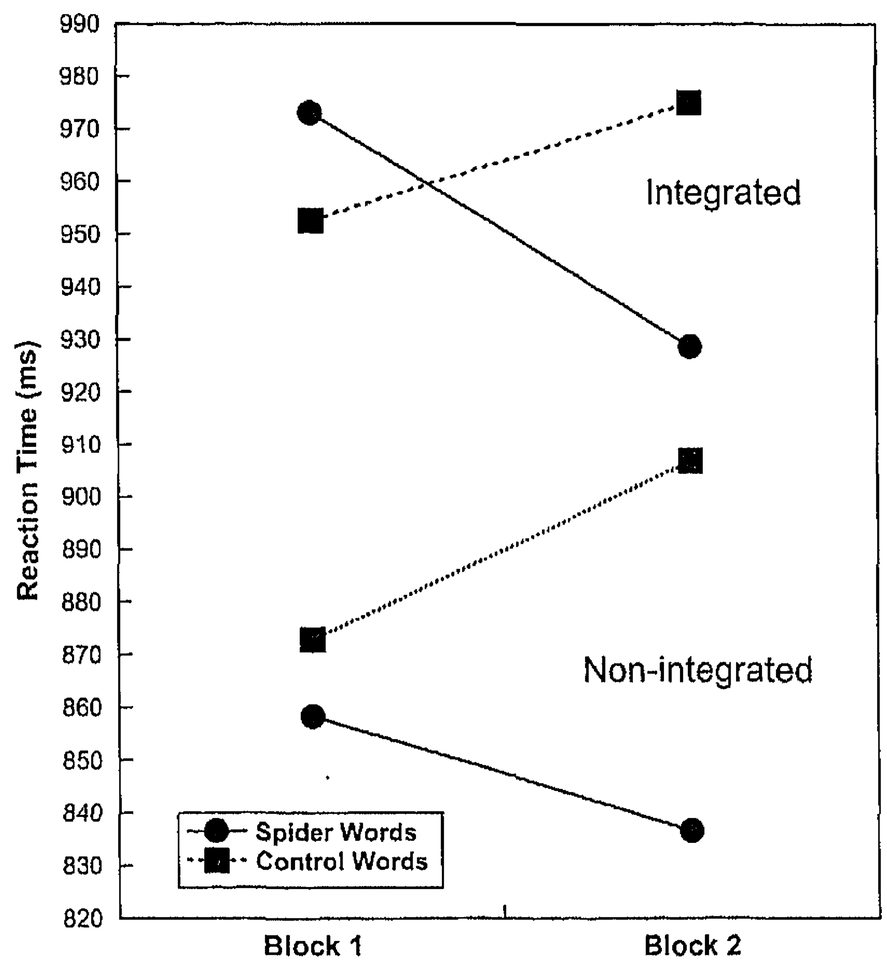
tern of findings. That is, children generally responded faster to spider words compared to control words. Furthermore, the expected relationship between age and processing bias in high and low fearful children was neither observed, and it could not be tested whether a difference in processing bias between high and low anxious children would emerge at a younger age in non-integrated stimuli compared to integrated stimuli (i.e., the third hypothesis).

2.3.4 Additional Analyses

It is apparent that the above findings diverge from those previously found by Kindt and colleagues (Kindt & Brosschot, 1999; Kindt et al., 1997a; 1997b; 2000). One factor that may explain this divergence is the length of the current Stroop task, which comprised 144 trials. Kindt and colleagues used remarkably shorter tasks, consisting of 48 to 96 trials. To explore whether the number of trials affected the current findings, the experiment was divided in two blocks. That is, mean reaction times were calculated for the first and second half of spider and control stimuli. Response latencies were then subjected to Word × Group × Age × Block ANOVAs for repeated measures, for integrated and non-integrated stimuli separately.

Figure 2.2 shows the mean reaction times for integrated and non-integrated stimuli in each block. For integrated stimuli, there was a significant Word × Block interaction, $F(1, 375) = 91.2$, $p < 0.001$. Follow-up paired t-tests showed that reaction times for spider words were shorter in block 2 ($M = 929$, $SD = 216$) than in block 1 ($M = 973$, $SD = 239$), whereas reaction times for control words were longer in block 2 ($M = 975$, $SD = 236$) than in block 1 ($M =$ 953, $SD = 223$), $ts > 3.0$, $ps < 0.005$. Paired t-tests also showed that in block 1, children responded slower to spider words than to control words, $t = 3.8$, $p < 0.001$, showing that the expected positive processing bias was present. In block 2, this pattern was reversed: children responded faster to spider words than to control words [$t = 8.3$, $p < 0.001$].

Figure 2.2: Mean reaction times in the first and second block of the spider Stroop for integrated stimuli and non-integrated stimuli



The finding of the expected processing bias for *integrated* stimuli in block 1 permitted a test of the hypothesis that bias decreases with age in low fearful children but persists in high fearful children. However, the crucial Word × Group × Age in-

teraction was not significant [$F(4, 375) = 1.0$, $p = 0.43$]. Subsequently, there was a significant Word × Age × Block interaction [$F(4, 375) = 7.2$, $p < 0.001$]. Separate analyses in each block revealed Word × Age interactions (Fs > 2.5, ps < 0.05), which could be explained by the following differences between spider and control words. In block 1, there was a bias in the expected positive direction for all ages, but only significant for ages 7 and 8 [paired ts > 2.2, ps < 0.05]. In block 2, this pattern was reversed, and significant for all ages [paired ts > 3.7, ps < 0.001], except for age 11 [paired $t = 1.1$, $p = 0.26$]. These results indicate that Stroop task length may differentially affect responses to integrated spider and control stimuli. That is, while a reversed pattern of results was present for integrated stimuli in block 2, the expected processing bias appeared in block 1.

For *non-integrated* stimuli, there also was an interaction of Word × Block, $F(1, 375) = 67.0$, $p < 0.001$. Follow-up paired t-tests revealed that reaction times for spider words were shorter in block 2 ($M = 837$, $SD = 180$) than in block 1 ($M = 858$, $SD = 202$), whereas those for control words were longer in block 2 ($M = 907$, $SD = 206$) than in block 1 ($M = 873$, $SD = 202$), all ts > 3.0, ps < 0.001. Paired t-tests further showed that the predicted processing bias was absent in both block 1 and 2 [ts > 3.1, ps < 0.005]. That is, in both parts of the Stroop experiment children responded faster to non-integrated spider stimuli than to non-integrated control stimuli. Thus, for the non-integrated stimuli task length also seemed to affect the processing of threat and non-threat-related material. However, no spurs of the expected processing bias were found in either block. Instead, the data revealed a reversed pattern that became even more pronounced in the second part of the experiment.

2.4 Discussion

The present study examined threat-processing bias in high and low spider fearful children aged 7 to 11 years using an emotional Stroop task with integrated and non-integrated stimuli. Results can be summarised as follows. First of all, children in this age range did not show the hypothesised threat processing effect. Instead, a reversed pattern of results emerged: that is, children were generally faster in colour-naming threat-relevant (i.e., spider) words compared to control words. Second, even in high fearful children no evidence could be obtained for a threat processing bias. Instead of responding slower to threat-related stimuli, these children also displayed faster reaction times to spider words than to control words. Third, the absence of clear-cut biased threat processing and differential age patterns precluded investigation of the hypothesis that a differential bias would emerge at a younger age for non-integrated stimuli than for integrated stimuli. Finally, additional analyses revealed that the predicted processing bias was present during the first half of the experiment, but only in the case of integrated stimuli.

The present findings are inconsistent with previous studies using the emotional Stroop or dot probe tasks to examine biased threat processing in children. These earlier studies reported the presence of a processing bias either in both high and low fearful children or only in high fearful children only (see for a review, Vasey & MacLeod, 2001). In contrast, the current data showed that high and low fearful children both responded faster to threat-related stimuli than to neutral stimuli. It can be argued that this reversed pattern of results is due to an unidentified peculiarity of the present ex-

perimental set-up. Note, however, that the design of the current study was highly comparable to earlier studies by Kindt and colleagues (e.g., 1999, 2000). Moreover, the study registered several effects that have been reported in earlier research using the Stroop task with children (see Kindt et al., 2000; Moradi et al., 1999b). That is, older children had faster reaction times than younger children, whereas high fearful children were slower in responding to the stimuli than low fearful children, findings that seem to support the internal validity of the present experiment.

It should be noted that the Stroop task that was employed in the present study differed in one important respect from that used in previous studies. That is, the present task comprised significantly more trials (i.e., 144) than earlier studies. Additional analyses revealed that experiment length had indeed some effect on the present findings. More specifically, results showed that the predicted processing bias was present in the first half of the experiment, although this was only the case for integrated stimuli and not for non-integrated stimuli. It can be argued that the large number of word presentations increasingly fatigued children towards the final stages of the task. If true, this would equally affect performance on spider and control words, resulting in a slowing down of reaction times on both word types. However, while it was observed that responses to control words in the second half decelerated compared to the first half, responses to spider words accelerated (see Figure 2.2).

A plausible explanation for the present findings may be that children found a way to avoid the threatening stimuli (cf. Mogg & Bradley, 1998; Vasey & MacLeod, 2001). In the present Stroop task, stimuli were removed immediately after children's vocal response. It may well be the case that shorter reaction times to threatening words reflected successful avoidance, and that children gradually improved this strategy during the course of the experiment. Conversely, the longer reaction times to neutral control stimuli may reflect a more laid-back response style upon detection of a non-threatening stimulus. Note that this explanation fits well with the observation that processing bias did occur for integrated stimuli during the first half of the experiment, while it was absent for non-integrated stimuli during the entire experiment. Children also seemed to have more trouble avoiding threatening stimuli when they were integrated than when they were non-integrated. This is in keeping with the notion that more cognitive effort is required to distract from threatening information that is perceptually integrated (MacLeod, 1991). Thus, with non-integrated stimuli more capacity remains available for avoiding threat-relevant stimuli.

Although the present findings show that a general processing bias was absent, the results from the additional analyses give us some clue that failed inhibition did occur to a certain extent. That is, if poor inhibition brings about processing bias, such bias would begin to emerge in children who have least developed these abilities (i.e., the youngest children). The additional analysis indeed showed that, even though as a group children showed the expected bias in the first half of the integrated stimuli, this bias only attained significance in 7- and 8-year-olds. However, no support was found for the hypothesis that there is a differential developmental pattern of processing bias in high and low anxious children. Further, if failed inhibition generates processing bias, less bias may be expected when stimuli are non-integrated. Because it requires less cognitive effort to separate word meaning from word colour of stimuli that are non-integrated, more processing resources remain available. This surplus of resources can then be deployed for other purposes, such as speeding up colour-naming responses. In line with this explanation, the present study showed that responses to non-

integrated stimuli were generally faster than responses to integrated stimuli, and that a reversed processing bias effect emerged at an earlier stage of the Stroop task in non-integrated than in integrated stimuli.

The present study has several limitations. First, the sample contained a high proportion of girls, which is consistent with a higher frequency of this type of anxiety complaints in girls (e.g., Craske, 1997). Note also that when the analyses were rerun without the boys, the results did not notably change. Second, the length of the present Stroop task may have precluded detection of an attentional bias effect in children. It is possible that inhibition occurs when children are confronted with novel stimuli, but that children learn to avoid processing these stimuli after repeated presentation. Future studies need to elucidate further how processing bias effects develop during the course of experimental tasks, such as the emotional Stroop task. Third, the present sample consisted of non-clinical children. Although the high fearful participants scored extremely high on a spider fear measure, it is not clear whether they met the diagnostic criteria for an anxiety disorder (i.e., specific phobia). It would be worthwhile to investigate whether there are differences in attentional bias between clinically referred and non-referred children, and to establish the clinical relevance of the phenomenon.

While it is generally assumed that attentional bias plays a role in the maintenance of anxiety problems by enhancing the perception of threat (e.g., Clark, 1999), the practical relevance of the attentional bias phenomenon seems to be restricted. As it comes to the clinical diagnosis of anxiety disorders, there appears to be no need for attentional bias measures. For the purpose of classification, the clinician should simply rely on anamnestic interviews eventually supplemented by self-report questionnaires and behavioural observations (Vasey & Lonigan, 2000). However, it has been argued that attentional bias measures tap a different aspect of the fear system (Lavy, Van den Hout, & Arntz, 1993). That is, while attentional bias is thought to assess an aspect of information processing itself, subjective and behavioural measures merely tap the result of this processing. Thus, attentional bias seems to represent a very basic index of anxiety pathology and so it may well be the case that such measure provides a more optimal predictor of treatment outcome. Unfortunately, studies addressing this issue have yielded disappointing results. For example, Lavy et al. (1993) examined the link between attentional bias and treatment outcome in a sample of spider phobic patients who received exposure in vivo therapy. These authors reached the following conclusion: "To our disappointment, we found only a marginal correlation between pretreatment attentional bias and treatment success" (p. 23; see also Lundh & Öst, 2001). Moreover, the current data showed that, especially in children, attentional bias is a complicated phenomenon that may not only reflect attentional processes towards threatening material. Attention away from threat cues or avoidance may at least play an equally important role. Before such theoretical problems are definitely solved, speculations on the practical implications of attentional bias seem premature.

Chapter 3

Attentional bias and spider fear in children aged 7 to 13 years: the role of cognitive inhibition and attentional control

Abstract

This study examined the cognitive inhibition hypothesis, which states that children are unable to inhibit the processing of emotional – notably threatening – information. This ability normally develops with age, but fails to do so in fearful children. Attentional bias arises when inhibition is unsuccessful. An emotional Stroop task was employed to measure attentional bias in high and low spider fearful children aged 7-13 years (N = 509). Results indicated that the association between attentional bias and age is positive in high fearful children, but negative in low fearful children. High fearful children showed less attentional bias than high fearful children at age 7-9, but more bias at age 12-13. This pattern of results only occurred in the first half of the experiment, not in the second half. Children's ability to effortful control their attention did not moderate the relationship between anxiety and processing bias. All together, these findings support the cognitive inhibition hypothesis.

Morren, M., Kindt, M., Van den Hout, M., & Boogerd, A. *Attentional bias and spider fear in children aged 7 to 13 years: the role of cognitive inhibition and attentional control.*

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3.1 Introduction

In 1976, Aaron Beck put forward that anxiety pathology is associated with the tendency to direct attention at information pertaining to the object of fear. After several decades of research, it has now become clear that anxious adults do indeed show this attentional bias effect, whereas non-anxious adults do not (see for reviews Logan & Goetsch, 1993; Williams, Mathews, & MacLeod, 1996). More recently, it has been proposed that a similar bias exists with children. That is, anxiety disorders in children are believed to be associated with the presence of danger schemas, which persistently direct processing resources to threat. These schemas in turn bring about a variety of cognitive distortions, including attentional bias (cf. Kendall, 1985; Daleiden & Vasey, 1997).

Studies investigating whether attentional bias is related to anxiety in children have yielded inconsistent findings. Like in adults, a number of studies found that anxious children exhibited attentional bias, whereas non-anxious children did not (e.g., Martin, Horder, & Jones, 1992; Richards, Richards, & McGeeney, 2000). However, in a recent series of studies with children aged 8 to 12 years by Kindt and colleagues (e.g., Kindt, Bierman, & Brosschot, 1997a; Kindt, Brosschot, & Everaerd, 1997b; Kindt, Van den Hout, De Jong, & Hoekzema, 2000; also see Ehrenreich, 1999; Eschenbeck, Kohlmann, Heim-Dreger, Koller, & Leser, 2004; Waters, Lipp, & Spence, 2004), attentional bias not only emerged in high fearful children, but in non-fearful children as well. This attentional bias decreased with age in low fearful children, but remained stable in high fearful children (Kindt et al., 1997a; 2000).

In order to explain their findings, Kindt et al. (1997a) put forward the cognitive inhibition hypothesis. According to this hypothesis, young children are unable to inhibit the processing of threat, and hence show information processing bias irrespective of their level of fear. Normally, these inhibitory abilities are developed between age 8 and 11 years; this causes the attentional bias to subside. In contrast, in fearful children attentional bias can persist into adulthood because inhibitory abilities fail to develop. The cognitive inhibition hypothesis is consistent with the notion that attentional bias in anxious adults stems from an inability to control attention; this then produces involuntarily attendance to and preferential processing of threatening information (MacLeod & Mathews, 1991a).

Apart from the well-defined relationship between attentional bias and anxiety, more general attentional control processes may also be more broadly involved in the regulation of emotional processes (Vasey & Macleod, 1991). Lonigan and Phillips (1991) recently suggested that such regulatory mechanisms might play a role in the development and maintenance of anxiety pathology (see also Lonigan, Vasey, Phillips, & Hazen, 2004). They hypothesized that anxiety pathology develops as a result of the interaction between the temperamental factors of negative affectivity and effortful control, which allows individuals to regulate affect through organizing their attention and other behaviors (cf. Lonigan & Phillips, 2001). Lonigan et al. further argued that the relationship between negative affectivity and effortful control, on the one hand, and anxiety, on the other hand, is mediated by information processing biases.

The few studies that thus far investigated Lonigan et al.'s hypothesis all focused on the attentional aspect of effortful control, which permits intentional control of the focus of attention in relation to emotion. Derryberry and Reed (2002) found support for the hypothesis, and found that high trait anxious adults only showed attentional bias

when they had poor effortful control, but not when they had good effortful control. In contrast, low trait anxious adults did not show attentional bias, irrespective of whether they showed low or high effortful control. In another study, a similar pattern of results was obtained with adolescents aged 12 to 15 years (Vasey, 2003 in Lonigan et al., 2004). However, in a study with children aged 8 to 13 years, no support was found for Lonigan and Phillips' hypothesis (Muris, De Jong, & Engelen, 2004).

In a previous study, Morren, Kindt, Van den Hout, and Van Kasteren (2003) found that different attentional bias effects occurred in the first and second half of the Stroop. More specifically, it was observed that responses to spider stimuli accelerated while responses to neutral control stimuli decelerated. This resulted in a reverse processing bias effect because responses to spider stimuli were significantly faster compared to responses to neutral control stimuli. This reverse effect was especially pronounced toward the stages of the Stroop. Morren et al.'s experiment seemed particularly susceptible to such changes in attentional bias, because their Stroop task was rather lengthy (i.e., 144 trials). Even though the Stroop task employed in the present study is much shorter, the fact that little is known about within-task variation of attentional responding to threat deemed investigation of this possibility of potential interest for information-processing accounts of anxiety.

The first aim of present study was to test of the cognitive inhibition hypothesis, and thus it was sought to replicate the findings of Kindt and colleagues (1997a, 2000) with a larger sample of children. More specifically, it was examined (a) whether young children preferentially process threat-related information, as evinced by the presence of a general attentional bias for threatening material regardless of fear levels; and (b) whether this bias decreases with age in low fearful children but persists with age in high fearful children. The second aim of current study was to examine Lonigan and Philips' (2001) hypothesis that the presence of attentional bias requires both high spider fear and low attentional control, whereas the absence of bias is characterized by high attentional control with or without spider fear. Because it was hypothesized that children develop the capacity to control attention as they grow older, the possibility that this relationship was modified by age was considered as well. Finally, it was examined whether these attentional bias effects would be different in the first and second half of our Stroop task.

3.2 Method

3.2.1 Participants

Participants in the present study had been selected one year earlier from a screening of 3,564 normal children. At that time, these children attended one of 46 primary schools in the Southwest of the Netherlands, and 580 children were selected on the basis of spider fear (for further details see Morren et al., 2003). The current study can be seen as a follow-up to this study. Because some children could not be contacted or refused further participation, present sample comprised 514 children. Another 5 children with incomplete data were removed from further analysis, which brought the final sample to 423 girls and 86 boys (mean age = 10.7 yr., SD = 1.4, range = 7 to 13). There were 2 children aged 7, 59 aged 8, 126 aged 9, 106 aged 10, 110 aged 11, 86 aged 12, and 20 aged 13 years. Because their numbers were few, children aged 7 and 13 years were collapsed with the adjoining age group.

To examine whether selective dropout had occurred, levels of spider fear at screening were compared between the current participants (N = 514; M = 10.8, SD = 10.4) and dropouts (N = 66; M = 12.6, SD = 10.4). No significant difference was found, $t(578) = 1.3$, $p = 0.19$.

3.2.2 Questionnaires

Spider fear was assessed by means of the *Spider Phobia Questionnaire for Children* (SPQ-C; Kindt, Brosschot, & Muris, 1996). This scale consists of 29 items that must be answered with *true* or *false* (e.g., "I enjoy reading a story about spiders", "I dislike looking at pictures of spiders"). Items scores were summed to get an index of spider fear, and scores may range from 0 to 29. The SPQ-C is a good predictor of spider fear behavior (Kindt et al., 1996).

The *Attentional Control Scale for Children* (ACS-C; Morren, Vasey, Kindt, & Muris, unpublished data) was translated and adapted from the ACS for adults (Derryberry & Reed, 2002), originally devised by Derryberry and Rothbart (1988). The ACS-C measures children's ability to purposely maintain and shift attention. The scale comprises 10 items that are answered on a four-point scale: 1 = *never*, 2 = *sometimes*, 3 = *often*, 4 = *always*. Sample items are "When concentrating I ignore feelings of hunger or thirst" and "It is easy for me to read or write while I'm also talking on the phone". A total score was computed by summing item scores (range = 10 to 40), so that higher scores indicating more attentional control. There is little information about the reliability and validity of the ACS-C. However, our preliminary findings in 669 children aged 7-13 years showed that the scale was internally consistent (α = 0.76), and correlated negatively with trait anxiety (r = -0.46), anxiety disorders symptoms (r = -0.50), and depression symptoms (r = -0.30), and positively with perceived control (r = 0.26).

3.2.3 Spider Stroop Task

The present spider Stroop was identical to Kindt et al.'s (2000) task. Words were written in black letters that were superimposed on blue, red, yellow, or green circles with a diameter of 145 millimeters (i.e., non-integrated stimuli). There were six spider words: spider, web, hairy, creep, cobweb, and itching (in Dutch: *spin*, *web*, *harig*, *kruipen*, *spinnenweb*, *kriebelen*, respectively), and six control words from a single semantic category: stool, chair, sit, back, armrest, and chair legs (in Dutch: *kruk*, *stoel*, *zitten*, *leuning*, *armleuning*, and *stoelpoten*). Spider words were matched with control words on average word length and number of syllables in Dutch. Each word was presented once on each circle colour, which resulted in 48 stimuli.

3.2.4 Apparatus

The SPQ-C and the Stroop were presented on an IBM-compatible 486 MHz computer operated by MEL (Micro Experimental Laboratory) professional software (Schneider, 1996). Stimuli were shown on a 15-inch SVGA monitor. A microphone connected to a voice key was used to record response times with millisecond (ms) accuracy. Before the experiment proper, the microphone sensitivity was adjusted to the child's voice volume. This voice test involved naming each of the four colours twice, and also served as a test for colour-blindness. Each trial started with a blank screen, until after 500 ms a fixation cross was shown for 500 ms in the centre of the screen. The stimulus word that subsequently replaced the fixation cross was shown until the subject's vocal re-

sponse was detected, with a maximum of 3000 ms. The experimenter was seated next to the child and recorded errors.

3.2.5 Procedure

Testing took place individually in a separate room at school, and took about 15 minutes. Children were seated roughly 50 cm from the computer monitor. The SPQ-C was completed first to prime the fear schemata of the children (cf. Lundh & Czyzykow-Czarnocka, 2001). This was followed by the Stroop during which children were required to hold the microphone 10 to 15 cm from their mouth. Standard instruction prompted children to ignore the word and to name the circle colour as quickly as possible without making errors into the microphone. After a short 12-trial practice, the Stroop was started. Stimuli were presented in fixed random order, allowing a maximum of two words of the same colour or stimulus category to be presented successively.

3.3 Results

3.3.1 Spider fear

The test-retest correlation between spider fear at screening and at the present measurement was high (r = 0.84, p < 0.001; test-retest interval: M = 12.5 months, SD = 1.1, range = 6.5 to 15.0). Still, the high and low spider fear groups that were composed at screening remained far from intact. Many children fell outside the initial criterion for the high fearful group (SPQ-C ≥ 16) and the low fearful group (SPQ-C ≤ 3). On average, SPQ-C score changed 4.3 (SD = 4.5); nearly 16% of the range of the questionnaire.

To avoid losing a disproportionately large number of participants, the high and low spider fearful groups were recomposed using gender appropriate median split scores of the present SPQ-C. Not surprisingly, a univariate analysis of variance (ANOVA) showed that the resulting high spider fearful group reported more spider fear (M = 16.5, SD = 5.4) compared to the low spider fear group (M = 2.4, SD = 1.8), $F(1, 499)$ = 2,302.6, p < 0.001. There were no significant Age and Spider Fear × Age effects.

Table 3.1: Mean color-naming latencies in milliseconds (SDs) for high and low fearful children aged 7/8 to 12/13 years on the spider Stroop

Age	Stimulus type	High fearful	*N*	Low fearful	*N*
7/8	Spider words	785 (160)	29	742 (135)	32
	Control words	809 (185)		718 (126)	
9	Spider words	767 (183)	58	720 (130)	68
	Control words	764 (162)		712 (152)	
10	Spider words	714 (145)	60	698 (117)	46
	Control words	698 (137)		700 (125)	
11	Spider words	728 (177)	61	665 (125)	49
	Control words	713 (157)		665 (137)	
12/13	Spider words	684 (128)	51	633 (80)	55
	Control words	678 (120)		637 (86)	
Total	Spider words	731 (163)	259	689 (123)	250
	Control words	725 (155)		685 (131)	

3.3.2 The processing of threat

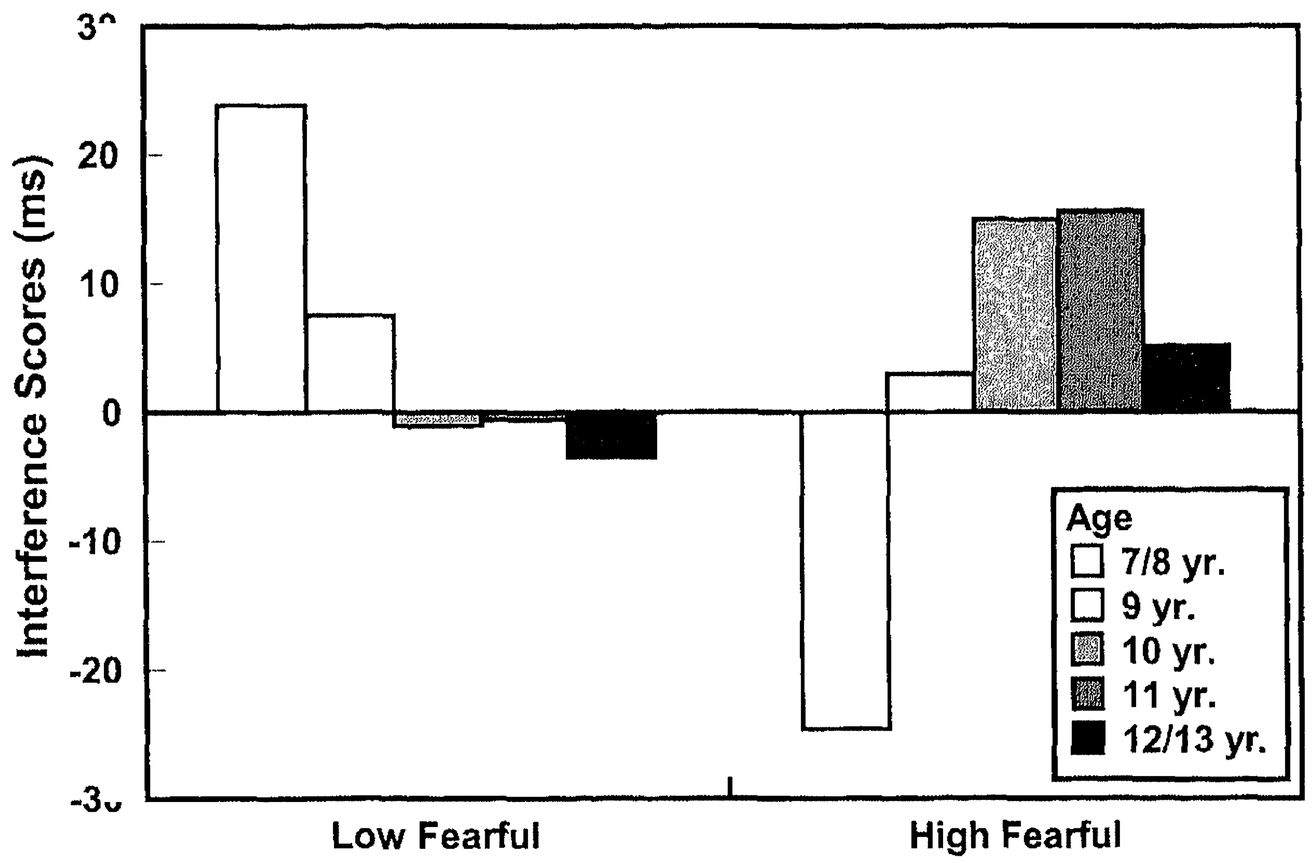
Mean color-naming latencies for spider and control words are presented in Table 3.1. The error rate was 5.2% (*SD* = 6.0) of spider trials and 5.6% (*SD* = 6.5) of control trials, and these RTs were discarded. Next, for spider and control words separately, reaction times (RTs) outside three SDs above or below a child's mean were removed, followed by RTs below 300 ms. Further note that the analyses reported below were carried out using log transformed mean RTs and errors in order to restore normality. Subsequently, RTs and errors were subjected to separate Spider Fear (high vs. low spider fearful) × Stimulus (spider vs. control words) × Age (7/8, 9, 10, 11, or 12/13 years) ANOVAs for repeated measures. The results obtained with the error analyses were highly similar but weaker, they are not reported.

3.3.3 Effect of spider fear and age on threat processing

The main purpose of the present study was to investigate whether attentional bias is present in young children irrespective of anxiety levels, and will wane with age in low fearful children but persist in high fearful children. To start with, main effects of Spider Fear and Age indicated that high fearful children responded slower than low fearful children [$F(1, 499) = 11.2$, $p < 0.001$], and that children responded faster as they were older [$F(4, 499) = 8.0$, $p < 0.001$). Although children responded slower to spider words than to control words, the main effect of Stimulus did only approach significance, $F(1, 499) = 2.97$, $p = 0.09$. Stimulus did not interact significantly with either Spider Fear or Age (both Fs < 0.6, *ns*), but the Stimulus × Spider Fear × Age interaction was significant, $F(4, 499) = 3.24$, $p < 0.05$.

To disentangle this three-way interaction, one-sample *t* tests on attentional bias (measured as RT_{spider}-$RT_{control}$) for high and low fearful children in each age group were

Figure 3.1: Mean interference scores ($RT_{spider} - RT_{control}$) on the Spider Stroop task for children in each age group separately



carried out. Results showed that attentional bias was significantly positive in high fearful children aged 10 and 11, *t*s > 1.90, *p*s < 0.05. In 7/8-year-olds, the bias was also significantly positive in the low fearful group, but significantly negative in the high fearful group, *t*s > 1.70, *p*s < 0.05. Furthermore, differences between high and low spider fearful children were examined by means of *t* tests for independent samples for each age group. At age 7/8 high fearful children showed significantly less bias than low fearful children, $t(59) = 2.38$, $p < 0.01$. No such difference was present in the other age groups, *t*s < 1.65, *p*s > 0.05 (see Figure 3.1).

To examine the prediction of the cognitive inhibition hypothesis that the association between attentional bias and age is positive in high fearful children but negative in low fearful children, two correlations were computed. In high fearful children the correlation between attentional bias and age was significantly positive ($r = 0.11$, $p < 0.05$), but in low fearful children it was significantly negative ($r = -0.14$, $p < 0.05$). A *t* test showed that these correlations differed significantly in magnitude, $t(507) = 2.82$, $p = 0.005$. The pattern of attentional bias is consistent with the second hypothesis that bias decreases with age in low fearful children but persists with age in high fearful children.

3.3.4 Moderating effect of attentional control

The second aim of this study was to examine whether the interaction of attentional control and trait anxiety would be related to processing bias. A trend toward a main effect of Attentional Control was found, showing that children with low attentional control had slower RTs than children with high attentional control, $F(1, 480) = 3.01$, $p = 0.08$. There were no significant interactions between Attentional Control, on the one hand, and Stimulus, Spider Fear or Age on the other, all *F*s < 0.68, *ns*. The error analyses revealed a similar though weaker pattern of results.

3.3.5 Separate analysis of the first and second half of the Stroop

The final aim of this study was to test whether the effects obtained from the previous analyses would occur differently in the first and second half of the Stroop. Therefore, mean scores were calculated for the spider and control words in each half separately, using the same procedure regarding outliers and fast responses as in the main RT analyses (see above). Log transformations of these RTs and errors were then subjected to separate Stimulus × Spider Fear × Age × Half (1st vs. 2nd) ANOVAs for repeated measures.

Table 3.2 shows mean RTs for high and low fearful children in both halves of the Stroop at different ages. The ANOVA showed that responses were generally faster in the first half of the Stroop task compared to the second half, $F(1, 499) = 11.0$, $p < 0.001$. Half interacted significantly with Stimulus, $F(1, 499) = 22.9$, $p < 0.001$ (see Figure 3.2) showing children responded slower to spider words ($M = 706$, $SD = 159$) than to control words ($M = 685$, $SD = 139$) in the first half, paired $t(508) = 5.48$, $p < 0.001$. In the second half, however, no difference emerged between spider words ($M = 703$, $SD = 143$) and control words ($M = 708$, $SD = 157$), paired $t(508) = 0.97$, *ns*. Responses to control words were also slower in the second half than in the first half [paired $t(508) = 5.71$, $p < 0.001$], whereas responses to spider words were constant [paired $t(508) = 0.23$, *ns*].

In order to test this possibility, data from the first half of the Stroop was analyzed separately.[1] Apart from the main effect of Stimulus (see *t* tests in the previous paragraph), again the relevant Stimulus × Spider Fear × Age interaction emerged, $F(4, 499) = 3.71$, $p < 0.01$. To unravel this interaction, further one-sample *t* tests were carried out at each level of age to test whether high and low spider fearful children's attentional bias significantly differed from zero. This revealed a significant positive attentional bias in low fearful children aged 7/8, 9, and 11, and in high fearful children aged 10, 11, and 12/13, *ts* > 1.77, *ps* < 0.05. In addition, while the bias was *smaller* in high fearful children compared to low fearful children at ages 7/8 and 9, it was *larger* at age 12/13, *ts* > 1.68, *ps* < 0.05. Again, the correlation between attentional bias and age was significantly positive in high fearful children ($r = 0.13$, $p < 0.05$), and significantly negative in low fearful children ($r = -0.18$, $p < 0.01$); the correlations differed significantly, $t(507) = 3.51$, $p < 0.001$. Thus, it seems fair to conclude that the attentional bias effects that emerged from the general analyses can be attributed to the occurrence of these effects in the first half of the Stroop, but not in the second half.

3.4 Discussion

This study examined the course of attentional bias in high and low fearful children aged 7 to 13 years. In addition, it was investigated whether this relationship between spider fear and attentional bias would be modified by attentional control. The results can be summarized as follows. First, as expected, children displayed attentional bias irrespective of anxiety levels, although this effect only attained significant when the first half of the stimuli from the Stroop was analysed. Second, and more importantly,

Table 3.2: Mean color-naming latencies in milliseconds (*SD*s) of the first and second half of the spider Stroop separately

		First half		Second half	
Age	Stimulus type	High fearful	Low fearful	High fearful	Low fearful
7/8	Spider words	781 (183)	746 (170)	782 (150)	723 (129)
	Control words	789 (187)	706 (130)	809 (197)	713 (148)
9	Spider words	753 (200)	723 (148)	762 (181)	711 (121)
	Control words	744 (168)	687 (143)	770 (175)	715 (163)
10	Spider words	709 (157)	683 (122)	706 (144)	704 (120)
	Control words	681 (132)	677 (119)	693 (139)	706 (123)
11	Spider words	730 (197)	666 (128)	714 (166)	651 (122)
	Control words	687 (134)	648 (124)	726 (184)	668 (153)
12/13	Spider words	676 (122)	628 (87)	674 (133)	633 (81)
	Control words	653 (112)	627 (88)	688 (134)	632 (80)
Total	Spider words	725 (176)	686 (136)	723 (160)	682 (119)
	Control words	703 (150)	667 (124)	730 (169)	685 (140)

Note: See Table 3.1 for the group sizes (*N*s).

[1] It should be mentioned that in the analysis of the second half of the Stroop, no relevant effects attained significance. In addition, the analyses involving attentional control revealed the same pattern of results as was presented above.

attentional bias was positively associated with age in high spider fearful children, but negatively in low spider fearful children. These correlations differed significantly in magnitude. Third, additional analyses showed that the attentional bias effects emanated primarily from the first half of the Stroop task. Finally, no evidence was found that the combination of high spider fear and low attentional control was associated with the presence of attentional bias.

The finding of an attentional bias in all children is consistent with previous results by Kindt and colleagues (e.g., 1997a; 2000, study 1), and thus further supports the cognitive inhibition hypothesis. More importantly, consistent with this hypothesis, the magnitude of attentional bias increased with age in high fearful children, but decreased with age in low fearful children. This pattern of results was more prominent in the first half of the Stroop. In line with Kindt et al. (2000, study 1), high fearful children exhibited more bias at age 12/13, and less bias at age 7/8, compared to low fearful children. These findings suggest that the attentional bias that is reliably found in adults does not differentiate between anxious and non-anxious children until at least age 12. This is a potentially important finding for it may explain why some studies did report a differential attentional bias effect between anxious and non-anxious children, whereas other studies did not. That is, children in studies reporting a differential bias were generally older than 12 years (e.g., Richards et al., 2000; Moradi, Taghavi, Neshat-Doost, Yule, & Dalgleish, 1999), whereas children in studies reporting an attentional bias in both anxious and non-anxious children were usually younger than age 12 (e.g., Ehrenreich, 1999; Eschenbeck et al., 2004; Kindt et al., 1997a; 2000; Waters et al., 2004; see for a review, Vasey & MacLeod, 2001). Together this suggests that attentional bias effects are not a characteristic of anxiety in children per se. It may be the case that bias in itself is not a vulnerability factor for anxiety problems, but a failure to acquire the inhibitory abilities that allow bias to subside (cf. Kindt & Van den Hout, 2001). Once instated, this attentional bias may help maintain anxiety by enhancing the perception of threat (e.g., Clark, 1999).

It seems, however, that the relationship between childhood anxiety and attentional bias is more complicated. The additional analyses revealed that these bias effects were most pronounced in the first half of the Stroop. In fact, bias collapsed completely in the second half of the Stroop due to a deceleration of children's responses to control stimuli in the second half of the experiment relative to the first half, while responses to spider stimuli were constant (see Figure 3.2). Recently, Morren et al. (2003) observed a similar deceleration of responses to control words in later stages of their Stroop task. In contrast to the present study, however, these authors also observed an acceleration of children's responses to spider stimuli to the point that the bias reversed. In that study, a lengthier Stroop task was employed (i.e., 144 stimuli), which may be responsible for this reverse attentional bias effect.

Additional factors besides task length may also be associated with the reversal of attentional bias. The results from the present and previous research indicate that the reversed bias effect especially seems to affect anxious children between age 7 and 9 years (Kindt et al., 1997a; 1997b; 2000, study 1; Kindt and Brosschot, 1999; Morren et al., 2003). Kindt and colleagues (2000) explicitly addressed this issue by examining whether they could replicate the reverse attentional bias that occurred in children aged 8 (study 1). In a second study with 8-year-olds only, no reverse bias was found, and so it was concluded that the presence of this effect in study 1 was a spurious finding. However, as Morren et al.'s (2003) found a reversed attentional bias in a sample of 375

children, this conclusion seems difficult to maintain. It should further be noted that bias reversal seems to be associated with failed inhibition, because both seem occur particularly in young, anxious children. In addition, Morren et al. observed the stimuli for which threat inhibition is more difficult also generate the greatest reversal effect.

Morren et al. (2003) proposed that the reversed bias may reflect some sort of cognitive avoidance, which prevents processing of the threatening stimuli (cf. Mogg & Bradley, 1998; Vasey & MacLeod, 2000). Evidence from a number of studies supports this explanation. Dalgleish, Moradi, Taghavi, Neshat-Doost, and Yule (2001) children PTSD aged 9 to 17 years directed attention away from depression-related stimuli. This tendency was less pronounced in older children. In addition, using an eye movement registration technique, Hermans, Vansteenwegen, and Eelen (1999) found that while spider phobics attended more to spider pictures at the beginning of stimulus presentation, they subsequently shifted attention away from the pictures. Control subjects showed a more stable viewing pattern. Vasey, El-Hag and Daleiden (1996) explain how this type of avoidance may contribute to the development of anxiety. They argue that anxious children will probably have minimal experience with threat, because their fast detection of threat cues allows prompt avoidance of encounters with threat. As a result, they fail to learn that stimuli they consider as threatening are not as dangerous as they thought, and this further focuses their cognitive processing on threat (Mogg & Bradley, 1998). If young children generally show a threat bias due to their failed inhibition, they may alternatively try to avoid the threat, and this may then foster the development of anxiety. Future research should further elucidate the role of attentional avoidance in anxiety pathology, and its relationship with cognitive inhibition.

Lonigan and Philips' (2001) hypothesis could not be supported in the present study. Although children with low attentional control tended to respond slower than children with high attentional control, low attentional control in combination with high spider fear was not found to be related to attentional bias (cf. Muris, Winands, & Horselenberg. 2003). This result diverges from findings in older individuals. More precisely, in adults and adolescents (aged 12 to 15 years), anxiety was associated with heightened attention toward threatening stimuli when attentional control was poor, but not when it was good (Derryberry and Reed, 2002; Vasey in Lonigan et al., 2004). The ability to exert control over attentional allocation may not develop until adolescence, and children in the present study may have been too young to find an effect of attentional control. Alternatively, the use of different tasks may explain the divergent findings. One characteristic of the Stroop task that was used in the present study, is that threatening stimuli that are *irrelevant* to the task (i.e., children are explicitly instructed to ignore the meaning of the words). As a result, there may be little room for strategic or voluntary control (Derryberry & Reed, 2002). In contrast, the threatening stimuli in the spatial orienting task are *relevant* to the task, which may make it more suitable to investigate the current hypothesis. Finally, it is doubtful whether individuals – especially children – will be able to provide accurate reports about their own cognitive processes (Nisbett & Wilson, 1977), such as their ability to control how they direct their attention.

The current study has several limitations. First, it relied on a sample of children with relatively mild anxiety complaints. Different or more clear-cut results may emerge in children who are truly spider phobic. However, in a recent study by Kindt, Bögels, & Morren (2003) no attentional bias effect was observed in clinically referred children aged 7-18 years suffering from an anxiety disorder (i.e., separation anxiety disorder,

social phobia, or generalized anxiety disorder). Second, the present sample comprised a high proportion of girls, which is consistent with the skewed gender distribution that is associated with anxiety across the life span (Mackinaw-Koons & Vasey, 2000). Note, however, that gender appropriate median split scores were used to devise high and low anxiety groups. Third, the present sample mainly comprised children of preadolescent age. The pattern of attentional bias that emerged in high and low spider fearful children, and their relationship with the interactive effect of attentional control and trait anxiety, may turn out to be more pronounced when older children are studied. Finally, a related issue is that the limited age range of the present sample (i.e., from 7/8 to 12/13 years) may have attenuated the magnitude of associations involving age. In sum, despite these weaknesses, this study offers some interesting findings concerning the dynamics of attentional bias in children.

Chapter 4

Anxiety and attentional bias in children: A prospective study

Abstract

The present study offers a prospective analysis of the relationship between attentional bias and anxiety in children. The aim of the study was twofold. First, it was examined whether attentional bias predicted later anxiety levels, or was merely a by-product of anxiety. Second, the cognitive inhibition hypothesis was tested, using both concurrent and temporal analyses. The hypothesis assumes that anxiety results from the inability to inhibit the processing of threat, and that attentional bias marks the presence of failing inhibition. Young children lack inhibitory competency but normally develop this as they mature, which is reflected in the gradual decline of their attentional bias. However, when children fail to attain such competency, their attentional bias is allowed to persist, which renders them vulnerable for anxiety pathology. In the present study, 186 children aged 7-13 years completed the emotional Stroop task and a self-report measure of anxiety on two occasions 10 months apart. Evidence was found that attentional bias positively predicted later anxiety. Furthermore, in line with the cognitive inhibition hypothesis, higher levels of attentional bias were associated with larger increases in anxiety over 10 months. This relationship was similar for children in different grades. The results are considered in light of previous findings concerning the relationship between attentional bias and anxiety in children. The implications for further research and for the treatment of childhood anxiety are briefly discussed.

Morren, M., Kindt, M., Chahid, N., & Van den Hout, M. *Anxiety and attentional bias: a prospective study.*

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4.1 Introduction

In 1976, Beck proposed that anxiety in adults is associated with a heightened attention to stimuli that he or she considers potentially dangerous. Fifteen years later, MacLeod and Mathews (1991a) suggested that this processing bias results from an inability to control the allocation of processing resources. Today, it has been firmly established that anxious adults, unlike normal controls, selectively direct their attention to threat-related information (see for reviews, Kindt & Van den Hout, 2001; Logan & Goetsch, 1993; Williams, Mathews, & MacLeod, 1996). Anxiety disorders often originate in childhood, and epidemiological studies report that anxiety disorders are highly common in children (e.g., Verhulst, 2001). For example, specific phobias are prevalent in about 5% of children in the general population, and in about 15% of clinically referred children (Ollendick, King, & Muris, 2002). While it is generally acknowledged that children resemble adults in that their anxiety is related to various information processing distortions (Kendall, 1985; Daleiden & Vasey, 1997), the question remains whether attentional bias contributes to the development of anxiety or is merely its epiphenomenon.

Most studies on anxiety-related processing distortions in children have been dedicated to attentional bias. The results indicated that anxious children, like anxious adults, preferentially attend to threat-related information (exceptions: Kindt, Bögels, & Morren, 2003; Morren, Kindt, Van den Hout, & Van Kasteren, 2003). However, findings with non-anxious children are mixed. In some studies, non-anxious children presented no attentional bias (e.g., Kindt et al., 2003; Martin, Horder, & Jones, 1992; Moradi, Taghavi, Neshat-Doost, Yule, & Dalgleish, 1999b; Richards, Richards, & McGeeney, 2000; Taghavi, Neshat-Doost, Moradi, Yule, & Dalgleish, 1999; Vasey, Daleiden, Williams, & Brown, 1995), whereas in other studies they did (e.g., Kagan, Snidman, Zentner, & Peterson, 1999; Kindt, Brosschot, & Everaerd, 1997b; Kindt, Van den Hout, De Jong, & Hoekzema, 2000; Morren, Kindt, Boogerd, & Van den Hout, submitted a; Waters, Lipp, & Spence, 2004). To explain why non-anxious children resemble anxious children in exhibiting an attentional bias, Kindt, Bierman, and Brosschot (1997a) formulated the cognitive inhibition hypothesis.

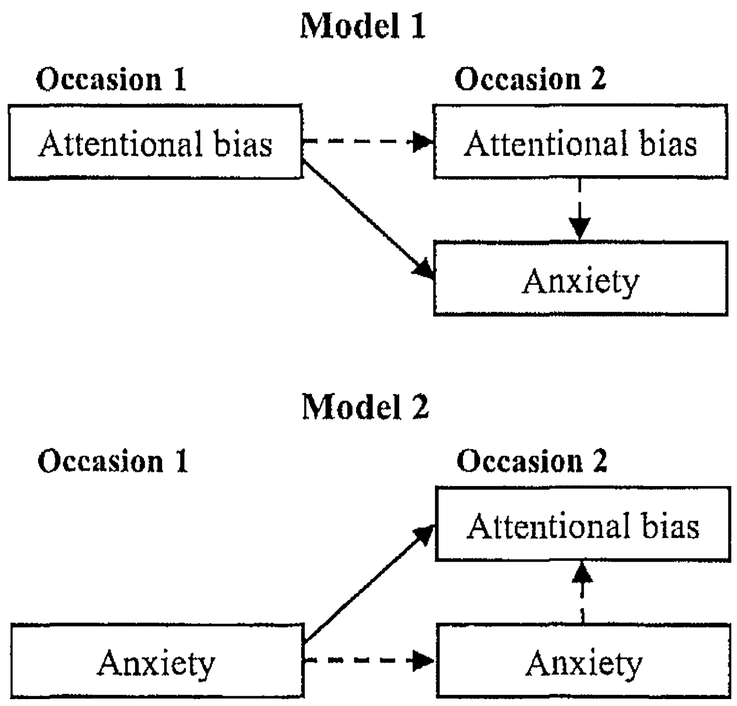
The cognitive inhibition hypothesis holds that young children have trouble diverting their processing resources away from threatening information. Hence, they show an attentional bias for threat. Normally, children acquire this ability to inhibit processing threat as their cognitive capacities increase with age, resulting in a gradual decline of their attentional bias. However, anxious children persistently show an attentional bias to threat-related information at older ages, because they fail to master inhibitory abilities (cf. Kindt et al., 1997b). In line with the cognitive inhibition hypothesis, three cross-sectional studies found that anxious children exhibited the same degree of attentional bias in all age groups, whereas bias was smaller in older non-anxious children (Kindt et al., 1997b, 2000; Morren et al., submitted a). However, cross-sectional findings cannot rule out that, even when children in different age groups exhibit the predicted pattern of attentional bias, over time they exhibit a different, unpredicted bias pattern. In order to provide a more stringent test of the cognitive inhibition hypothesis, which assumes a certain developmental trend, prospective research is required. The present prospective study was aimed to allow for such test.

Besides the cognitive inhibition hypothesis, prospective evidence on whether attentional bias is a vulnerability factor for anxiety *per se* is scarce. In adults, two studies examined whether high attentional bias was associated with increased emotional responding. Attentional bias, as measured using an emotional Stroop with backwardly masked and subliminally presented stimulus words, was identified as the best predictor of the intensity of emotional distress upon receiving a diagnosis of cervical pathology (MacLeod & Hagan, 1992), and of self-reported vulnerability to life stress (Van den Hout, Tenney, Huygens, Merckelbach, & Kindt, 1995). In addition, MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002) subjected participants to an experimental procedure that induced an attentional bias to negative emotional stimuli. These individuals showed an increased emotional reaction during a subsequent stress task compared to controls. Unfortunately, the prospective connection between attentional bias and anxiety has not yet been studied in children, although two studies with children addressed the relationship between anxiety and later interpretation bias (Muris, Jacques, & Mayer, 2003b; Morren, Muris, Kindt, Schouten, & Van den Hout, submitted b). The results of these studies showed that enhanced threat perception (Muris et al.) and emotional reasoning (Morren et al.) predicted later anxiety.

The first purpose of the present study was to investigate the prospective connection between anxiety and attentional bias, which were measured on two occasions. Two hypotheses were formulated on how this connection could take shape (Figure 4.1). First, we examined whether a prospective relationship between attentional bias and anxiety would be present. More specifically, we tested whether attentional bias on occasion 1 would predict anxiety on occasion 2 (model 1), or whether anxiety on occasion 1 would predict attentional bias on occasion 2 (model 2). Second, we investigated whether these connections would be direct (solid lines) or indirect (dotted lines).

The second purpose of our study was to examine the cognitive inhibition hypothesis, which was done using cross-sectional and temporal analyses. In the cross-section analysis, it was expected that the relationship between attentional bias and anxiety would become increasingly more positive for children in higher grades. To be more precise, children in low grades are h-'d no' y-* *o be able *^ inhibit the processing of threat; hence, they are all predicted to show an attentional bias regardless of whether they are anxious or not. As children's inhibitory skills grow as they mature and thus their attentional bias disappears, this wou__ ...use the_r anx_ety to wane. However, when children remain incompetent inhibitors their attentional bias will persist, allowing their anxiety to persist. In addition, temporal analyses were carried out to test the cognitive inhi-

Figure 4.1: Hypothesised models of the prospective pathways between anxiety and attentional bias



bition hypothesis. In line with the hypothesis a failure to develop inhibitory abilities, as evidenced by a maintenance or increase of attentional bias, was expected to be predictive of higher anxiety levels on occasion 2 (i.e., maintenance or increase of bias → high fear). Similarly, we expected that higher levels of attentional bias on occasion 1 would lead to an increase in anxiety (i.e., high bias → maintenance or increase in fear). In addition, we explored the possibility that these changes would be more distinct for children in higher grades. These hypotheses were investigated in a sample of 192 children, completed the Spider Phobia Questionnaire for Children (SPQ-C; Kindt, Brosschot, & Muris, 1996) and the spider Stroop. These assessments were repeated 10 months later.

4.2 Methods

4.2.1 Participants

The 192 children participating in this study attended elementary schools in the southwest of the Netherlands. The current data was drawn from a longer-term research project investigating the relationship between spider fear and cognitive biases in children (see Morren et al., 2003). Participants enrolled in the project one year before occasion 1 from a sample of 3564 on the basis of high or low spider fear (SPQ-C ≥ 16 or ≤ 3, respectively). Of the 192 children who completed testing on both occasions, 5 girls and 1 boy (3%) were excluded from further analysis because they had high error rates on the Stroop (i.e., >50%). The study population thus consisted of 186 children (30 boys and 156 girls) with ages on occasion 1 ranging from 7 to 13 years (M = 10.4, SD = 1.3). They attended grades 5 to 8 of elementary school and grade 1 of secondary school (hereafter: grade 9). They had all moved to the next grade on occasion 2.

4.2.2 Instruments

The *SPQ-C* (Kindt et al., 1996) measures subjective spider fear, and was completed on a computer. It comprises 29 true-false items, such as "Even a toy spider scares me a bit", and "Some spiders are quite funny to watch". A total spider fear score was calculated by summing item scores, higher scores indicating higher levels of spider fear (range 0-29). The SPQ-C has been shown successful in predicting children's fear behaviour on a behavioural approach test, a test that challenges children to move toward a life spider in a number of preset steps (Kindt et al., 1996).

The *spider Stroop* (Kindt et al., 2000) comprised 48 word stimuli displayed in 8-mm high black letters superimposed on red, blue, green, and yellow circles with a 145-mm diameter (i.e., non-integrated stimuli). There were 6 spider words (i.e., spider, web, hairy, creep, cobweb, and itching) and 6 control words (i.e., stool, chair, sit, back, armrest, and chair legs), and each word appeared once in each colour. Control words – all from one semantic category – were matched with spider words for average word length and number of syllables.

4.2.3 Apparatus

The SPQ-C and the Stroop were presented on a 15" SVGA colour monitor controlled by an IBM-compatible 486 MHz computer operating on MEL (Micro Experimental Laboratory) software (Schneider, 1996). Response times (RTs) to stimuli were recorded

with millisecond (ms) accuracy via a microphone connected to a voice key. To adjust microphone sensitivity to the child's voice volume and to rule out colour-blindness, children named each colour twice. Each trial presentation involved the following events: a blank screen (500 ms), a fixation dot in the centre of the screen (500 ms), and the stimulus. If no response was detected after 3000 ms, the trial was considered a missing value. The experimenter sat by the child to record errors (e.g., naming the wrong colour, accidentally activating the voice key, etc.).

4.2.4 Data collection procedures

Before the research project started, all parents received an information letter. Written consent was provided by the parents of participating children. The mean time interval between both testing occasions was 9.5 months (*SD* = 1.0, range = 7.6-11.0).

SPQ-C and Stroop were completed in a quiet room at school; children sat 50 cm from the computer screen. The SPQ-C was administered first to prime children's fear schemas (cf. Lundh & Czyzykow-Czarnocka, 2001). The Stroop started with a standard written instruction to name the circle colour into the microphone as fast as possible, without making mistakes. Twelve practise trials allowed children to familiarise with the task, after which the Stroop was started during which children held the microphone themselves. Stimuli were presented in fixed random order, with the restriction that no more than two words of the same stimulus category or colour could appear consecutively.

4.2.5 Data reduction and statistical analyses

Mean colour-naming latencies were calculated on both occasions for each word category (excluding errors). We then removed outliers diverting over three standard deviations (*SD*s) from the mean, followed by RT recordings below 300 ms. Attentional bias was expressed as the mean RT for spider words minus the mean RT for control words. Log-transformations of RTs were used for analysis to correct normality. The Statistical Package for Social Sciences (SPSS) was used for all data processing and analysis.

T tests were employed to examine differences between groups (tests for independent samples) and over time (tests for paired data). Stability was assessed by means of intra-class correlation using the two-way mixed effects model with absolute agreement condition (ICC).

Stepwise regression analysis was performed to investigate the prospective connection between attentional bias and spider fear as well as the cognitive inhibition hypothesis. In each regression, to control for possible effects of gender and length of the test-retest interval (only for analyses involving both occasions), these variables were forced into the equation on step 0. The strength of the relationships obtained from the regression analyses will be reported as unstandardised (*B*) and standardised (β) beta coefficients.

The prospective connection between bias and anxiety was examined by means of two regressions. In the first, the dependent variable was attentional bias on occasion 2. Attentional bias and spider fear on occasion 1, and grade were first entered into the equation (step 1), followed by spider fear on occasion 2 (step 2). Next, interactions between attentional bias and grade on occasion 1 (step 3) and 2 (step 4) were added. In the second regression, spider fear on occasion 2 was the dependent variable. Again, attentional bias and spider fear on occasion 1 were entered into the equation first (step

1), but now attentional bias on occasion 2 was added next (step 2). Finally, interactions between spider fear and grade on occasion 1 (step 3) and 2 (step 4) were included.

The cognitive inhibition hypothesis was examined by means of two concurrent and two temporal regression analyses. In both concurrent regressions, attentional bias on the pertinent occasion was the dependent variable. Spider fear and grade were entered into the equation as predictor variables first (step 1), followed by their interaction (step 2). Then two temporal regression analyses were carried out. In the first, spider fear on occasion 2 was the dependent variable. Predictor variables were grade and change in attentional bias from occasion 1 to 2, calculated as bias on occasion 2 minus bias on occasion 1 (step 1), followed by their interaction (step 2). To establish whether these effects would appear independently from spider fear on occasion 1, that variable was forced into the equation on step 0. In the second regression, change in spider fear between both occasions was the dependent variable, whereas predictors were grade and attentional bias on occasion 1 (step 1), attentional bias on occasion 2 (step 2), and the interaction between grade and fear-change (step 3).

4.3 Results

4.3.1 Spider fear

Children were included in the study one year before occasion 1 when their level of spider fear was high (SPQ-C ≥ 16) or low (SPQ-C ≤ 3). On occasion 1, 58.6% still met these criteria, and only 42.5% still did on occasion 2. There was a significant decrease of spider fear between occasion 1 (M = 8.3, SD = 7.6) and occasion 2 (M = 7.6, SD = 6.5), $t(185) = 2.24$, $p = 0.026$. Girls reported somewhat more spider fear than boys, but only significantly so on occasion 2, $t(187) = 3.92$, $p < 0.001$ (on occasion 1, for girls M = 8.5, SD = 7.8, for boys M = 7.3, SD = 6.8; on occasion 2, for girls M = 8.2, SD = 6.7, for boys M = 4.7, SD = 3.9). The reliability of the SPQ-C was excellent both in terms of internal consistency (on occasion 1 and 2, KR-20 = 0.94 and 0.92) and 10-month stability (ICC = 0.81).

4.3.2 General Stroop findings

On occasion 1, the error rate was 6.2% (SD = 6.3) for spider stimuli and 6.9 (SD = 7.1) for control stimuli on; on occasion 2, these respective figures were 3.7% (SD = 4.6) and 3.9% (SD = 4.9). The mean RTs for spider and control words of children in each grade on both occasions are shown in Table 4.1. Within both stimulus categories, response

Table 4.1: Results of the prospective regression analysis of attentional bias on occasion 1 predicting spider fear on occasion 2

Predictor	Partial r	B	SE	β	T	p
Constant		4.98	2.47		2.02	0.045
Grade	0.07	0.19	0.21	0.03	0.89	0.376
Spider fear 1	0.83	0.69	0.03	0.82	20.94	< 0.001
Attentional bias 1	0.22	9.41	3.15	0.12	2.99	0.003
Model: $R^2 = 0.68$, $F(3, 180) = 149.7$, $p < 0.001$.						

Note: R^2 and F statistics pertain to the step on which the predictor variables were entered into the regression equation (i.e., change statistics).

times and error rates decreased significantly over time, *ts*(185) > 4.8, *ps* < 0.001. This is consistent with the fact that children were more familiar with the spider Stroop on occasion 2; alternatively, it may reflect further development of their cognitive abilities during the 10-month follow up. In addition, the respective stability coefficients for spider and control stimuli were 0.56 and 0.52 (*ps* < 0.001), which is moderate. Attentional bias, on the other hand, was highly unstable (ICC = -0.02, *ns*). Note that the analyses below were also executed with errors instead of reaction times, but not reported because similar but somewhat weaker results were obtained.

4.3.3 Prospective relationships between attentional bias and spider fear

In the first regression, predicting attentional bias on occasion 2, none of the steps revealed significant coefficients (βs range from -0.33 to 0.32, *ps* > 0.4; on each step: ΔR^2 < 0.01, ΔF < 0.41, *p* > 0.5). In the second regression, however, both spider fear and attentional bias on occasion 1, but not grade, significantly predicted spider fear on occasion 2 (Table 4.2). When attentional bias on occasion 2 was added as a predictor, this did not affect the relationship between attentional bias on occasion 1 and spider fear on occasion 2. Neither attentional bias on occasion 2 (step 2), nor the interactions between grade and attentional bias on occasion 1 (step 3) and 2 (step 4) contributed to spider fear on occasion 2 (βs range from -0.1 to 0.1, *ps* > 0.3; on each step: ΔR^2 < 0.01, ΔF < 0.78, *ps* > 0.3; not in table).

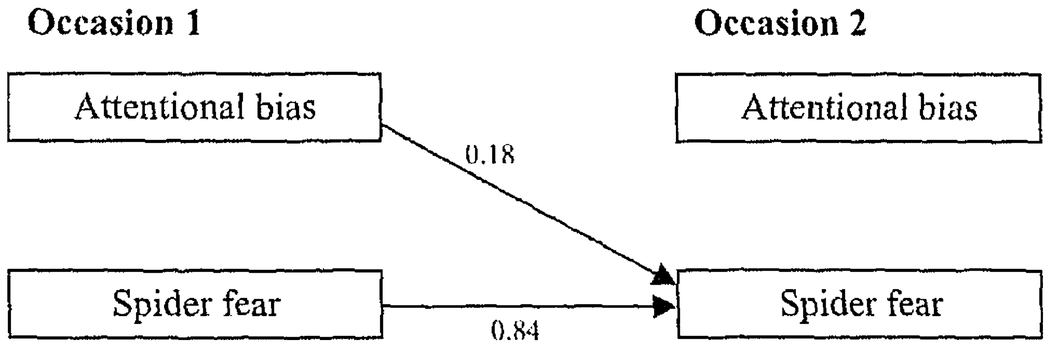
Figure 4.2 presents the final model of the prospective relationships between attentional bias and spider fear, built on the basis of the results of the regression analyses. There were independent pathways from spider fear and attentional bias on occasion 1 to spider fear on occasion 2, but not to attentional bias on occasion 2. Moreover, on each separate occasion, attentional bias and spider fear were unrelated. This final model is consistent with model 1 presented in the introduction, indicating that attentional bias predicts later anxiety.

Table 4.2: Mean colour-naming latencies in milliseconds (*SDs*) for spider and control words on both occasions in each grade

Grade*	Word category	Occasion 1	Occasion 2	Age	*n*
5	Spider	777 (180)	677 (151)	8.78 (0.49)	36
	Control	752 (140)	675 (169)		
6	Spider	704 (154)	632 (127)	9.65 (0.44)	61
	Control	715 (158)	639 (131)		
7	Spider	726 (127)	649 (130)	10.85 (0.43)	40
	Control	729 (150)	670 (145)		
8	Spider	659 (138)	619 (114)	11.70 (0.49)	35
	Control	660 (142)	616 (111)		
9	Spider	606 (98)	582 (81)	12.84 (0.40)	14
	Control	618 (106)	572 (80)		
All	Spider	707 (154)	638 (129)	10.37 (1.31)	186
	Control	707 (150)	643 (138)		

Note: Grade on occasion 1; grade 5-8 pertains to primary school, grade 9 to the first year of secondary school.

Figure 4.2: Model of the prospective pathways between attentional bias and spider fear based on the results of the regression analyses



Note: Only significant pathways are displayed.

4.3.4 Cognitive inhibition hypothesis

The concurrent regressions yielded non-significant intercepts on both occasions, indicating that RTs of spider and control words did not differ, i.e. there was no general attentional bias effect (*B*s between -0.01 and 0.01, *ns*). In subsequent steps of the analyses, no significant main or interactive effects emerged for either occasion, indicating that levels of attentional bias did not systematically change with spider fear, grade, or their interaction (βs range from -0.25 to 0.25, *ns*; on each step: $\Delta R^2 < 0.02$, $\Delta F < 1.2$, *ns*; not tabulated).

The temporal analysis revealed the following results. The first analysis (with spider fear on occasion 2 as dependent variable) yielded a significant effect of change in attentional bias on step 1, over and above the effect of spider fear on occasion 1 (Table 4.3). The second analysis revealed that attentional bias on occasion 1 explained a significant change in spider fear (Table 4.3). In both analyses, no interaction with grade emerged on step 2 (β = 0.12 and -0.22, *ns*; $\Delta R^2 < 0.01$, $\Delta F < 1.2$, *ns*). In sum, these

Table 4.3: Results of the temporal regression analyses of attentional bias change predicting spider fear on occasion 2 and spider fear change

Predictor	Partial *r*	*B*	*SE*	β	*T*	*p*
		Dependent variable: Spider fear 2				
Constant		4.58	2.50		1.83	0.069
Grade	0.07	0.21	0.21	0.04	0.99	0.325
Spider fear 1	0.84	0.69	0.03	0.82	20.68	< 0.001
Attentional bias change	-0.15	-4.09	2.03	-0.08	2.01	0.046
Model: $R^2 = 0.01$, $F(2, 180) = 2.62$, $p = 0.076$.						
		Dependent variable: Spider fear change				
Constant		2.76	2.99		0.92	0.357
Grade	0.01	0.09	0.26	0.03	0.36	0.720
Attentional bias	0.18	10.14	3.82	0.19	2.65	0.009
Model: $R^2 = 0.04$, $F(2, 181) = 3.66$, $p = 0.028$.						

Note: R^2 and *F* statistics pertain to the step on which the predictor variables were entered into the regression equation (i.e., change statistics).

findings indicate that even though children exhibited less spider fear when their increase in attentional bias in the preceding 10 months was smaller, higher levels of attentional bias were in fact associated with larger increases of spider fear. Although these effects were small, they are consistent with the cognitive inhibition hypothesis.

4.4 Discussion

An important finding of this study is that attentional bias significantly predicted spider fear 10 months later. This pathway persisted independently of the much stronger prospective connection of spider fear on occasion 1 predicting spider fear on occasion 2. In addition, we found partial evidence for the cognitive inhibition hypothesis. That is, our temporal analyses showed that, as expected, higher bias levels positively predicted increases in anxiety. However, no concurrent relationship between spider fear and attentional bias emerged, and the developmental analyses did not show that the association between attentional bias and anxiety became increasingly more positive in children in higher grades.

Our finding that bias predicts anxiety is consistent with the notion that attentional bias is a vulnerability factor for developing anxiety. While many studies have shown that anxiety is concurrently linked to attentional bias in adults as well as children (see for reviews: Kindt & Van den Hout, 2001; Logan & Goetsch, 1993; Vasey & MacLeod, 2001), longitudinal evidence is scarce. In adults, four studies report that attentional bias predicts the intensity of emotion following life stress (Beevers & Carver, 2003; MacLeod & Hagan, 1992; Van den Hout et al., 1995). In addition, MacLeod et al. (2002) showed that a standard stress task produced an emotional reaction in adults who were trained to show an attentional bias to negative emotional stimuli. These adult studies suggest that, either experimentally induced or in real life, attentional bias predicts emotional states in conjunction with stress (for similar findings with children, see Bijttebier, 1998). In the present study, we were able to show that without stress too, attentional bias at a certain moment in life can lead to higher anxiety levels some time later.

This is the first study with children showing that the presence of attentional bias at a certain time can predict later anxiety. Two previous studies with children also reported a prospective connection between two types of interpretation bias and anxiety, namely threat perception bias (Muris et al., 2003b) and emotional reasoning (Morren et al., submitted b). However, while in the current investigation the pathway from attentional bias to later anxiety was found to be *direct*, both interpretation bias studies reported an *indirect* connection. That is, the presence of interpretation bias on time 1 was linked to interpretation bias on time 2, which in turn was associated with higher anxiety levels (i.e., the dotted pathways in model 1 of Figure 4.1). It is difficult to explain why different findings were obtained with both types of information processing bias when a direct comparison of these biases in a single sample is unavailable. Possibly attentional bias and interpretation bias are linked to anxiety in a different way, but dissimilar study populations or study designs (e.g., the length of the test-retest interval) may also be responsible.

Partial support was found for the cognitive inhibition hypothesis. That is, the expected associations between attentional bias and anxiety were obtained in the temporal analyses, but not in the concurrent analyses. To be more precise, the concurrent

analyses revealed no grade-dependent connection between attentional bias and anxiety. In fact, the children, as a group, did not present a significant attentional bias (cf. Kindt et al., 2003). The temporal analysis showed that higher levels of attentional bias at a certain time predicted increases in anxiety, thereby confirming previous cross-section results (e.g., Kindt et al., 1997b, 2000; Morren et al., submitted a). This effect was similar for children in the different grades, as the interactive effect was not significant. Thus, this is the first prospective evidence for the cognitive inhibition hypothesis. Note however, that our evidence is indirect in that attentional bias was measured rather than cognitive inhibition. Experimental paradigms that assess inhibition directly, like negative priming (cf. Fox, 1994), may help to test the validity of our findings.

The absence of a general bias was unexpected, but not unprecedented (Kagan et al., 1999; Kindt & Brosschot, 1999; Kindt et al., 1997a, 1997b, 2000; Morren et al., 2003). It might be explained as follows. Firstly, it might be argued that children's anxiety levels were too low, but this seems doubtful as previous studies have found that attentional bias can be present in non-anxious children (e.g., Kindt et al., 2000; Waters et al., 2004), and absent in clinically anxious children (Kindt et al., 2003). Likewise, Kindt et al.'s (2003) explanation for not finding attentional bias in clinically anxious children with separation anxiety disorder, social phobia, and generalised anxiety disorder does not seem to be applicable. They proposed that a general bias can only be observed for information that is related to particular fears when children are in the sensitive period to develop these fears. Hitherto, a general bias effect has only been observed for spider stimuli in children aged 7 to 9 years old. At that age, the prevalence of normal childhood fears for small animals peaks (Marks, 1987), and specific phobias often begin (Öst, 1987). Since the age range of Kindt et al.'s sample was wide (i.e., 7-18 years), it seems plausible that only a minority was in their sensitive period, particularly because there were only few children per diagnosis group (i.e., 6-18). However, it seems irrelevant whether the children in this study were at a sensitive age, because they already were clinically anxious. Attentional bias has been firmly established in clinically anxious adults, who have clearly outgrown their sensitive period. Moreover, even though over 45% of the children in our study was in the sensitive period for developing spider fear (i.e., 7-9 years old), no general bias emerged.

This study has several limitations. At the beginning of the research project, high spider fearful children were selected and matched for gender and age with a low fearful control group. As a result, a higher proportion of girls were included, which is consistent with the higher prevalence of simple phobias in girls (Mackinaw-Koons & Vasey, 2000; Ollendick et al., 2002). Although we eliminated possible gender effects by controlling for this variable in our analyses, a more balanced gender distribution would have given us the opportunity to look into possible gender differences in the relationship between attentional bias and anxiety. A second consequence of this way of selection is that our sample originally consisted only of children scoring on the extreme ends of the SPQ. Although this dichotomy had largely disappeared, it may have decreased the reliability of our results. Furthermore, it might be argued that our non-clinical sample rendered detection of anxiety-specific effects more difficult. However, with clinically anxious children our attempt to establish a prospective link would almost certainly have failed, because anxiety levels would already have been at their maximum, and could only change to decline. A related issue is that the initial dichotomy of high and low spider fearful children had been fading out over time, probably

due to an ongoing regression toward the mean. Because such effects reduce the power of statistical analyses, it is encouraging that attentional bias on occasion 1 nevertheless positively predicted spider fear on occasion 2. Still, it may explain our failure to detect a general attentional bias while at the same time our Stroop data revealed a pattern of results, which confirms validity of our results. That is, younger and more fearful children responded slower, and error rates and reaction times decreased between occasion 1 and 2 (cf. Kindt et al., 2000; Moradi et al., 1999b; Morren et al., 2003).

What are the clinical implications of these results? This study shows that changes in attentional bias beget changes in the level of children's anxiety, suggesting that it may be possible to neutralise anxiety by removal or reduction of attentional bias. Indeed, several studies have shown that attentional bias can be modified (e.g., Fulcher, Mathews, Mackintosh, & Law, 2001; MacLeod et al., 2002). Interestingly, there is some strong preliminary evidence showing that it possible to treat anxiety disorders by way of modifying attentional bias (see Mohlman, 2004, for a review). A promising approach might be to develop computer-based techniques to counter anxious children's inclination to direct their attention toward the object of their fear (i.e. games or practise scenarios), and might add to recent successful applications of Internet-based treatment (e.g., Lange, Rietdijk, Hudcovicova, Van de Ven, Schrieken, & Emmelkamp, 2003). In addition, if attentional bias increases children's vulnerability to develop anxiety pathology, it would be most desirable to prevent such bias to arise in the first place. Such an approach might be fruitful with children who are otherwise at risk, for instance because anxiety runs in the family or they display behavioural inhibition. Attentional bias has indeed been established in children for whom this is the case (Moradi, Neshat-Doost, Taghavi, Yule, & Dalgleish, 1999a; Schwartz, Snidman, & Kagan, 1996). In sum, the present study presents the first evidence that attentional bias serves as a risk factor for the development of later anxiety, a finding that unbolts new possibilities for research and clinical applications.

Chapter 5

Emotional reasoning and parent-based reasoning in normal children

Abstract

A previous study by Muris, Merckelbach, and Van Spauwen (2003c) demonstrated that children display emotional reasoning irrespective of their anxiety levels. That is, when estimating whether a situation is dangerous, children not only rely on objective danger information but also on their *own* anxiety-response. The present study further examined emotional reasoning in children aged 7 to 13 years (N = 508). In addition, it was investigated whether children also show parent-based reasoning, which can be defined as the tendency to rely on anxiety-responses that can be observed in parents. Children completed self-report questionnaires of anxiety, depression, and emotional and parent-based reasoning. Evidence was found for both emotional and parent-based reasoning effects. More specifically, children's danger ratings were not only affected by objective danger information, but also by anxiety-response information in both objective danger and safety stories. High levels of anxiety and depression were significantly associated with the tendency to rely on anxiety-response information, but only in the case of safety scripts.

Morren, M., Muris, P., & Kindt, M. (2004). Emotional reasoning and parent-based reasoning in normal children. *Child Psychiatry and Human Development, 35*, 3-20.

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5.1 Introduction

Childhood fears are considered as an integral and adaptive part of normal development in reaction to real or imagined threat (Gullone, 2000). These fears wax and wane as children become older, and although they usually disappear in due course, in some children they persist and come to interfere with daily functioning (Ollendick, King, & Muris, 2002). Epidemiological studies found that the prevalence of anxiety disorders in children and adolescents varies between 5.7 and 17.7% in community samples (Costello & Angold, 1995). Researchers and clinicians in the field of child and adolescent psychopathology have recently reached consensus on the anxiety disorders that may occur in children and adolescents (American Academy of Child and Adolescent Psychiatry, 1997). The most common childhood anxiety disorders are social anxiety, separation anxiety disorder, and generalized anxiety disorder. According to Kendall's (1985) theory of childhood fear and anxiety, anxiety disorders result from overactive danger schemas. These overactive schemas are presumed to chronically focus processing resources on threat-relevant information. This gives rise to erroneous cognitive processing – i.e., cognitive distortions – that produce maladaptive or dysfunctional thoughts and behaviors. Crick and Dodge's (1994) information-processing model allows that distinctive cognitive distortions emerge during different stages of information processing (see for a review: Daleiden & Vasey, 1997). One example of a cognitive distortion is interpretation bias, which reflects children's tendency to attribute threatening meaning, intent, or outcome expectations to ambiguous situations (Daleiden & Vasey, 1997).

Emotional reasoning is a form of interpretation bias that was first described by Beck, Emery, and Greenberg (1985), who observed that "Many anxious patients use their feelings to validate their thoughts and thus start a vicious circle: 'I'll be anxious when I ask for the date so their must be something to fear.'" (p. 198). In other words, anxiety patients not only rely on objective information to determine the danger status of an event, but also on information provided by their own anxiety response. Arntz, Rauner, and Van den Hout (1995) experimentally examined this phenomenon, and found evidence for emotional reasoning in spider phobics, panic patients, social phobics, and patients with other anxiety disorders. However, these emotional reasoning effects were not content-specific: that is specific anxiety complaints could not be linked to emotional reasoning in disorder-specific situations. Similar findings were obtained with PTSD patients who appeared to infer danger from both their own anxiety responses and their intrusions (Engelhard, Macklin, McNally, Van den Hout, & Arntz, 2001; Engelhard, Van den Hout, Arntz, & McNally, 2002). Thus, it seems that anxious subjects strongly act on the proposition: "If I feel anxious, there must be danger".

Muris, Merckelbach, and Van Spauwen (2003c) recently examined the emotional reasoning phenomenon in children. Normal primary school children (N = 101) were exposed to scripts that systematically combined objective danger and objective safety situations with or without anxiety-response information. The scripts described situations related to social phobia, separation anxiety disorder, and generalized anxiety disorder, and children were asked to provide danger ratings for the pertinent scripts. The authors found some support for a general emotional reasoning effect. That is, danger ratings to objective safety scripts were inflated when anxiety-response information was included. In addition, emotional reasoning was significantly associated with both

trait anxiety and anxiety sensitivity in objective safety situations. Comparable results were obtained in a second study of normal school children (N = 156). In that study, Muris, Merckelbach, Schepers, and Meesters (2003d) found that anxiety-response information enhanced children's perception of threat. It should be noted, however, that these findings are at odds with Arntz et al. (1995) and Engelhard et al. (2001, 2002), who showed that such emotional reasoning effects are *absent* in normal adults. Thus, whereas normal adults merely rely on objective danger information when estimating the dangerousness of hypothetical scenarios, normal children seem to resemble anxious adults in their additional use of anxiety-response information to evaluate threat.

These findings seem to suggest that emotional reasoning in children is not necessarily a pathological phenomenon (Muris et al., 2003c). It is plausible that emotional reasoning constitutes a normal characteristic of development that may serve to protect children from potential threats. Anxiety responses may sensitize children to potential danger even under rather harmless circumstances, which chimes in with the high prevalence of specific fears in children (Muris & Merckelbach, 2001). Normally, children would gradually learn to neglect these anxiety responses and increasingly rely on objective danger information, and the emotional reasoning heuristic will be disengaged. Failure of this learning process would lead to an increased risk for developing an anxiety disorder Muris, Bodden, Merckelbach, Ollendick, & King, 2003a).

Interestingly, a similar developmental pattern has been proposed for another type of information processing bias, namely attentional bias. In a study by Kindt, Brosschot, and Everaerd (1997b), attentional bias was found to be present in young children irrespective of their fear level. From about age 11, this bias seemed to decrease in non-fearful children, whereas it persisted in fearful children (Kindt, Bierman, & Brosschot, 1997a). This finding was replicated in subsequent studies (Kindt, Van den Hout, De Jong, & Hoekzema, 2000; Morren, Kindt, Van den Hout, & Boogerd, submitted). If emotional reasoning in children follows a similar developmental pattern, its relationship with anxiety can be expected to change with age. That is, emotional reasoning will wane with age in non-anxious children, but will persist in anxious children.

If it is assumed that emotional reasoning follows such differential pattern, the question would be, of course, what factors are involved in the disappearance or persistence of this phenomenon? Relevant in this context may be the process of social referencing, which is defined as the tendency to make appraisals of a stimulus based on one's perception of another person's response to this stimulus (Feinman, 1992). Children frequently use their parents as the main source for social referencing, and there is indeed evidence showing that young children react with fear and avoidance to novel stimuli after having observed their mothers' negative affective response (Camras & Sachs, 1991; Gerull & Rapee, 2002; Gunnar & Stone, 1984; Zarbatany & Lamb, 1985). The process of social referencing bears strong resemblance to modeling, which is generally considered as one of the three pathways to the development of fear and anxiety (Rachman, 1997, 1991; King, Gullone, & Ollendick, 1998). Thus, children may not only estimate danger on the basis of their own anxiety response (i.e., emotional reasoning), but perhaps use their parents' response as well (i.e., parent-based reasoning).

In sum, the present study investigated (1) whether children aged 7 to 13 years exhibit emotional and parent-based reasoning in response to objective danger and objective safety situations, (2) whether higher levels of anxiety and depression are associated with a greater tendency to infer danger from personal and parent anxiety-

response information, and (3) whether anxiety, to a greater degree than depression, is associated with this tendency. Furthermore, it was examined (4) whether emotional reasoning is content-specific: that is, are specific anxiety symptoms (i.e., social anxiety, separation anxiety, and generalized anxiety) linked to emotional reasoning in response to stories depicting disorder-specific situations. Finally, the present study examined (5) whether emotional and parent-based reasoning show the predicted developmental pattern (i.e., decrease in non-anxious children, persistence in anxious children).

5.2 Methods

5.2.1 Participants

The present study was part of the one-year follow-up of an ongoing project investigating the relationship between spider fear and processing bias (Morren, Kindt, Van den Hout, & Van Kasteren, 2003). The project initially enrolled 580 children selected from 3564 children on the basis of spider fear.[1] Children attended regular primary schools in the Southern part of the Netherlands. Information about children's socioeconomic status was not available. However, schools were situated in urban and rural areas, in neighborhoods with varying socioeconomic status. Informed consent had been obtained at baseline from a primary caretaker who stated that the child was allowed and wanted to participate in the study. All children were still willing to participate when the assessment took place. Attrition reduced the present sample with 12% to 508 children (424 girls), mainly because children refused further participation or could not be contacted. Mean age of the children was 10.6 years (SD = 1.4; range 7.7 to 13.9 years), and boys and girls did not differ significantly in age, $t(506) < 1$, $p = 0.9$. There were 61 children aged 7/8, 127 aged 9, 108 aged 10, 107 aged 11, 84 aged 12, and 21 aged 13 years.

5.2.2 Materials

5.2.2.1 Questionnaires

The *short version of the Revised Children's Anxiety and Depression Scale* (RCADS; Muris, Meesters, & Schouten, 2002) is derived from Chorpita, Yim, Moffitt, Umemoto, and Francis' (2001) scale using exploratory and confirmatory factor analysis. The 25-item RCADS can be used to assess symptoms of generalized anxiety disorder (e.g., "I worry about bad things happening to me"), separation anxiety disorder (e.g., "I fear being away from my parents"), social phobia (e.g., "I am afraid to talk in front of the class"), panic disorder (e.g., "My heart suddenly beats too quickly for no reason"), and major depressive disorder (e.g., "I feel that nothing is much fun anymore"). Each subscale contains five items that are answered on a four-point scale: 0 = never, 1 = sometimes, 2 = often, 3 = always. Subscale scores can be obtained by summing relevant items. In addition, a total anxiety symptoms score is computed by summing scores of the four anxiety subscales. Reliability and validity of the RCADS are both good (Muris et al., 2002).

[1] Spider fear was measured using the Spider Phobia Questionnaire for Children (Kindt, Brosschot, & Muris, 1996), which contains 29 true-false items. The scale has been shown to be a good predictor of fear behavior in confrontation to a spider.

The *trait anxiety scale of the State-Trait Anxiety Scale for Children* (STAIC; Spielberger, 1973) is a 20-item measure of chronic anxiety symptoms such as "I get a funny feeling in my stomach" and "I am scared". Children rate how often they experience each anxiety symptom on a three-point scale (1 = almost never, 2 = sometimes, and 3 = often). Summed item ratings produce a total trait anxiety score (range 20-60), with higher scores being indicative of higher levels of trait anxiety.

5.2.2.2 Stories

Stories were based on the stories of two previous studies investigating emotional reasoning in children (Muris et al., 2003c) and adults (Arntz et al., 1995). In both studies, an emotional reasoning effect was identified by means of this story material. In the present study, the stories portrayed four situations that children may experience, pertaining to the following themes of anxiety: (1) social anxiety story: talking in front of the class, (2) separation anxiety story: taking the subway with parents on holidays abroad, (3) generalized anxiety story: getting your report card from the teacher, and (4) parent anxiety story: traversing a pedestrian crossing with your mother. There were four versions of each story: (a) with objective danger information and subjective anxiety-response information, (b) with objective danger information and subjective positive-response information, (c) with objective safety information and subjective anxiety-response information, and (d) with objective safety information and subjective positive-response information. Great care was taken that the wording of different versions of a story were as similar as possible, apart from the descriptions of danger and response information. Table 5.1 shows the anxiety- and positive-response information that was included in the stories.

The 16 stories were presented in paper-and-pencil format. The order of presentation was fixed random with the restriction that two stories describing the same situation, or the same objective danger or response information did not follow each other. To reduce the possibility of systematic order effects, the stories were counterbalanced: half of the children first received stories 1 to 8 followed by stories 9 to 16, whereas this order was reversed for the other half of the children.

Children were instructed to read each story carefully. They were encouraged to imagine that they were the leading character of the story and that they were actually confronted with the events that the stories described. Children were asked to indicate how dangerous they found each story on a scale from 1 (*not at all dangerous)* to 10 (*very dangerous*).

Table 5.1: Anxiety and positive responses for the four stories

Story	Anxiety Response	Positive Response
Social phobia	You feel embarrassed and your heart is in your mouth	You don't care about it and still feel good and at ease
Separation anxiety	Suddenly feel afraid and start to tremble	You smile and wave to your parents
Generalized anxiety	You become frightened and feel sick	You remain calm and feel good
Parent anxiety	It frightens your mum and her legs start to tremble.	Your mum looks happy, and she smiles and waves to her friend in the car

5.2.3 Procedure

All children from one and the same school completed the questionnaires (RCADS and STAIC) and stories together in a separate room at school. The experimenter was always available to provide assistance when necessary.

5.2.4 Statistical analysis

The Statistical Package for Social Sciences (SPSS) was used for data analysis. Missing values on questionnaires were replaced with the mean of a child's summed valid item score on a particular questionnaire (or subscale) if less than 10% was missing. When more than 10% were missing, the particular questionnaire sum score was discarded from the analyses. As a result, *N*s varied across analyses. To examine general emotional reasoning effects, danger ratings for the same version of the social, separation, and generalized anxiety stories were averaged. Danger ratings to the child and parent anxiety stories were subjected to separate 2 (Situation: objective danger versus objective safety) × 2 (Response: anxiety- versus positive-response) analyses of variance (ANOVAs).

To investigate the association between emotional and parent-based reasoning, on the one hand, and anxiety symptoms, on the other hand, a number of calculations were made. First, difference scores were computed by subtracting ratings for stories containing positive-response information from ratings for similar stories containing anxiety-response information, both for objective danger (i.e., danger scores) and objective safety stories (i.e., safety scores). In addition, index scores were obtained by averaging safety and danger scores. Subsequently, gender-corrected correlations were computed between danger ratings, danger, safety, and index scores for the child and parent anxiety stories, on the one hand, and anxiety and depression symptoms (RCADS) and trait anxiety (STAIC), on the other hand. Relationships of anxiety and depression with emotional and parent-based reasoning were examined by comparing the magnitude of correlations. In addition, specificity of emotional reasoning was examined by comparing whether danger ratings and danger, safety, and index scores of an anxiety-specific story correlated higher with corresponding than with other anxiety symptoms. Finally, to investigate the developmental course of emotional and parent-based reasoning, a series of hierarchical regression analyses were carried out using z-transformed variables. In these analyses, index, safety or danger scores of the child or parent anxiety

Table 5.2: Mean scores (*SD*s), gender differences, and reliability coefficients for the RCADS scales and the STAIC

	Total	Boys	Girls	$N_{boys, girls}$	Cronbach's α
RCADS					
Total score	15.3 (9.4)	12.1 (7.9)	15.9 (9.6)*	84, 423	0.92
Generalized anxiety	5.0 (3.1)	3.9 (2.7)	5.2 (3.2)*	83, 422	0.83
Separation anxiety	2.7 (2.8)	2.0 (2.3)	2.9 (2.9)*	84, 420	0.80
Social anxiety	4.0 (2.8)	3.1 (2.5)	4.1 (2.9)*	83, 414	0.75
Depression symptoms	3.5 (2.1)	3.1 (1.8)	3.6 (2.2)	82, 411	0.66
STAIC	32.3 (7.9)	29.8 (6.8)	32.8 (8.0)*	84, 422	0.92

Notes: RCADS = Revised Children's Anxiety and Depression Questionnaire, STAIC = trait anxiety scale of the State-Trait Anxiety Inventory for Children. * Significant gender differences at $p < 0.01$.

story were the dependent variables, whereas gender, age, either STAIC or RCADS anxiety (step 1), and the interaction of interaction of anxiety and age (step 2) were the predictors. Note that variables with significant skewness and kurtosis were normalized.

5.3 Results

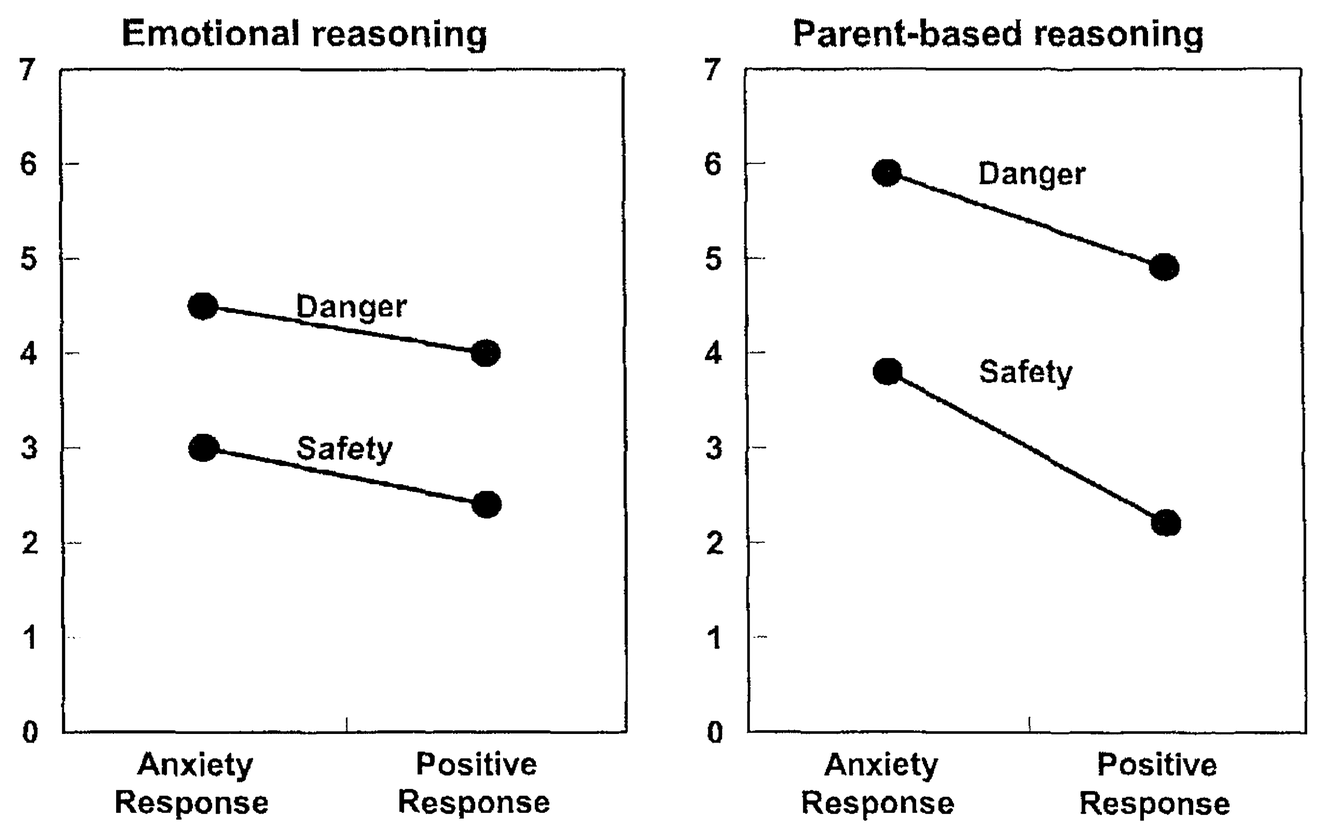
5.3.1 General findings

Before the main results are presented, several general issues should be pointed out. First, in correspondence with previous research (Craske, 1997), girls displayed significantly higher anxiety scores than boys did (see Table 5.2). No gender differences emerged for RCADS depression symptoms. Second, girls had higher danger ratings than boys for the child anxiety story [$ts(503) > 2.4$, $ps < 0.05$], while for the parent anxiety story only the rating of the objective safety story with a positive response reached significance [$t(489) = 2.4$, $p = 0.01$]. No gender differences were present for safety, danger, and index scores [$ts(503) < 1$, ps = ns]. Finally, internal consistencies of the measures were modest to excellent: for the anxiety and depression measures Cronbach's αs were between 0.66 and 0.92), and for the four versions of the child anxiety stories these values were between 0.56 and 0.73.

5.3.2 General emotional reasoning and parent-based reasoning effects

Table 5.3 shows means and standard deviations for the child anxiety story. As expected, the ANOVA showed that children evaluated objective danger stories as signifi-

Figure 5.1: General emotional reasoning effect (left panel; N = 505) and parent-based reasoning effect (right panel; N = 490): mean danger ratings for objective danger and objective safety stories with anxiety- or positive-response information as computed for the total sample



cantly more dangerous than objective safety stories [$F(1, 504) = 916.2$, $p < 0.001$]. Furthermore, children found stories containing anxiety-response information more dangerous than stories with positive-response information [$F(1, 504) = 149.6$, $p < 0.001$]. As the left panel of Figure 5.1 shows, children again rated the objective danger and safety stories as more dangerous when containing anxiety-response information compared to positive-response information [both paired $ts(504) > 8.4$, $ps < 0.001$]. However, the magnitude of this emotional reasoning effect did not differ significantly between objective danger and safety stories [paired $t(504) = 1.8$, $p = 0.2$; see Figure 5.1, left panel].

Table 5.3 also displays means and standard deviations the parent anxiety story. Again, the ANOVA revealed significant main effects of Situation [$F(1, 490) = 520.0$, $p < 0.001$] and Response [$F(1, 490) = 164.2$, $p < 0.001$], as well as a significant interaction effect [$F(1, 490) = 41.8$, $p < 0.001$]. A Situation × Response interaction [$F(1, 490) = 5.57$, $p < 0.025$] showed that the magnitude of this emotional reasoning effect was somewhat larger in objective safety situations compared to objective danger situations [paired $t(490) = 4.6$, $p < 0.001$], although it was significant in both the safety and danger stories [paired $ts(490) > 6.4$, $ps < 0.001$; see Figure 5.1, right panel].

Thus, children not only showed a general emotional reasoning effect, they also exhibited parent-based reasoning in response to both objective safety and objective danger situations. Effects were more pronounced in the objective safety situation.

Table 5.3: Means (SDs) for story-based scores, and correlations (corrected for gender) between RCADS anxiety, depression and STAIC, on the one hand, and danger ratings, danger, safety, and index scores for the child anxiety story ($N = 487$) and the parent anxiety story ($N = 473$), on the other hand

Story	Danger rating	Mean (*SD*)	RCADS anxiety	RCADS depression	STAIC
Child Anxiety	Danger/anxiety response	4.5 (2.3)	0.43^{**}_{a}	0.24^{**}_{b}	0.43^{**}_{a}
	Danger/positive response	4.0 (2.2)	0.43^{**}_{a}	0.21^{**}_{b}	0.41^{**}_{a}
	No danger/anxiety response	3.0 (2.1)	0.43^{**}_{a}	0.22^{**}_{b}	0.42^{**}_{a}
	No danger/positive response	2.4 (1.7)	0.40^{**}_{a}	0.24^{**}_{b}	0.40^{**}_{a}
	Danger score	0.5 (1.4)	0.03_{a}	0.06_{a}	0.06_{a}
	Safety score	0.6 (1.3)	0.16^{**}_{a}	0.06_{b}	0.16^{**}_{a}
	Index score	0.6 (1.1)	0.12^{*}_{a}	0.07_{a}	0.14^{*}_{a}
Parent Anxiety	Danger/anxiety response	5.9 (3.1)	0.31^{**}_{a}	0.11^{*}_{b}	0.29^{**}_{a}
	Danger/positive response	4.9 (3.0)	0.25^{**}_{a}	0.05_{b}	0.27^{**}_{a}
	No danger/anxiety response	3.8 (2.8)	0.26^{**}_{a}	0.13^{*}_{b}	0.25^{**}_{a}
	No danger/positive response	2.2 (2.1)	0.20^{**}_{a}	0.09_{b}	0.18^{**}_{ab}
	Danger score	0.9 (3.0)	0.07_{a}	0.06_{a}	0.04_{a}
	Safety score	1.6 (2.7)	0.12^{*}_{a}	0.06_{a}	0.11^{*}_{a}
	Index score	1.3 (2.3)	0.11^{*}_{a}	0.08_{a}	0.09^{*}_{a}

Notes: RCADS = Revised Children's Anxiety and Depression Questionnaire, STAIC = trait anxiety scale of the State-Trait Anxiety Inventory for Children. Correlations in the same row that do *not* share the same subscript differ at $p < 0.05/3$. $^{*}p < 0.01$, $^{**}p < 0.001$, two-tailed.

5.3.3 Relationship of anxiety and depression with emotional and parent-based reasoning

To examine the relationship of emotional and parent-based reasoning with RCADS and STAIC, gender-corrected correlations were calculated (see Table 5.3). In general, both anxiety measures were significantly and positively associated with the danger ratings to the child anxiety story (*r*s range from 0.40 to 0.43, *p*s < 0.001) and the parent anxiety story (*r*s range from 0.18 to 0.31, *p*s < 0.001). Most importantly, small but significant correlations emerged between anxiety measures and the safety and index scores of the child as well as the parent anxiety story (*r*s range from 0.09 to 0.16, *p*s < 0.05). However, no significant correlations were found between the anxiety measures and the danger scores of both stories.

In most cases, depression also correlated positively with danger ratings (*r*s range from 0.05 to 0.24), although it should be noted that correlations were considerably smaller than those obtained between anxiety and danger ratings. Most importantly, depression symptoms did not correlate with any of the danger, safety, and index scores (all *r*s < 0.08).

To examine whether anxiety was more strongly associated with emotional and par-

Table 5.4: Correlations (corrected for gender) between RCADS generalized anxiety, separation anxiety, and social anxiety, on the one hand, and danger ratings, danger, safety, and index scores of the generalized anxiety, separation anxiety, and social anxiety story

Story	Danger rating	Generalized anxiety	Separation anxiety	Social anxiety
Generalized Anxiety	Danger/anxiety response	0.30**	0.33**	0.27**
	Danger/positive response	0.27**	0.30**	0.32**
	No danger/anxiety response	0.23**	0.25**	0.24**
	No danger/positive response	0.23*	0.28**	0.24**
	Danger score	0.04	0.06	-0.05
	Safety score	0.09*	0.05	0.10*
	Index score	0.09*	0.08	0.03
Separation Anxiety	Danger/anxiety response	0.27**	0.29**	0.25**
	Danger/positive response	0.27**	0.27*	0.21*
	No danger/anxiety response	0.23**	0.20**	0.23**
	No danger/positive response	0.24**	0.22**	0.22**
	Danger score	-0.01	0.00	0.03
	Safety score	-0.01	-0.00	0.03
	Index score	-0.02	0.00	0.04
Social Anxiety	Danger/anxiety response	0.24**	0.26**	0.26**
	Danger/positive response	0.22**	0.24**	0.30**
	No danger/anxiety response	0.25**	0.30**	0.27**
	No danger/positive response	0.20**	0.22**	0.22**
	Danger score	0.06	0.05	-0.00
	Safety score	0.13*	0.17**	0.14*
	Index score	0.12*	0.14*	0.08

Notes: $N = 460$. *$p < 0.01$, **$p < 0.001$, two-tailed.

ent-based reasoning compared to depression symptoms, tests for comparing correlation coefficients were carried out (Meng, Rosenthal, & Rubin, 1992). As can be seen in Table 5.3, danger ratings for both the child and parent anxiety stories generally were more substantially correlated with both anxiety measures than with depression. This was also the case for the safety score of the child anxiety story.

In addition, partial correlations were computed in order to investigate whether anxiety and depression were independently associated with emotional and parent-based reasoning. When controlling for anxiety (i.e., RCADS, STAIC, or both), correlations between depression and child and parent danger ratings and scores significantly attenuated and were no longer significant in the expected direction (*r*s between -0.15 and 0.05). However, when controlling for depression, the significant correlations between both anxiety indices and the child and parent anxiety story danger ratings and scores remained substantial (*r*s between 0.10 and 0.39), except for the correlations with the index score of the parent anxiety story (both *r*s < 0.09, *ns*).

5.3.4 Content-specificity of emotional reasoning

As can be seen in Table 5.4, no support was found for the notion that the tendency to rely on subjective-response information when estimating danger is anxiety-specific. That is, the few significant differences that emerged were either opposite to the predictions (e.g., the safety score of the social anxiety story correlated stronger with RCADS generalized anxiety than with RCADS social anxiety) or irrelevant (e.g., RCADS generalized anxiety correlated stronger with the safety score of the social anxiety story than with that of the separation anxiety story).

5.3.5 Emotional and parent-based reasoning as a function of age and anxiety

To find out whether emotional and parent-based reasoning effects persist with age in anxious children but wane with age in non-anxious children, 12 regressions were carried out. The danger, safety or index score of the child or parent anxiety story was predicted by gender, age, and RCADS or STAIC scores (step 1), and by the interaction of RCADS/STAIC × age (step 2). After Bonferroni-correction ($\alpha/12$) had been applied, both RCDAS and STAIC significantly predicted the safety score of the child anxiety story, whereas only the RCADS significantly predicted the safety as well as index score of the parent-anxiety story. No significant effects of age or gender on emotional or parent-based reasoning emerged. The only significant interaction effect was between age and STAIC, predicting the index score of the parent anxiety story ($p < 0.05/12$). Inspection of this interaction indicated that, in contrast with the prediction, the general parent-based reasoning effect significantly decreased with age in high trait anxious children, whereas it increased with age in low trait anxious children.

5.4 Discussion

The present study investigated emotional and parent-based reasoning in children. Results can be summarized as follows. First, evidence was found that children generally displayed emotional and parent-based reasoning. More specifically, children not only used objective information to determine the dangerousness of a situation, but also relied on anxiety- and positive-response information. These effects were demonstrated

in both objective safety and objective danger situations. Second, anxiety was more substantially associated with most of the emotional and parent-based reasoning scores than depression, and this was especially true for scores pertaining to objective-safety stories. No evidence was found that the relationships between anxiety, and emotional and parent-based reasoning were content-specific. Last, no evidence was found for the hypothesis that emotional and parent-based reasoning remain stable with age in high anxious children, but decrease with age in low anxious children.

The emotional reasoning effect emerged not only in objective safety situations, like in Muris et al.'s (2003c) study, but also in objective danger situations. Several differences between the stories of both studies may explain this discrepancy. First, the anxiety-response information in the Muris et al. study only involved a physical symptom (e.g., trembling), whereas an explicit anxiety-affect (e.g., being scared) was added to the physical symptom in the present study (Arntz et al., 1995). Second, Muris et al.'s control stories contained no anxiety-response information, whereas control stories in the current study contained positive-response information in the form of positive affect (e.g., feeling happy) and positive behaviour (e.g., laughing). These modifications may have made the present experiment more sensitive to tap emotional reasoning effects, and may thus explain why emotional reasoning emerged in both objective safety and objective danger stories.

The present findings indicate that children not only rely on their own emotional response when deciding whether threat is imminent (i.e., emotional reasoning), but also on their mother's response. This general parent-based reasoning effect adds to the evidence on social referencing (Camras & Sachs, 1991) and parental influences on cognitive bias in children (Barrett, Rapee, Dadds, & Ryan, 1996; Chorpita, Albano, & Barlow, 1996). Moreover, this finding is consistent with an emerging body of research that supports the role of modelling and negative information in the development of childhood anxiety (Field, Argyris, & Knowles, 2001; Muris et al., 2003c; Gerull & Rapee, 2002) and avoidance behaviour (Silverman, Cerry, Nelles, & Burke, 1988). Of course, the present investigation did not directly address the relationship between parent-based reasoning and modelling or social referencing. For example, one way in which these phenomena may be different is the extent to which intrapersonal processes like cognition are hypothesized to be relevant. In addition, the hypothesis that modelling, social referencing, or parent-based reasoning plays is associated with anxiety in children presupposes that parent anxiety, when present, will be expressed in certain behavioural responses. The mutual connection between these variables might be of considerable interest for future research.

The general emotional reasoning effect that was found in the present sample is in line with the results of Muris et al. (2003c) In contrast, Arntz et al. (1995) found that normal adults only use objective danger information to rate threat, and do not rely on anxiety-response information. As mentioned in the introduction, developmental issues may explain this discrepancy. Emotional reasoning may be a normal phenomenon in young children, which gradually disappears as children become able to discriminate between objective danger information and subjective response information. When anxious children fail to master this ability, emotional reasoning persists. Some evidence for such a developmental pattern has been found with attentional bias (Kindt et al., 2000; Morren et al., submitted). Present findings did not support this hypothesis, although it should be pointed out that all children in the present study were still rather young (i.e., younger than 14 years). Emotional reasoning may not wane until later in

adolescence (Muris et al., 2003c). The current study did find a significant age × anxiety interaction for parent-based reasoning. That is, general parent-based reasoning decreased in high trait anxious children, but remained stable in low trait anxious children. It is plausible to assume that high trait anxious children gradually rely less on their mother's anxiety response as they get older, and increasingly rely on their own response instead.

Consistent with previous studies (Arntz et al., 1995; Muris et al., 2003c), high levels of trait anxiety, and anxiety and depression symptoms were significantly associated with the tendency to use personal and parental response information when rating the dangerousness of the situations. These associations were significantly stronger for anxiety than for depression. Moreover, the relationship between anxiety, on the one hand, and emotional and parent-based reasoning, on the other hand, seemed to be independent of depression. Thus, although results indicated that emotional and parent-based reasoning are anxiety-related phenomena, it should also be mentioned that specific anxiety complaints were not specifically linked to emotional reasoning in situations relevant to these complaints. In other words, no evidence was found that the tendency to infer danger from subjective anxiety response information was content-specific (Arntz et al., 1995).

The present study has several limitations. First, the current sample consisted of normal children that did not meet the diagnostic criteria for an anxiety disorder. It would be worthwhile to replicate these findings in a sample of clinically referred children. Second, this sample contained a relative large proportion of girls. However, the findings are in line with Muris et al. (2003c), who studied a sample with a more balanced gender distribution. Third, emotional and parent-based reasoning were assessed by means of a paper-and-pencil assessment. Future studies should further establish the ecological validity of emotional and parent-based reasoning by using experimental analogues of the task. This could also resolve some of the drawbacks of the correlational nature of present study, because one could actually examine whether emotional reactions of children or their parents directly produce changes in the child's level of fear to stimuli or situations. Fourth, with respect to parent-based reasoning only the tendency to rely on maternal response information was investigated, which may differ from children's tendency to rely on paternal response information. In addition, it might be interesting to examine non-parental sources of response information, such as peers or familiar and unfamiliar adults. Fifth, because children's age range was limited, the developmental pattern of emotional and parent-based reasoning in children and adolescents could not be fully clarified. Finally, a possible alternative explanation of the inflated danger ratings in stories with anxiety symptoms is that they did not result from emotional reasoning, but from general emotion or ground and ceiling effects. To conclude, the present study strongly suggests that emotional and parent-based reasoning are normal phenomena in children, and adds to the extant body of research investigating the development of anxiety.

Chapter 6

Emotional reasoning and parent-based reasoning in normal children, and their prospective relationships with anxiety symptoms

Abstract

Emotional and parent-based reasoning refer to the tendency to rely on personal or parental response information rather than on objective danger information when estimating the dangerousness of a situation. This study investigated the prospective relationships of emotional and parent-based reasoning with anxiety symptoms in a sample of normal children (N = 122). Children completed an anxiety measure and provided danger ratings of scenarios that systematically combined objective danger and objective safety information with anxiety-response and positive-response information. This procedure was repeated 10 months later. Emotional and parent-based reasoning effects emerged on both occasions. Emotional and parent-based reasoning were modestly stable, but only in the case of objective safety situations. Evidence was found that the presence of anxiety at a certain time is positively related to emotional reasoning at a later time. Similarly, the presence of emotional reasoning at a certain time was positively related to anxiety at a later time, but only age was taken into account. That is, this relationship changed from being positive in younger children to negative in older children. No significant prospective relationships emerged between anxiety and parent-based reasoning.

Morren, M., Muris, P., Kindt, M., Schouten, E., & Van den Hout. *Emotional-reasoning and parent-based reasoning in normal children, and their prospective relationships with anxiety symptoms.*

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6.1 Introduction

Anxiety disorders are among the most frequently diagnosed psychopathological problems in children and adolescents. It is generally agreed that children normally show developmentally appropriate fears that wax and wane spontaneously. Nevertheless, epidemiological studies report a prevalence of clinical anxiety levels in 5.7 to 17.7% of the youths (e.g., Costello & Angold, 1995; Verhulst, 2001). In addition, symptoms of specific phobias and overanxious disorder are fairly common (i.e., up to 20%) in children with no history of psychiatric illness (Bell-Dolan, Last, & Strauss, 1990). According to Kendall's (1985) theory of childhood anxiety, pathological fear and anxiety are associated with hyperactive danger schemas that give rise to cognitive biases at different stages of information processing (Daleiden & Vasey, 1997; Vasey & MacLeod, 2001). For example, anxious children tend to exhibit schema-congruent interpretations (i.e., threatening) of ambiguous stimuli (i.e., interpretation bias).

Several studies demonstrated that anxious children display interpretation bias (see for a review Vasey & MacLeod, 2001). Hadwin, Frost, French, and Richards (1997) instructed children to indicate the meaning of ambiguous homophones by pointing at a neutral or a threatening picture. They found that trait anxiety was associated with a greater tendency to interpret homophones as threatening. Barrett, Rapee, Dadds, and Ryan (1996) presented children with anxiety disorders, children with oppositional defiant disorder, and non-anxious control children with several ambiguous vignettes. Anxious and oppositional children more often interpreted these situations as threatening. When asked how they would deal with the situations, anxious children more often chose avoidant solutions compared to the other groups (for similar findings, see Bell-Dolan, 1995; Bögels, Snieder, & Kindt, 2003; Creswell, Schniering, & Rapee, 2005; Bögels & Zigterman, 2000; Chorpita, Albano, & Barlow, 1996). Finally, Muris and colleagues (e.g., Muris, Merckelbach, & Damsma, 2000c, Muris, Jacques, & Mayer, 2003b; Muris, Rapee, Meesters, Schouten, & Geers, 2003e) carried out a series of studies to investigate threat perception abnormalities, which refers to anxious children's tendency to require only minor threat cues to decide that danger is present. In these studies, children were confronted with ambiguous stories that were presented sentence-by-sentence. After each sentence, children were asked to predict how the story would end (i.e., threatening or non-threatening). Results indicated that high levels of anxiety were associated with a lowered threshold for detecting threat, a high frequency of threat perception and threat interpretation, and higher threat ratings of the stories.

These studies have in common that the misinterpretation concern external, environmental stimuli. Alternatively, however, misinterpretation may concern interoceptive information (cf. Clark, 1999), such as feelings of anxiety or bodily symptoms. For example, Beck, Emery, and Greenberg (1985) observed that anxiety patients frequently use their personal feelings to validate their thoughts, and rely on information provided by their own anxiety response rather than on objective information to determine whether a situation is dangerous. Arntz, Rauner, and Van den Hout (1995) found that this 'emotional reasoning' effect was present in adult social phobics, spider phobics, panic patients, and patients with other anxiety disorders, but not in normal controls. Similarly, PTSD patients estimate danger on the basis of both their anxiety responses and intrusions (Engelhard, Macklin, McNally, Van den Hout, & Arntz, 2001; Engel-

hard, Van den Hout, Arntz, & McNally, 2002), and social phobics use internal bodily information to decide upon the dangerousness of social situations (e.g., Mansell & Clark, 1999; Papageorgiou & Wells, 2002). Emotional reasoning typically involves the use of specific interoceptive information to determine whether danger is present, and may play a role in the development and maintenance of fear and anxiety. When a stimulus is considered to be threatening and elicits an anxious reaction, the very presence of this reaction may be taken as evidence that threat is impending (i.e., emotional reasoning). This increased sense of threat would in turn maintain or intensify the anxiety response, and so on.

In children, three studies provide evidence for emotional reasoning. To begin with, Muris, Merckelbach, and Van Spauwen (2003c) confronted children (N = 101) with scenarios in which objective danger and objective safety were systematically combined with the absence or presence of anxiety-response information. Scenarios were written around themes of generalised anxiety, separation anxiety, and social anxiety, and children were required to provide danger ratings for each scenario. Results indicated that a general emotional reasoning effect was present. That is, children generally rated objective *safety* scenarios as more dangerous when anxiety-response information was present as compared to when this information was absent. In addition, only in the case of objective safety scenarios, this emotional reasoning effect was more substantial in children who reported more anxiety complaints. Similar results were obtained by Morren, Muris, and Kindt (2004) in a second sample of non-clinical children (N = 508). However, emotional reasoning emerged not only in objective safety scenarios, but also in objective *danger* scenarios. These authors further found that children not only rely on their own anxiety-response information when estimating the dangerousness of a situation, but also on *parental* response information (i.e., parent-based reasoning). Further evidence of emotional reasoning was obtained by Muris, Merckelbach, Schepers, and Meesters (2003d), who found that children (N = 156) rated ambiguous scenarios as more threatening when anxiety-response information was included as compared to when it was not.

From the above-described studies, an important difference in emotional reasoning between adults and children transpires. While the tendency to infer danger from one's personal anxiety response is only present in adults with anxiety disorders, it seems to be present in children irrespective of their anxiety levels. This suggests that young children are highly sensitive to threat, but as they get older increasingly learn to rely on objective danger information rather than on anxiety-response information. This learning process might be established on the basis of environmental input, through the process of modelling or the transfer of verbal information (e.g., Field, Argyris, & Knowles, 2001; Muris, Bodden, Merckelbach, Ollendick, & King, 2003a; Rachman, 1991). Under normal circumstances, this would lead to deactivation of the emotional reasoning heuristic (cf. Morren et al., 2004). However, when this learning process is hampered, for instance as a result of predisposing vulnerabilities (e.g., behavioural inhibition), flawed models or faulty information, children may develop anxiety. Interestingly, a similar developmental pattern has been proposed for another information processing bias, namely attentional bias. That is, while children normally learn to inhibit the tendency to selectively focus their attention on fear-related information, anxious children fail to do so (cf. Kindt, Bierman, & Brosschot, 1997a). In the case of emotional reasoning, children may learn to appraise a certain stimulus by watching others respond to this stimulus, in particular their parents. In support of this idea, there is

evidence that children exhibit fear and avoidance to novel stimuli after they observed their mother display a negative affective response (e.g., Camras & Sachs, 1991; Gerull & Rapee, 2002). In addition, we recently found that children rely on their mother's response when they evaluate the dangerousness of a situation (Morren et al., 2004). Thus, while emotional reasoning normally subsides as children learn to rely on objective information, anxious children may fail to do so because important others like parents wrongly provided anxiety-response information in the absence of danger.

Most research on the relationship between anxiety and interpretation biases in children is cross-sectional (e.g., Creswell et al., 2005; Muris et al., 2000a; 2003c). This is problematic because such research offers no certainty as to whether cognitive bias is a predictor of later anxiety, and it is equally likely that the direction of this relationship is reversed which may render cognitive bias an epiphenomenon of anxiety. Thus far, only one study (Muris et al., 2003b) investigated the temporal relationships between threat perception abnormalities and anxiety, using a 4-week time interval. The results of this study were not supportive of a *direct* prospective link between bias and anxiety, but suggested that this connection might rather be *indirect*. That is, current anxiety was predicted by previous bias, but only via current bias. Similarly, current bias was predicted by previous anxiety, but only via current anxiety. Although the prospective relationships could only be indirectly revealed, they indicate that processing biases are not merely epiphenomena of anxiety, and support the hypothesis by MacLeod (1991) that anxiety and processing biases are mutually reinforcing.

The main purpose of the present study was to examine the prospective relationships between anxiety, and emotional and parent-based reasoning in children. One-hundred-and-twenty-two primary school children completed the short version of the Revised Children's Anxiety and Depression Scale (RCADS; Muris, Meesters, & Schouten, 2002) and responded to vignettes measuring emotional and parent-based reasoning. These measurements were repeated some 10 months later. On both occasions, it was hypothesised that children would exhibit general emotional and parent-based reasoning effects, and that these effects would be more pronounced when anxiety was higher. More importantly, emotional and parent-based reasoning were expected to predict later anxiety symptoms. In addition, it was anticipated that this relationship would be affected by age: the connection between anxiety and emotional reasoning was expected to be stronger in older children. No specific hypotheses were formulated as to the causal direction of this connection, nor as to whether this connection would be direct or indirect (cf. Muris et al., 2003b).

6.2 Methods

6.2.1 Participants

Participants were 122 children (106 girls) from primary schools in the Southern part of the Netherlands. Their mean age was 10.5 years (*SD* = 1.3, range 7-13 years). Children were a random sample of children taking part in a project on the relation between spider fear and cognitive bias in children (see Morren, Kindt, Van den Hout, & Van Kasteren, 2003). For the purpose of the project, one year before the present study, children were selected on the basis of high spider fear and matched as closely as possible on gender and age with low spider fearful children. Thus, consistent with the higher prevalence of anxiety complaints in girls compared to boys (e.g., Costello & Angold,

1995; Verhulst, 2001), the present sample consisted mainly of girls. Note, however, that when the present study commenced the distribution of spider fear scores was no longer dichotomous, but approached normality (i.e., skewness and kurtosis were negligible). Informed consent was obtained from a primary caretaker prior to the start of the project.

6.2.2 Assessments

The short version of the *RCADS* (Muris et al., 2002) assesses DSM-defined anxiety disorders symptoms in youths. This 20-item questionnaire contains four subscales: generalised anxiety (e.g., "I worry that something bad will happen"), separation anxiety (e.g., "I feel scared when I have to sleep on my own"), social phobia (e.g., "I am scared when I have to take a test"), and panic disorder (e.g., "My heart suddenly beats too quickly for no reason"). Items are rated on a four-point scale: 0 = *never*, 1 = *sometimes*, 2 = *often*, 3 = *always*. A total score was calculated by summing ratings of the four subscales (range 0-60). The RCADS has good reliability and validity (Muris et al., 2002).[1]

Four *vignettes* were presented in a paper-and-pencil format. Three vignettes were designed to measure emotional reasoning, and each depicted a child responding to situations pertaining to generalised anxiety (i.e., getting your report card from the teacher), separation anxiety (i.e., taking the subway with parents on holidays abroad), or social anxiety (i.e., talking in front of the class). The fourth vignette was designed to measure parent-based reasoning and depicted the child witnessing his or her mother's response to a traffic situation (i.e., traversing a pedestrian crossing). From each vignette, four scenarios were derived in which objective danger or objective safety information was systematically combined with subjective anxiety-response or subjective positive-response information. The wording of sentences describing objective situational and subjective response information was the same in the pertinent scenarios of a particular vignette (see Table 6.1 for an example).

Table 6.1: Example of a vignette

The social anxiety vignette		
Intro	Everybody has to give a presentation in front of the class. It is your turn ...	
Situation	*A. Objectively dangerous:* ... Suddenly, you don't know how to go on. You start to blush. The other children give you an angry look and laugh at you ...	*B. Objectively safe:* ... You do well and decide to make a joke. The other children look happy at you and laugh about your joke ...
Response	*C. Anxiety:* ... You feel more and more embarrassed and your heart is in your mouth.	*D. Positive:* ... You don't care about it and still feel good and at ease.

Note: On the basis of this vignette, four scenarios can be composed which consist of the intro, a situation (A or B), and a response (C or D), respectively.

[1] As an alternative measure of anxiety, the 20-item trait anxiety form of the State-Trait Anxiety Inventory for Children (Spielberger, 1973) was administered. However, only the results involving the RCADS are reported, because both measures yielded a highly similar pattern of results.

Children were instructed to read each scenario carefully, and to project themselves into the leading character experiencing the events in the scenario. Then they were asked to rate the dangerousness of the scenario on a 10-point scale (1 = *not at all dangerous*; 10 = *very dangerous*). The scenarios were presented in a fixed random order, with the constraint that scenarios describing the same situation or subjective response information were never presented consecutively. To prevent systematic order effects, scenario administration was counterbalanced within and across occasions.

6.2.3 Procedure

Testing took place on two occasions, with a mean test-retest interval of 10 months (range 8-11 months). Questionnaires and scenarios were administered in a quiet room at school. The experimenter was available to provide assistance, if necessary. The RCADS was completed first, followed by the scenarios.

6.2.4 Statistical analyses

Data were analysed using the Statistical Package for Social Sciences (SPSS). To examine general emotional reasoning effects, the average was taken of danger ratings from the same scenario of the social, separation, and generalised anxiety vignettes. Danger ratings of the child and parent anxiety scenarios were then subjected to 2 (Situation: objective danger versus objective safety) × 2 (Response: anxiety- versus positive-response information) analyses of variance (ANOVAs).

Associations between anxiety symptoms, on the one hand, and emotional and parent-based reasoning, on the other hand, were examined by means of correlations (while controlling for gender and age). In order to do so, ratings of the child and parent anxiety scenarios containing positive-response information were subtracted from ratings from scenarios containing anxiety-response information. This was done separately for scenarios containing objective danger (i.e., danger scores) and objective safety information (i.e., safety scores). Lastly, index scores were obtained by computing an average of the safety and the danger score to obtain a general measure of emotional and parent-based reasoning. To examine the stability of the anxiety measures and of emotional and parent-based reasoning ratings and scores, intra-class correlation coefficients were calculated, using the two-way mixed effects model with absolute agreement condition (ICC).

Prospective relationships between emotional reasoning and anxiety disorders symptoms were examined by way of two stepwise linear regression analyses using *z*-transformed variables. Extreme outliers were removed from the analyses, and gender and age were forced into the equation on step 0. In the first analysis, emotional reasoning on occasion 2 was the dependent variable. Emotional reasoning and anxiety symptoms on occasion 1 were entered into the equation on step 1, followed by anxiety symptoms on occasion 2 on step 2. Next, the interaction of anxiety disorders symptoms × age on occasion 1 (step 3) and occasion 2 (step 4) were added. In the second analysis, anxiety disorders symptoms on occasion 2 was the dependent variable. Again, anxiety disorders symptoms and emotional reasoning on occasion 1 were entered on step 1. This was followed by emotional reasoning on occasion 2 on step 2, and the interaction of emotional reasoning with age on occasion 1 (step 3) and occasion 2 (step 4). The relationship between parent-based reasoning and anxiety was examined in a similar

fashion. The same analyses were performed, which now involved parent-based reasoning instead of emotional reasoning.

6.3 Results

6.3.1 General findings

Before the main results are presented, several general issues should be addressed. First, although girls displayed somewhat higher levels of anxiety disorders symptoms than boys on both occasions, these differences did not reach statistical significance, *ts*(118) < 1.9, *ps* > 0.07. Second, no significant sex differences emerged for emotional and parent-based reasoning scores, *ts*(118) < 1.7, *ps* > 0.10. Finally, the internal consistency of the RCADS was excellent on both occasions (both Cronbach's alphas were 0.88).

6.3.2 Emotional reasoning and parent-based reasoning on occasion 1 and 2

Mean emotional and parent-based reasoning scores on occasion 1 and 2 are shown in Table 6.2. The ANOVAs of the child and parent anxiety vignettes yielded main effects of Situation on both occasions, indicating that objective danger scenarios were rated as significantly more dangerous than objective safety scenarios [*Fs*(1, 119) > 73.8, *ps* < 0.001]. Main Response effects for both types of vignettes on both occasions indicated

Table 6.2: Mean scores (*SD*s) and 8-month test-retest coefficients of the emotional reasoning and parent-based reasoning variables, and anxiety disorders symptoms

	Occasion 1		Occasion 2		Stability
	M	(*SD*)	*M*	(*SD*)	ICC
Child anxiety vignette					
Danger/anxiety response rating	3.63	(2.15)	3.88	(2.25)	0.60***
Danger/positive response rating	3.41	(2.15)	3.60	(2.17)	0.57***
Safety/anxiety response rating	2.74	(1.95)	2.97	(2.04)	0.62***
Safety/positive response rating	2.26	(1.63)	2.48	(1.69)	0.41***
Safety score	0.48	(1.28)	0.49	(1.34)	0.26**
Danger score	0.23	(1.45)	0.29	(1.01)	-0.13
Index score	0.35	(1.02)	0.39	(0.79)	0.22**
Parent anxiety vignette					
Danger/anxiety response rating	5.52	(2.85)	5.57	(2.96)	0.20*
Danger/positive response rating	4.97	(2.79)	4.89	(2.82)	0.35***
Safety/anxiety response rating	3.77	(2.58)	3.78	(2.60)	0.27**
Safety/positive response rating	2.14	(2.03)	1.85	(1.74)	0.33***
Safety score	1.63	(2.64)	1.93	(2.81)	0.23**
Danger score	0.55	(3.03)	0.68	(2.77)	0.08
Index score	1.09	(2.29)	1.30	(2.10)	0.14
RCADS	14.71	(8.59)	13.77	(7.87)	0.57***

Notes: *n* = 120. RCADS = revised Children's Anxiety and Depression Questionnaire. *p < 0.05, **p < 0.01, ***p < 0.001, one-tailed.

that scenarios with anxiety-response information were perceived as more dangerous than scenarios with positive-response information: i.e., emotional and parent-based reasoning effects [*Fs*(1, 119) > 14.4, *ps* < 0.001]. In addition, there was a Situation × Response interaction on both occasions for the parent anxiety vignette [*Fs*(1, 119) > 12.2, *ps* < 0.001], but not for the child anxiety vignette. This was due to the fact that the parent-based reasoning effects were somewhat larger for objective safety than for objective danger scenarios [paired *ts*(119) > 3.4, *ps* < 0.001]; however, the effect itself was significant in both scenarios [paired *ts*(119) > 1.99, *ps* < 0.05]. For the child anxiety vignette, a significant emotional reasoning effect was present on both occasions for the objective safety scenario [paired *ts*(119) > 3.9, *ps* < 0.001]; for the objective danger scenario, this effect was significant only on occasion 2 [paired-*t*(119) = 3.1, *p* < 0.01].

6.3.3 Concurrent relationships between anxiety and emotional and parent-based reasoning on both occasions

Table 6.3 shows the correlations (controlled for gender and age) between the RCADS and the emotional and parent-based reasoning indices on both occasions. Anxiety symptoms were modestly but significantly associated with the safety score of the child anxiety scenario on both occasions, the index score only on occasion 2 (*rs* range from 0.18 to 0.27). For the parent anxiety scenario, only the associations of anxiety symptoms with the safety and index score on occasion 1 reached significance (both *rs* were low – 0.15 – but significant).

6.3.4 Stability of emotional and parent-based reasoning

The right column of Table 6.2 shows the 10-months test-retest coefficients for the anxiety questionnaire (RCADS) and the ratings and scores of the child and parent anxiety scenarios. A high test-retest correlations were found for the RCADS (ICC = 0.57). Furthermore, stability coefficients for ratings of the child anxiety scenarios (ICCs between 0.41 and 0.62) were somewhat larger than those for the parent anxiety scenarios (ICCs between 0.20 and 0.35), and all attained significance. The stability of the safety, danger, and index scores of both the child and the parent anxiety scenario were mostly lower (all ICCs below 0.30). The emotional and parent-based reasoning effects in response to safety scenarios (i.e., safety scores) were both moderately stable; this was not

Table 6.3: Correlations between anxiety symptoms and emotional and parent-based reasoning scores on occasion 1 and 2 (while controlling for gender and age)

	RCADS anxiety symptoms	
	Occasion 1	Occasion 2
Emotional reasoning		
Safety score	0.18*	0.27**
Danger score	-0.10	0.02
Index score	0.04	0.27**
Parent-based reasoning		
Safety score	0.15*	0.13
Danger score	0.10	0.07
Index score	0.15*	0.13

Notes: $n = 120$. *$p < 0.05$, **$p < 0.01$, one-tailed.

the case for the danger scenarios. The ICCs for general emotional reasoning (i.e., index score) was also significant.

6.3.5 Prospective relationships between anxiety, and emotional and parent-based reasoning

Prospective connections between anxiety disorders symptoms, on the one hand, and emotional and parent-based reasoning, on the other hand, were examined by means of two regression analyses (Table 6.4). Note that the analyses below only concern emotional and parent-based reasoning in safe situations (i.e., safety scores). The analyses involving emotional and parent-based reasoning in dangerous situations (i.e., danger scores and general index scores) showed a similar though somewhat weaker pattern of results.

In the first regression analysis, it was tested whether emotional reasoning was an epiphenomenon of anxiety. The dependent variable was emotional reasoning on occasion 2 (Table 6.4, upper half). On step 1, anxiety symptoms and emotional reasoning on occasion 1 were entered into the analysis, but only the latter contributed significantly to emotional reasoning on occasion 2. Anxiety symptoms on occasion 2, which was entered into the equation next, accounted for an additional proportion of variance in emotional reasoning on occasion 2. The interaction of anxiety symptoms × age on occasion 1 was added on step 3. However, this interaction was only significance on step 4, after the non-significant interaction of emotional reasoning × age on occasion 2 was added into the equation. Because the regression model of step 3 and 4 did not significantly explain additional variance, these interactions are not interpreted.

In the second regression, anxiety symptoms on occasion 2 was the dependent variable (Table 6.4, upper half). On step 1, anxiety on occasion 1, but not emotional reasoning on occasion 1, was a significant predictor. Emotional reasoning on occasion 2 was entered on step 2, and explained a further significant proportion of variance of anxiety on occasion 2. Even though emotional reasoning on occasion 1 was no significant predictor by itself, it's interaction with age on occasion 1 explained additional variance (step 3), indicating that the positive association between emotional reasoning on occasion 1 and anxiety on occasion 2 in younger children changed to being significantly negative in older children. The interaction between emotional reasoning and age on occasion 2 also was significant (step 4), indicating that although the relationship between emotional reasoning and anxiety on occasion 2 was positive in younger children, in older children this relationship was in the same direction significantly weaker.

The analyses involving parent-based reasoning can be described concisely (Table 6.4, lower half). With parent-based reasoning on occasion 2 as dependent variable, parent-based reasoning and anxiety disorders symptoms on occasion 2 both independently explained a significant proportion of variance. Neither anxiety disorders on occasion 2, nor the interaction of anxiety with age on both occasions contributed significantly on subsequent steps of the analysis. With anxiety symptoms on occasion 2 as the dependent variable, the only significant predictor was anxiety symptoms on occasion 1.

Figure 6.1 depicts the relationships between emotional reasoning and anxiety symptoms that emerged from the regression analyses. As can be seen, emotional reasoning was reasonably stable. In addition, the relationships predicting anxiety on occasion 2 on the basis of previous and concurrent emotional reasoning were modified by age. In the pathway from emotional reasoning on occasion 1 to later anxiety, the connection between these factors gradually changed from being positive in the youngest age group

to being negative in the oldest age group (see Figure 6.1, upper panel). In the pathway from emotional reasoning on occasion 2 to concurrent anxiety, a significantly positive connection emerged at all ages, which was weaker in older age groups (see Figure 6.1,

Table 6.4: Results of the regression analyses (standardized βs) involving emotional reasoning (upper half) and parent-based reasoning (lower half) in objective safety situations

Emotional reasoning				
	Dependent variable: ER2			
Predictors	Step 1	Step 2	Step 3	Step 4
ER1	0.24**	0.23*	0.23*	0.21*
A1	0.13	-0.02	-0.03	-0.01
A2		0.26*	0.28*	0.23
A1 × age			0.14	0.23*
A2 × age				-0.15
Model R^2-change	0.084**	0.040*	0.019	0.011
	Dependent variable: A2			
Predictors	Step 1	Step 2	Step 3	Step 4
A1	0.61***	0.59***	0.59***	0.60***
ER1	0.03	-0.01	-0.03	-0.04
ER2		0.17*	0.18*	0.24**
ER1 × age			-0.16*	-0.14*
ER2 × age				-0.16*
Model R^2-change	0.369***	0.027*	0.026*	0.020*
Parent-based reasoning				
	Dependent variable: PBR2			
Predictors	Step 1	Step 2	Step 3	Step 4
PBR1	0.19*	0.19*	0.19*	0.19*
A1	0.26**	0.30**	0.30**	0.31**
A2		-0.07	-0.07	-0.08
A1 × age			-0.03	-0.01
A2 × age				-0.04
Model R^2-change	0.117**	0.003	0.001	0.001
	Dependent variable: A2			
Predictors	Step 1	Step 2	Step 3	Step 4
A1	0.63***	0.64***	0.64***	0.64***
PBR1	-0.06	-0.05	-0.04	-0.04
PBR2		-0.05	-0.05	-0.07
PBR1 × age			0.04	0.05
PBR2 × age				-0.04
Model R^2-change	0.371***	0.002	0.002	0.001

Notes: In all regressions analyses, gender and age were forced into the equation on step 0. A1 = anxiety disorders symptoms on occasion 1, A2 = anxiety disorders symptoms on occasion 2, ER1 = emotional reasoning on occasion 1, ER2 = emotional reasoning on occasion 2, PBR1 = parent-based reasoning on occasion 1, PBR2 = parent-based reasoning on occasion 2. Standardised β is significant at $*p < 0.05$, $**p < 0.01$, $***p < 0.001$. Empty cells indicate that the independent variable was not entered in the regression equation on that particular step. $n = 120$.

lower panel). The connection in the reverse pathway from anxiety on occasion 2 to concurrent emotional reasoning was also significantly positive, but did not differ across age groups.

The prospective relationships between parent-based reasoning and anxiety are more transparent than those between emotional reasoning and anxiety. Like anxiety, parent-based reasoning was reasonably stable; in addition, on occasion 2 it was predicted by anxiety on occasion 1 (see Figure 6.1, lower panel).

6.4 Discussion

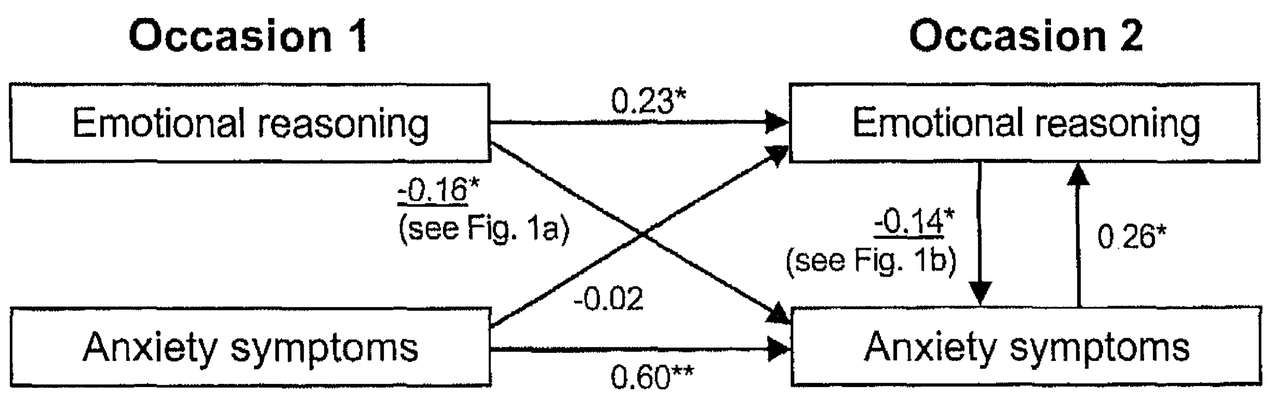
The present study investigated temporal relationships between emotional and parent-based reasoning and anxiety disorders symptoms in non-clinical children aged 7 to 13 years. Results can be summarised as follows. To begin with, general emotional and parent-based reasoning effects emerged in response to both objective safety and objective danger scenarios on both occasions: children not only used objective danger information to estimate the dangerousness of a situation, but also personal and parental anxiety-response information. Second, anxiety symptoms were significantly associated with emotional reasoning in objective safety situations on both occasions, and with general emotional reasoning on occasion 2. Anxiety was also significantly related to parent-based reasoning in objective safety situations and to general parent-based reasoning, but only on occasion 1. Third, modest 10-month stability coefficients were found for emotional and parent-based reasoning, primarily in the case of objective safety situations. Fourth and finally, evidence was found for a prospective link between anxiety and emotional reasoning; the magnitude and direction of these relationships varied as a function of age.

Consistent with our previous studies (Morren et al., 2004; Muris et al., 2003c), children displayed both emotional and parent-based reasoning effects. That is, on both occasions children relied not only on objective danger information to estimate the dangerousness of a situation, but also on information provided by their own or their mother's anxiety-response. Both effects were present in both objective safety and objective danger scenarios, but were most pronounced in the former. These results are at variance with findings from adult studies showing that only anxiety patients show emotional reasoning, whereas non-anxious controls do not (Arntz et al., 1995; Engelhard et al., 2001; 2002). A developmental explanation may be pertinent here. In the introduction, we argued that the emotional reasoning heuristic might normally get deactivated as children learn to rely increasingly on objective danger information. Children may acquire this ability by observing how other people, especially their parents, respond to potentially dangerous situations (Field et al., 2001; Muris et al., 2003a). Those who fail to do so, for instance because they observed others respond with anxiety to stimuli that pose no realistic threat, may be at risk for developing high anxiety levels. Note that a similar developmental pattern has been proposed for attentional bias (cf. Kindt et al., 1997a).

The temporal stability of emotional reasoning was lower than expected as emotional and parent-based reasoning in objective safety situations shared only 6 to 7% of their variance over a 10-month period. In contrast, anxiety disorders symptoms on occasion 1 and 2 shared 38% of variance. Compared to Muris et al.'s study (2003b), in which the stability of interpretation bias was examined, the magnitude of the present coefficients

was considerably smaller. That is, even though Muris et al. employed different story material to assess threat perception on both occasions, shared variance was still 37% for threat perception and 72% for anxiety symptoms scores. Note, however, that these authors used a considerably shorter time interval (i.e., 4 weeks). Nevertheless, although the 10-month stability was modest, analyses indicated that prospective relationships were significant; emotional reasoning on occasion 1 explained a significant proportion of the variance of emotional reasoning on occasion 2, even after controlling for past and present anxiety disorders symptoms, and this also appeared to be the case for parent-based reasoning and anxiety disorders symptoms (Figure 6.1).

Figure 6.1: Prospective relationships of emotional reasoning (upper panel) and parent-based reasoning (lower panel) in the safe situation with anxiety disorders symptoms



Notes: Figures 1a and 1b show the interactions between age and emotional reasoning for a combination of 1 *SD* above and below the mean. *$p < 0.05$; **$p < 0.01$.

On both occasions, emotional reasoning and anxiety were related, especially in the case of objective safety scenarios. This is consistent with previous findings (Morren et al., 2004; Muris et al., 2003b). The prospective analyses indicated that emotional reasoning has an indirect influence on later anxiety. More precisely, emotional reasoning on occasion 1, but not anxiety on occasion 1, predicted emotional reasoning on occasion 2, which in turn predicted concurrent levels of anxiety, and this appeared especially true in younger children. This pattern of results suggests that current levels of emotional reasoning mediate the prospective relationship between emotional reasoning and later anxiety. To test this notion, two additional correlations were computed: one between anxiety symptoms on occasion 1 and emotional reasoning on occasion 2 (r = 0.18, p = 0.03), and one between emotional reasoning on occasion 1 and anxiety on occasion 2 (r = 0.14, p = 0.07). Although both correlations were (marginally) significant, the direct prospective relationships completely disappeared in the regression analyses when current and later levels of anxiety and emotional reasoning were controlled for. These results are consistent with a mediation model (Baron & Kenny, 1986), and similar to the finding by Muris et al. (2003b) of an indirect connection between threat perception abnormalities and anxiety. The small magnitude of both correlations may result from the large time interval. In real life, the mutual relationship between emotional reasoning and anxiety would be continuous and dynamic. Still, the results of Muris et al. and the present study suggest that interpretative biases, like emotional reasoning and threat perception bias, may indirectly affect future anxiety levels.

Unexpectedly, parent-based reasoning did not influence anxiety at a later time. A positive association was found between anxiety and parent-based reasoning on occasion 1, but not on occasion 2. Moreover, both parent-based reasoning and anxiety symptoms on occasion 1 significantly predicted parent-based reasoning on occasion 2. Anxiety symptoms on occasion 2 were only predicted by anxiety symptoms on occasion 1. This suggests that parent-based reasoning does not significantly contribute to the maintenance of anxiety symptoms, but rather should be viewed as a result of anxiety. The absence of a prospective link between parent-based reasoning and anxiety may be due to the fact that the tendency to use the parental fear response in order to determine the dangerousness of a situation is only present in relatively young children. Direct evidence that children seek reference from their parents to determine their own affective response to novel stimuli typically comes from studies with young children (e.g., Gerull & Rapee, 2002; Rosen, Adamson, & Bakeman, 1992). It is possible that the tendency to rely on response information is instated in early childhood when children appraise how their parents' respond to threat. Once this tendency becomes internalised in older children, they come to rely more on their own emotional reaction rather than on that of their parents. Studies with children of a wider or different age range are required to examine the presence of parent-based reasoning in different age groups.

The current study has several limitations. First, the present sample included normal children who did not meet the diagnostic criteria of an anxiety disorder. Children who are most sensitive to personal or parental anxiety responses are most likely to develop anxiety pathology, and hence constituted only a minor fraction of the present sample. Therefore, the present findings demand replication with anxiety-disordered children. In addition, the present sample contained a large proportion of girls. However, the current emotional and parent-based reasoning effects were highly identical to those obtained in a previous study in which gender was more equally balanced (Muris et al.,

2003c). We also controlled for gender in all analyses, even though evidence has suggested that gender does not influence the relationship between anxiety and threat perception abnormalities (e.g., Muris et al., 2003e). Furthermore, because emotional and parent-based reasoning were assessed by means of paper-and-pencil measures, the ecological validity of these concepts needs to be established. Finally, it should be noted that the danger ratings of the child anxiety scenario were based on three vignettes, whereas those of the parent anxiety scenario were based on only one. This may have resulted in less reliable measurements, which may have attenuated strength of the association between anxiety and parent-based reasoning as compared to the association between anxiety and emotional reasoning.

In sum, then, the current study shows that the presence of anxiety at a certain point in time leads to anxiety in the future, at which point anxiety brings about emotional reasoning. Similarly, emotional reasoning at a certain moment in time leads to future emotional reasoning, at which point emotional reasoning produces anxiety. These relationships were quite weak, however, which may result from the large time interval (i.e., 10 months). Future research might benefit from several repeated measurements with shorter intervals to gain insight in the dynamics of the conjoint development of emotional and parent-based reasoning and anxiety. The promise of emotional reasoning as a factor in the maintenance or even development of anxiety further raises the question as to whether emotional reasoning wanes after successful therapy or whether anxiety is reduced as emotional reasoning decreases. Thus, to further unravel developmental issues and test the cognitive inhibition hypothesis, future studies should examine how the prospective connection between interpretation biases, such as emotional reasoning, and anxiety is shaped at different ages.

Chapter 7

General Discussion

7.1 Introduction

The general purpose of this thesis was to investigate the role of cognitive bias in the development of anxiety in children. The studies presented in previous chapters concentrated on attentional bias and interpretation bias in schoolchildren between the ages of 7 and 13 years. The following research questions were addressed. First, it was tested whether anxious and non-anxious children of different ages would exhibit the pattern of attentional bias predicted by cognitive inhibition hypothesis in children. Second, it was examined whether children would exhibit two forms of interpretation bias, namely emotional reasoning and parent-based reasoning, and whether these biases would be associated with anxiety. Third and finally, it was investigated whether attentional bias and both types of interpretation bias could be linked prospectively to childhood anxiety. The most important findings can be summarised as follows:

1. The cognitive inhibition hypothesis was supported in part. First, attentional bias in children was found to be present irrespective of spider fear, but only for integrated stimuli in the first half of the Stroop task (chapter 2). Second, in high spider fearful children a positive association between attentional bias and age was found, whereas in low spider fearful children this association was negative (chapter 3). Third, children with a larger attentional bias showed higher subsequent increases in spider fear (chapter 4).
2. A reversal of attentional bias towards later stages of the Stroop task was observed, because responses to threat stimuli accelerated and responses to neutral stimuli decelerated. It was put forward that this reversal occurred because children successfully employed cognitive avoidance of the threat (chapter 2 and 3).
3. A direct pathway from attentional bias to later spider fear was found, i.e. not mediated by later attentional bias. This finding supports the hypothesis that attentional bias is a vulnerability factor for the development of spider fear (chapter 4).
4. Emotional reasoning and parent-based reasoning are normal characteristics of primary school children, but are more prominent with higher anxiety levels (chapter 5 and 6).
5. Emotional reasoning indirectly contributes to anxiety vulnerability in children, but this effect decreases as children enter adolescence (chapter 6).
6. Parent-based reasoning is a by-product of anxiety and has no aetiological significance (chapter 6).

Below, these findings will be considered in light of previous research on cognitive bias in children and adolescents, and an attempt will be made to reconcile them with the information-processing theory of anxiety as applied to youths.

7.2 Attentional bias

7.2.1 The cognitive inhibition hypothesis

A primary purpose of this thesis was to test the cognitive inhibition hypothesis (Kindt, Bierman, & Brosschot, 1997a). The hypothesis was formulated to satisfy the urgent need for information-processing theory aimed specifically at children. The extant the-

ory is mainly founded on research with adults, and considers anxiety to be associated with the presence of extensive, easily accessible schemas around themes of anxiety, so-called danger schemas. These schemas are held to be responsible for the occurrence of cognitive biases such as attentional bias. The accuracy of this account is corroborated by a massive body of evidence, which indicates that anxious adults show an attentional bias for threat, but normal adults do not (e.g., Logan & Goetsch, 1993; MacLeod & Mathews, 1991b; Williams, Mathews, & MacLeod, 1996). Indeed, the first studies with younger participants confirmed that the connection between anxiety and attentional bias was shaped the same in children and adolescents (Martin, Horder, & Jones, 1992; Martin & Jones, 1995; Vasey, Daleiden, Williams, & Brown, 1995; Vasey, El-Hag, & Daleiden, 1996). However, three experiments by Kindt and colleagues revealed a very different pattern of results (Kindt et al., 1997a, Kind, Brosschot, & Everaerd, 1997b). To be precise, attentional bias was observed in both anxious and control children aged 8-11 years. In addition, the bias appeared to decrease with age in normal control children, but to persist in the high anxiety group.

The cognitive inhibition hypothesis of childhood anxiety was formulated to explain this divergent pattern of attentional bias for threat in children (Kindt et al., 1997a), and combines insights from two fields of research. First, the hypothesis utilised the cognitive-developmental concept of cognitive inhibition: the ability to suppress the processing of task-irrelevant information, thus keeping the focus of attention on the pertinent task. As inhibitory processing gains efficiency with age, children become increasingly able to selectively attend to relevant information in the context of distracting information (Harnishfeger, 1995; also see Lane & Pearson, 1982). Second, this general notion of inhibition was applied to threat processing by incorporating an aspect of the information-processing theory of adult anxiety. That is, the understanding that anxiety-related cognitive biases, such as attentional or interpretative bias, result from the assignment of processing priorities to the threat-related aspect of encountered stimuli while ignoring neutral information (MacLeod & Mathews, 1991a). Experimental evidence indeed indicates that anxiety is associated with impaired threat inhibition (Wood, Mathews, & Dalgleish, 2001). The cognitive inhibition hypothesis holds that it is normal for young children to exhibit an attentional bias for threatening information, because they have not yet developed the ability to inhibit threat. As children normally develop this ability with age, the bias gradually disappears. However, when children fail to attain inhibitory competency, their attentional bias is allowed to persist (Kindt et al., 1997a). Presumably, this makes them vulnerable for developing an anxiety disorder.

7.2.2 Cross-sectional evidence for the cognitive inhibition hypothesis

Two predictions can be inferred from the cognitive inhibition hypothesis. The first prediction, that young children exhibit an attentional bias irrespective of their anxiety, was partly supported by this thesis. Chapter 3 provides the most explicit support, namely that both high and low spider fearful children generally responded slower to spider stimuli than to neutral stimuli in the emotional Stroop task. It should be noted, however, that this effect was most pronounced at early stages of the Stroop. In chapter 2, this general attentional bias effect was confined to the first experimental half, and emerged only with integrated stimuli. These results confirm previous evidence that children present a general threat bias in relation to not only spider fear (Kindt &

Brosschot, 1999; Kindt et al., 1997ab; Kindt, Van den Hout, De Jong, & Hoekzema, 2000), but also general anxiety (Bijttebier, 1998; Ehrenreich, 1999; Eschenbeck, Kohlmann, Heim-Dreger, Koller, & Leser, 2004; Kagan, Snidman, Zentner, & Peterson, 1999; Waters, Lipp, & Spence, 2004), PTSD after being abused (Freeman & Beck, 2000), and behavioural inhibition (Kagan et al., 1999; Schwartz, Snidman, & Kagan, 1996). In sum, the present thesis found evidence for the first prediction of the cognitive inhibition hypothesis.

The second prediction of the cognitive inhibition hypothesis is that attentional bias will decrease with age in non-fearful children, but persist or increase in fearful children. Consistent with this prediction, in chapter 3, attentional bias was positively related to age in high spider fearful children, but negatively in low fearful children. The difference between these associations was significant, and again the effects were stronger early in the Stroop. This pattern of attentional bias across anxiety groups has previously been obtained in three experiments (Kindt et al., 1997a; 2000; Vasey et al., 1995), but not in several others studies (Martin & Jones, 1995; Martin et al., 1992; Taghavi, Neshat-Doost, Moradi, Yule, & Dalgleish, 1999). It should be pointed out, however, that there were several differences between theses studies. Whereas Kindt et al. examined normal children aged 8-12 years using the single-trial Stroop, Martin and colleagues applied the card Stroop. In Taghavi et al.'s study, children with GAD were examined whose ages covered a much wider range (i.e., 9-17 years). It is not clear to what extent these study differences are responsible for the presence or absence of significant anxiety-dependent associations between age and attentional bias. Two additional experiments could not reveal a correlation between age and bias, but failed to take differences in anxiety into account (Moradi, Neshat-Doost, Taghavi, Yule, & Dalgleish, 1999a; Moradi, Taghavi, Neshat-Doost, Yule, & Dalgleish, 1999b). Taken together, these results yield inconclusive evidence for the second prediction of the cognitive inhibition hypothesis. Although sample and task differences may be responsible, future research should decide to what extent this is true.

Nevertheless, the evidence seems to validate the cognitive inhibition hypothesis at least in part, even though null-findings were obtained in chapter 2 (in the overall analyses) and in chapter 4 (in the cross-sectional analyses). Some previous studies have similarly been unable to obtain an attentional bias in children with anxiety disorders (Dalgleish, Taghavi, Neshat-Doost, Moradi, Canterbury, & Yule, 2003; Kindt, Bögels, & Morren, 2003) and spider fear (Kindt & Brosschot, 1999; Kindt et al., 2000). There is also a considerable body of research indicating that like adults, anxious children and adolescents but not controls display an attentional bias for threatening material. This differential attentional bias has been established in youths with various anxiety disorders (Dalgleish et al., 2003; Moradi et al., 1999b; Taghavi, Dalgleish, Moradi, Neshat-Doost, & Yule, 2003; Taghavi, Neshat-Doost, Moradi, Yule, & Dalgleish, 1999; Vasey et al., 1995; Vasey et al., 1996), but also in those with trait anxiety (Richards, Richards, & McGeeney, 2000; Waters et al., 2004), spider fear (Kindt & Brosschot, 1999; Martin & Jones, 1995; Martin et al., 1992), and test anxiety (Vasey et al., 1996).

It has been proposed that this kaleidoscopic collection of attention bias findings in children and adolescents attests that this effect is unreliable, especially with non-clinical populations (Waters et al., 2004). However, when differences in samples and task characteristics of the pertinent studies are scrutinised, things do not seem quite so pessimistic (see Table 1.1). Two sample differences are most important. First, the general attentional bias effect has typically been obtained with children between 8 and 12

years of age, whereas a differential bias usually emerged only when adolescents were also part of the sample, and ages ranged from 7-19 years (but see Martin & Jones, 1995; Martin et al., 1992). The second difference relates to the anxiety level of the samples used: the high anxiety group of the studies that found a general threat bias always comprised normal children with high self-reported anxiety, whereas the high anxiety group of studies revealing a differential bias usually comprised children with anxiety disorders (but see Kindt et al., 2003). Remarkably, there has been no systematic investigation of the combination of age and anxiety level. Only one study has examined attentional bias exclusively in youths older than 12 years, reporting a bias in normal 16-18-year-olds but not in controls (Richards et al., 2000). Similarly, only one study investigated attentional bias of anxiety-disordered children age up to age 12, and found that both anxious and control children exhibited an attentional bias. In sum, there is no reason to abandon the cognitive inhibition hypothesis when sample differences are taken into account.

In addition, the cognitive inhibition hypothesis also seems to hold when differences in task characteristics are considered. The only studies that did obtain a differential attentional bias with young, non-clinical children, i.e. those by Martin and colleagues mentioned above, used the card version of the Stroop. However, the main problem with those studies is that the experimenter manually registered response latencies to each card. Moreover, the experimenter was not blinded for the anxiety status of the children, which may have inadvertently influenced his or her objectivity (cf. Kindt et al., 1997a). Another aspect of the Stroop task that may influence attentional bias effects is the stimulus format. That is, a general threat bias in single-trial versions of the Stroop invariably occurred with *integrated* stimuli. As was argued in chapter 2, it requires more cognitive effort to extract target information when it is integrated with distracting information than when it is not, which may explain why integrated Stroop stimuli yield more bias than non-integrated ones (Kindt & Brosschot, 1997; 1999). Since the inhibitory skills that children require to be able to ignore threatening distracters develop with age, it will be easier to obtain a differential bias with non-integrated stimuli. This concurs nicely with the fact that the differential attentional bias effect seems to be most robust when the visual dot probe (VDP) task is utilised, in which stimuli are non-integrated by definition. Interestingly, the only notable exceptions have been found with non-clinical young children aged 9-12 (Ehrenreich, 1999; Waters et al., 2004), or slightly older children (Bijttebier, 1998).

7.2.3 Prospective evidence for the cognitive inhibition hypothesis

The cognitive inhibition hypothesis also proposes a mechanism of how attentional bias may contribute to the development of anxiety pathology. As children acquire the ability to inhibit threat with age, their attentional bias would be expected to decrease, thus permitting their anxiety to fade. However, incessant failure of threat inhibition would allow the attentional bias to persist and foster a continuation or rise of anxiety complaints. The possibility that impaired threat inhibition does indeed enhance children's anxiety complaints, was tested in chapter 4. Consistent with the hypothesis, it was found that higher levels of attentional bias were associated with larger increases of spider fear in the following 10 months. Unexpectedly, however, increases of attentional bias over this period were negatively associated with spider fear at the end of the period, but only after adjusting for previous spider fear.

Thus, the presence of attentional bias seems to promote spider fear, as the cognitive inhibition hypothesis predicted. However, contrary to expectation, increases of attentional bias were inversely related to subsequent fear. In other words, increases in bias seemed to reduce rather than to intensify fear. It is difficult to explain this unexpected finding. One possibility is that the time interval of 10 months was too short to take effect on spider fear, but this does not explain why higher levels of bias were associated with decreases in subsequent spider fear. Another possibility is that the rise of spider fear was not associated with an actual decrease of attentional bias, but with an increase of reversed bias. As will be argued in the next section, bias reversal may signal successful avoidance of the threatening stimuli, and thereby promote fear. Note, however, that this explanation is rather speculative. When the inverse relationship is not a spurious finding, it might compromise the cognitive inhibition hypothesis. Because this finding is the first of its type, however, and other finding seem more in harmony with the hypothesis, it seems premature to draw this conclusion at this point.

7.2.4 The reversal of attentional bias

An unanticipated finding of chapter 2 and 3 was the occurrence of a reversed attentional bias. That is, responses to spider stimuli were significantly *faster* than responses to control stimuli, rather than *slower* as is the case with the regular attentional bias effect. This reversal was more distinct at later stages of the Stroop, and resulted from a combination of an acceleration of responses to spider stimuli and a deceleration of responses to neutral stimuli. As an explanation, it was proposed in chapter 2 that this effect might arise because the children avoided the threatening spider stimuli, and gradually learned how to do this successfully as the Stroop task progressed. At the same time, responses to neutral stimuli relaxed because there was no threat to be avoided. The effectiveness of this strategy may rest in the fact that presentation of the stimulus was terminated as soon as the child responded.

Although it might be argued that the reversed attentional bias in chapter 2 and 3 represents an accidental finding, there is some evidence to suggest otherwise. Several studies have similarly reported faster reaction times to threat-related stimuli than to neutral control stimuli (Kindt et al., 1997ab; 2000). In addition, it seems that the reversal of attentional bias does not occur in children randomly, but is related to the degree to which successful inhibition can be accomplished. The results of both chapter 2 and 3 and previous research suggest that the reversal of attentional bias particularly affects younger children, between 7 and 9 years of age, and children who are fearful. According to the cognitive inhibition theory, the ability to inhibit threatening information is least developed in this group of children. What is more, in chapter 2 the reversal of attentional bias was stronger for non-integrated stimuli than for integrated stimuli. It requires more cognitive effort to extract target information from stimuli that are integrated compared to non-integrated (cf. MacLeod, 1991). In the context of the Stroop task, this concerns identification of word colour while ignoring word meaning, which may have either a threatening or a neutral connotation. Because this requires more cognitive resources for integrated stimuli, fewer resources remain available than there would when processing non-integrated stimuli. These resource leftovers can then be employed for other purposes, such as speeding up responses to spider stimuli in order to avoid their threatening content. Hence, a larger avoidance effect can be accomplished for non-integrated stimuli than for integrated stimuli.

What do these unanticipated findings signify? As was discussed in the previous section, the reversal of attentional bias seemed to explain, at least to some extent, why only partial support for the cognitive inhibition hypothesis could be obtained. However, the results give some indication that the reversal of the threat bias itself may vary depending on children's inhibitory capacities. More precisely, the reversal of attentional bias seemed to be most prominent when threat inhibition failed. The strongest avoidance effect was obtained in the youngest children, whose inhibitory skills would be least developed, and in anxious children due to their failure to acquire the ability to inhibit threatening information. In addition, the effect was most apparent in response to stimuli for which inhibition would have been most difficult, namely the integrated stimuli. Thus, it is reasonable to assume that failed inhibition did affect children's attentional responding, but presented itself in an unexpected way. Furthermore, the tendency to rely on cognitive avoidance may provide children with poor inhibitory skills with a safety net allowing them to evade threat. Rather than evading the processing of threat by shifting attention toward non-threat, as with cognitive inhibition, they use cognitive avoidance to terminate their exposure to the threat itself. The Stroop versions used here permitted them to do this, because stimuli were not presented for a fixed duration but removed from the computer screen as soon as a response was detected. Future studies should verify the validity of this explanation.

The possibility that children could avoid the threatening stimuli is consistent with the vigilance-avoidance account of anxiety-related information processing (e.g., Mogg, Bradley, de Bono, & Painter, 1997). The hypothesis proposes that individuals first direct their attention towards threat, but then immediately engage in a strategic attempt to avoid further processing to minimise their discomfort (e.g., Mogg & Bradley, 1998). The early detection of threat cues probably rewards anxious children with the opportunity to quickly evade encounters with threat. Since this minimises experience with threat in the environment, these children probably fail to learn that such encounters are not as dangerous as they think (Vasey et al., 1996), and do not habituate to the alleged threat. Instead, their cognitive apparatus becomes abnormally focused on the processing of threat cues, thereby contributing to the maintenance of anxiety (Mogg & Bradley, 1998). Several studies have found support for the vigilance-avoidance hypothesis in adult samples (e.g., Amir, Foa, & Coles, 1998; Hermans, Vansteenwegen, & Eelen, 1999; Koster, Verschuere, Crombez, & Van Damme, 2005; Mogg, Bradley, Miles, & Dixon, 2004).

So far, the vigilance-avoidance hypothesis has not been tested in child and adolescent populations. However, the observation of chapter 2 and 3 that children showed a general tendency to respond faster to the spider stimuli compared to the neutral stimuli, may indicate that the children processed threat in a vigilance-avoidance way. As noted already, children could avoid exposure to the threatening stimuli by fast responding. As the children increasingly refined this strategy as the task progressed, they could further speed up their responses to spider stimuli and relax when neutral information was presented. The vigilance-avoidance pattern of attentional responding may be especially damaging for children. As children normally do not acquire the ability to inhibit the processing of threat until a certain age, they are amenable to avoidant strategies until that age. When children do not develop these inhibitory skills, or fail to learn to rely on them, this may put them at risk for developing anxiety disorders.

7.3 Interpretation bias

If attentional bias enhances the perception of threat, this will have consequences for other areas of information processing. One such area involves children's understanding of their environment, and to what extent they experience it as threatening. The evidence presented in chapter 1 clearly shows that anxiety in children can be linked to a number of interpretation biases, which lead to an overestimation of threat. In this way, anxious individuals confirm their view of the world as a threatening place, thus reinforcing and extending the danger schemas in their memory. Furthermore, if cognitive inhibition produces attentional bias in children, and this attentional bias then improves threat perception, the presence of interpretation bias in children would probably follow the same developmental pattern as attentional bias. That is, it should decrease with age in non-anxious children, but increase or persist in anxious children. This hypothesis was tested with two types of interpretation bias that have hitherto received little scrutiny: emotional reasoning and parent-based reasoning. Note that the term 'reasoning' may be somewhat confusing when referring to interpretation biases, but was chosen to hook up with the terminology of previous research (cf. Arntz, Rauner, & Van den Hout, 1995; Clark, 1999; Muris, Merckelbach, & Van Spauwen, 2003c). However, as is the case with interpretation biases, emotional reasoning and parent-based reasoning involve selective misinterpretation of information as evidence of threat, such that negative beliefs are confirmed and anxiety is reinforced.

7.3.1 Emotional reasoning

Emotional reasoning involves the tendency of individuals to use their own anxiety response to decide whether threat is impending, rather than objective information. The related concept of parent-based reasoning reflects the child's tendency to rely on information provided by the parental anxiety response in order to make this decision. Parent-based reasoning was introduced in chapter 5 to take into account that children tend to model their fear response on that of their parents (e.g., Gerull & Rapee, 2002). It was argued that especially in young children, parent-based reasoning might substitute emotional reasoning, but this will be discussed in more detail in the next section (3.2). As to emotional reasoning, the chapter 5 and 6 results indicated that all children use anxiety-response information to establish whether danger is imminent. Additionally, as children reported higher levels of anxiety disorders symptoms, their tendency for emotional reasoning was larger; however, only in case of the objective safety situation. This corresponds closely with the results of previous studies on this effect in children (Muris et al., 2003c; Muris, Merckelbach, Schepers, & Meesters, 2003d), but contrasts with evidence showing that adults with anxiety disorders show emotional reasoning, whereas non-anxious controls do not (Arntz et al., 1995; Engelhard, Macklin, McNally, Van den Hout, & Arntz, 2001; Engelhard, Van den Hout, Arntz, & McNally, 2002).

In chapter 5 and 6, emotional reasoning emerged under conditions of objective safety and objective danger, rather than in the safe situation alone, as Muris and colleagues (2003c) found. This may indicate that the present stories were more sensitive to detect emotional reasoning effects than Muris et al's stories. The following explanation may elucidate this difference. Muris et al measured emotional reasoning as the contrast between the presence and absence of an anxiety response, whereas emotional reasoning in chapter 5 and 6 was measured as the contrast between an anxiety re-

sponse and a *positive* response (e.g., smiling). It is quite feasible that this positive response was responsible for the emotional reasoning effect under conditions of threat. It is unlikely that the anxiety response contributed to this effect, because it would have produced emotional reasoning in Muris et al.'s danger stories as well. In addition, since the magnitude of the emotional reasoning effect was comparable in the safe and the dangerous situation, the positive response probably did not augment the effect in the dangerous situation.

In sum, emotional reasoning in safe situations probably originated from the tendency to infer danger from anxiety-response information, while in dangerous situations it originated from the tendency to infer safety from the presence of positive response information. This is consistent with information-processing theory of anxiety, which predicts that anxiety focuses children's processing resources on threat, not on safety. In line with this explanation, the positive relationship between emotional reasoning and anxiety in children only emerged under safe circumstances, not under dangerous ones (see chapter 5 and 6 and Muris et al., 2003c). When the presence of threat is unmistakable, it benefits anxious as well as non-anxious children to seek a safe harbour. Or, to put it differently: On encounter with a bear, pursuit of safety cues would dramatically increase survival, as opposed to searching for another bear. On the other hand, when bears are clearly absent, vigilance for bears would increase survival, whereas searching for the absence of other bears would be pointless. The same principle may operate in attentional bias, which was suppressed in the presence of the object of their fear (Amir et al., 1996; Mathews & Sebastian, 1993).

7.3.2 Parent-based reasoning

Parent-based reasoning is the tendency to rely on information provided by a parent's emotional response to a given situation rather than to objective information. The concept of parent-based reasoning was introduced in chapter 5 to acknowledge children's use of their parent's behaviour as a basis for their own behaviour. Modelling is generally recognised as one of the major pathways to the development of fear, provided of course that the model behaves anxiously (e.g., King, Gullone, & Ollendick, 1998; Rachman, 1977). The key to the effectiveness of modelling may be social referencing, a process of emotional communication whereby a person's appraisal of a stimulus is based on his or her perception of another person's reaction to that stimulus (Feinman, 1992). Several studies indicate that children react with fear and avoidance to novel stimuli after they observed their mothers respond with negative affect to these stimuli (e.g., Camras & Sachs, 1991; Gerull & Rapee, 2002). For example, Zarbatany and Lamb (1985) showed that infants tended to move more closely towards a toy spider when their mothers conveyed a happy expression compared to a fearful expression. However, when a stranger conveyed these responses, the infants did not respond differently to both expressions.

As would be expected on the basis of the former, the parent-based reasoning findings followed a very similar pattern as the emotional reasoning findings. That is, children exhibited a general parent-based reasoning effect that was larger at higher anxiety levels, especially under conditions of objective safety (chapter 5 and 6). The finding of a general parent-based reasoning effect is consistent with an emerging body of research which stresses the role of modelling and negative information in the development and maintenance of childhood anxiety (Gerull & Rapee, 2002; Field, Argyris, & Knowles, 2001; Muris, Bodden, Merckelbach, Ollendick, & King, 2003a; Muris et al.,

2003c) and avoidance behaviour (Field, Hamilton, Knowles, & Plews, 2003; Silverman, Cerny, Nelles, & Burke, 1988). Even though these processes bear resemblance to parent-based reasoning, it remains to be seen to what degree they are interrelated. In addition, in this thesis the parent-based reasoning effect was observed in reaction to affective responding by the mother. The question remains whether children will also exhibit this effect when the father conveys the response, and whether they will similarly rely on other familiar adults (e.g., the child's teacher) or peers to decide whether threat is impending.

7.3.3 Age effects

If it is assumed that failure of cognitive inhibition produces attentional bias in children, and that this in turn enhances threat perception, other cognitive biases may follow the same developmental pattern as attentional bias. This underlies the prediction that emotional and parent-based reasoning decrease with age in anxious children, but increase or persists in non-anxious children. However, chapter 5 found no evidence for the presence of anxiety-related developmental differences in emotional reasoning. As was argued, this null finding may have emerged because the children were too young (i.e., 7-13 years). Emotional reasoning may not wane until late adolescence or early adulthood (cf. Muris et al., 2003c), which may explain why adults with anxiety problems show emotional reasoning but normal controls do not (Arntz et al., 1995). The same was largely true for parent-based reasoning, although one significant age effect was found. That is, parent-based reasoning decreased with age in high anxious children but persisted across different ages in low anxious children. Although this was contrary to prediction, it may indicate that high anxious children gradually rely less on the emotional response of their mother as they get older, and more on their own responses. Apparently, this is less relevant for low anxious children, because they may already be less inclined to use emotional and parent-based reasoning.

7.3.4 Domain-specificity and content-specificity

If cognitive biases to specific classes of stimuli foster the development of pertinent anxiety problems, they should be unrelated to other emotional problems. This is referred to as the domain-specificity and content-specificity of cognitive biases. For anxiety, these concepts can be elucidated as follows. Domain-specificity refers to the situation where children with anxiety problems exhibit information-processing abnormalities to information related to the anxiety domain, but not to information related to other domains of psychopathology, such as depression. Content-specificity refers to the situation where children with a certain type of anxiety problem display information-processing abnormalities related to the content of their anxiety type, but not to information that is related to other anxiety problems.

The domain- and the content-specificity of both emotional reasoning and parent-based reasoning were examined in chapter 5. The domain-specificity of both phenomena was examined by comparing whether they were more strongly related to anxiety than to depression. The results indicated that this was the case for children's ratings of the dangerousness of the stories, both when the child and the parent expressed the emotional response. More importantly, emotional and parent-based reasoning in the safe situation were related to anxiety, but not to depression. However, no evidence was found that emotional and parent-based reasoning only emerged in anxiety-*relevant* fear-evoking situations. In other words, emotional and parent-based reasoning are

characteristics of anxious children, not of depressive children. However, within the anxiety domain these processes cannot be used to distinguish children with different types of anxiety. The latter implies that although it is possible that emotional and parent-based reasoning contribute to children's anxiety in general (not depression), it cannot explain why children develop specific anxiety problems.

7.4 Cognitive biases a vulnerability factor for anxiety?

If cognitive biases contribute to the development of anxiety, children who exhibit a cognitive bias at a certain point in time should some time later exhibit higher levels of anxiety compared to children in whom the bias is absent or less pronounced. This idea was tested in chapter 4 for attentional bias, and in chapter 6 for emotional and parent-based reasoning. Three models of the prospective connection between bias and anxiety were considered. First, it was tested whether the bias would directly predict later anxiety. Second, whether this relationship would be indirect, that is, mediated by later bias. Finally, the possibility was considered that the bias would not precede anxiety, but be its consequence. These models are depicted in figure 6.1.

Although parent-based reasoning seemed to be a by-product of anxiety, attentional bias and emotional reasoning were both found to predict later anxiety (i.e., 10 months later). Attentional bias predicted later anxiety independent of concurrent anxiety, and this relationship was not modified by age. This is the first time such a connection was demonstrated in children. In adults, two studies indicated that higher levels of attentional bias were associated with a more intense emotional reaction after experiencing significant stress (MacLeod & Hagan, 1992; Van den Hout, Tenney, Huygens, Merckelbach, & Kindt, 1995). The results of chapter 4 show that attentional bias can also predict later anxiety in the absence of stressful experiences.

For emotional reasoning, the connection was more complex. Although there was an overall effect of emotional reasoning predicting later anxiety independent of concurrent anxiety, this connection was modified by age. Emotional reasoning was found to promote anxiety only in the youngest children, but to reduce anxiety in the older children. However, there also was a significant indirect pathway from emotional reasoning to later anxiety, which was mediated by later emotional reasoning. In this case, anxiety predicted emotional reasoning in all children, but the effect was significantly stronger in the youngest. Muris, Jacques, and Mayer (2003b) similarly found an indirect connection between threat perception bias and anxiety, but did not consider the effect of age.

Together, these findings support the premise of the information-processing theory of childhood anxiety that cognitive biases play a role in the aetiology and maintenance of anxiety. The evidence suggests, however, that this connection may be complex, and mediated or moderated by other factors. For research with children, it seems especially important to consider developmental differences, which may influence the manifestation of information-processing abnormalities considerably. Another important issue is that although naturalistic prospective evidence such as that presented in this thesis is indispensable to establish the existence of a causal link between cognitive bias and anxiety, it is not sufficient. Additional evidence is required, which shows that the experimental induction of bias produces anxiety. In adults, but not in children, there is

some naturalistic evidence for the role of attentional bias in anxiety (MacLeod & Hagan, 1992; Van den Hout, Tenney, Huygens, Merckelbach, & Kindt, 1995). Experimental evidence exists for both the induction of attentional bias (Fulcher, Mathews, Mackintosh, & Law, 2001; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002) and interpretation bias (Mathews & Mackintosh, 2000; Wilson, MacLeod, Mathews, & Rutherford, 2006; Yiend, Mackintosh, & Mathews, 2005). Such evidence is also required to strengthen the claim that failed inhibition fosters childhood anxiety via attentional bias.

7.5 Methodological considerations

The specific methodological limitations of the individual studies of this thesis have already been addressed. In this section, several of these issues will be revisited, and some additional concerns will be considered.

A first limitation relates to the use of the emotional Stroop task to examine the cognitive inhibition hypothesis. The emotional Stroop task was not designed to measure threat inhibition. For that reason, the evidence for this hypothesis presented here is indirect. The Stroop can merely be used to demonstrate to what extent the obtained pattern of attentional bias is consistent with the pattern of attentional bias predicted by the cognitive inhibition hypothesis, but not that failed inhibition could actually be observed. Thus, two issues should be addressed in future research. First, direct measures of cognitive inhibition, such as the negative priming task (cf. Fox, 1994), should be employed to assess whether anxious and non-anxious children show the pattern of inhibition predicted by the cognitive inhibition hypothesis. Second, the relationship between cognitive inhibition and attentional bias in children and adolescents should be investigated.

A related issue concerns that there is some debate as to whether the emotional Stroop task does in fact measure attentional bias. MacLeod, Mathews, and Tata (1986) argued that although it may be true that the emotional Stroop effect emerges because anxious respondents' attentional resources are selectively directed towards threat, there is an alternative explanation. It is possible that the effect occurs because anxious individuals experience an emotional reaction when they are confronted with the threatening stimuli. In other words, children may pay equal attention to threatening and neutral stimuli, but experience anxiety when they read the spider stimuli, and this subsequently interferes with their colour-naming performance (cf. Vasey, 1996). To resolve this possible confound, MacLeod et al. (1986) designed the visual dot probe task, which was later adapted for use with children by Vasey et al. (1995). The VDP controls for a potential emotion effect because attentional bias is calculated – on trials presenting both a threatening and a neutral probe stimuli – as a combination of detection of dots that replace threatening probes (faster responses indicate bias) and dots that replace neutral probes (slower responses indicate bias).

There are, however, compelling reasons why MacLeod et al. may be wrong, and that the emotional Stroop actually is a valid index of attentional bias in youths. The first reason transpires when Stroop and VDP findings are compared (see table 1.1); although they seem incompatible at first sight, this can almost completely be explained by sample and task differences. For instance, most studies among non-selected primary school children obtained a general attentional bias effect with both the VDP

(Bijttebier, 1998; Ehrenreich, 1999; Waters et al., 2004, exp. 1) and the Stroop (Eschenbeck, exp. 1; Kindt et al., 1997b, exp. 2; 2000, exp. 2). The second reason concerns the differential interference that is obtained with integrated and non-integrated Stroop stimuli. As noted above, it is more difficult to selectively attend to target information (the colour) when it is integrated with distracting information (word meaning). Consistent with this idea, evidence suggests that integrated Stroop stimuli produce more interference than non-integrated ones, both in children and adults (Kindt & Brosschot, 1997; 1999). On the other hand, it should be noted that low correlations have been obtained between the bias indices of Stroop and VDP in adult pain patients (Asmundson, Wright, & Hadjistavropoulos, 2005) and anxiety disordered children (Dalgleish et al., 2003). However, order of task administration was not counterbalanced in Dalgleish's study, which emphasises the need for a more systematic comparison between both tasks. Finally, it is unlikely that an emotion effect is responsible for the Stroop effect in the single-trial format, because the presence and absence of emotion would have to alternate very quickly depending on whether a threatening or a neutral stimulus is presented. As can be seen in Table 1.1, attentional bias can readily be obtained using the single-trial Stroop.

A second limitation is that emotional reasoning and parent-based reasoning were assessed by means of paper-and-pencil tasks. Emotional and parent-based reasoning involve the use of subjective information from the affective reaction of the child itself or a parent, respectively, to establish the perceived danger status of a situation. To this end, children were asked to provide danger ratings of stories in which the presence of an anxiety response or a positive response in a threatening or in a safe situation were systematically varied. The ecological validity of this assessment method may be rather limited, which was employed even though both phenomena are quite suitable for real-life testing. For instance, it would be interesting to examine whether children evaluate hypothetical or real situations as more dangerous when they are actually experiencing the bodily sensations that are associated with anxiety, like sweating, trembling, or feeling their heart pound. This might be accomplished by physical exercise, or by altering environmental conditions (e.g., increasing temperature and atmospheric humidity). As children from age 7 associate such bodily symptoms with fear (Muris, Hoeve, Meesters, & Mayer, 2004), emotional reasoning under such conditions would not come as a surprise. Naturalistic evidence for parent-based-reasoning-like effects has already been obtained with infants and toddlers (Camras & Sachs, 1991; Gerull & Rapee, 2002; Zarbatany & Lamb, 1985). It would be relatively easy to present children with parents, teachers, peers or other persons who display an anxiety response under threatening of safe circumstances, either in role-playing of which they are unaware, or by means of videotaped enactments.

A third limitation concerns the participation of non-clinical children in the studies in this thesis. It might be argued that studies using such populations lack the sensitivity to detect cognitive biases, especially when attentional bias is targeted. The most reliable differential bias effects have been obtained with clinically anxious children and adolescents (cf. chapter 1). However, when the role of cognitive biases in the development of anxiety is under scrutiny, clinical populations are useless because these individuals have already developed the anxiety. The merits of investigating children who already have been diagnosed with anxiety disorders are confined to the cognitive determinants of the *maintenance* of anxiety. It will not come as a surprise when these children will exhibit all the cognitive biases that typify the pertinent anxiety disorder.

Only two types of evidence are permissible when the cognitive origins of anxiety are pursued, both to be obtained from normal populations. First, observational (i.e., naturalistic) studies can catalogue cognitive bias, which is than followed up and linked to anxiety changes occurring over time. This type of evidence is extremely scarce in children, and was only addressed in three studies, two of which in this thesis (chapter 4 and 6, Muris et al., 2003b). Alternatively, the effect of experimental manipulation of the bias on subsequent anxiety can be examined; this type of research is considered the golden standard, but is currently lacking in children.

A final consideration involves the skewed gender distribution in the presented studies. This originated from the method of selecting children for the research project. After high spider fearful children had been identified, a comparable group of non-fearful controls was selected from normal primary school children. Hence, the present sample reflects the well-known fact that anxiety in general is more prevalent in girls than in boys (e.g., Costello & Angold, 1995; Verhulst, 2001). Although gender effects were controlled for in the analyses, it cannot be ruled out that different results would have been obtained when the gender distribution was more balanced. Additionally, researchers may find it helpful to consider the following potential confounders in their research of the cognitive biases relevant for childhood anxiety. First, insufficient reading ability may falsely suggest that the bias does not occur in a particular child. Second, children may vary considerably in the extent to which they find stimuli scary, negatively valenced, or arousing, and this may influence the magnitude of their bias. Controlling for these differences may enhance the sensitivity of studies for detecting group differences between anxious and control children. Third, the experimental procedure may elicit state anxiety, which may compromise the targeted effect. This is especially relevant for the examination of emotional reasoning by means of a story paradigm, because children might confuse the anxiety response of the story's main character with their own feelings of apprehension.

7.6 Clinical Implications

Because this thesis presents fundamental research, it has no immediate clinical relevance. Nevertheless, there are several clues as to how the present findings might eventually help improve the prevention, diagnosis, and treatment of anxiety disorders in children and adolescents. In chapter 4 and 6, respectively, evidence was found that attentional bias and interpretation bias (i.e., emotional reasoning) may make children vulnerable to the development anxiety problems (cf. Muris et al., 2003b; in adults, cf. MacLeod & Hagan, 1992; Van den Hout et al., 1995), which is in line with the information-processing account of anxiety (e.g., Clark, 1999). This implies that such a development might be counteracted by eliminating or attenuating biases that have already emerged. Several studies have reported that it is in fact possible to modify cognitive bias, although thus far such investigations have been limited to adults. For example, MacLeod et al. (2002) demonstrated that adults who were induced with an attentional bias to negative stimuli showed an elevated emotional reaction in response to stress compared to controls (also see Fulcher et al., 2001). Similarly, experimental induction of interpretation bias favouring positive or negative material has been linked with congruent changes in anxiety (Mathews & Mackintosh, 2000; Wilson et al., 2006; Yiend et al., 2005). Moreover, there is some promising evidence to suggest that removal of at-

tentional bias can be used for the treatment of anxiety disorders (see for a review, Mohlman, 2004; Hazen, Vasey, & Schmidt in Bijttebier, Vasey, & Braet, 2003).

An important issue with respect to prevention is how children who are prone to develop anxiety can be identified. Cognitive biases such as attentional bias and emotional reasoning do not seem suitable for this: although it was found that these biases predicted later anxiety, they seem to be normal characteristics of children especially at younger ages. Failed threat inhibition may be a better candidate, but this would first require that the link between inhibition and attentional bias be established directly. Thus, given the current state of affairs, identification of vulnerable children would probably be most successful on the basis of non-cognitive risk factors, such as parental anxiety or behavioural inhibition (cf. Moradi, 1999a; Schwartz et al., 1996). A promising approach to the prevention of anxiety problems in children is the use of computer- and internet-based methodologies to eliminate attentional bias (cf. Lange et al., 2003). If such techniques could be moulded into games, children might even be eager to play them. This might render such games popular in large groups of children, and thus reduce the importance of identifying children at risk.

In addition to these potential applications for prevention and treatment, several general implications of cognitive-emotional research in children and adolescents might be relevant for clinical practice. First, such research may elucidate the processes responsible for treatment success or failure, and may foster improvement of therapy (Bijttebier et al., 2003). For instance, the suggestion that impaired threat inhibition is responsible for the presence of attentional bias in anxiety patients, may explain why attentional bias is unrelated to treatment success (e.g., Devineni, Blanchard, Hickling, & Buckley, 2004; Thorpe & Salkovskis, 1997; but see Mogg, Bradley, Millar, & White, 1995). Although treatment probably attenuates the perceived threat value of phobogenic stimuli, inhibition may still be impaired. Similarly, anxiety therapies most likely reduce the patient's avoidance at a behavioural level, but not at the cognitive level. After a while, cognitive avoidance may gradually reinstate behavioural avoidance, and revive the phobia.

Second, a problem with cognitive processes is that clinicians lack the proper tools for their assessment. Thus, they are bound to rely on self-report measures such as anamnestic interviews and questionnaires, which have an important limitation. That is, while cognitive biases provide a measure of information processing itself, questionnaires only evaluate the outcome of this processing, the cognitive products (Lavy, Van den Hout, & Arntz, 1993). In addition, since cognitive processes usually occur outside conscious awareness, they are not available for self-report (Bijttebier et al., 2003). Nevertheless, research on the cognitive processes pertinent to anxiety may identify active ingredients in the treatment of anxiety, and help to improve it. However, although the application of cognitive bias reduction strategies seems clinically viable (Mohlman, 2004), substantial changes in the therapeutic procedures and equipment would be necessary. To summarise, the clinical translation of cognitive-experimental insights on anxiety has only just begun, but seems to have great promise.

7.7 Concluding remarks

And now the conclusion. The introductory chapter of this thesis ended with four research questions aiming to clarify the role of cognitive bias in childhood anxiety. This

concluding paragraph seeks to provide an answer to these questions. Concerning the first question, evidence was found that attentional bias contributes to the development of anxiety. The results indicated that attentional bias directly predicted spider fear several months later. Second, emotional reasoning also appeared to put children at risk for anxiety disorders, although this was mainly the case in the youngest children. No evidence was found that parent-based reasoning was a risk factor for anxiety in children, although like emotional reasoning it was positively related to anxiety. As to the third and fourth research question, the cognitive inhibition hypothesis was partly, and under specific conditions, supported. That is, children displayed an attentional bias independent of their anxiety, and the predicted developmental pattern emerged in one of two attempts. These results could be traced back to early stages of the Stroop task. Prospective testing of the cognitive inhibition hypothesis revealed that higher levels of attentional bias set about an increase of anxiety. However, it was also found that increases of attentional bias were associated with lower anxiety levels. Finally, worth mentioning is the serendipitous finding that attentional bias reversed during the course of the Stroop, especially when inhibition failed.

An immutable law of scientific research seems that each study generates new research questions that may be taken up in future investigations. This thesis is no exception. First, it is obvious that the present naturalistic evidence that attentional and interpretation bias contribute to the development of anxiety should be replicated. Nevertheless, conclusive evidence for this connection calls for experimental evidence obtained from normal children. Second, it was argued that Stroop and VDP yield equivalent attentional bias effects. However, direct proof for this claim is currently lacking, as both tasks have never been administered within a single group of children (for a comparison between both tasks in adults, see Brosschot, De Ruiter, & Kindt, 1999). The results of such studies might indicate that Stroop and VDP findings are complementary, which would allow researchers to concentrate on theoretical issues rather than on methodological differences. A third important challenge for future research concerns the measurement of cognitive inhibition, which has hitherto been achieved indirectly via attentional bias. Strong evidence for the cognitive inhibition hypothesis should involve the direct measurement of cognitive inhibition, and demonstrate that this lack of inhibition in fact fosters attentional bias. A related issue concerns why attentional bias shows reversal during the course of the Stroop task, and whether this effect can be explained with the vigilance-avoidance hypothesis. Fourth, although many types of interpretation bias seem relevant for anxiety, little is known about how they relate to each other and to attentional bias. Finally, there is some indication that it is feasible to reduce cognitive bias in order to treat anxiety disorders, but such possibilities have yet to be explored in children. In addition, if further naturalistic studies show that cognitive biases constitute a risk factor of anxiety, they may be used to identify vulnerable children and prevent the development of anxiety.

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Summary

The information processing account of anxiety embraces the idea that anxious individuals possess broad cognitive schemas around themes of anxiety and danger, which can be accessed very easily. It is assumed that these schemas bring about a variety of cognitive biases, such as attentional and interpretation bias. The evidence that anxiety is indeed associated with these cognitive biases is overwhelming. For adults, that is; research on the presence of these biases in children is much less prevalent. In this thesis, the role of cognitive bias in the development of childhood anxiety was considered.

There were two main objectives. First, the cognitive inhibition hypothesis of the development of attentional bias in children was tested (Kindt, Bierman, & Brosschot, 1997a). According to the hypothesis, it is normal for young children to exhibit an attentional bias for threatening information, because they have not yet developed the ability to inhibit threat. As children normally develop this ability with age, the bias gradually disappears. However, when children fail to attain inhibitory competency, their attentional bias is allowed to persist. This puts them at risk for anxiety disorders. The second objective of this thesis was to further examine a form of interpretation bias named emotional reasoning, the tendency to infer the presence of danger and being threatened from personal feelings of anxiety. The importance of this phenomenon rests in the fact that it illustrates that anxiety is self-perpetuating. It also shows clearly that feelings of anxiety can be attributed to stimuli that just happen to be present, which may eventually grow to phobic proportions. Because children often rely heavily on their parents in determining how to respond to a certain situation, the concept of parent-based reasoning was developed, which is the tendency to infer danger and threat from the anxious reaction of a parent. More specifically, the purpose of this thesis was to investigate whether:

1. attentional bias contributes to the development of anxiety in children;
2. emotional reasoning, and the related concept of parent-based reasoning, contribute to the development of childhood anxiety;
3. children exhibit attentional bias irrespective of their anxiety in line with the predictions of the cognitive inhibition hypothesis;
4. non-anxious children show a decrease of attentional bias as they get older, while this bias persists in anxious schoolchildren, as is predicted by the cognitive inhibition hypothesis.

This thesis presents five studies that were carried out as part of a longitudinal project on the relationship between cognitive bias and anxiety in children. Forty-six primary schools in the southwest of the Netherlands participated in the project. Children were eligible for participation when they attended grade 4 (age 7 or 8 years) through grade 8 (age 11 or 12 years); parents provided informed consent for their child. First, 3,564 children were screened for spider fear by means of self-report. Subsequently, contrast groups were formed consisting of 280 spider fearful and 300 non-fearful control children, comparable on gender, age and grade. These children completed the emotional Stroop task on three occasions, over next 3 years, and completed repeated spider fear measurements and stories designed to assess emotional and parent-based reasoning.

The study in chapter 2 investigated whether the pattern of attentional bias predicted by the cognitive inhibition hypothesis could be obtained with children who were afraid of spiders. More specifically, it was examined whether 375 children aged 7 to 11 years showed an attentional bias regardless of their fear, and whether this bias persists with age in spider fearful children but decreases in non-fearful controls. An additional aim of the study was to see whether the level of perceptual integration of the Stroop stimuli would influence these effects. For this purpose, an emotional Stroop task was administered which comprised 144 linguistic stimuli, half of which were integrated (i.e., words with coloured letters) and the other half non-integrated (i.e., words superimposed on coloured circles). It is more difficult to ignore irrelevant information when it is integrated in a stimulus compared to when this is not the case (MacLeod, 1991). More cognitive effort is therefore required to extract target information from stimuli in integrated format. If, as the cognitive inhibition hypothesis proposes, the ability to inhibit irrelevant information develops gradually with age, it follows that attentional bias would start to decline at a younger age for non-integrated stimuli than for integrated stimuli. Accordingly, a difference in attentional bias between anxious and control children was anticipated to emerge at a younger age for non-integrated stimuli than for integrated stimuli.

The results were highly surprising. Rather than showing the expected attentional bias effect with slower responses to spider stimuli than to neutral stimuli, the opposite pattern of results emerged. That is, for both stimulus formats, children generally responded faster to spider stimuli than to control stimuli, which was labelled a *reversed* attentional bias. It was suggested that the length of the Stroop task might have been responsible for these results, which considerably exceeded the 48 to 96 trials of previous research with comparable Stroop tasks (Kindt & Brosschot, 1999; Kindt et al., 1997a; Kindt, Brosschot, & Everaerd, 1997b; Kindt, Van den Hout, De Jong, & Hoekzema, 2000). It was reasoned that if task length is responsible for the divergent findings of chapter 2, the expected pattern of results should emerge in early stages of the Stroop, and reverse in later stages. To examine this possibility, the first and second half of the Stroop were analysed separately, both for integrated and non-integrated stimuli. This yielded the following results.

For the *non-integrated* stimuli, the reversed attentional bias effect emerged once again in spider fearful as well as in control children in both halves. For *integrated* stimuli, this effect was only present in the second half of the experiment. In the first half, however, attentional bias was in the expected direction. The latter finding may be taken as evidence that inhibition failed if the largest attentional bias effect is presented by children whose inhibitory skills are least developed: i.e., the youngest children. Indeed, subsequent analyses showed that bias was only significant in the youngest children, aged 7-8 years; however, the anticipated developmental pattern of attentional bias did not emerge. This, however, is not the only clue in the results of chapter 2 that failed inhibition occurred. If attentional bias results from the failure of inhibition, the magnitude of this bias should be smaller as fewer cognitive resources are required to ignore distracting information that is embedded in the stimulus. The resources that are not used up for inhibiting distracting information can then be deployed for other purposes, such as speeding up responding. Compared to integrated stimuli, it is relatively easy for children to extract target information from non-integrated stimuli. This may therefore explain why children responded faster to non-integrated stimuli, and showed the reversed attentional bias earlier in the task for these stimuli.

To explain the reversed attentional bias effect, it was proposed that the large number of stimulus trials might have fatigued children increasingly as the Stroop task progressed. However, this seemed unlikely because it would have similarly affected responses to spider and control words, which was not the case: responses to control words did indeed slow down in the second half, but responses to spider words got faster. As an alternative explanation, it was hypothesised that children might have found a way to avoid the threatening meaning of the spider words. They might have achieved this by giving fast responses, because the stimuli in this particular Stroop were removed from the screen upon detection of a response. The slowing down of responses to control stimuli would then reflect a more relaxed reaction to stimuli rendered as non-threatening. This explanation tallies up with the notion that children require more cognitive effort to respond to target information when it is integrated with distracting information than when it is not (MacLeod, 1991). The results presented in chapter 2 seemed to indicate that children had more difficulty avoiding threatening meaning in stimuli when it was integrated with the target (i.e., the colour). That is, in the first half of the Stroop, the reversed attentional bias was already present for non-integrated stimuli but not for integrated stimuli, and in the second half this effect was larger for non-integrated compared to integrated stimuli.

The original plan was to provide a prospective test of the cognitive inhibition hypothesis by obtaining repeated measurements of attentional bias from the same child. However, given the results of chapter 2, it did not seem sensible to proceed with this approach with the same lengthy task. Therefore, for the experiment described in chapter 3 it was decided to use a spider Stroop with which attentional bias for spider-related information had previously been uncovered successfully (i.e., the task devised by Kindt et al., 2000). This task consists of 48 non-integrated stimuli, and was administered to 259 spider fearful and 250 control children 7 to 13 years old. Again, to test the cognitive inhibition hypothesis, it was examined whether children would show an attentional bias for threatening information, and whether this bias would decrease with age in non-fearful controls but persist in spider fearful children. In line with the cognitive inhibition hypothesis, the results of the experiment in chapter 3 revealed that attentional bias increased with age in spider fearful children, but decreased with age in control children. Moreover, the magnitude of these associations differed significantly. Separate analysis of the two halves of the Stroop task revealed that this could be attributed to children's pattern of responding in the first half. Analysis of the second half revealed no significant effects.

The second purpose of chapter 3 was to investigate whether broader attentional control mechanisms would be involved in the regulation of anxiety (Vasey & MacLeod, 2001). For this purpose, effortful control was measured, which is an aspect of temperament allowing children to exert intentional (i.e., effortful) control on the focus of attention in relation to a certain emotional constitution (Lonigan & Phillips, 1991). The ability to exert effortful control would allow fearful children to control their attention in such a way that they would perform on a Stroop task in the same way as non-fearful children: thus, their attentional bias would decrease with age. However, the attentional bias of fearful children with poor effortful control would fail to subside and persist into adulthood. To test this hypothesis, it was examined whether attentional bias would be present in high spider fearful children low on effortful control, but absent in high spider fearful children high on effortful control. For low anxious control children it was predicted that effortful control would not exert an effect on attentional bias. Because

effortful control improves as children grow older, age effects were also considered. However, no supportive evidence was found that effortful control modifies the relationship between attentional bias and anxiety in children.

Chapter 4 presents the third and final study on attentional bias of this thesis, and offers a prospective analysis of the relationship between attentional bias and childhood fear. The purpose was (1) to provide a prospective test of the cognitive inhibition hypothesis, and (2) to examine the prospective connection between anxiety and attentional bias. Thus, a random sub-sample of 186 children from chapter 3 completed the Stroop a second time 10 months later. Because the original division between high spider fearful children and controls of chapter 2 was badly disrupted, a regression approach was used to analyse the Stroop data. These analyses revealed the following. First, it was found that attentional bias significantly predicted spider fear 10 months later. Moreover, the pathway from bias to spider fear was direct, not mediated by later attentional bias. This is the first study to find evidence that attentional bias contributes to the development of anxiety in children. Second, partial support for the cognitive inhibition hypothesis was obtained. The concurrent analyses did not reveal any attentional bias effect. However, the temporal analyses showed that children who exhibited higher levels of attentional bias at the first measurement occasion showed higher increases in anxiety from occasion 1 to occasion 2. This effect did not differ for children of different grades.

Chapters 5 and 6 present two studies on emotional reasoning. Emotional reasoning is a form of interpretation bias that involves misinterpretation of interoceptive information. Rather than relying on objective information from the environment to establish whether danger is imminent, anxious individuals rely on subjective information from their own anxiety response to decide whether threat is present. In chapter 5, the concept related to emotional reasoning is introduced, namely parent-based reasoning. As opposed to emotional reasoning, parent-based reasoning involves misinterpretation of the anxiety response of other persons, a parent for instance, as evidence for threat. Children regularly use their parents as source of information about the world in order to learn how they should deal with their environment, which has also been described as social referencing of modelling. Whereas the latter two processes are defined more broadly, parent-based reasoning specifically tunes into on how the parental anxiety response, or the absence hereof, affects the child's fearfulness. Both emotional and parent-based reasoning are quantified with short stories. There are four versions of each story, obtained by systematically varying the presence or absence of objective danger with an anxiety response or a positive response expressed by the main character of the story. Children are urged to identify with this main character and to rate the dangerousness of each story version.

In the studies presented in chapters 5 and 6, the emotional reasoning stories were written around three anxiety themes, namely social phobia, separation anxiety, and generalised anxiety; there also was one parent-based reasoning story. In chapter 5, these stories were presented to 508 children aged 7-13 years old. In addition, these children provided self-report of anxiety and depression. General emotional reasoning and parent-based reasoning effects were found: the children not only relied on objective information to establish whether a situation was dangerous, but also based their rating on the anxiety response and the positive response. In addition, in the objectively safe situations, emotional reasoning as well as parent-based reasoning was stronger as children's anxiety levels were higher. Furthermore, both phenomena were domain-

specific, because they only related to anxiety and not to depression. Finally, no evidence was found that reasoning is content-specific: the relationship between each of the three anxiety types and emotional reasoning was similarly strong in anxiety-relevant and anxiety-irrelevant situations.

Chapter 6 examined whether emotional and parent-based reasoning might contribute to the development of anxiety, or are merely its by-products. From a sub-sample of 122 children, self-reported anxiety and ratings of the emotional and parent-based reasoning stories, were obtained a second time approximately 10 months later. Again, general emotional and parent-based reasoning effects emerged, and were stronger under conditions of safety when children's anxiety was higher. More importantly, evidence indicated that emotional reasoning predicted later anxiety, while parent-based reasoning was merely a by-product of anxiety. That is, there was a direct pathway of emotional reasoning enhancing anxiety in younger children, but reducing anxiety in older children. In addition, emotional reasoning seemed to predict anxiety indirectly. More specifically, current emotional reasoning was predicted by previous emotional reasoning, and predicted concurrent anxiety, particularly in younger children. In addition, current anxiety was predicted by previous anxiety, and predicted concurrent emotional reasoning. These findings indicate that while emotional reasoning seems to be a risk factor for developing later anxiety complaints in younger children, this does not seem to apply to older children.

In chapter 7, the results of chapter 3 to 6 are discussed. The main conclusions can be catalogued as follows. First, the results of this thesis support the notion that attentional bias and emotional reasoning are vulnerability factors for the development of anxiety. This was not the case for parent-based reasoning. Second, partial support was found for the cognitive inhibition hypothesis. Attentional bias emerged independent of children's anxiety levels, and on one of two occasions, the expected developmental pattern of bias was found. Interestingly, these effects could mainly be attributed to the first half of the Stroop task. Third and finally, an unanticipated finding was that attentional bias reversed towards later stages of the Stroop task. Several directions for future research were proposed. First, experimental evidence should establish that attentional bias is responsible for the development of anxiety. Second, the gap between research measuring attentional bias with Stroop and VDP should be narrowed by direct comparison between both methodologies. Third, a more robust confirmation of the cognitive inhibition hypothesis would require assessment of cognitive inhibition directly. Fourth, further research is required to explain the reversal of attentional bias. Finally, the clinical relevance of the present studies is limited. However, as a risk factor for anxiety, it might be attempted to identify vulnerable children and prevent them developing anxiety by eliminating the cognitive bias.

Samenvatting

De informatieverwerkingstheorie van angst gaat er vanuit dat individuen met angstproblemen uitgebreide, snel te activeren cognitieve schema's bezitten rond het thema angst en gevaar. Deze schema's worden verantwoordelijk gehouden voor selectieve informatieverwerking op allerlei gebied, zoals aandachtsbias en interpretatiebias. Er zijn zeer sterke aanwijzingen dat bij volwassenen angst inderdaad geassocieerd is met deze selectieve informatieverwerking. Onderzoek naar het bestaan van selectieve informatieverwerking bij kinderen is veel schaarser. In dit proefschrift wordt de rol van selectieve informatieverwerking in de ontwikkeling van angst bij kinderen onderzocht.

Er waren twee hoofddoelen. Allereerst werd de cognitieve inhibitiehypothese van de ontwikkeling van aandachtsbias bij kinderen getest (Kindt, Bierman, & Bosschot, 1997a). Volgens deze hypothese is het normaal dat jonge kinderen een aandachtsbias hebben voor dreigende informatie, omdat het hen nog ontbreekt aan het vermogen om dreiging te inhiberen. Normaliter ontwikkelen kinderen dit vermogen geleidelijk naarmate ze ouder worden, zodat hun aandachtsbias geleidelijk verdwijnt. Wanneer kinderen dit inhibitievermogen niet ontwikkelen, kan hun aandachtsbias blijven voortbestaan. Dit maakt deze kinderen kwetsbaar voor het ontwikkelen van een angststoornis. Als tweede doel van dit proefschrift werd een vorm selectieve interpretatie, te weten emotioneel redeneren, onder de loep genomen. Emotioneel redeneren verwijst naar de geneigdheid om de aanwezigheid van gevaar en dreiging af te leiden uit de eigen angstgevoelens. Het belang van dit fenomeen is erin gelegen dat angst zichzelf ermee in stand kan houden. Het onderschrijft tevens dat angstgevoelens kunnen worden toegeschreven aan stimuli die toevallig aanwezig zijn, en die tot fobische proporties kunnen uitgroeien. Omdat kinderen op hun ouders afgaan om te bepalen hoe met een bepaalde situatie om te gaan, is voorts het concept ouderafhankelijk redeneren ontwikkeld. Het wordt gedefinieerd als de geneigdheid om de aanwezigheid van gevaar en dreiging af te leiden uit de ouderlijke angstreactie. Meer specifiek was het doel van dit proefschrift om te onderzoeken of:

1. aandachtsbias bijdraagt aan de ontwikkeling van angst bij kinderen;
2. emotioneel redeneren, en het gerelateerde concept ouderafhankelijk redeneren, bijdragen aan de ontwikkeling van angst bij kinderen;
3. kinderen een aandachtsbias tentoonspreiden ongeacht hun angstniveau, zoals de cognitieve inhibitiehypothese voorspelt; en
4. tevens conform de cognitieve inhibitiehypothese, of de aandachtsbias van niet-angstige kinderen afneemt naarmate zij ouder worden, terwijl deze bij angstige kinderen blijft voortbestaan.

In dit proefschrift worden vijf onderzoeken gepresenteerd die deel uitmaakten van een longitudinaal project over de relatie tussen selectieve informatieverwerking en angst bij kinderen. Zesenveertig basisscholen in zuidwest Nederland namen deel aan het project. Kinderen van groep 4 (7 of 8 jaar) tot en met groep 8 (11 of 12 jaar) konden meedoen, nadat hun ouders hiervoor toestemming had gegeven. Er werden 3.564 kinderen door middel van vragenlijsten gescreend op spinangst. Vervolgens werden contrastgroepen van 280 angstige en 300 niet-angstige kinderen samengesteld, die verge-

lijkbaar waren met betrekking tot leeftijd, geslacht en groep. In de drie jaar daarna voerden deze kinderen drie keer de emotionele Strooptaak uit en werd hun spinangst gemeten. Om emotioneel en ouderafhankelijk redeneren vast te stellen beoordeelden de kinderen de bedreigendheid van een serie speciaal hiervoor geconstrueerde scenario's.

Het belangrijkste doel van hoofdstuk 2 was te onderzoeken of spinangstige kinderen het patroon van aandachtsbias vertonen, zoals dat voorspeld wordt door de cognitieve inhibitiehypothese. Hiertoe werd een emotionele Strooptaak met 144 stimuli taak afgenomen bij 375 kinderen in de leeftijd van 7 tot 11 jaar. Op grond van de inhibitiehypothese werd verwacht dat alle kinderen, ongeacht hun angst, een aandachtsbias hebben. Daarnaast werd gekeken of de mate van perceptuele integratie van de stimuli in de Strooptaak deze effecten zou beïnvloeden. Daarom was de helft van de stimuli in de Stroop geïntegreerd (woorden met gekleurde letters) en de andere helft niet-geïntegreerd (woorden op gekleurde cirkels). Verondersteld werd dat het lastiger zou zijn om informatie te negeren wanneer deze geïntegreerd is in een stimulus dan wanneer dit niet het geval is (MacLeod, 1991). De achterliggende gedachte hierbij is dat bij geïntegreerde stimuli meer cognitieve inspanning nodig is om relevante stimulusinformatie (de kleur) uit haar irrelevante stimuluscontext (de woordbetekenis) te extraheren dan bij niet-geïntegreerde stimuli. Als inhibitievermogens zich inderdaad conform de hypothese gestaag met de leeftijd ontwikkelen, dan zou de aandachtsbias bij niet-geïntegreerde stimuli op jongere leeftijd beginnen af te nemen dan bij geïntegreerde stimuli. Daarom werd verwacht dat met niet-geïntegreerde stimuli op jongere leeftijd een verschil in aandachtsbias tussen angstige en niet-angstige controlekinderen waarneembaar zou zijn dan met geïntegreerde stimuli.

De resultaten van hoofdstuk 2 waren zeer verrassend. In plaats van de verwachte aandachtsbias, met langzamere reacties op spinwoorden dan op neutrale woorden, werd het tegenovergestelde gevonden. Het bleek namelijk dat kinderen sneller reageerden op spinstimuli dan op controlestimuli, hetgeen werd aangeduid als *omgekeerde* aandachtsbias. Een verklaring werd gezocht in de aanzienlijke lengte van de gebruikte Strooptaak in vergelijking met de 48 of 96 stimuli in eerder onderzoek met vergelijkbare taken (Kindt & Brosschot, 1999; Kindt e.a., 1997a; 1997b; 2000). Als de lengte van de taak verantwoordelijk is voor de afwijkende bevinding van hoofdstuk 2, zo werd geredeneerd, dan zou het verwachte patroon van aandachtsbias vooral aangetroffen kunnen worden in het beginstadium van de Stroop en pas in later stadium omkeren. Om dit verder te onderzoeken werden de eerste en tweede helft van de Strooptaak apart geanalyseerd, zowel voor geïntegreerde en niet-geïntegreerde stimuli. Dit leverde de volgende bevindingen op.

Voor de *niet-geïntegreerde* stimuli werd in beide helften van de Stroop opnieuw een omgekeerde aandachtsbias gevonden bij zowel spinangstige als controlekinderen. Voor *geïntegreerde* stimuli bestond dit effect alleen in de tweede helft van het experiment. Echter, in de eerste helft was de aandachtsbias in de verwachte richting. Dit mag worden opgevat als bewijs voor falende inhibitie, indien de reguliere aandachtsbias vooral optreedt bij kinderen wier vermogen tot cognitieve inhibitie het minst ontwikkeld is: de jongsten. Dit bleek inderdaad het geval te zijn: wanneer de leeftijdsgroepen apart geanalyseerd werden bleek alleen kinderen van 7-8 jaar aandachtsbias te vertonen. Maar dit was niet de enige aanwijzing voor slechte inhibitie in de resultaten van hoofdstuk 2. Als aandachtsbias een uiting is van falende inhibitie, is dit effect naar verwachting kleiner naarmate minder cognitieve capaciteit nodig is om afleidende, irrelevante

stimulusinformatie te negeren. De capaciteit die niet wordt gebruikt om afleidende informatie te inhiberen kan worden ingezet voor andere doeleinden, zoals het versnellen van de reactie. In vergelijking tot geïntegreerde stimuli is het voor kinderen relatief eenvoudig om specifieke informatie uit niet-geïntegreerde stimuli te extraheren. Dit verklaart waarschijnlijk ook waarom de kinderen sneller reageerden op niet-geïntegreerde stimuli, en waarom een omgekeerde aandachtsbias voor deze stimuli al in een vroeg stadium van de Strooptaak opdook.

Als verklaring voor de omgekeerde aandachtsbias werd geopperd dat de kinderen door het grote aantal stimuli steeds vermoeider werden naarmate de Stroop voortschreed. Bij nadere inspectie van de resultaten bleek deze verklaring echter niet houdbaar. Vermoeidheid zou het reageren op spin- en controlewoorden namelijk in gelijke mate beïnvloeden, hetgeen niet het geval was. Voor controlewoorden bleek in de tweede helft van de Stroop inderdaad een vertraging van de reactietijden op te treden; voor spinwoorden was er echter een versnelling. Als alternatieve verklaring werd daarom aangevoerd dat de kinderen een manier hadden uitgedokterd om de bedreigende betekenis van de spinwoorden te vermijden. Door snel te reageren verdwenen de stimuli eerder van het scherm. Het vertragen van de reactietijden bij controlestimuli zou daarmee een meer relaxte manier van reageren weerspiegelen op stimuli die niet bedreigend waren. Deze verklaring sluit aan bij het al eerder genoemde idee dat kinderen meer cognitieve capaciteit nodig hebben om op specifieke stimulusinformatie te reageren, die geïntegreerd is met afleidende informatie dan wanneer dat niet zo is (MacLeod, 1991). De resultaten van hoofdstuk 2 lieten zien dat kinderen meer moeite hadden om bedreigende stimulusinformatie te negeren wanneer deze geïntegreerd was met de informatie waarop zij moesten reageren (de stimuluskleur). Vandaar dat er in de eerste helft van de Stroop wel een omgekeerde aandachtsbias was voor niet-geïntegreerde stimuli, maar niet voor geïntegreerde stimuli. In de tweede helft was dit effect echter groter voor niet-geïntegreerde stimuli dan voor geïntegreerde stimuli.

Bij aanvang van het project was het de bedoeling om de cognitieve inhibitiehypothese prospectief te testen door aandachtsbias herhaald te meten. Met het oog op de bevindingen van hoofdstuk 2 leek het echter niet zinvol deze doelstelling na te blijven streven met dezelfde lange Strooptaak. Daarom werd besloten voor het experiment in hoofdstuk 3 een kortere Stroop te gebruiken, waarmee in eerder onderzoek een aandachtsbias voor spininformatie kon worden aangetoond (namelijk die van Kindt e.a., 2000). Deze taakt telt 48 niet-geïntegreerde stimuli en werd afgenomen bij 259 spinangstige en 250 controle kinderen in de leeftijd van 7 tot 13 jaar. Om de cognitieve inhibitiehypothese te testen werd wederom onderzocht of alle kinderen een aandachtsbias voor bedreigende informatie hadden. Vervolgens werd weer nagegaan of die aandachtsbias bij de angstige kinderen zou aanhouden of toenemen en bij niet-angstige kinderen geleidelijk zou afnemen met de leeftijd. De resultaten van hoofdstuk 3 bevestigden de cognitieve inhibitiehypothese: de aandachtsbias nam geleidelijk toe bij spinangstige kinderen, maar nam af bij de controlekinderen. Bovendien verschilde de omvang van beide associaties significant. Afzonderlijke analyse van de twee helften van deze Stroop lieten bovendien zien dat deze bevindingen konden worden toegeschreven aan de eerste helft van de taak. Analyse van de tweede Stroophelft leverde geen significante effecten op.

Het tweede doel van hoofdstuk 3 was om na te gaan of mechanismen van aandachtscontrole in bredere zin betrokken zijn bij de angstregulatie (Vasey & MacLeod, 2001). Hiertoe werd *effortful control* gemeten, een aspect van het temperament dat

kinderen in staat stelt doelbewust (*effortful*) de focus van hun aandacht te richten in de context van een bepaalde emotionele geneigdheid (Lonigan & Phillips, 1991). Het vermogen doelbewust de aandacht te controleren zou het angstige kinderen mogelijk maken hun aandacht zodanig te sturen dat zij een Strooptaak hetzelfde zouden kunnen uitvoeren als niet-angstige kinderen. Ook zou hun aandachtsbias met de leeftijd afnemen, terwijl de aandachtsbias van kinderen die hun aandacht slecht doelbewust kunnen richten niet zou afnemen en voortbestaan tot in de volwassenheid. Om deze hypothese te toetsen werd nagegaan of spinangstige kinderen met slechte aandachtscontrole een aandachtsbias vertonen, terwijl spinangstige kinderen met goede aandachtscontrole en controlekinderen ongeacht hun vermogen tot aandachtscontrole geen aandachtsbias tentoon spreiden. Aangezien kinderen hun aandacht beter kunnen controleren naarmate ze ouder worden, werd ook gekeken naar de invloed van leeftijd. Er werden geen aanwijzingen gevonden dat het vermogen tot aandachtscontrole de relatie tussen angst en aandachtsbias bij kinderen beïnvloedt.

In hoofdstuk 4 wordt het derde en laatste onderzoek over aandachtsbias van dit proefschrift gepresenteerd. Er wordt een prospectieve analyse uitgevoerd van de relatie tussen aandachtsbias en angst bij kinderen. Het doel was (1) om de cognitieve inhibitiehypothese prospectief te testen en (2) om de prospectieve relatie tussen angst en aandachtsbias te beproeven. Hiertoe deed een willekeurige selectie van 186 kinderen uit het onderzoek van hoofdstuk 3 na 10 maanden opnieuw de Stroop. Omdat de originele tweedeling in wel en niet angstige kinderen van hoofdstuk 2 nog amper kon worden teruggevonden, werden de Stroopgegevens met regressie geanalyseerd. Dit leverde het volgende op. Ten eerste bleek aandachtsbias een significante voorspeller van spinangst 10 maanden later. Daarmee is dit het eerste onderzoek waarin aanwijzingen gevonden worden dat aandachtsbias een bijdrage levert aan de ontwikkeling van angst in kinderen. Ten tweede werd gedeeltelijk bewijs gevonden voor de cognitieve inhibitiehypothese. Cross-sectionele analyse leverde geen aandachtsbias op. Temporele analyses liet wel zien dat kinderen met meer aandachtsbias bij meting 1 een grotere angsttoename tentoonspreidden tussen de twee metingen. Dit effect verschilde niet tussen kinderen uit de verschillende klassengroepen.

Hoofdstuk 5 en 6 gaan over emotioneel redeneren, een vorm van selectieve interpretatie waarbij misinterpretatie van interoceptieve informatie centraal staat. Om te bepalen of er gevaar dreigt gebruiken angstige individuen niet alleen objectieve omgevingsinformatie, maar ook hun eigen angstreactie. In hoofdstuk 5 wordt een aan emotioneel redeneren gelieerd concept geïntroduceerd, namelijk ouderafhankelijk redeneren. Anders dan bij emotioneel redeneren maken kinderen bij ouderafhankelijk redeneren gebruik van de angstrespons van andere aanwezigen, in dit geval een ouder, om de gevaarstatus van een situatie te bepalen. Kinderen gebruiken hun ouders als vaste bron van informatie over de wereld, om te leren omgaan met uiteenlopende situaties die zij tegemoet treden. De algemene benaming voor deze geneigdheid is *social referencing* of *modelling*. Waar de twee laatstgenoemde processen echter breder gedefinieerd zijn, gaat ouderafhankelijk redeneren specifiek in op de wijze waarop een ouderlijke angstrespons, of de afwezigheid hiervan, de mate van angst van het kind beïnvloedt. Zowel emotioneel als ouderafhankelijk redeneren worden geoperationaliseerd door middel van korte scenario's. Er zijn steeds vier versies van elk scenario, die worden verkregen door systematisch de aanwezigheid of afwezigheid van objectief gevaar te combineren met een angstrespons of een positieve respons. Deze respons wordt geuit door de hoofdpersoon van het scenario en de kinderen worden aangemoedigd zich met

deze hoofdpersoon te identificeren. Vervolgens wordt hen gevraagd te beoordelen hoe gevaarlijk zij elke versie van het scenario vinden.

De scenario's van hoofdstuk 5 en 6 waren geschreven rondom drie angstthema's, namelijk sociaal fobie, separatieangst, en gegeneraliseerde angst; daarnaast was er één ouderafhankelijk redeneren scenario. In hoofdstuk 5 werden deze scenario's aangeboden aan 508 kinderen van 7 tot 13 jaar oud. Verder gaven de kinderen aan in hoeverre zij over het algemeen angstig of depressief waren. Er werd een effect gevonden van zowel emotioneel als ouderafhankelijk redeneren. Dat wil zeggen, de kinderen bleken niet alleen objectieve informatie te gebruiken om te bepalen of een situatie gevaarlijk was, maar bleken hun inschatting ook te baseren op de angstrespons en de positieve respons. Verder bleken zowel emotioneel als ouderafhankelijk redeneren in de objectief veilige situatie positief samen te hangen met angst. Bovendien waren beide fenomenen domeinspecifiek in de zin dat ze alleen samenhingen met angst, maar niet met depressie. Er waren echter geen aanwijzingen dat emotioneel redeneren inhoudsspecifiek was: de relatie tussen de drie typen angst en emotioneel rederenen was even sterk in situaties die relevant waren voor de specifieke angst als in situaties die hiervoor niet relevant waren.

In hoofdstuk 6 werd onderzocht of emotioneel en ouderafhankelijk redeneren een rol spelen in de ontwikkeling van angst, of hiervan slechts een bijproduct zijn. Dit werd onderzocht bij 122 kinderen die 10 maanden na het onderzoek uit hoofdstuk 5 een tweede keer de angstvragenlijst invulden en het scenario op gevaar beoordeelden. Ook in dit onderzoek bleek dat kinderen over het algemeen sterk geneigd waren tot emotioneel en ouderafhankelijk redeneren, vooral in de objectief veilige situatie en naarmate kinderen meer angst rapporteerden. Interessanter was echter dat emotioneel redeneren latere angstniveaus voorspelde; ouderafhankelijk redeneren bleek slechts een bijproduct van angst. Er was een directe samenhang, waarbij meer emotioneel redeneren bij jonge kinderen meer angst en bij oudere kinderen minder angst tot gevolg had. Er werd echter ook een indirecte connectie tussen emotioneel redeneren en angst aangetoond. Hierbij voorspelde emotioneel redeneren 10 maanden eerder het huidig emotioneel redeneren; dit huidig emotioneel redeneren voorspelde vervolgens de huidige angst. Daarnaast voorspelde angst 10 maanden eerder de huidige angst; die huidige angst voorspelde vervolgens het huidig emotioneel redeneren. Deze resultaten geven aan dat hoewel emotioneel redeneren waarschijnlijk een risicofactor is voor angst bij jongere kinderen, dit waarschijnlijk niet zo is bij oudere kinderen.

In hoofdstuk 7, ten slotte, worden de bevindingen uit hoofdstuk 3 tot en met 6 bediscussieerd. De belangrijkste conclusies luiden als volgt. Ten eerste blijkt dat aandachtsbias en emotioneel redeneren kwetsbaarheidfactoren zijn voor de ontwikkeling van angst. Voor ouderafhankelijk redeneren bleek dit niet het geval. Ten tweede werd gedeeltelijke ondersteuning voor de cognitieve inhibitiehypothese gevonden. Aandachtsbias trad op ongeacht het angstniveau van de kinderen, en het verwachte ontwikkelingspatroon van aandachtsbias werd gevonden in een van twee onderzoeken. Opvallend was dat deze effecten vooral toegeschreven konden worden aan de eerste helft van de Strooptaak. Eveneens vermeldenswaardig is de onverwachte bevinding dat aandachtsbias gedurende de Stroop geleidelijk omkeerde. Vervolgens werden aanbevelingen voor toekomstig onderzoek gedaan. Allereerst is experimentele ondersteuning nodig om vast te stellen dat aandachtsbias verantwoordelijk is voor de ontwikkeling van angst. Daarnaast dient door middel van een directe vergelijking tussen aandachtsbias gemeten met Stroop en VDP een brug geslagen te worden tussen beide onder-

zoeksmethodieken. Op de derde plaats zou krachtiger bewijs voor de cognitieve inhibitiehypothese vergaard moeten worden door meting van cognitieve inhibitie zelf. Ten vierde is verder onderzoek nodig om de omgekeerde aandachtsbias te verklaren. Ten slotte blijkt de klinische relevantie van gepresenteerde onderzoeken vrij beperkt. Aangezien cognitieve bias een risicofactor voor angst is gebleken, zou getracht kunnen worden te voorkomen dat kwetsbare kinderen angst ontwikkelen door hen te identificeren en hun cognitieve bias te elimineren.

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Curriculum Vitae

Mattijn Morren was born on February 3, 1974, in Nijmegen. After obtaining his VWO diploma in 1986 (athenaeum B) at the Dominicus College in Nijmegen, he studied Health Sciences at the University of Maastricht in 1992. During this study, he conducted research on determinants of hostility, a risk factor of coronary heart disease. He graduated in 1997 with a major in Mental Health Sciences, after which he was employed for two years as a research assistant at the Max Planck Institute for Psycholinguistics in Nijmegen. In 1999, he started his PhD project at the Department of Medical, Clinical, and Experimental Psychology of the University of Maastricht; at the same time, he worked as a lecturer at this Department. In 2003, he changed jobs to NIVEL, the Netherlands Institute for Health Services Research, in Utrecht, to work with the Panel of Patients with a Chronic Disease. Five months later, he joined the 'disaster team' in the monitoring of the health consequences of Enschede fireworks explosion on May 13, 2000. His work focused on the impact of the disaster on the health of rescue workers and children. His current project involves an examination of the effectiveness of situational feedback in the treatment of patients with chronic low back pain and irritable bowel syndrome using mobile information technology.

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