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Threat-based cognitive biases in anxious children: Comparison with non-anxious children before and after cognitive behavioural treatment

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Abstract

Attention and interpretation biases for threat stimuli were assessed in 19 anxious (ANX) children before and after cognitive behavioural therapy (CBT), and compared with responses from 19 non-anxious (NA) control children collected over the same period. Attentional bias was assessed using a picture version of the visual probe task with threat, neutral and pleasant pictures. Threat interpretation bias was assessed using both a homographs task in which children used homograph words in a sentence and their neutral or threatening meaning was assessed, and a stories task in which children rated their negative emotion, danger judgments, and influencing ability in ambiguous situations. ANX children showed attention biases towards threat on the visual probe task and threat interpretation biases on the stories task but not the homographs task at pre-treatment in comparison with NA children. Following treatment, ANX children's threat interpretation biases as assessed on the stories task reduced significantly to within levels comparable to NA children. However, ANX children continued to show larger attentional biases towards threat than pleasant pictures on the visual probe task at post-treatment, whereas NA children did not show attentional biases. Moreover, a residual threat interpretation style on the stories task at post-treatment was associated with higher anxiety symptoms in both ANX and NA children.

Keywords: Cognitive biases; Cognitive behavioural treatment; Childhood anxiety disorders

Introduction

Cognitive biases in the form of disproportionate allocation of attention to threat cues and danger-laden interpretations both characterize and are believed to contribute to anxiety disorders among both children and adults. Cognitive theories of anxiety disorders propose that biased attention processes toward threat play a role in the maintenance of anxiety by potentiating sensitization and interfering with habituation and

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re-appraisal of stimuli as non-threatening (Mogg & Bradley, 1998; Williams, Watts, MacLeod, & Mathews, 1997). Therefore, increased attention to threat stimuli is likely to maintain the capacity of stimuli to elicit anxiety over time and continue to be interpreted as threatening (Bögels & Mansell, 2004).

Threat-based biases in attention and interpretation have been repeatedly documented in high trait anxious (ANX) and clinically ANX adults (e.g., Butler & Mathews, 1987; Eysenck, Mogg, May, Richards, & Mathews, 1991; Foa, Franklin, Perry, & Herbert, 1996; Lavy, van den Hout, & Arntz, 1993; MacLeod, Mathews, & Tata, 1986; Maidenberg, Chen, Craske, Bohn, & Bystristsky, 1996; Mogg, Philippot, & Bradley, 2004). However, there is an expanding literature focused on ANX children showing that the patterns of results are not as consistent as those seen in adults, particularly in relation to attentional biases towards threat stimuli. The current study adds to this literature by examining attentional and interpretation biases towards threat stimuli in ANX and non-anxious (NA) children. Additional study aims were to determine whether these biases in ANX children reduced to levels comparable to NA controls after treatment with cognitive behavioural therapy (CBT), and to test associations between biases and anxiety symptoms.

Attentional bias

Several studies have found that ANX children and adolescents show an abnormal attentional bias for threat stimuli (e.g., Dalgleish, Moradi, Taghavi, Neshat-Doost, & Yule, 2001; Dalgleish et al., 2003; Martin, Horder, & Jones, 1992; Monk et al., 2006; Moradi, Taghavi, Neshat-Doost, Yule, & Dalgleish, 1999; Pine et al., 2005; Stirling, Eley, & Clark, 2006; Taghavi, Neshat-Doost, Moradi, Yule, & Dalgliesh, 1999; Vasey, Daleiden, Williams, & Brown, 1995; Vasey, El-Hag, & Daleiden, 1996). These studies have employed word or picture stimuli in either visual probe tasks or emotional Stroop tasks with clinically ANX youths and NA controls ranging in age from 9 to 19 years. Several other studies have found that a threat-related attentional bias is common to children in general, regardless of anxiety status (e.g., Ehrenreich & Gross, 2002; Kindt, Bierman, & Brosschot, 1997; Kindt, Brosschot, & Everaerd, 1997; Morren, Kindt, van den Hout, & van Kasteren, 2003; Waters, Lipp, & Spence, 2004). These studies have employed both word and picture stimuli in visual probe tasks and emotional Stroop tasks with children of a younger age (i.e., 8–12 years).

Findings across these studies have not been consistent however, and a combination of methodological, clinical and developmental factors is thought to contribute to this (see Vasey & MacLeod, 2001; Puliafico & Kendall, 2006, for reviews). The suitability of the visual probe task versus the emotional Stroop task for assessing attentional bias in children and the merits of using picture versus word stimuli in these tasks have received considerable attention (see Puliafico & Kendall, 2006). Studies using the visual probe task have shown an anxiety-specific threat bias (e.g., Stirling et al., 2006; Vasey et al., 1995) as well as a common threat bias among children (e.g., Ehrenreich & Gross, 2002; Waters et al., 2004). Similarly, studies using the emotional Stroop task have shown an anxiety-specific threat bias (e.g., Moradi et al., 1999) as well as a common threat bias among children (e.g., Kindt Bierman et al., 1997; Kindt Brosschot et al., 1997). Studies employing the word stimuli have shown a threat bias to be specific to ANX children (e.g., Dalgleish et al., 2001) as well as characteristic of children in general (e.g., Kindt Bierman et al., 1997). Similarly, studies employing picture stimuli have found both anxiety-specific effects (e.g., Monk et al., 2006; Pine et al., 2005) and that a threat bias was present in children in general (e.g., Waters et al., 2004).

Clinical factors in terms of variation in anxiety severity may in part contribute to the inconsistent results. Studies showing an anxiety-specific threat bias have typically assessed clinically ANX/more severe children versus NA youths (e.g., Monk et al., 2006; Moradi et al., 1999; Pine et al., 2005; Taghavi et al., 1999; Vasey et al., 1995), whereas studies showing a common threat bias among children have tended to include high versus low fearful children (Ehrenreich & Gross, 2002; Kindt Brosschot et al., 1997) or compared clinically ANX versus non-selected children (Waters et al., 2004) (although see Vasey et al. (1996) for different results).

Developmental factors may also play a contributory role to inconsistencies with studies showing an anxiety-specific effect including children from a wider age range (9–19 years; Dalgleish et al., 2003; Monk et al., 2006; Moradi et al., 1999; Taghavi et al., 1999), and studies showing a common threat bias mainly including younger children (i.e., 8–12 years; Ehrenreich & Gross, 2002; Kindt Bierman et al., 1997; Kindt Brosschot et al., 1997; Waters et al., 2004). It has been suggested that NA children develop the ability to inhibit processing of threat stimuli, whereas ANX children instead retain threat-based attentional biases over time (Kindt, Brosschot et al., 1997). This explanation may accord with recent evidence that ANX children have difficulty with effortful attentional control, or the ability to shift attention away from unpleasant stimuli and focus on other tasks in order to regulate negative emotion (Derryberry & Reed, 2002; Lonigan, Vasey, Phillips, & Hazen, 2004). Other factors may also be important to consider, such as whether the stimuli are general (e.g., broad-based threat words and pictures) (e.g., Vasey et al., 1995; Waters et al., 2004) versus specific (e.g., distinct emotional faces) (e.g., Stirling et al., 2006) and whether they are congruent with children's anxiety problems (e.g., Kindt, Brosschot et al., 1997). Recent studies employing emotional faces in visual probe tasks with children and adolescents with social anxiety and generalized anxiety disorder, for whom emotional faces are highly relevant, have yielded more consistent anxiety-specific results (e.g., Monk et al., 2006; Stirling et al., 2006; Waters, Mogg, Bradley, & Pine, in press). Nevertheless, further research on factors that differentially influence attention to threat in children and adolescents and accentuate such biases in ANX children is clearly warranted.

Interpretation bias

The evidence for threat-related interpretation bias in ANX versus NA children is more consistent and has been derived from studies assessing interpretations of homograph words (e.g., *dye*) and ambiguous scenarios. Using the homograph paradigm, increases in levels of children's trait anxiety were associated with threatening interpretations of homographs (Hadwin, Frost, French, & Richards, 1997), and children with generalized anxiety disorder were found to make more threatening than neutral interpretations of homograph words (Taghavi, Moradi, Neshat-Doost, Yule, & Dalgleish, 2000).

Using the ambiguous scenario approach, a number of studies have found that ANX children expect more negative emotion, adopt more maladaptive action plans, overestimate danger and underestimate their ability to cope, and make threatening judgments of ambiguous scenarios based on less information (Barrett, Dadds, Rapee, & Ryan, 1996; Bögels, van Dongen, & Muris, 2003; Bögels & Zigterman, 2000; Chorpita, Albano, & Barlow, 1996; Creswell, Schniering, & Rapee, 2005; Muris et al., 2000; Waters, Craske, Bergman, & Treanor, 2008). These findings are thought to result from ANX children's lower estimates of their coping ability and impaired self-efficacy compared with NA children (e.g., Bögels & Zigterman, 2000; Kendall, 1985). Moreover, such biases are thought to exacerbate ANX children's emotional state and avoidant behaviour, which further biases children in favour of threatening meanings, creating a vicious cycle that maintains anxiety (Taghavi et al., 2000).

The effects of treatment on attention and interpretation biases

The effects of CBT on *attentional biases* toward threat have been examined in a variety of adult anxiety disorders, such as spider phobia (e.g., Lavy et al., 1993), social phobia (Mattia, Heimberg, & Hope, 1993) and generalized anxiety disorder (Mathews, Mogg, Kentish, & Eysenck, 1995). Results have generally indicated that such biases diminish when ANX mood is normalized following treatment, and often return to levels comparable to NA controls (e.g., Mathews et al., 1995; Mogg, Bradley, Millar, & White, 1995). These findings may suggest that cognitive biases are primarily a function of state variables, such as ANX mood or stress, or they may be an interactive function of state variables and trait vulnerability to anxiety. However, it is also possible that treatment directly modifies cognitive factors that contribute to anxiety vulnerability, which in turn eliminates the attentional bias toward threat (Mogg & Bradley, 1998). To date, there have been no studies that have examined the effects of CBT on attentional bias towards threat stimuli in ANX children, a gap that the present study aimed to address.

There also have been few studies of CBT and *threat interpretation bias* in children. However, successfully treated and recovered ANX adults demonstrate interpretations that resemble NA controls more than currently ANX adults. For example, recovered adults (and controls) were more likely to complete three-letter stems with neutral than threatening words, in contrast to currently ANX adults (Mathews et al., 1995). Similarly, recovered adults (and controls) interpreted ambiguous sentences with relatively neutral meanings, in contrast with currently ANX adults who more often interpreted them as threatening (Eysenck et al., 1991).

Threat interpretation bias is a relevant target because CBT for children encourages the restructuring of anxiety-promoting cognitions (i.e., threatening interpretations) and the search for additional information before deciding that a situation is threatening and responding (Muris et al., 2000). Barrett, Dadds, and Rapee (1996) investigated pre- to post-treatment changes in children's interpretations following discussions about ambiguous scenarios with their parents. ANX children in a CBT plus family intervention showed greater reductions in threat interpretations and avoidant plans at post-treatment, in comparison with children in the individual CBT and waitlist conditions. Creswell et al. (2005) assessed threat interpretations using similar ambiguous scenarios as Barrett et al. (1996) before and after a 9-week group CBT programme. At pre-treatment, ANX children (and their mothers) interpreted the ambiguous scenarios in a more threatening manner than NA children (and their mothers). Following CBT, both ANX children and their mothers reported significant reductions in threat interpretations.

Current study

Attentional and interpretation biases towards threat stimuli were investigated in children identified as ANX and NA. ANX children also participated in a CBT treatment programme that included both child and parent sessions to assess whether attentional and interpretation biases reduced to levels comparable to NA controls after treatment. It was hypothesized that prior to treatment, ANX children would show significantly greater threat interpretation biases in comparison with NA controls. Furthermore, it was hypothesized that there would be significant reductions in threat interpretations in ANX children following successful treatment to within levels comparable to NA children. Specific hypotheses were not formulated for attentional biases, given the inconsistent evidence of anxiety-specific effects in children between 8 and 12 years of age, and in the absence of studies examining pre- to post-treatment change in attentional bias in children.

Method

Participants

Anxious children

The ANX group included 19 children between 8 and 12 years of age (11 male, 8 female; M age = 9.8 years, SD = 1.2 years). They were referred to the Griffith University Child and Adolescent Anxiety Disorders Research Programme by guidance counsellors at local primary schools, community mental health agencies and pediatricians.

Diagnostic interviews were performed using the parent interview schedule of the Anxiety Disorders Interview Schedule for the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV): Child/Parent Versions (ADIS-C/P; Silverman & Albano, 1996). Only children with an ADIS-C/P clinical severity rating (CSR) of 4 or higher for their principal anxiety diagnosis were included. Children were excluded if they had a comorbid externalizing disorder, pervasive developmental disorder, organic brain damage or psychosis. Major depressive disorder (MDD) was not an exclusionary reason, given the high comorbidity between anxiety and depression (Craske & Waters, 2005). Children who were currently involved in psychological or pharmacological treatment for anxiety disorders were also excluded.

Children's principal diagnoses included generalized anxiety disorder (GAD) ($n = 8$), social phobia ($n = 4$), separation anxiety disorder ($n = 3$) and specific phobia ($n = 4$). The four children with specific phobia as their principal diagnosis were included because they all had comorbid GAD or social phobia. All children had comorbid anxiety disorders with an average of 3.2 anxiety diagnoses per child. No child had comorbid MDD or any other psychiatric disorder as determined by the ADIS-C/P.

Non-anxious children

The NA group included 19 children between 8 and 12 years of age (13 male, 6 female; M age = 10.1 years, SD = 1.3 years), recruited from a local primary school following approvals from the Education Department and school principal, as well as written informed consent from parents. Initial exclusion criteria were the same as for ANX children. Diagnostic interviews were conducted with parents of the 19 NA children using the telephone administration of the ADIS-C/P (Lyneham & Rapee, 2005) to ensure that all NA children did not meet diagnostic criteria for any psychiatric disorder.

Additional information about the ANX and NA children was obtained through the parent and children versions of the Spence Children's Anxiety Scale (SCAS-P and SCAS-C; Nauta et al., 2004; Spence, 1998), and the Children's Depression Inventory (CDI) (Kovacs, 1992) (see Results for group comparisons). The majority of children (94%) in both groups combined were born in Australia, with over 70% of children living with parents who were married and both employed in the workforce. There were no significant differences between the groups in socio-economic status of mothers or fathers, as measured by the Daniel Prestige Scale (Daniel, 1983), a measure of Australian occupational prestige, $t(36) = .86$, $p = .39$, and $t(36) = 1.02$, $p = .31$, respectively.

Equipment and materials

Structured diagnostic interview

The ADIS-C/P (Silverman & Albano, 1996) was used to assess the diagnostic status of participants. The same parent (primarily mothers) was used as the informant at all assessment intervals for both groups. Pre- and post-treatment diagnostic interviews using the ADIS-C/P were conducted face-to-face for the ANX group and via the telephone administration for the NA group. The telephone administration of the ADIS-C/P has been shown to have good inter-assessor reliability (Cobham, Dadds, & Spence, 1999) and a high level of agreement with face-to-face administration (Lyneham & Rapee, 2005). The ADIS-C/P is the most commonly used diagnostic interview in childhood anxiety research, and has shown good sensitivity to treatment effects (Barrett et al., 1996; Spence, Donovan, & Brechman-Toussaint, 2000) and possesses sound psychometric properties (Rapee, Barrett, Dadds, & Evans, 1994; Silverman, Saavedra, & Pina, 2001). A CSR (0–8 scale) is assigned to each DSM-IV diagnosis for which children meet criteria. A CSR of 4 or greater is defined as representing a clinically significant diagnosis.

Spence Children's Anxiety Scale, Parent and Child Versions (SCAS-P and SCAS-C; Spence, 1998)

The SCAS was also administered as it yields total scores and subscale scores in accordance with the anxiety disorders symptom clusters specified in the DSM-IV (American Psychiatric Association, 1994). Both the parent and child versions contain subscales that assess separation anxiety, social anxiety, obsessive–compulsive disorder, panic and agoraphobia, physical injury phobia/fears, and generalized anxiety. Respondents are asked how frequently certain things happen to them (or their child) (e.g., ''When I have a problem, I get a funny feeling in my stomach''). Responses ranged from 0 (*never*) to 3 (*always*). Mean SCAS-P total scores of 14.20 and 31.80 and mean SCAS-C total scores of 18.80 and 32.20 have been reported for non-clinical controls and clinically ANX children, respectively (Nauta et al., 2004; Spence, 1998). The SCAS-C and SCAS-P have good psychometric properties (Nauta et al., 2004; Spence, 1998).

The Children's Depression Inventory

CDI (Kovacs, 1985) is a widely used, 27-item questionnaire with a 3-point response scale. This scale yields a total *t* score, indicating the severity of depressed mood, as well as several factor scores. Acceptable psychometric properties have been reported for this measure (e.g., Kovacs, 1981).

Attentional bias: visual probe task

The present study employed the visual probe task (Vasey et al., 1995; Waters et al., 2004) to assess attentional bias toward threat stimuli because this task is considered superior to the emotional Stroop task (e.g., Vasey et al., 1996; Vasey & MacLeod, 2001). Participants completed a visual probe task previously utilized by Waters et al. (2004). The task was presented on identical 486 IBM-compatible PCs with 17″ colour monitors (Dell Trinitron)—one located at the local school where NA children were assessed and the other in a university research laboratory where ANX children were assessed. The task was controlled by custom-written software run under DOS. Reaction time (RT) was recorded using a dual-key button-press device attached to the game port of the computer. The two response keys had a diameter of 1 cm and were placed 4 cm apart (centre to centre). Picture stimuli were three sets of 20 pictures, with each picture depicting threat, neutral and pleasant scenes from the Internal Affective Picture System (Center for the Study of Emotion & Attention, 1999). Threat stimuli included pictures of vicious dogs, snakes, spiders, sharks, aimed guns, dental procedures, injections and abduction scenes. Pleasant pictures included puppies, kittens, ice cream, candy and smiling faces. Neutral pictures included household items and appliances. The pictures were processed using Paint Shop Pro (v6) and were stored with a palette of 256 colours (Web save format, error diffusion method) at a size of 300×225 pixels. The same picture stimuli were used at pre- and post-treatment assessments.

A set of nine trials was developed by pairing each threat, neutral and pleasant picture with a picture from the same valence category and with a picture from each other valence category. The set of nine trials was then duplicated to take account of visual probes presented on both the left and right sides of the screen for each picture pair. The 18 sets of trials were randomly ordered and duplicated 10 times to produce a total of 180 trials. With two picture presentations contained in each trial over 180 trials, resulting in 360 picture presentations across the three valence categories, 120 picture presentations were required per valence category. The 20 pictures within each valence category were presented six times across the 180 trials—three times on the left and three times on the right side of the screen. No two pictures were paired together more than once across the 180 trials, and no picture was repeated within a set of 18 trials.

A trial started with the presentation of a white fixation cross (one pixel wide, subtending $1.53^\circ \times 1.53^\circ$) for 500 ms at the centre of the screen. This was followed by two pictures centred on the left and right sides of the screen for 1250 ms (Vasey et al., 1995; Waters et al., 2004). Each picture subtended $7.03^\circ \times 9.39^\circ$ and was surrounded by a white frame 1 pixel wide. The gap between the pictures was 2.95°. These pictures were replaced by a white dot (eight pixels, $.33^\circ$ in diameter) at the centre of either the left or right half of the screen. Participants had a maximum of 5000 ms to press one of the buttons labelled 'left' or 'right'. The fixation cross remained on the screen from the beginning of the trial until the offset of the visual probe or until a button press was made. This was followed by an inter-trial interval of 1000 ms after which the next fixation cross was presented. The task was the same at pre- and post-treatment assessment intervals.

Interpretation bias: homograph task

Interpretation bias was assessed with a homograph task (e.g., Taghavi et al., 2000) and an ambiguous scenarios task (e.g., Bögels et al., 2003) in the absence of evidence that one measure is preferable to the other. In the homograph task, participants provided meanings of homograph words that had both threat and neutral interpretations (e.g., *hit*, *tank*, *hang*), previously utilized by Taghavi et al. (2000). The stimuli were 19 homographs and 7 non-ambiguous filler words (e.g., bell, mother, bulb) selected from Neshat-Doost, Moradi, Taghavi, Yule, and Dalgleish (1999) plus 2 practice words. Each word was presented individually on a card (10×15 cm) in Times New Roman 72-size font. The same word stimuli were used at pre- and post-treatment assessments.

Interpretation bias: story task

This task involved children providing interpretations of 12 ambiguous stories; 9 taken from Bögels and Zigterman's (2000) study and 3 developed by Waters et al. (2008). Small wording changes were made to six stories to ensure their appropriateness for Australian children. To ensure consistency in the way stories were presented, they were recorded (male and female voices) as audio files and played to participants on a computer. Participants listened to six stories at pre-treatment assessment and the other six stories at post-treatment assessment. The stories were presented in the same fixed order for all participants, with the 1st, 4th, 7th and 10th story concerning generalized anxiety; the 2nd, 5th, 8th and 11th story concerning separation anxiety; and the 3rd, 6th, 9th and 12th story concerning social anxiety.

Treatment programme

The treatment programme was conducted at the Griffith University Psychology Clinic by three psychologists trained in CBT for child anxiety. Each group had a primary therapist (the second author) and a co-facilitator (a clinical intern). Therapists followed a detailed therapist manual and received weekly group supervision involving ongoing review of treatment progress and viewing of videotaped sessions to check programme adherence. Treatment integrity was also maintained by the use of a checklist completed after each exercise by the primary therapist, which in turn was checked during supervision.

The intervention was based on theoretical and empirical research relating to the psychosocial factors involved in the development of child anxiety (e.g., Craske & Waters, 2005; Dadds & Roth, 2001; Rapee, 2001; Rapee & Spence, 2004) and evidence-based CBT interventions that highlight that CBT plus parental involvement in treatment produces the strongest treatment outcomes (e.g., Barrett, 1998; Cobham et al., 1999; Kendall, 1994; Rapee, Wignall, Hudson, & Schniering, 2000; Spence et al., 2000; Spence, Holmes, March, & Lipp, 2006). Thus, the treatment comprised 10 child sessions and 6 parent sessions, plus a booster session held 1 month post-treatment. Child sessions were conducted in a group format and were 1 h in duration, conducted weekly for 10 weeks. The treatment included (a) psycho-education about anxiety, (b) somatic management of physiological symptoms (i.e., breathing exercises, progressive muscle relaxation), (c) cognitive restructuring (i.e., identifying and challenging ANX thoughts with positive, coping-focused self-talk), (d) graded exposure to anxiety-provoking situations, (e) coping skills such as problem solving, (f) social skills such as assertiveness and (g) relapse prevention and maintenance skills. Parent sessions were also in a group format and of 1 h duration, held over 6 weeks approximately every second week of the child sessions. Parent sessions included (a) psycho-education about child anxiety, (b) parent strategies for managing child anxiety and improving the parent–child relationship and (c) strategies for assisting their child to learn the techniques covered in the child sessions. The booster session for children and parents combined, held 1 month after the final child session, included a review of progress, problem solving and reinforcement of the CBT strategies covered in treatment. Children and parents received separate workbooks containing session handouts and homework exercises.

Procedure

Anxious children

An initial semi-structured screening interview was conducted over the phone with referred parents. The interview addressed the inclusion criteria and the nature of the child's anxiety problems. Eligible children and parents then attended a diagnostic interview and experimental session at the university clinic. After signing the consent form, the ADIS-C/P was administered by the second author who was trained to reliability in the administration of the ADIS-C/P. After this, parents completed the questionnaires,[1] while children completed the experimental session in the research laboratory with a research assistant. Children completed the three cognitive bias tasks in a counterbalanced order across participants, followed by the SCAS-C and CDI to avoid drawing children's attention to anxiety and depressive symptoms before the tasks. Questionnaire items were read aloud to participants to minimize the impact of variation in reading ability. The experimental session lasted approximately 50 min.

Both child and parent treatment sessions were conducted in therapy rooms at the Griffith University Psychology Clinic. Children were treated in two groups, one with 9 children (6 males, 3 females) and the other including 10 children (5 males, 5 females) and commenced 1 month apart. All children were assessed via the ADIS-C/P interview and questionnaires within 2 weeks prior to commencing treatment. Treatment attendance was high with children attending an average of 9.79 (SD = 1.39) of 10 sessions, and parents attending an average of 4.42 (SD = 1.71) of 6 sessions.

ANX children and their parents completed the post-treatment assessments within 2 weeks after treatment completion. The ADIS-C/P (Silverman & Albano, 1996) was administered face-to-face with parents by an independent diagnostician blind to children's group status (i.e., a clinical intern trained to reliability in the administration of the ADIS-C/P), while children completed the cognitive tasks and questionnaires again in the same research laboratory with a research assistant. The interval from pre- to post-treatment assessment of ANX children was approximately 5.5 months.

Non-anxious children

The study was explained to classes of Grades 5–7 children at a local primary school from within the same geographical community that ANX children were recruited from. Children gave parents a research study

[1]Parent psychopathology was not assessed using a diagnostic interview procedure. However, the Depression, Anxiety Stress Scale (DASS) (Lovibond & Lovibond, 1995) was completed by parents of anxious children during the pre-treatment assessment session. Results revealed that parents' mean levels of depression ($M = 5.21$), anxiety ($M = 4.00$), and stress ($M = 11.05$) were within the normal range.

information sheet, consent form, a family information sheet requesting basic demographic details and the SCAS-P (Nauta et al., 2004). Children whose parents gave consent returned the completed forms in a sealed envelope to a box in their classroom.

Of the 109 children granted parental consent, the 19 children with the lowest SCAS-P (Nauta et al., 2004) scores were contacted for participation in this study. A telephone interview was held with parents (all mothers) of these children, during which parental consent was confirmed and the parent version of the ADIS-C/P was completed over the phone by a trained research assistant blind to children's group status and purposes of the study. Parents were informed that their child would complete the experimental session in a research room on school grounds while being supervised by a research assistant. None of the NA children had been in the resource room prior to the study. The pre-treatment experimental session for NA children followed the same procedure as for ANX children.

NA children were re-assessed over the same interval of time the second group of ANX children was re-assessed after completing treatment. There was a time lag of 1 month between the re-assessment of the first group of ANX children and the controls. This was due to restrictions by the primary school on the number of times student classes could be interrupted to test participating control children.[2] Mothers of the 19 NA children again gave consent for their child to participate, and the parent version of the ADIS-C/P (Silverman & Albano, 1996) was administered over the telephone by a research assistant blind to children's previous assessment results. This assessment was to ensure that NA children continued not to meet diagnostic criteria for a psychiatric disorder. Parents were then sent the SCAS-P (Nauta et al., 2004), which was returned within 2 weeks on average from the date of postage. The post-treatment experimental session for NA children was conducted in the same research room on school grounds.

Attentional bias: visual probe task

The task procedure replicated that of Waters et al. (2004). Each participant was seated in a comfortable chair approximately 60 cm from the computer monitor. Children were informed that a cross would appear at the centre of the screen followed by two pictures and then a dot either on the left or right side of the screen. They were asked to focus on the cross and indicate the location of the dot by pressing either the left or right button as quickly and accurately as possible. Participants responded using the index and middle fingers of the dominant hand and completed 10 practice trials. They were given a 30 s break every 3 min during the test trials. The task took about 10 min to complete.

Interpretation bias: homograph task

The procedure replicated that of Taghavi et al. (2000). Children were shown 28 cards one at a time with one word on each card. For each word, children were asked to think of a sentence in which they could use the word. The words were presented in a fixed order, starting with a non-ambiguous filler word, and then one filler word between every three homographs. Children completed two practice trials, then the 26 test trials, and were given an unlimited time to complete each sentence. The task took about 15 min.

Interpretation bias: story task

The procedure replicated that of Bögels and Zigterman (2000). Children were told they would listen to stories that might happen to kids and were asked to imagine the events in each story happened to them. Then children rated how they would feel if they were in the situations based on a number of different emotions (i.e., scared, shy, guilty, angry, sad, responsible, worried). Children also rated how much they judged the situations to be (a) dangerous, (b) frightening and (c) unpleasant. Finally, children rated how they would deal with the situations, (a) helplessness, (b) confident they would know what to do and (c) able to influence the situation. Each item was rated on a closed 5-point scale: *not at all* (0), *a little bit* (1), *some* (2), *a lot* (3) *very much* (4). Open item questions were not included to prevent participant fatigue, given children were completing several tasks in the one session. Participants circled their responses in the task booklet. The task took about 15 min to complete.

[2]There were no significant differences between the two treatment groups on any measure and results of both groups were the same when compared separately with controls.

Response definitions and statistical analyses

Treatment efficacy

Repeated measures analyses of variance (ANOVA) and *t*-tests were used to compare ANX and NA children at pre- and post-treatment. Calculations revealed adequate power to detect moderate or larger effect sizes when comparing two groups on two repeated measurements of one variable. Assuming a correlation between repeated measures of .70, a sample size of 38 (19 per group) provides power of .64 to detect a clinically meaningful effect size of .15, at $\alpha < .05$. Even if the correlation between repeated measures is lower, power increases with an increasing effect size. For example, assuming a correlation between repeated measures of .60, the power to detect an effect size of .20 with a sample of 38 is .77, at $\alpha < .05$. Assuming a correlation between repeated measures of .50, the power to detect an effect size of .35 with a sample of 38 is .99, at $\alpha < .05$.

Attentional bias: visual probe task

Analyses were based on RT in ms. Error data, defined as incorrect button presses and trials exceeding the maximum RT, and outliers, defined as values that were three standard deviations above or below the mean (Waters et al., 2004), were excluded from analyses (1.3% of trials). As there were no group differences in the percentage of errors or evidence of speed accuracy trade-offs, these results are not reported.

Analyses of RT data were based on attentional bias scores to assess the direction of attention either towards or away from emotional pictures (e.g., Bradley, Mogg, & Millar, 2000). RTs to probes were averaged separately for congruent trials (i.e., trials on which the probe replaced the threat or pleasant picture and a neutral picture was on the other side), and for incongruent trials, (i.e., trials on which the probe replaced the neutral picture and a threat or pleasant pictures was on the other side). Bias scores were calculated separately for threat and pleasant pictures by subtracting the average RT on congruent trials from the average RT on incongruent trials. Positive values of the bias score indicate attention towards either the threat or pleasant pictures (i.e., faster RTs on congruent than incongruent trials). Negative values of the bias score indicate attention away from either the threat or pleasant pictures (i.e., faster RTs on incongruent than congruent trials). Bias scores were analysed using a 2 Bias (threat; pleasant) $\times$ 2 Time (pre-; post-treatment) $\times$ 2 Group (ANX; NA) repeated measures ANOVA. The significance of multiple follow-up comparisons was determined using Bonferroni adjustment. Partial eta squared (η_p^2) was calculated to estimate effect size.

Interpretation bias: homograph task

Analyses were based on the number of sentences corresponding to neutral and threat interpretations, based on coding conducted by the second author who was blind to children's group status at the time of coding, because all identifying details were removed from the response booklets by the first author before coding. Also, an independent coder rated a random sample of responses from over 50% of children ($N = 10$) in each group at pre- and post-treatment, and the coders agreed on 97% of responses. Analyses were conducted using independent and paired samples *t*-tests on Homograph Difference Index scores (i.e., HDI; sum of threat interpretations−sum of neutral interpretations; Taghavi et al., 2000).

Interpretation bias: story task

Correlations were assessed prior to analyses, consistent with Bögels and Zigterman (2000). As reported by Bögels and Zigterman (2000), the negative emotions (i.e., guilt, shy, scared, sad, worried, responsible, angry) were significantly correlated ($r = .32$–$.79$, p's $< .01$) and averaged to one 'Negative Emotion' score, with higher scores indicating greater negative emotion. Judgments about the dangerousness of the situations (i.e., dangerous, frightening, unpleasant) were highly correlated ($r = .66$–$.76$, p's $< .001$) and averaged to one 'Danger Judgments' score. Higher scores indicate greater perceived danger in the situations. Children's influencing responses (i.e., helpless (reverse scored), confidence, influence) were significantly correlated ($r = .27$–$.76$, p's $< .05$) and averaged to one 'Influence' score. Higher scores reflect greater ability to influence the situations. Analyses were conducted using independent and paired samples *t*-tests.

Results

Treatment effects

Anxiety diagnostic status

Table 1 displays descriptive information from the diagnostic and questionnaire measures for ANX and NA children. Of the 19 ANX children receiving treatment, 100% achieved non-clinical status on the ADIS-C/P by post-treatment. Mean ADIS-C/P CSR ratings (scale 0–8) for the ANX group reduced significantly from 6.7 at pre-treatment to 2.8 at post-treatment ($t(18) = 10.81$, $p < .001$).

Questionnaire measures

Analyses of SCAS-P total scores revealed significant main effects of Time ($F(1, 36) = 29.45$, $p < .001$, $\eta_p^2 = .45$) reflecting higher scores at pre- compared with post-treatment, and Group ($F(1, 36) = 64.55$, $p < .001$, $\eta_p^2 = .64$) reflecting higher scores in the ANX compared with the NA group. The interaction between Time and Group was also significant ($F(1, 36) = 13.05$, $p < .001$, $\eta_p^2 = .27$), reflecting greater difference between pre- and post-test anxiety scores ($p < .001$) in the ANX group than in the NA group ($p = .21$). Yet, SCAS-P Total scores for the ANX group were significantly higher compared with the NA group at post-treatment, as they were at pre-treatment (both $p < .001$).

Analyses of the SCAS-C Total scores revealed the same pattern of results, with significant Time ($F(1, 36) = 45.88$, $p < .001$, $\eta_p^2 = .56$) and Group ($F(1, 36) = 19.00$, $p < .001$, $\eta_p^2 = .36$) main effects and Time $\times$ Group interaction ($F(1, 36) = 22.21$, $p < .001$, $\eta_p^2 = .38$). ANX children had significantly higher SCAS-C Total scores at pre- compared with post-treatment ($p < .001$), whereas there was no significant difference as a function of Time in the NA group ($p = .15$). SCAS-C Total scores were significantly higher in the ANX than in the NA group at pre- and post-treatment (both $p < .001$).

Analyses of the CDI Total *t*-scores revealed significant main effects of Time ($F(1, 36) = 12.44$, $p < .001$, $\eta_p^2 = 26$), reflecting higher scores at pre- compared with post-treatment, and Group ($F(1, 36) = 7.45$, $p = .01$, $\eta_p^2 = .17$), reflecting higher scores in the ANX compared with the NA group, regardless of Time. The interaction was not significant ($F < 1.5$, ns).

Attentional bias: visual probe task

Fig. 1 displays the mean threat and pleasant attentional bias scores for ANX and NA children at pre- and post-treatment. Attentional bias towards threat pictures in ANX children was significantly different from zero at both pre-treatment ($t(18) = 5.33$, $p < .001$) and post-treatment ($t(18) = 3.30$, $p = .004$), whereas the pleasant bias scores were not (both $t < 1.05$, ns). In the NA group, attentional bias scores were significantly different from zero for threat pictures at the first ($t(18) = 2.8.3$, $p = .01$) but not the last assessment ($t(18) = 1.82$, $p = .74$), and were not significant for pleasant pictures at either assessment time (both $t < 1.69$, ns).

Table 1
Mean scores on diagnostic and questionnaire measures for ANX and NA children at pre- and post-treatment

Measures	Pre-treatment		Post-treatment	
	ANX *M* (SD)	NA *M* (SD)	ANX *M* (SD)	NA *M* (SD)
ADIS-C/P CSR	6.79 (1.08)	–	2.00 (1.56)	–
SCAS-P Total	33.11 (13.52)	10.16 (4.95)	18.16 (6.78)	7.16 (4.50)
SCAS-C Total	38.53 (15.02)	17.05 (9.88)	20.05 (10.64)	13.74 (6.89)
CDI Total *t*	45.68 (5.83)	41.32 (3.71)	41.32 (5.28)	39.16 (3.33)

Note: ADIS-C/P CSR = Anxiety Disorders Interview Schedule for Children, Principal Anxiety Diagnosis Clinical Severity Rating; SCAS-P = Spence Children's Anxiety Scale—Parent; SCAS-C = Spence Children's Anxiety Scale—Child; CDI = Children's Depression Inventory Total *t*-score.

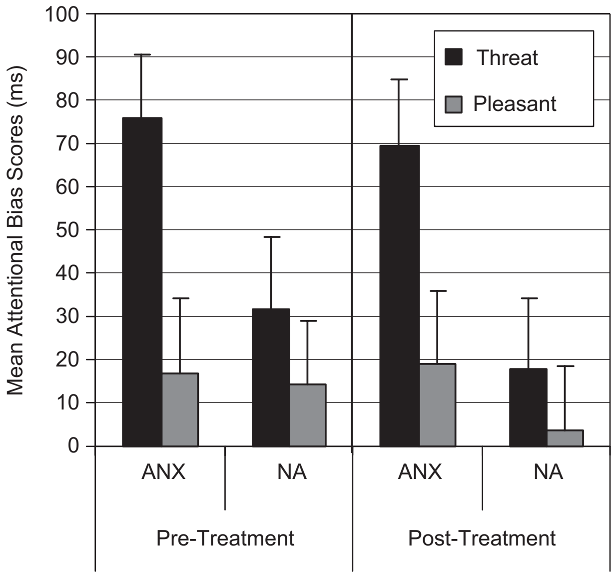

Fig. 1. Mean attentional bias scores for threat and pleasant pictures at pre- and post-treatment for ANX and NA children.

Table 2
Mean scores from the homographs task and the stories task for NA and ANX children at pre- and post-treatment

Measures	Pre-treatment		Post-treatment	
	ANX *M* (SD)	NA *M* (SD)	ANX *M* (SD)	NA *M* (SD)
HDI Score	3.16 (2.61)	0.26 (2.46)	1.47 (2.84)	−1.16 (2.19)
Negative emotion	6.24 (2.25)	5.41 (1.66)	6.52 (4.18)	6.29 (2.48)
Danger judgments	7.33 (3.75)	6.26 (2.08	7.21 (4.37)	7.46 (3.69)
Influencing ability*	13.77 (3.53)	18.11 (3.36)	18.47 (3.19)	19.02 (3.13)

Note: HDI Score = Homograph Index Score from the homograph task; negative emotion, danger judgments and influencing ability from the stories task. (* Indicates significant differences.)

The 2 Bias (threat; pleasant) × 2 Time (pre-; post-treatment) × 2 Group (ANX; NA) repeated measures ANOVA revealed main effects of Bias ($F(1, 36) = 16.41$, $p < .001$, $\eta_p^2 = .31$), indicating a larger attentional bias towards threat pictures compared with pleasant pictures, and Group ($F(1, 36) = 5.46$, $p = .03$, $\eta_p^2 = .13$), reflecting more attentional bias overall in ANX compared with NA children. The Time main effect was not significant ($F < 1.54$, ns). The Bias × Group interaction also was significant ($F(1, 36) = 6.14$, $p = .02$, $\eta_p^2 = .14$). This reflected that regardless of Time, the attentional bias was significantly larger towards threat pictures compared with pleasant pictures in the ANX group ($p < .001$), whereas no significant difference was found for the NA group ($p = .27$). Moreover, the attentional bias was significantly larger in the ANX group compared with the NA group for threat pictures ($p < .001$) but this group difference was not found for pleasant pictures ($p = .65$).

Interpretation bias: homograph task

Table 2 displays the HDI scores (i.e., number of threat interpretations−number of neutral interpretations) for ANX and NA children at pre- and post-treatment. Although there was some indication that ANX children had higher average HDI scores than NA children at both pre- and post-treatment, the analyses revealed no significant within- or between-subjects main effects or interactions (all F's < 2.10, ns).

Interpretation bias: story task

Table 2 also displays the mean negative emotion, danger judgements and influence scores on the stories task for ANX and NA children at pre- and post-treatment. There were no significant main effects or interactions from analyses of negative emotion or danger judgments (all F's < 1.40). The analysis of children's influence scores revealed significant main effects of Time ($F(1, 36) = 37.64$, $p < .001$, $\eta_p^2 = .51$), reflecting higher levels of perceived influencing ability at post- compared with pre-treatment, and Group ($F(1, 36) = 6.30$, $p = .02$, $\eta_p^2 = .15$), reflecting lower influencing scores in ANX compared with NA children. The Time × Group interaction was also significant ($F(1, 36) = 17.15$, $p < .001$, $\eta_p^2 = .32$). This indicated an average significant improvement in the influencing ability of ANX children from pre- to post-treatment ($p < .001$), but there was no significant change for the NA group ($p = .17$). The influencing ability of ANX children was significantly lower at pre-treatment in comparison with NA children ($p < .001$) but did not differ from NA children at post-treatment ($p = .60$).

Associations between Anxiety and Cognitive Bias Measures

Correlations between questionnaire measures and attention and interpretation bias scores were examined for each group at each time of measurement. For the ANX group at pre-treatment, higher SCAS-P total scores and SCAS-C total scores were significantly associated with higher negative emotion and danger judgments scores on the stories task (all r's > .52, all $p < .01$). A higher SCAS-P score was also significantly related to a lower influence score on the stories task ($r = -.57$, $p = .01$). At post-treatment assessment, a higher SCAS-C total score for ANX children remained significantly positively correlated with negative emotion and danger judgments (both r's > .50, both $p < .03$). The SCAS-C total score was also associated with a lower influence score on the stories task ($r = -.50$, $p = .03$).

For NA children at the first assessment, a higher SCAS-C total score covaried with a higher danger judgments ($r = .60$, $p < .001$) and lower influence score on the stories task ($r = -.59$, $p < .001$). At the second assessment, NA children with a higher SCAS-C total score had a relatively lower influence score on the stories task ($r = -.59$, $p < .001$).

Analyses to assess the relationship between change in anxiety symptoms and change in cognitive bias from pre- to post-treatment revealed low and non-significant correlations between changes in SCAS scores and changes in attention and interpretation biases, r's ranged from −.36 to .23, all $p > .12$. The strongest association was found between change in SCAS-P scores and change in influence scores on the stories task; however, this was not significant, $r = -.36$, $p = .13$.

Discussion

A major outcome of the present study was that ANX children displayed attention and interpretation biases towards threat stimuli compared with NA children. Moreover, following successful treatment with CBT, ANX children's threat interpretation biases but not attentional biases for threat stimuli reduced to within levels comparable to NA controls.

The attentional bias task results indicated that both ANX and control children showed a significant threat bias at the first assessment and that this bias was larger in ANX children compared with control children. These findings support previous findings that a threat bias is common to children of a younger age (e.g., Ehrenreich & Gross, 2002; Kindt, Bierman et al., 1997; Kindt, Brosschot et al., 1997; Waters et al., 2004) and those studies showing that such a bias is enhanced in ANX children compared with controls (e.g., Dalgleish et al., 2001, 2003; Taghavi et al., 1999; Vasey et al., 1995, 1996). Additionally, the results provide evidence that the attentional bias in ANX children was selectively enhanced for threatening stimuli relative to generally emotional stimuli (e.g., Mogg & Bradley, 1998; Williams et al., 1997), since the attentional bias was significantly larger in ANX children for threat than pleasant pictures.

These findings call into question the underlying processes that mediate attention towards threat in young children generally and accentuate these biases in ANX children. The present findings do not elucidate the underlying processes that mediate these effects. However, some interesting possibilities include variation in children's inhibitory control/attention control capabilities (e.g., Derryberry & Reed, 2002; Kindt & van den Hout, 2001), the general nature of the pictorial stimuli which were not specific to children's anxiety concerns, children's subjective appraisal of the stimuli (e.g., Mogg & Bradley, 1998), the influence of normative developmental fears of childhood which are associated with intrusive thoughts and avoidance behaviour (McCarthie & Spence, 1991), and differences in coping competence or self-efficacy (Lengua, Sandler, West, Wolchik, & Curran, 1999; Skinner & Zimmer-Gembeck, 2007).

This last possibility may be supported by the finding that ANX children showed a *threat interpretation bias* in terms of lower perceived influencing ability (a measure of perceived coping capability) on the stories task at pre-treatment compared with NA children, a finding that replicates previous research (i.e., Bögels & Zigterman, 2000). These findings have previously been discussed in terms of ANX children's lower estimates of the probability they will cope successfully in situations compared with NA children, which is thought to be due to impaired self-efficacy expectations and an undervaluation of their abilities (e.g., Bögels & Zigterman, 2000; Kendall, 1985).

It is notable that significant interpretation bias effects were not observed on the homographs task. This was surprising, given that at least two studies employing this task have yielded reliable threat interpretation effects amongst ANX children (e.g., Hadwin et al., 1997; Taghavi et al., 2000) and the word stimuli used in the present homographs task were taken from Taghavi et al. (2000). One possibility is that this task is less sensitive than the stories task to anxiety-related differences in children. A second possibility is that a larger sample or more power was required for significant effects to be observed. It is notable that the scores of ANX children on the homographs tasks reported in Taghavi et al. (2000) are very similar to those reported in the current study.

A primary purpose of the present study was to determine whether cognitive bias effects would persist in ANX children after they had been treated with CBT. The finding that the threat attentional bias in ANX children did not reduce significantly following treatment differs from results with ANX adults in which the threat bias had diminished to levels comparable with NA controls after treatment (e.g., Mathews et al., 1995). There are several possibilities for these diverging results. One is that CBT protocols for child anxiety disorders need to specifically target attentional processes for threat biases to reduce in ANX children. Future studies that incorporate these processes into treatment might yield different results (see Bögels & Mansell, 2004). The results may alternatively be attributed to residual anxiety. Even though ANX children's SCAS-P and SCAS-C anxiety scores reduced to within non-clinical ranges, their scores remained significantly higher than NA children at post-treatment. ANX children's attentional biases towards threat may reduce in conjunction with further residual symptom reduction, or possibly, over a longer timeline after treatment compared with interpretation biases, perhaps after further accumulation of evidence of successful coping in a variety of situations. A final consideration is that the broad-based pictorial stimuli utilized in the visual probe task were insensitive to changes in attentional biases that took place with treatment. Studies demonstrating threat attentional bias reductions in ANX adults with treatment employed word rather than picture stimuli in the visual probe task (e.g., Mathews et al., 1995). These explanations combined suggest that further research is required that includes the assessment of attentional and interpretation biases at follow-up intervals after treatment and the utilization of other stimulus materials in visual probe tasks.

The finding that ANX children's judgments about their influencing ability improved significantly after treatment extends on previous research using similar stories tasks (e.g., Barrett et al., 1996; Creswell et al., 2005), by showing that these improvements were clinically meaningful as they were comparable to NA controls by post-treatment. Because ANX children participated in didactic tasks during treatment that focused on cognitive restructuring and thus may have been ''taught'' better responses and coping strategies (Creswell et al., 2005), the finding of improved influencing ability with treatment may reflect on a response bias in ANX children. On the other hand, such an explanation does not account for the specificity of effects to the influence measure versus the negative emotion and especially the danger judgments measures. Thus, pre- to post-treatment changes in ANX children's influencing ability may reflect on genuine improvements in their interpretation style associated with increased engagement in exposure tasks which is emphasized in CBT and promotes the accumulation of evidence of successful coping (Bouchard, Mendlowitz, Coles, & Franklin., 2004; Kendall et al., 2005). Future studies would benefit from utilizing tasks that entail ''online'' measures of children's interpretation style that are less susceptible to response bias (e.g., Hirsch & Mathews, 2000) as well as their cognitive, emotional and behavioural responses to real threats and stressors.

Correlation analyses showed that negative emotion, danger judgments and perceived influencing ability play a role in child anxiety symptoms. Similar relationships between cognitive biases and panic symptoms, for example, have been observed in recent adult studies (e.g., Teachman, Smith-Janik, & Saporito, 2007). However, the role of cognitive biases in symptom improvement during the treatment of childhood anxiety remains unclear. The correlations between anxiety and cognitive bias measures revealed that children's rating of influence on the stories task was most consistently associated with SCAS-P and SCAS-C scores across groups and assessment times. Children with more anxiety symptoms, whether they were in the ANX or control group, perceived relatively less influence over anxiety-themed stories. The findings that higher negative emotion and danger judgments scores were linked to higher SCAS-P total scores in ANX children and that SCAS-C total scores were associated with danger judgments in NA children suggest that further research is warranted on the role of threat interpretation bias as a vulnerability marker for child anxiety.

There was little evidence that changes in attention and interpretation biases were associated with changes in anxiety following treatment. These findings are difficult to discuss, given that previous studies have not reported on the relationship between change in anxiety symptoms and change in cognitive biases with treatment (e.g., Barrett et al., 1996; Creswell et al., 2005; Mathews et al., 1995). However, some correlations in the present study were above .3, suggesting that future research should include a larger sample of ANX children. This could provide the power needed to determine whether small to moderate associations exist between change in anxiety symptoms and change in cognitive biases. It is also possible that reassessment of cognitive biases at follow-up assessment intervals after treatment would help clarify the temporal relationship between both types of cognitive biases and anxiety in children and whether a residual threat interpretation style plays a role in relapse over time. Similarly, the relationship between interpretation scores on the stories task and higher SCAS-C scores in NA children at post-treatment suggests that reassessment of cognitive biases and anxiety symptoms over time in children who do not meet criteria for anxiety would elucidate whether cognitive biases play a role in the onset of anxiety disorders in children.

Although the present study extended previous research in several important ways, there were notable limitations. In particular, the inclusion of a randomized clinical waitlist group would have shown convincingly that change in anxiety symptoms and cognitive biases were due to treatment rather than to natural remission over time. Although child anxiety diagnoses of waitlist groups have been shown to remain stable over a 10-week period (e.g., Spence et al., 2006) similar to the treatment duration of the present study, and that stability of child anxiety symptoms has been reported for up to 6 months duration (Beidel, Fink, & Turner, 1996), it will be a methodological requirement in future studies to include a randomized clinical waitlist group. That the second assessment of NA control children could not be more closely matched to the post-treatment assessments of ANX children also was a limitation of the present study. Future studies should avoid this problem, perhaps by recruiting control children through locations other than schools. Another limitation was that cognitive biases were not reassessed at follow-up intervals after treatment, which would have allowed for the temporal relationship between cognitive biases and associations with relapse to be assessed. Future studies would also benefit from recruiting larger samples of children from a wider age range. The small sample sizes prevented the examination of age-related differences and specificity effects to particular anxiety disorders (e.g., Kindt & van den Hout, 2001).

In summary, the present study replicated previous research by showing that ANX children possess threat-based attention and interpretation biases in comparison with NA children. Following successful treatment with CBT, ANX children's threat interpretation bias, as assessed by the stories task by not the homographs task, reduced significantly to within levels comparable to NA children. However, ANX children continued to show a significant attentional bias towards threat stimuli after treatment, whereas NA children did not. These findings encourage further research on cognitive biases in ANX children and their associations with symptom change during treatment; in particular, cognitive behavioural treatments that propose that anxiety is caused and maintained by distorted cognitive processes and aim to improve the processing of threat-based information.

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