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Exploring the Impact of Intervention on Children and Young Peoples' Anxiety and Information Processing

by

Kayleigh Parkins

Thesis for the degree of Doctor of Educational Psychology

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ABSTRACT

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EXPLORING THE IMPACT OF INTERVENTION ON CHILDREN AND YOUNG PEOPLES' ANXIETY AND INFORMATION PROCESSING

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The efficacy of cognitive behavioural therapy (CBT) for reducing anxiety in children is well documented, however the mechanisms underlying this reduction in symptoms is unclear. This paper presents a systematic review and empirical paper. The review explores the impact of CBT, Cognitive Bias Modification of Interpretation (CBMI) and Attentional Bias Modification Therapy (ABMT) on children and young people's anxiety levels, attentional biases and interpretation biases, and the relationships between the variables. The review identifies that CBT efficiently reduces anxiety, the impact of CBMI and ABMT on anxiety is not clear. CBMI and ABMT induced their intended cognitive biases, however the effect of altering cognitive biases on anxiety was unclear. Furthermore, no studies considered the interaction between changes in cognitive biases. The limited available evidence supports the proposal that changes in anxiety result in changes in cognitive biases, however further research is necessary to consider the impact of changing cognitive biases on anxiety and the interaction between changes in cognitive biases. The empirical paper assessed whether reductions in anxiety following CBT are linked to improvements in attention (e.g., the ability to focus and shift attention and to suppress attention to threat). The study utilised a time lagged randomised control trial to explore the effects of CBT (vs. waitlist control) on anxiety and attention in young people reporting elevated anxiety. Participants completed questionnaire measures of anxiety and attentional control and experimental measures of inhibitory control and attentional biases to emotional stimuli at pre-intervention, post-intervention and at 10-12 week follow-up. Significant reductions in anxiety were found over time in the CBT and waitlist control groups. Reductions in anxiety were associated with increased top-

down control (i.e. self-reported attentional control) and increased top-down control was associated with less bottom-up processing (i.e. greater vigilance for threat).

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DECLARATION OF AUTHORSHIP

I, Kayleigh Parkins

declare that the thesis entitled

Exploring the Impact of Intervention on Children and Young Peoples' Anxiety and Information Processing

and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- this work was done wholly or mainly while in candidature for a research degree at this University;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- where I have consulted the published work of others, this is always clearly attributed;
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- where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
- none of this work has been published before submission.

Signed: ……..

Date: 26.08.2013…….

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Definitions and Abbreviations

ABMT	Attentional Bias Modification Training
ACSC	Attentional Control Scale - Child
ACT	Attentional Control Theory
ANOVA	ANalysis Of VAriance
BYI	Beck Youth Inventory
BYI-A	Beck Youth Inventory for Anxiety
CBMI	Cognitive Bias Modification of Interpretation
CBT	Cognitive Behavioural Therapy
GAD	Generalised Anxiety Disorder
n/s	Not specified
ns	Non-significant
M	Mean
ms	milliseconds
OCD	Obsessive Compulsive Disorder
PTSD	Post Traumatic Stress Disorder
RT	Reaction Time
SCAS	Spence Children's Anxiety Scale
SD	Standard Deviation
SDQ	Strengths and Difficulties Questionnaire
T1	Time 1
T2	Time 2
T3	Time 3

T4	Time 4
VAS	Visual Analogue Scale
vs.	Versus

Chapter 1: Exploring the Efficacy of Cognitive Behavioural Therapy, Cognitive Bias Modification of Interpretation and Attentional Bias Modification Training to Reduce Anxiety and Modify Information Processing Biases in Children and Young People.

Around 2.5 to 5% of children and adolescents meet the criteria for an anxiety disorder (Rapee, Schniering, & Hudson, 2009). Anxiety disorders negatively impact children's academic achievement (La Greca & Lopez, 1998) and social functioning (Essau, Conradt, & Petermann, 2000). Moreover, children diagnosed with an anxiety disorder (compared to those without anxiety) are at an increased risk of developing poor mental health in adulthood (Green, McGinnity, Meltzer, Ford, & Goodman, 2005); specifically externalising diagnoses and depression (Kim-Cohen et al., 2003). It is important to diagnose anxiety and intervene early as research suggests that intervention in childhood and/or adolescence reduces anxiety and may reduce the risk of future mental health concerns (Dadds, Seinen, Roth, & Harnett, 2000).

Common anxiety disorders in childhood and adolescence include generalised anxiety disorder (GAD), separation anxiety, social phobia and specific phobia (Beesdo, Knappe, & Pine, 2011). GAD is a heightened worry and pre-occupation with a wide range of negative events or situations. Separation anxiety involves developmentally inappropriate and excessive anxiety in response to separation from the home or care giver(s). Social phobias are the fear of social humiliation, which can include fear of social interactions and/or negative evaluations. Some individuals experience fear in response to exposure to circumscribed objects or situations (specific phobia; American Psychiatric Association, 2000). Anxiety disorders differ in their sources of fear/anxiety, yet all types of anxiety disorders are likely to cause individuals to worry about (and where possible avoid) the sources of their anxiety and this can hinder a person's everyday functioning.

Cognitive Behavioural Therapy (CBT) is the typical non-pharmacological treatment choice for children and adolescents who develop an anxiety disorder (National Insitiute of Mental Health, 2009). It is an established form of treatment that focuses on eliciting and challenging an individual's misinterpretations of events and their resources to deal with the events (Mobini & Grant, 2007). Typically CBT sessions involve teaching specific skills relating to affect (e.g., recognising emotions in the body)

and cognition (e.g., modification of maladaptive thoughts) and also gradually expose children to their feared situation or stimuli (Kingery et al., 2006).

The development of CBT and its focus on altering an individual's interpretation of events is related to schema theory (A. T. Beck & Clark, 1997). Schema theory proposes that cognition is one of the key components of anxiety; specifically interpretation. Interpretation involves the simultaneous evaluation of the situation and the resources the individual has to respond to the event. An individual's interpretation of an event is likely to be biased by their schema (i.e., their expectations, interests and concerns). This framework proposes that some schemas will be active and others inactive and there will be individual differences in this pattern of activation. An active schema is suggested to guide what aspects of the situation are noticed and those that are ignored; typically individuals attend to information that is consistent with their active schema. The theory proposes that following the initial interpretation of an event, an individual will continue to reappraise a situation, further developing (and typically confirming) their active schema. This reinforcement increases the likelihood of such schema being activated in a similar situation. Anxious individuals have a bias to activate threat-related schemas, leading to a tendency to evaluate situations as threatening and underestimate their own resources to respond to the event.

CBT is an effective treatment to reduce children's anxiety levels (Cartwright-Hatton, Roberts, Chitsabesan, Fothergill, & Harrington, 2004). Cartwright et al. (2004) reviewed the impact of CBT for anxious children and young people. They found that individuals randomly allocated to CBT had a higher (56.5%) remission rate (i.e., they no longer met diagnostic criteria for an anxiety disorder) compared to anxious control groups (34.8% remission rate). The authors concluded that this indicates a strong positive effect of CBT (compared with no treatment).

However, given that CBT is not effective for all anxious individuals, researchers have begun exploring alternative therapeutic mechanisms to reduce anxiety. The mechanisms of these therapies can be conceptualised using Crick and Dodge's model of social information processing (1994). The model proposes that individuals follow a series of steps when they engage with and process stimuli. These stages are broadly sequential, although active simultaneously which allows a reciprocal relationship between the stages. Two of these stages are biased by anxiety (encoding and

interpretation). The model outlines the following stages in information processing: (1) *Encoding* - the individual receives and codes the stimuli; some information is preferentially processed and some information is neglected (e.g., a bias towards certain stimuli). (2) *Interpretation* – the individual accesses schema relating to similar situations (based on the encoded stimuli) and uses these schema to understand the current situation. Interpretations may be influenced by schemas and schemas may be altered by a person's interpretation of an event. (3) *Clarification of goal* – the individual selects a desired outcome for the situation. (4) *Response access or construction* – the individual identifies possible responses to the situation. (5) *Response decision* – the individual evaluates the possible responses and selects one. (6) *Behavioural enactment* – the selected response is performed. (7) *Peers evaluate and respond* – others consider and respond to the individual's behaviour. Other's responses modify and/or confirm the individual's schema relating to that situation and this informs future social cognition.

For anxious individuals the interpretation stage of processing is biased such that they tend to interpret ambiguous information negatively (compared to non-anxious individuals). Anxious individuals have an increased propensity to interpret ambiguous situations as threatening (Creswell, Shildrick, & Field, 2011) and focus on the negative elements of a situation (Tuschen-Caffier, Kühl, & Bender, 2011). Creswell and O'Connor (2011) measured children's interpretation bias and anxiety. Seventy-five children completed measures of anxiety at three time points over a year, separated by five or six months. At each time point, participants were also presented with ambiguous scenarios that could be interpreted as threatening or non-threatening and they were asked to infer the outcome of the scenario. The study highlighted that high levels of anxiety were associated with a greater proportion of threat-related interpretations (compared to non-threatening interpretations). The authors suggest that interpretation biases are associated with anxiety and, therefore, these biases may be valuable targets for assessment and intervention.

In response to the consistent findings of interpretation biases in anxiety, Cognitive Bias Modification of Interpretation (CBMI) was recently developed to manipulate individuals' interpretation of events and to reduce anxiety. CBMI is a training version of the ambiguous scenarios paradigm that is often used to measure

interpretation biases. CBMI involves the presentation of multiple incomplete ambiguous scenarios. At the end of each scenario participants are asked to resolve the emotional salience of the scenario by completing a word fragment (where they identify the missing letters in an emotionally valenced word; e.g., agr_ _ m_nt) or choosing a sentence (from a choice of two; one positive and one negatively valenced). In order to induce a negative interpretation bias, participants are presented with (and rewarded for completing/selecting) negative word fragments or sentences (i.e., told their response was correct or incorrect). If a positive interpretation bias is induced, participants are rewarded for completing a positive word fragment or selecting the positive sentence. Unlike CBT, CBMI solely focuses on the participant's interpretation of scenarios. Bowler et al. (2012) recruited 63 anxious adults and compared the effects of CBMI (which reinforced a positive interpretation bias), CBT and no intervention (control group) on anxiety levels and interpretation biases. They found that both therapies had a modest effect on anxiety levels and interpretation biases (compared to the control group). The CBMI group experienced a greater reduction in the number of negative interpretations of ambiguous scenarios (compared to the control group), and a similar trend was found when compared to the CBT group. This suggests that CBMI has greater efficacy to reduce negative interpretation biases (compared to CBT).

The encoding stage of cognition is also biased by threat. Attentional systems of anxious individuals are highly sensitive to threat-related stimuli. Anxious individuals tend to direct their attention towards threatening stimuli at early, automatic stages of cognitive processing (Bar-Haim, Dominique, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007; Cisler & Koster, 2010). They are more likely to orient their attention towards threat-related (vs. non-threat) stimuli (Bardeen & Orcutt, 2011) and have difficulty shifting their attention away from threat-related (vs. non-threat) stimuli (Bar-Haim, Lamy, & Glickman, 2005).

Attentional biases and attentional control are considered a causal mechanism underpinning anxiety. Attentional Control Theory (ACT) outlines that anxious individuals demonstrate difficulties directing their attention, ignoring task irrelevant stimuli and holding information in their working memory (i.e., poor attentional control) and they automatically allocate attentional resources to threat-related stimuli (i.e., attentional bias towards threat). ACT proposes that these characteristics of attentional

processing result from a decreased influence of the goal-directed attentional system and increased influence of the stimulus-driven attentional system (Eysenck & Derakshan, 2011; Eysenck, Derakshan, Santos, & Calvo, 2007)

The attentional bias to threat is commonly assessed using the dot-probe paradigm. The dot-probe paradigm is a computer based assessment in which participants are presented with two stimuli simultaneously (typically one threat-related and one neutral stimuli), the stimuli are replaced with a probe in the location of one of the stimuli and participants are expected to identify a prescribed characteristic relating to the probe (i.e., the orientation of the probe). The participant's reaction times (RTs) are recorded and used to calculate their attentional bias. The probe replaces the location of the threat stimulus in congruent trials, whereas the probe replaces the neutral stimulus in incongruent trials. If an individual has an attentional bias towards threat, then RTs will be faster when the probe replaces the threat (vs. neutral) stimulus. Participant's RTs to congruent trials are subtracted from incongruent trials to identify the participant's attentional bias, where a positive score indicates an attentional bias towards threat-related stimuli.

Roy et al. (2008) used the dot-probe task to assess children's attentional bias. Fifty-one non-anxious and 50 anxious participants (with GAD, social phobia and/or separation anxiety) were presented with pairs of threat with neutral stimuli (threat-neutral) and positive stimuli paired with neutral stimuli (positive-neutral). Participants were asked to identify the spatial location of the probe. The results showed that anxious participants (compared to non-anxious controls) demonstrated a greater attentional bias towards threat and this bias did not significantly vary across anxiety disorders.

It has been suggested that the dot-probe paradigm prohibits exploration of the components of attentional biases and, specifically, it is unclear if the faster response times to congruent (vs. incongruent) trials are the product of faster engagement with threat or a difficulty disengaging from threat. Koster et al (2004; 2006) adapted the dot-probe paradigm to consider this. They included trials with pairs of neutral stimuli presented simultaneously (neutral-neutral trials) and compared RTs for neutral-neutral pairs with threat-neutral pairs. If there is faster engagement with threat, then RTs will be faster when the probe replaces the threat stimulus in threat-neutral pairs compared with the neutral stimuli in neutral-neutral pairs. If there are difficulties with

disengagement from threat, then RTs will be slower when the probe replaces the neutral stimulus in threat-neutral pairs compared to neutral stimuli in the neutral-neutral trials. Salemink, van den Hout, & Kindt (2007) used this paradigm with 133 students and found that elevated anxiety was associated with difficulties disengaging from threat and not rapid engagement with threat.

The spatial cueing paradigm (Posner, 1980) also allows identification of differences between engagement and disengagement with threat. The spatial cueing paradigm is a computer based task in which a cue appears in one of two peripheral locations and is followed by a target either in the cued location (valid trials) on the majority of the trials and at the alternative location (invalid trials) on a minority of trials. Systematic manipulation of the emotional content of the cues (e.g., threat, neutral or positive cues) allows exploration of attentional biases for different emotional valences. If there is a vigilant attentional engagement with threat, then RTs to respond to the target will be faster following valid threat (vs. non-threat) cues. If there are difficulties disengaging attention from threat, then RTs to respond to the target will be slower following invalid threat (vs. non-threat) cues. Amir et al. (2009) examined the attentional biases of 18 adults with social phobia and 20 non-anxious controls using the spatial cueing paradigm task. They found that anxious individuals had difficulties disengaging attention from threat.

The early attentional bias towards threat-related stimuli is proposed to play a causal role in anxiety (Bar-Haim, et al., 2007; Williams, Watts, MacLeod, & Mathews, 1997); therefore, researchers have manipulated participants' attentional bias and explored the effect on anxiety, with the aim of developing a novel treatment for anxiety (Otto, Smits, & Reese, 2004). Attentional Bias Modification Training (ABMT) aims to modify individuals' attentional bias towards threat-related stimuli using a training version of the dot-probe or spatial cueing paradigm. For ABMT, the stimuli presentation is the same as the dot-probe or spatial cueing paradigm, although the frequency with which the target replaces the threatening stimulus is manipulated to induce a bias towards or away from threat-related stimuli. The probe can appear in one of two spatial locations; replacing the threat-related stimuli (encouraging participants to attend towards the threatening stimuli) or replacing the non-threat-related stimuli (encouraging an attentional bias away from threat). To reduce attentional bias towards

threat, the target replaces the neutral stimuli on 80-100% of the trials (Hallion & Ruscio, 2011). Over tens or hundreds of trials, a bias towards threat is reduced because participants implicitly learn the association between neutral stimuli and the probe location and, therefore, attend to the neutral stimulus to improve their task performance.

A review of ABMT on anxiety levels and attentional biases analysed 12 studies (467 adults) and concluded that ABMT shows promise as a new treatment for anxiety (Hakamata et al., 2010). ABMT significantly reduced anxiety levels with a medium to large effect size for clinically anxious individuals (d=.79) and a small to medium effect size for non-anxious controls (d=.48). ABMT also significantly reduced attentional biases towards threat (d=1.16).

To summarise, there is some evidence to suggest that CBT, CBMI and ABMT are effective at reducing anxiety levels; however, the mechanism by which this is achieved is likely to be different for each of the three interventions. CBT aims to reduce anxiety and changes in attentional and interpretation biases are considered an epiphenomenon. In contrast, reductions in anxiety are considered a consequence of reductions in the interpretation bias following CBMI or reductions of the attentional bias following ABMT. Whilst the effects of these therapies on anxiety are well documented for adults and the literature for children is developing, the precise details of how anxiety levels change (i.e., through changes in interpretation and/or attention) are less well documented. In other words, it is not clear whether reductions in anxiety following training are directly associated with change in attentional or interpretation biases.

To the author's knowledge, no review has yet considered the effect of ABMT, CBMI and CBT on anxiety and both areas of cognition (attention and interpretation). If we assume, as Crick and Dodge (1994) suggest, that these stages of cognition are reciprocally related, then it is plausible that changes in biases at one stage of cognition will influence other stages of cognition and/or anxiety. Changes in anxiety (that result from CBT) may be associated with changes in cognitive biases. The changes in interpretation that result from CBMI may influence anxiety and/or attentional biases. Similarly, the changes in attentional biases that result from ABMT may cause changes in an individual's level of anxiety and/or interpretation of events.

Aims and objectives

This review aims to compare the effect of CBT, CBMI and ABMT on anxiety, attentional biases and interpretation biases to explore the mechanisms underlying anxiety reduction following these interventions. The current paper presents a systematic review of intervention studies that aim to reduce anxiety levels and change attentional or interpretation biases in children and adolescents by utilising CBT, CBMI and/or ABMT. The review will allow researchers and clinicians to assess the efficacy of these intervention techniques compared to the implementation of different interventions (i.e., experimental designs that utilise active control groups) or no intervention (i.e., experimental designs that utilise passive control groups). It will also consider moderators for the relationship between anxiety and cognitive biases, where this is examined in the research. This review provides a comprehensive assessment of the quality of the studies and allows some comparison of the strengths and limitations of studies examining each approach to treatment.

Method

Literature Base

Searches were conducted in PsychInfo (via Ebsco: 1981-2012), Medline (via Ebsco; 1973 – 2012); Embase (via Ovid; 1974-2012) and Web of Science (1970-2012). The search terms or key words were generated by the author. Reference lists from the publications that were eligible for inclusion in the review were manually searched to identify further studies.

Inclusion Criteria

The following inclusion criteria were applied to the studies:

Participants. All included studies were comprised of samples with a mean age below 18 years with any type of anxiety (e.g., separation anxiety, generalised anxiety, phobias). A diagnosis of anxiety was not required for inclusion; studies with participants experiencing non-clinical anxiety levels were included.

Intervention Type. Studies employing CBT techniques to target anxiety were included. Studies using modification of attentional bias and/or modification of individual's interpretation of situations were included. Control groups consisted of anxious individuals allocated to a wait-list or active control condition (receiving alternative intervention) or non-anxious control groups.

Outcome Variables and Analysis. Studies were included if the outcome variables included measures of anxiety and attentional or interpretation bias. The term attentional bias was defined as an individual's systematic tendency to attend preferentially to a particular class of stimuli (Harvey, Watkins, Mansell, & Shafran, 2004) and interpretation bias was defined as an individual's construction/appraisal of a situation (A. T. Beck & Emery, 2005). Studies measuring only the individual's evaluation of themselves (e.g., general self-esteem or self-efficacy) were not included (e.g., Hagh-Shenas, Bahredar, & Rahman-Setayesh, 2009).

Publication Requirements. Studies were eligible for inclusion in the review if they were written in English and published in an academic or professional journal.

Exclusion Criteria

There are several limits to this literature review. Whilst it is acknowledged that anxiety is often highly comorbid with depression (Lamers et al., 2011), it is beyond the scope of this review to consider the effects of interventions delivered to target depression. It is also beyond the limits of this review to consider the effect of prevention studies, or the effect of therapy on adults. See existing reviews for the effect of intervention for adults (e.g., Bar-Haim, 2010; Hallion & Ruscio, 2011; Pflug, Seehagen, & Schneider, 2012). Unpublished work and studies reported in books, abstracts, conference proceedings and review articles were not included.

The Search Process

Searches of electronic databases and reference lists on 10th December 2012 produced 13,127 records. See Appendix 1 for the search terms. The titles and abstracts from these records were manually screened to establish whether the pre-determined inclusion and exclusion criteria were satisfied, this process led to the removal of 12,975 records. Full texts were retrieved for 152 records; 52 of these records were duplications of records. Twenty three of the papers satisfied the inclusion criteria. The reference lists of the included studies were searched and one further study was included. This process resulted in the inclusion of 24 studies in this review. Appendix 2 illustrates the process to identify the studies.

Study Description

Details of the participant characteristics, study design, intervention, outcome measures and results for each study are described and summarised in Table 1. The

participant characteristics included the sample size, mean participant age, the percentage of male participants and the participant's level and type of anxiety. Details of the intervention were recorded for the intervention and control group(s); this information included the number and frequency of sessions, the paradigm used and the direction of the induced bias. The outcome measures and related results for anxiety, attentional bias and interpretation bias were recorded.

Quality Assessment

The author used a modified version of the checklist devised by Downs and Black (1998) to assess the quality of eligible studies. This checklist was designed to assess the methodological quality of studies of health care interventions. The checklist is comprised of 27 questions that cover five areas; reporting, external validity, internal validity, confounding bias and power to detect an effect. Questions related to reporting considered whether the paper provided sufficient information to allow the reader to assess the study findings (e.g., the clarity of reporting the hypotheses, interventions, outcome measures and main findings). The external validity questions assessed the extent to which the recruited sample was representative of the population. Internal validity questions explored the extent to which the findings were a result of the intervention, rather than the expectations of the participants or researcher (e.g., due to a lack of blinding), unreliable outcome measures or inappropriate statistical tests. Questions about the confounding bias explored if there were biases in the selection of participants (e.g., the result of non-random allocation of groups) or biases in statistical analyses (e.g., a failure to conduct intention-to-treat analyses). The power question assessed whether the study reported a priori power calculation to establish the appropriate sample size.

Results

Twenty four studies considered the effect of CBT, CBMI or ABMT on children and adolescents anxiety levels and changes in attentional and/or interpretation biases. Eight studies employed CBT, 10 used CBMI and six explored the impact of ABMT. For the CBT studies, the primary outcome of therapy was individual's anxiety levels and the secondary outcome was the effect on attentional and/or interpretation biases.

Whereas, for CBMI and ABMT the primary outcome was interpretation or attentional bias, respectively, and the secondary outcome was anxiety.

CBT.

Study Design. The majority of CBT studies used mixed experimental designs or made within group comparisons. There were no randomised control trials. Of the three CBT studies that employed a control group, two recruited non-anxious participants and one study included an anxious wait-list control group. Four studies did not employ a control group and made only within group comparisons. One study introduced a stepped care programme, where all participants received group CBT and those with continued levels of high anxiety, after the group CBT, received a further 10 sessions of individual CBT. Two studies utilised double blinding and the remainder (six studies) did not specify blinding techniques.

Measurements. Anxiety was measured at pre-intervention, post-intervention and follow-up with structured interviews (e.g., the Anxiety Disorders Interview Schedule for DSM-IV) and/or questionnaires (e.g., Spence Children's Anxiety Questionnaire).

Compared to other therapies, a broad range of measures were used to measure cognitive biases. Attentional biases were measured using the dot-probe paradigm, eye-tracking and the emotional Stroop task. Eye-tracking apparatus involves the measurement of participant's eye gaze. The emotional Stroop task is an adaptation of the classic Stroop task (Stroop, 1935), it requires participants to identify the colour of emotional and neutral words. The difference in the RTs for emotional and neutral words indicates participant's attentional bias. Shorter RTs for emotional (compared to neutral) words indicates an attentional bias towards emotional stimuli. Interpretation biases were measured using ambiguous scenarios and homographs. Homographs are words that can be interpreted in multiple ways. These homographs could be interpreted in threatening and neutral ways (e.g., hang). The frequency of threat and neutral interpretations of the homophones were assessed.

The majority of CBT research took post-intervention measurements within two weeks of completing the intervention and did not include follow-up assessment. Two CBT studies took follow-up measurements of anxiety 3 months after the intervention (Bögels & Siqueland, 2006; Ishikawa et al., 2012), one study also documented the effect

on interpretation biases at 3 months (Ishikawa, et al., 2012). In-Albon and Schneider (2012) are in the process of collecting follow-up data at 12 and 24 months after intervention.

Recruitment. The CBT studies recruited anxious participants from a range of populations. All except one study recruited participants from mental health clinics, parental and professional referrals, flyers and advertisements in the community. In-Albon and Schneider (2012) recruited participants from another study that explored the efficacy of CBT in treating separation anxiety disorder.

Sample Characteristics. All participants receiving CBT had a primary diagnosis of an anxiety disorder. The presence of clinical levels of anxiety was confirmed using structured interviews.

Exclusion Criteria. CBT studies generally excluded participants with learning difficulties, obsessive compulsive disorder (OCD), post traumatic stress disorder (PTSD), suicide idealation and concurrent intervention (pharmacological or psychotherapy). Two CBT studies did not state their exclusion criteria.

The Intervention. The majority of CBT studies included participants with a variety of different anxiety disorders and aimed to target general symptoms of anxiety. Two studies targeted specific types of anxiety; separation anxiety (In-Albon & Schneider, 2012) and panic disorders (Wiener, et al., 2012). Some of the CBT interventions were manualised (Legerstee et al., 2010; Legerstee et al., 2009; Waters, Mogg, & Bradley, 2012; Waters, Wharton, Zimmer-Gembeck, & Craske, 2008; Wiener, Perloe, Whitton, & Pincus, 2012) and others were unpublished programmes (Bögels & Siqueland, 2006; In-Albon & Schneider, 2012; Ishikawa, et al., 2012). Some interventions also included social skills training (Waters, et al., 2012; Waters, et al., 2008) and relaxation techniques (Legerstee, et al., 2010; Legerstee, et al., 2009; Waters, et al., 2012; Waters, et al., 2008).

CBT interventions involved group or individual therapy that focussed on the interaction of thoughts, feelings and behaviours. The content of the CBT interventions was relatively consistent across the studies (teaching skills relating to affect and cognition, and encouraging exposure to anxiety sources), but the information available about how the interventions were conducted varied considerably. The majority of

studies documented the content of the session, the number and timing of the sessions and the format (group or individual).

The studies provided between 8 and 20 sessions of CBT, some studies provided parental sessions (Legerstee, et al., 2010; Legerstee, et al., 2009; Waters, et al., 2012; Waters, et al., 2008) and some studies also provided booster sessions to remind participants of the taught techniques (Ishikawa, et al., 2012; Waters, et al., 2008). The majority of the sessions were delivered weekly, although two studies did not specify the regularity of sessions, and Wiener, et al. (2012) provided daily therapy sessions. Two studies reported the attendance rates for the CBT intervention (Waters, et al., 2012; Waters, et al., 2008), whilst the remaining studies did not report attendance rates. Where documented, the sessions lasted between 60 and 90 minutes (Ishikawa, et al., 2012; Waters, et al., 2012; Waters, et al., 2008). Three studies employed group CBT (with between three and six participants in each group), one study provided individual CBT sessions, and two studies provided a combination of group and individual CBT. Two studies did not specify the format of the CBT sessions.

Effects on Anxiety. Six of the eight studies reported a significant decline in anxiety symptoms from pre-intervention to post-intervention with a medium to large effect size (d>0.6; Bögels & Siqueland, 2006; In-Albon & Schneider, 2012; Ishikawa, et al., 2012; Waters, et al., 2012; Waters, et al., 2008; Wiener, et al., 2012). Wiener, et al., (2012) also reported that the mean anxiety level fell within the non-clinical range at post-intervention. The improvements in anxiety were sustained three months after the intervention (Bögels & Siqueland, 2006; Ishikawa, 2012).

Four studies documented the number of participants that fulfilled the diagnostic criteria for anxiety following intervention. Ishikawa, et al., (2012) found that 54% of those who were intended to be treated (58% of treatment completers) were free from their principal anxiety disorder following CBT. The percentage of anxiety disordered children that were free from any anxiety disorder following CBT varied considerably between studies, between 36% and 100% (Ishikawa, 2012; Legerstee, et al., 2010; Legerstee, et al., 2009; Waters, et al., 2008). Three months after the intervention, 61% of those who were intended to be treated (64% of participants who completed the therapy) were free from their primary diagnosis (Ishikawa, et al., 2012). Furthermore, 48% of participants who were intended to receive CBT (52% of participants that

completed the CBT) were free from all anxiety disorders at three month follow-up (Ishikawa, 2012).

No significant changes in anxiety levels were found for the control groups. The two studies with non-anxious control groups compared change scores for anxious and non-anxious groups (In-Albon & Schneider, 2012; Waters, et al., 2008). They identified significant differences between the groups; the anxiety levels of anxious participants receiving CBT significantly reduced compared to the change in anxiety levels for non-anxious control groups. However, both studies also identified that anxious participants had significantly higher anxiety (compared to non-anxious participants) at pre-intervention and post-intervention, suggesting although the anxious participant's anxiety levels declined, their anxiety levels had not declined to a non-anxious level. Bögels and Siqueland (2006) had an anxious wait-list control group. They report that anxiety levels did not reduce whilst anxious participants were waiting for treatment. However, the researchers did not directly compare the change scores between the CBT and wait-list groups, prohibiting a direct comparison of how anxious children's anxiety levels change over time with and without CBT intervention.

Changes in anxiety were found for both formats (individual and group) of CBT (Ishikawa, et al., 2012; Legerstee, et al., 2009). No significant differences were found between the formats (Legerstee, et al., 2009).

Effects on Interpretation Biases. The three studies that consider the impact of CBT on interpretation biases document mixed findings, which may be the result of differences in measurements. Studies that assessed the interpretation using ambiguous scenarios found that participants receiving CBT interpreted situations more positively at post-intervention compared with pre-intervention (Bögels & Siqueland, 2006; Ishikawa, et al., 2012) and they had an increased perception of their ability to influence situations (Waters, et al., 2008). These studies report a medium and large (d>.7 and $\eta\rho^2$=.51) effect size on positive interpretation bias. Furthermore, this effect was sustained at a three month follow-up (Ishikawa, et al., 2012). However, the use of homophones to measure interpretation bias found that CBT had no significant impact on participants' interpretation bias (Waters, et al., 2008). Whilst homophones require the participants to interpret the meaning of the word, the judgement of the homophone is relatively context

free and unlikely to have required interpretation and problem solving skills (which are taught in CBT).

Effects on Attentional Bias. Six studies measured the effects of CBT on attentional bias. One study used eye-tracking apparatus to identify changes in participant's attentional bias. They found changes in participant's attentional bias following intervention (In-Albon & Schneider, 2012). Two groups (anxious and non-anxious) completed eye-tracking measurements; the anxious group completed measures before and after 16 sessions of CBT, the non-anxious group received no intervention and were reassessed over the same time interval. Pre-treatment eye-tracking measures showed that all participants (the anxious and non-anxious control groups, at pre-intervention and post-intervention) initially attended away from the threat-related images for the first 1000 milliseconds (ms) of image presentation. There were group differences from 1000 to 2000ms of image presentation; at pre-intervention measurements, between 1000 and 1500ms the anxious (vs. non-anxious) group showed increased attention towards the threat image and between 1500 and 2000ms their attention towards the threat-related stimuli peaked. Between 1000 and 2000ms, the non-anxious controls attended away from threat (at pre-intervention and post-intervention). At post-intervention, the anxious group did not significantly differ from the non-anxious controls. After 2000ms of image presentation, the anxious and non-anxious participants attended away from the threat.

Two studies used a dot-probe task to measure attentional biases and reported a change following intervention (Legerstee, et al., 2010; Waters, et al., 2008). Waters et al. compared attentional biases for anxious individuals receiving CBT and non-anxious controls at two time points. The study showed that non-anxious participants' bias scores were significantly greater than zero at pre-intervention (where a score greater than zero indicates an attentional bias towards threat), but not at post-intervention, indicating non-anxious participant's attentional bias towards threat diminished over time and/or with repeated measures. Anxious participant's bias for threat were significantly greater than zero at pre-intervention and post-intervention, indicating the attentional bias towards threat did not change after CBT. In contrast, Legerstee, et al. compared attentional biases before and after CBT intervention and identified differences

in participants' attentional biases prior to intervention (some attended towards and others away from threat) but by post-intervention they had no attentional biases.

Wiener, et al. (2012) used the emotional Stroop paradigm to measure and compare participants' attentional biases. They measured participant's RTs to general threat, panic related, positive emotion and neutral words. They found that prior to intervention anxious participants had an attentional bias for threat words (panic and general threat) compared to other word types (positive and neutral) but this effect was not present after CBT.

The Relationship between Anxiety and Cognitive Bias Outcomes. Two (of three) studies that measured interpretation bias considered the relationship between change in the interpretation bias and change in anxiety. Waters, et al. (2008) found low and non-significant correlations between the change scores from pre-intervention to post-intervention. Whereas, Ishikawa, et al. (2012) found increases in positive interpretation biases were associated with reductions in anxiety levels.

Two studies considered the change in anxiety and attentional biases over the duration of a CBT intervention (Waters, et al., 2012; Waters, et al., 2008). Waters, et al. (2008) found a low non significant correlation between changes in anxiety and attentional biases. Waters, et al. (2012) found that an increase in attentional biases toward threat is weakly associated with a reduction in anxiety. However, this finding is counter intuitive and may be a product of the small sample size.

Four (of six) studies found that attentional biases at pre-test were associated with a reduction in children's anxiety. A reduction in anxiety was not observed in all participants following CBT and therefore many of the researchers have split the data into treatment responders (individuals who report a reduction in anxiety following intervention) and non-responders. Treatment responders can be identified by their attentional bias at pre-assessment, however the nature of this attentional bias appears to be contradictory. Some research identifies that anxious participants with an attentional bias towards threat at pre-test have a greater reduction in anxiety following CBT (Waters, et al., 2012), whereas other research identified that anxious participants with an attentional bias away from threat at pre-test experienced a reduction in anxiety levels following CBT (Legerstee, et al., 2009). This seemingly contradictory finding can be explained by methodological differences. During the dot-probe task Waters, et al.,

presented the stimuli for 1250ms before expecting participants to respond, whereas Legerstee, et al. presented the stimuli for 500ms. In-Albon and Schneider (2012) found that at pre-test anxious individuals attend away from threat in the first 1000ms of image presentation and towards threat between 1000 and 2000ms of image presentation. Therefore, before intervention the treatment responders are likely to attend away from threatening stimuli that are presented for 500ms (as measured by Legerstee, et al.) and towards threatening stimuli at 1250ms (as measured by Waters, et al.).

The interaction between attentional biases prior to intervention and anxiety reduction may be further complicated by the nature of the CBT intervention used. Legerstee, et al. (2010) found that attentional biases indicated the level of intervention necessary to reduce anxiety levels; those with an attentional bias towards threat responded to group CBT, whereas those with an attentional bias away from threat responded to individual CBT.

Legerstee, et al. (2009) calculated the components of attentional bias to identify treatment responders and non-responders. They presented stimuli for 500ms and found that treatment responder's RTs on congruent threat trials were greater than response times to neutral-neutral trials at a trend level. The authors suggest this illustrates that treatment responders tended to not engage their attention toward threat prior to intervention. Non-responders had significantly greater RTs for incongruent threat trials (compared to neutral-neutral trials), the authors suggest this illustrates non-responders had difficulties disengaging attention away from threat.

CBMI.

Study Design. All of the CBMI studies used a mixed experimental design with randomised group allocation. Seven studies used a single blind design, two used a double blind design and one study did not specify details of blinding procedures (Lothmann, Holmes, Chan, & Lau, 2011).

Measurements. All except one study used a standardised measure of anxiety. Standage, Ashwin and Fox (2010) used a visual analogue scale (VAS) to measure anxiety, where participants rate their level of anxiety on a line. Two studies used standardised measures of anxiety prior to intervention only, thus prohibiting the calculation of change scores (Muris, Huijding, Mayer, & Hameetman, 2008; Muris, Huijding, Mayer, Remmerswaal, & Vreden, 2009). Three studies used standardised

measurement prior to intervention and measured anxiety with a VAS before and after intervention to allow calculation of change scores (Lau, Molyneaux, Telman, & Belli, 2011; Lester, Field, & Muris, 2011; Lothmann, et al., 2011). Four studies measured anxiety before and after the intervention using standardised measures (Salemink & Wiers, 2011, 2012; Vassilopoulos, Banerjee, & Prantzalou, 2009; Vassilopoulos, Blackwell, Moberly, & Karahaliou, 2012).

The majority (six) of the CBMI studies took pre-intervention measures, delivered the intervention and took post-intervention measurements in one day (Lau, et al., 2011; Lester, et al., 2011; Lothmann, et al., 2011; Salemink & Wiers, 2011, 2012; Standage, et al., 2010). Two studies took pre-intervention measurements the week before the intervention, delivered the intervention in one session and took post-intervention measurements on the same day as the CBMI (Muris, et al., 2008; Muris, et al., 2009). Two studies took pre-intervention measurements the week before and post-intervention measurements the week after the intervention (Vassilopoulos, et al., 2009; Vassilopoulos, et al., 2012). No studies conducted follow-up measures.

Recruitment. All of the studies recruited participants from schools, except Standage, et al. (2010) who recruited participants from a departmental open day for A Level students.

Sample Characteristics. The majority of research in this area is based on samples of children and adolescents with average levels of anxiety. Researchers recruited opportunity samples of students and did not exclude according to anxiety level. Three studies considered the effects of CBMI for highly anxious individuals. The high anxiety levels were measured using standardised measures of anxiety and participants were determined to have a high anxiety score compared to the standardised mean. No groups had clinical levels of anxiety.

Exclusion Criteria. The majority of CBMI studies applied relatively few exclusion criteria and most included all individuals that opted in. This sampling method is desirable because the sample is representative of a range of children and adolescents, but also causes difficulties because the impact of extraneous variables (e.g., age, gender, learning needs) are often not measured and/or controlled for. Some CBMI studies excluded participants with a self-reported history of clinical depression or anxiety to avoid the random allocation of participants who are susceptible to anxiety or depression

to the negative interpretation group (which was hypothesised to increase negative affect).

The Intervention. The CBMI training involved the presentation of hypothetical situations and reinforced positive, negative or benign interpretations of the situations. The precise implementation of CBMI varied considerably. Some studies used a traditional version of CBMI training where ambiguous scenarios were presented, the participant's response (to a word fragment or sentence selection) completed the scenario and their response emphasised induced bias (Lau, et al., 2011; Lester, et al., 2011; Lothmann, et al., 2011; Muris, et al., 2008; Muris, et al., 2009; Salemink & Wiers, 2011, 2012; Standage, et al., 2010). Participants were given feedback (correct or wrong) about their letter or sentence selection and this feedback was used to reinforce the desired interpretation. Some studies incorporated a comprehension question to emphasise the emotional valence of the scenario (Lau, et al., 2011; Lothmann, et al., 2011; Salemink & Wiers, 2011, 2012). Between 80% and 100% of trials were congruent with the induced interpretation, some studies diluted the congruency to disguise the aim of the CBMI (Lau, et al., 2011; Lothmann, et al., 2011). Participants were exposed to between 30 and 60 scenarios, which were typically delivered in one day.

Some studies utilised a more condensed version of CBMI (Standage, et al., 2010; Vassilopoulos, et al., 2009; Vassilopoulos, et al., 2012). Standage, et al. (2010) presented with 30 scenarios reinforcing a positive, negative or benign interpretation bias (depending on group allocation) and they were asked to read the scenarios for five minutes. Vassilopoulos, et al., (2009; 2012) provided participants with hypothetical social situations with prescribed interpretations of the scenarios and asked participants to complete a comprehension question for each scenario. In the condensed versions of CBMI training, the interpretation was 100% congruent with the induced bias. Participants were exposed to between 30 and 72 trials. Some studies split the trials over two or three weeks (Vassilopoulos, et al., 2009; Vassilopoulos, et al., 2012).

Effect on Anxiety. Approximately half (4/10) of the CBMI studies document a significant reduction of anxiety levels following intervention (compared to pre-intervention). CBMI had a small ($\eta\rho^2$=.03) but significant effect on anxiety levels over time (Vassilopoulos, et al., 2012) and a medium to large effect (r=.4 and $\eta\rho^2$=.38)

compared to the control groups (Lothmann, et al., 2011; Standage, et al., 2010; Vassilopoulos, et al., 2009). Lothman, et al. (2011) found that participants with higher anxiety had the greatest reductions in anxiety. Negatively focussed CBMI was found to have mixed results, Lothman, et al., reported no change in anxiety whereas Standage, et al., found a significant increase in anxiety (compared to the positive CBMI group and across time). The anxious wait-list control group was found to have no significant changes in anxiety (Vassilopoulos, et al., 2009).

Six (of ten) studies report no significant change in anxiety levels (Lau, et al., 2011; Lester, et al., 2011; Muris, et al., 2009; Salemink & Wiers, 2011, 2012). The majority of these studies compared anxiety levels across time and/or with a randomly assigned control group. These non-significant findings were found across participants with a range of ages and using a variety of measurements for anxiety.

Effect on Interpretation Bias. All CBMI studies report changes in interpretation biases following intervention (in the induced direction). The interpretation biases were generally induced within the first 20 scenarios (Muris, et al., 2008; Muris, et al., 2009). Positively focussed CBMI led to a significant reduction in threat-related interpretation of scenarios, with a medium to large effect size (d=.71 and $\eta\rho^2$=.17) compared to control groups (Lau, et al., 2011; Lester, et al., 2011; Lothmann, et al., 2011; Muris, et al., 2009; Salemink & Wiers, 2011; Standage, et al., 2010; Vassilopoulos, et al., 2009). Four (of six) studies found that negatively focussed CBMI significantly increased participant's threat-related interpretation across time and compared to control groups (Lau, et al., 2011; Muris, et al., 2009; Salemink & Wiers, 2011, 2012). The effect of the negative interpretation was large when compared to the positive CBMI group (d>.97) and small to medium when compared across time ($\eta\rho^2$=.12). This suggests that negative and positive CBMI alters interpretation biases in the induced direction. Most studies (2/3) that induced no bias for control groups found no significant change in interpretation biases; one study found a reduction in threat-related interpretation for the control group although a greater reduction in threat-related interpretation was found for the intervention group. This suggests that changes in interpretation may partially be a product of time, but mostly a product of intervention.

Effect on Attentional Bias. The effect of CBMI on participant's attentional biases has not been considered in this research.

The Relationship between Anxiety and Cognitive Bias Outcomes. Correlations of change in interpretation bias and anxiety are contradictory. One study found no association between change in anxiety and interpretation bias (Lester, et al., 2011) whereas other studies found a positive correlation; specifically greater reductions in anxiety were associated with greater reductions in negative interpretations (Muris, et al., 2009; Vassilopoulos, et al., 2009; Vassilopoulos, et al., 2012). Some studies reported non-significant changes in anxiety levels following therapy, yet they found a significant reduction in negative interpretation bias. This suggests that alterations in negative interpretation biases do not necessarily result in changes in anxiety levels.

One study explored the effect of CBMI on anxiety and interpretation bias, whilst controlling for the effect of attentional control (measured by the Stroop task; Salemink & Wiers, 2012). They found that the association between anxiety and interpretation bias was moderated by attentional control. At pre-test, individuals with high anxiety and low attentional control interpreted information more negatively (compared to the control condition). In addition, attentional control moderated the effectiveness of CBMI; participants with low attentional control and high levels of anxiety had a reduction in interpretation bias (compared to participants with high attentional control and the control condition).

ABMT.

Study Design. All ABMT studies employed mixed group designs (where participants were randomly allocated to one of two experimental groups), except Rozenman, Weersing and Amir (2011) who did not employ a control group and Cowart and Ollendick (2011) who used a multiple baseline assessment design. In Cowart and Ollendick's study, a random number of baseline assessments were completed prior to the intervention twice per week. This methodology allowed the participants to act as their own controls, however the absence of a passive control group makes it difficult to disentangle the impact of the intervention from the passage of time.

Some studies utilised blind study designs. One study used a double blind design and one used a single blind design. The remaining studies did not specify details of blinding.

Measurements. All studies used a standardised measure of anxiety at pre-intervention and post-intervention. Two studies complemented the standardised

measurement of anxiety with a VAS (Bar-Haim, Morag, & Glickman, 2011; Eldar, Ricon, & Bar-Haim, 2008). Eldar, et al, (2008) measured changes in anxiety using a stress induction task following the intervention. They elicited a negative mood state by asking participants to complete three difficult puzzles in a short time. Participant's anxiety levels were measured before and after the stress induction task. Five studies measured attentional biases using the dot-probe paradigm and one study used the spatial cueing paradigm.

For most studies, pre- and post-intervention measurements were taken on the first and last day of ABMT. For two studies, pre-intervention measurements were taken three to seven days prior to intervention and post-intervention measurement within one week of the intervention ending (Cowart & Ollendick, 2011; Rozenman, et al., 2011). Eldar, et al. (2008) took follow-up measures of anxiety and attentional bias nine months after the intervention.

Recruitment. Participants in the ABMT studies were recruited from a wide range of sources; two studies recruited from health clinics (Eldar et al., 2012; Rozenman, et al., 2011), one used flyers and advertisements in the community (Cowart & Ollendick, 2011), two recruited from other studies (Bar-Haim, et al., 2011; Pitică, Susa, & Benga, 2010) and one study did not specify the details of recruitment.

Sample Characteristics. Most of the ABMT research was based on clinically anxious adolescents. The clinical level of anxiety was confirmed using a range of interviews and/or questionnaires. One study was based on highly anxious children or adolescents, compared to the sample mean; specifically the 50% most anxious participants in the sample (Bar-Haim, et al., 2011). One study recruited participants with typical levels of anxiety (within one standard deviation of the standardised mean; Eldar, et al., 2008).

Exclusion Criteria. Half of the ABMT studies applied no exclusion criteria. The other half excluded participants with pervasive developmental disorders, PTSD, OCD, depression, learning difficulties, suicide idealisation and concurrent intervention.

The Intervention. All ABMT interventions involved a computerised presentation of facial stimuli; five studies altered attentional biases using the dot-probe paradigm and one study used the spatial cueing paradigm. The facial stimuli varied in emotion and duration across the studies. All studies used angry faces for threat-related

stimuli and some encompassed faces of disgust (Cowart & Ollendick, 2011; Rozenman, et al., 2011). Typically neutral faces were used for non-threatening stimuli, although one study used happy faces for this purpose (Pitică, et al., 2010). Most studies presented the faces for 500ms (Bar-Haim, et al., 2011; Eldar, et al., 2012; Eldar, et al., 2008; Pitică, et al., 2010), although Eldar, et al. (2008) presented the faces for a longer duration (700ms).

ABMT was delivered in a variety of ways. Participants received between 384 (Bar-Haim, et al., 2011) and 1920 trials (Eldar, et al., 2012; Rozenman, et al., 2011) in total, distributed over one to five training sessions per week. The sessions were distributed across a number of weeks, ranging from one to five weeks. The most intensive ABMT training delivered 1800 trials in a week over 5 sessions, each session consisted of 360 trials (Pitică, et al., 2010) whereas other studies delivered a similar number of trials (1600) in more (10) sessions over a longer time frame (5 weeks; Cowart & Ollendick, 2011).

Effect on Anxiety. Four of the studies statistically explored the effect of intervention on anxiety and three found a significant reduction in anxiety over the duration of the intervention (Bar-Haim, et al., 2011; Eldar, et al., 2012; Rozenman, et al., 2011). This effect was significant with a medium to large effect size (d>.79). Two studies induced an attentional bias away from threat and report a significant reduction in clinical levels of anxiety. Following ABMT that was designed to induce an attentional bias away from threat, 33% of the participants in the ABMT condition and 13% of the placebo condition no longer met the diagnostic criteria for an anxiety disorder at post-intervention (Eldar, et al., 2012). One study induced an attentional bias towards threat (Eldar, et al., 2008), they found an increase in anxiety with a large effect size (d=2.09).

Two studies were unable to report statistics to determine the effect of treatment, due to a limited sample sizes (two and four participants). In one study the descriptive statistics identified a decline in anxiety levels from pre-intervention to post-intervention for both participants and the post-intervention scores were near normative levels of anxiety (Cowart & Ollendick, 2011). In Pitică et al. (2010) two (of four) of the participants presented reduced anxiety scores following intervention and two reported no changes in anxiety. The authors concluded that no consistent changes in anxiety level could be observed following ABMT intervention.

One study implemented ABMT with non-anxious individuals and induced biases towards and away from threat. They found differences in stress induction; participants who were trained to attend towards threat-related stimuli showed increased anxiety following stress induction (compared to prior to the stress induction task) and those who were trained to attend to neutral faces showed no change in anxiety levels from before to after the stress induction task. These effects were not sustained at the 9 month follow-up (Eldar, et al., 2008).

The reduction in anxiety was also observed in control groups. Three studies used control groups, and two report significant reductions in anxiety for the control group from pre-intervention to post-intervention. Bar-Haim, et al. (2011) and Eldar, et al. (2012) both found a significant decline in anxiety from pre-intervention to post-intervention, regardless of the training condition (ABMT or active control group).

Effect on Interpretation Bias. The effect of ABMT on participant's interpretation bias has not been considered in this research.

Effect on Attentional Bias. The effect of ABMT on attentional biases is relatively consistent. Most studies report that ABMT designed to induce attentional bias away from threat reduced attentional bias towards threat and/or facilitated disengagement from threat-related stimuli (Bar-Haim, et al., 2011; Eldar, et al., 2012; Pitică, et al., 2010). This effect was found to be large (d>.8). Two studies report a non-significant reduction in the attentional bias towards threat, however the researchers propose this difference did not reach statistical significance due to the small sample size and substantial variability in the bias scores (Eldar, et al., 2008; Rozenman, et al., 2011). Eldar, et al. (2008) successfully induced an attentional bias towards threat using ABMT. Whilst Cowart & Ollendick (2011) measured participants attentional bias, they did not interpret it because participants had an attentional bias away from threat at pre-test. No changes in attention were observed in the control groups. One study found no significant reduction in attentional bias or disengagement with threat (Eldar, et al., 2008).

Reductions in participants' attentional bias towards threat may partially be a product of familiarity with the test stimuli, but the effects have also been generalised to novel stimuli. The majority of studies use the same faces for pre-intervention measurements, the intervention and post-intervention measurements. Participant's

increased familiarity with the threat-related stimuli may partially explain the reduction in attentional bias towards threat by post-intervention. To overcome this, some studies have included novel and familiar faces at post-intervention to assess participant's ability to generalise the induced bias. These studies found that the attentional bias at post-intervention for novel stimuli was similar to the bias for familiar stimuli, however the change in attentional bias between pre-test and post-test was more robust for familiar compared with new stimuli (Eldar, et al., 2012; Eldar, et al., 2008; Pitică, et al., 2010). This suggests that the attentional bias away from threat that is induced during ABMT can be generalised to novel stimuli, although to a lesser degree than trained stimuli.

The Relationship between Anxiety and Cognitive Bias Outcomes. Three ABMT studies considered the relationship between changes in attentional bias and anxiety levels over the course of the intervention. Rozenman, et al. (2011) found that the reduction in attentional bias towards threat (which resulted from ABMT designed to train attention away from threat) significantly correlated with anxiety levels prior to intervention; specifically high levels of anxiety were associated with the greatest reductions in attentional bias away from threat. However, the change in anxiety did not significantly correlate with changes in attentional bias and the authors suggest that this was due to the small sample and substantial variability in scores. Eldar, et al. (2008) found that children who were trained to attend towards threat showed increases in anxiety following a stressor, whereas children who were trained to attend to neutral faces showed no change in anxiety levels.

Eldar, et al., (2012) tested a mediation and moderation model to explore the interrelations between intervention, attentional bias and anxiety. They specifically tested the changes in anxiety that result from ABMT and the mediator/moderator role of attentional bias. The ABMT intervention reduced anxiety (compared to the control groups), however the relationship between intervention and attentional bias, and the relationship between attentional bias and anxiety were not significant.

Bar-Haim, et al., (2011) considered the changes in disengagement from threat and anxiety in response to a stressor. To identify changes in disengagement, the participants' mean RT for the last block (96 trials) of training (with incongruent threat-related trials) was subtracted from the mean RT for the first block of training. A positive score indicated a reduction in RTs and therefore improved disengagement. A

negative score indicated an increase in RTs and greater difficulties disengaging from threat. Changes in anxiety (in response to the stressor) were calculated by subtracting the anxiety level prior to the stress induction from the anxiety level after the stress induction. A positive score indicated an increase in anxiety following the stressor (vs. before the stressor) and a negative score indicated a reduction in anxiety. A correlation analysis identified steeper changes in disengagement (for the intervention group) were associated with lower anxiety in response to the stressor task. This suggests that participants who learnt to disengage with threat related stimuli had reduced levels of anxiety.

Quality Assessment.

The strengths and limitations of the studies were qualitatively assessed on the five areas of the quality assessment checklist.

Reporting Subscale. The studies generally provided a full description of the hypotheses, outcome measures, participant characteristics, interventions, principal findings, estimates of variability for these findings and the potential adverse effects associated with the interventions. Only five (of 24) of the studies reported exact *p* values for significant findings. For all intervention types, the characteristics of participants lost to follow-up were reported inconsistently between papers.

External Validity. The majority of papers provided some details of the source population. The papers provided limited information about the proportion of individuals from the source population that were recruited to the study. This ambiguity makes it unclear whether those recruited into the study were representative of the source population. For all types of intervention, the interventions were representative of treatments that could typically be available, increasing the ecological validity of the study.

Internal Validity. This subscale considered biases in measurement and outcomes. There was considerable variability between the studies with respect to whether or not they reported single or double blind conditions. One ABMT, two CBT and two CBMI studies used double blind techniques. One ABMT and seven CBMI studies used single blind techniques. The majority of the remaining studies did not specify their use of blinding techniques. It is important to blind participants and experimenters to ensure their expectations do not have an effect on the outcome

measures. In addition, effective blinding can also ensure that the groups receive similar amounts of attention and quality of treatment. Most of the studies conducted appropriate statistical tests, including valid and reliable outcome measures and controlled for the time between outcomes measurements.

Internal Validity (Confounding/Selection Bias). This subscale considered biases in the selection of participants, the allocation of participants to groups and the assessment of confounding variables in statistical analyses. The recruitment and random allocation of participants to intervention and control groups varied according to intervention type. For CBT, anxious participants were assigned to the intervention group in a non-randomised manner. Non-anxious participants or natural (non-randomised) wait-list control groups were used as control groups for CBT studies. For ABMT and CBMI, participants were typically randomly allocated to a group. A randomised design was used in no CBT, four ABMT and all (10) CBMI studies. The majority of studies recruited participants over a similar time-period.

There was also large variability in participants' compliance with the interventions. None of the ABMT or CBMI interventions reported participants' compliance with the intervention. Two of the CBT interventions reported participant's attendance rates.

A further limitation was that a number of studies did not report (or only partially reported) adjustments in the analysis for confounding variables. For example, some studies only reported analyses based on participants who completed the intervention (rather than also including an intention-to-treat (ITT) analysis) or the studies did not report on compliance (making it impossible to determine whether an ITT analysis was necessary).

Power. One study reported conducting a power calculation to determine the appropriate sample size (In-Albon & Schneider, 2012).

Table 1

Summary of the Study Design, Participant Characteristics, the Intervention, Outcome Measures and Findings for Studies Included in the Systematic Review

Study	Design	Participant Characteristics			Intervention			Outcome Measures	Findings
		Anxiety level and type	N (% male)	Participant age in years M (SD)	N of sessions & timescale	Paradigm	Induced Bias Direction		
					CBT				
Bögels, et al., (2006)	Repeated measures intervention study Natural wait-list control group	Clinical anxiety	17 (47%)	12.7 (2.1)	n/s	Family CBT	Reduce threat-related interpretation	*Anxiety* 1)KSKID 2)SCARED *Interpretation bias* Ambiguous scenarios	1)Reduction in anxiety[1,4] 2)Increase in positive interpretation of events [1,4]
Ishikawa, et al., (2012)	No control group Repeated measures intervention study	Clinical anxiety	31 (38%)	11.13	8 sessions	Group or individual CBT	Reduce threat-related interpretation	*Anxiety* 1)ADIS 2)SCAS *Interpretation bias* CCES	1)58% anxiety remission rate[1] 2)Increase in positive interpretations[1,4] 3)Reductions in anxiety correlate with increases in positive interpretation[1,4]
In-Albon &	Mixed design	Clinical	31 (Exp	10.45	*Exp*	*Exp(n=18)*	Reduce	*Anxiety*	1)Reduction in

Schneider (2012)	Anxious intervention group and non-anxious control group Double blind	separation anxiety	44%, Con 34%)		16	Disorder specific CBT. *Con(n=13)* Time.	threat-related interpretation	1)Kinder-DIPS 2)SAI *Attentional bias* Eye-tracking	anxiety[1,2] 2)At pre-intervention, exp attended towards threat (vs. non anxious) 3)At post-intervention, no differences in attentional bias
Legerstee, et al., (2009)	Mixed design Non-randomised allocation to individual or group CBT.	Clinical anxiety	131 (50%)	11.1	n/s	FRIENDS for Life	Reduce threat-related interpretation	*Anxiety* ADIS *Attentional bias* Dot-probe task	1)46% anxiety remission rate 2)Treatment responders showed an attentional bias away from threat at pre-intervention.
Legerstee, et al., (2010)	Repeated measures, stepped care programme No control group Double blind	Clinical anxiety	91 (50%)	11.1	*Phase 1* 10 sessions *Phase 2* 10 sessions	*Phase 1 (n=91)* FRIENDS for Life *Phase 2 (n=50)* Individual CBT with a parent	Reduce threat-related interpretation	*Anxiety* 1)ADIS *Attentional bias* 1)Dot-probe task	1)44% anxiety remission rate for phase 1, 42% for phase 2[1] 2)Phase 1 responders had an attentional bias away from severe threat at pre-test 3)Phase 2 responders had an attentional bias towards severe threat at pre-test

Waters, et al., (2008)	Mixed design Non-anxious control group	Clinical (exp) and low (con) anxiety	38 (63%)	9.95	10 sessions in 10 weeks	*Exp (n=19)* Group CBT sessions *Con (n=19)* Time	Reduce threat-related interpretation	*Anxiety* 1)ADIS 2)SCAS *Attentional bias* Dot-probe paradigm *Interpretation* 1)Homographs 2)Ambiguous scenarios	1)Exp had reduction in anxiety [1] 2)Exp attended towards threat at pre-test and post-test 3)Con had attentional bias; towards threat at pre-test and not at post-test 4)Exp had increased positive interpretation of events[1]
Waters, et al., (2012)	Repeated measures design No control group	Clinical anxiety	35 (51%)	9.58	10 sessions in 10 weeks	Take Action Programme – group CBT sessions.	Reduce threat-related interpretation	*Anxiety* 1)ADIS 2)SCAS *Attentional bias* Dot-probe task.	1)Significant reduction in anxiety levels[1] 2)Treatment responders had attentional bias towards threat at pre-test
Wiener, et al., (2012)	Repeated measures design No control group	Clinical panic disorder	25 (56%)	15.19	8 sessions in 8 days	Individual CBT for panic disorders	Reduce threat-related interpretation	*Anxiety* 1)ADIS 2)PDSS 3)CASI 4)SSS-C *Attentional bias* Emotional Stroop task	1)Reduction in anxiety [1] 2)Reduction in attentional bias towards threat[2]

					CBMI				
Lau, et al., (2011)	Random allocation Two experimental groups Single blind	Average anxiety	36 (36%)	16.49	1 session in 1 day	Ambiguous scenarios	*Exp1 (n=17)* Positive interpretation *Exp2 (n=19)* Negative interpretation	*Anxiety* 1)VAS 2)STAIC *Interpretation bias* Ambiguous scenarios	1)Exp1 had increased positive interpretations [3] 3)Exp2 had increased negative interpretations[3]
Lester, et al., (2011)	Random allocation Four experimental groups Single blind	All anxiety	103 (41%)	11.09	1 session in 1 day	Ambiguous scenarios	*Exp1(n=25)* Positive interpretation *Exp2(n=26)* Negative interpretation *Exp3(n=26)* Positive interpretation *Exp4(n=26)* Negative interpretation	*Anxiety* 1)TAI-C 2)FSSC-R 3)VAS *Interpretation bias* Ambiguous scenarios	1)Exp1 and 3 had increases in positive interpretation[2] 2)Exp2 and 4 had increases in negative interpretation[2]
Lothman, et al., (2011)	Randomly allocated Two experimental conditions	All anxiety	82 (36%)	*10.03*	1 session 1 day	Ambiguous scenarios	*Exp1 (n=41)* Positive interpretation *Exp2 (n=41)* Negative interpretation	*Anxiety* 1)TAI-C 2)VAS *Interpretation bias* Ambiguous scenarios	1)Exp1 had reduction in anxiety 2) Exp1 had increases in positive interpretations[2]
Muris, et al., (2008)	Randomly allocated Two experimental groups	All anxiety	70 (49%)	10.03	1 session 1 day	Ambiguous scenarios	*Exp1 (n=36)* Positive interpretation *Exp2 (n=34)* Negative interpretation	*Anxiety* SCARED *Interpretation bias* Ambiguous scenarios	1)Anxious participants in Exp2 had increased threat interpretations[,] 2)At post, threat

	Double blind								perception was higher in Exp2 [3]
Muris, et al., (2009)	Randomly allocated Two experimental groups Double blind	All anxiety	120 (53%)	10.86	1 session 1 day	Ambiguous scenarios	*Exp1 (n=57)* Positive interpretation *Exp2 (n=63)* Negative interpretation	*Anxiety* SCARED *Interpretation bias* Ambiguous vignettes	1)Exp1 had an increase in positive interpretations, 2)Exp2 had increase in negative interpretations [2] 3)Reduction in anxiety correlated with reduction in negative interpretations
Salemink & Wiers (2011)	Randomly allocated Two experimental groups Single blind	High social anxiety	170 (47%)	14.5	1 session in 1 day	Ambiguous scenarios	*Exp1 (n=81)* Positive interpretation *Exp2 (n=77)* No bias	*Anxiety* STAI-C *Interpretation bias* Ambiguous scenarios	1)Exp2 interpreted new ambiguous situations more positively [3]
Salemink, et al., (2012)	Randomly allocated Two experimental groups Recruited from another study Single blind	High social anxiety	65 (38%)	14.5	1 session in 1 day	Ambiguous scenarios	*Exp1 (n=34)* Positive interpretation *Exp2 (n=31)* No bias	*Anxiety* STAI-C *Interpretation bias* Ambiguous scenarios	1) Exp1 and 2 had a reduction in threat-related interpretation bias, greatest reduction in Exp1 [2]

Standage, et al., (2010)	Randomly allocated Two experimental groups Single blind	All anxiety	30 (17%)	17.6	1 session in 1 day	Scrambled sentences	*Exp1 (n=15)* Positive interpretation *Exp2 (n=15)* Negative interpretation	*Anxiety* VAS *Interpretation bias* Scrambled sentences	1) Exp1 had lower anxiety than Exp2 at post-intervention 2)Exp1 made more positive interpretations [1]
Vassilopoulos, et al., (2009)	Randomised control trial Anxious control and intervention group Single blind	High social anxiety	43 (41%)	10.6	3 sessions in 1 week	*Exp* Ambiguous situation *Con* Time	*Exp (n=22)* Positive interpretation *Con (n=21)* None	*Anxiety* SASC-R *Interpretation bias* Ambiguous situations	1) Reduction in anxiety following intervention[2] 2)Reduction in negative interpretation for Exp[2] 3)Reduction in anxiety correlated with reduction in negative interpretation bias
Vassilopoulos, et al., (2012)	Random allocation Two experimental groups (visual or auditory focus for instructions) Single blind	All anxiety	94 (53%)	10.5	4 sessions in 3 weeks	Ambiguous scenarios	Reduce negative interpretation	*Anxiety* SASC-R *Interpretation bias* Ambiguous situations	1) Significant reduction in anxiety[1] 2) Reduction in negative interpretation[1] 3)Reduction in anxiety correlated with reduction in negative interpretation bias
					ABMT				
Bar-Haim	RCT	High anxiety	34	*Exp*	2 sessions	Spatial	*Exp (n=18)*	*Anxiety*	1) Reduction in

et al., (2011)	Active control		(29%)	10.2 (0.47) *Con* 10.0 (0.40)	in 4-6 days	cueing	Away from threat *Con (n=16)* No bias	1)TAIC 2)VAS *Attentional bias* Spatial cueing	anxiety for Exp and Con[1] 2)Facilitated disengagement from threat for Exp[2]
Cowart & Ollendick (2011)	Multiple baseline assessment Random number of baseline assessments	Clinical social anxiety	2 (100%)	Range 8-9	10 sessions in 5 weeks	Dot-probe	Away from threat	*Anxiety* 1)ADIS 2)SCAS *Attentional bias* Dot-probe paradigm	1)Subclinical levels of anxiety at post-intervention for both participants[,]
Eldar et al., (2008)	Random allocation Two experimental groups	Average anxiety	26 (69%)	*Exp1* 9.31 (1.52) *Exp2* 9.63 (1.81)	2 sessions in 6 days	Dot-probe	*Exp1 (n=13)* Towards threat *Exp2 (n=13)* Away from threat	*Anxiety* 1)STAIC 2)VAS *Attentional bias* Dot-probe task	1)Increased anxiety following stress induction for Exp1[4] 2)Development of an attentional bias towards threat for Exp1[2]
Eldar et al., (2012)	RCT Two active control groups Double blind	Clinical anxiety	40 (45%)	*Exp* 9.5 (1.5) *Con 1* 9.8 (2.0) *Con 2* 10.5 (2.0)	4 sessions in 1 week	Dot-probe	*Exp (n=15)* Away from threat *Con 1 (n=15)* No bias *Con 2 (n=10)* No threat stimuli	*Anxiety* 1)ADIS 2)SCARED *Attentional bias* Dot-probe task	1) Reduction in anxiety for all groups[1] 2)Reduced attention to threat for Exp[2]
Pitică, et	Case studies	High anxiety	4 (75%)	Range 10-12	5 sessions	Dot-probe	*Exp*	*Anxiety*	1) 2/4 participants

al., (2010)					in 1 week		Away from threat	SCAS *Attentional bias* Dot-probe task	had reductions in anxiety 2)Vigilance towards threat was reduced for 3/4 participants
Rozenman, et al., (2011)	Feasibility study Single blind	Clinical anxiety	16 (31%)	14.00 (2.66)	12 sessions in 4 weeks	Dot-probe	Away from threat	*Anxiety* 1)K-SADS-P 2)PARS 3)SCARED *Attentional bias* Dot-probe task	1)Reduced symptoms of anxiety for Exp[1].

[1] Significant within-group change at post-intervention (vs. pre-intervention).
[2] Difference between groups in change scores from pre-intervention to post-intervention (i.e., an interaction between group and time that favours the experimental compared with control group).
[3] Significant between-group differences at post-test
[4] Significant within-group change at follow-up (vs. pre-intervention).

ADIS= Anxiety Disorders Interview Schedule; **ASR**= Adult Self-report; **CASI**= Childhood Anxiety Severity Scale; **CCES=** Children's Cognitive Error Scale; **Con**= control group; **Exp**= Experimental group; **FSSC-R**= Fear Survey Schedule for Children – Revised; **K-SADS=** Schedule for Affective Disorders and Schizophrenia for School Age Children; **Kinder-DIPS**= Diagnostic Interview for Mental Health Disorders (in German); **KSCID=** Structured Clinical Interview for DSM-IV; **n/s=** not specified; **PANAS**= Positive and Negative Affect Scale; **PARS=** Paediatric Anxiety Rating Scale; **PDSS**= Panic Disorder Severity Scale; **RTs** = reaction times; **SASC-R=** Social Anxiety Scale for Children – Revised; **SCARED=** Screen for Child Anxiety Related Emotional Disorders; **SCAS=** Spence Children's Anxiety Scale; **SSS=** Subjective Symptoms Scale; **SAI=** State anxiety inventory; **STAI=** State trait anxiety inventory; **STAIC=** State-Trait Anxiety Inventory for Children; **TAIC=** Trait Anxiety Inventory for Children; **VAS=** Visual Analogue Scale.

Discussion

This review explored the efficacy of CBT, CBMI and ABMT interventions that aim to reduce symptoms of anxiety and alter attentional and/or interpretation biases. Current literature documents the impact of these therapies on anxiety, whilst the cognitive mechanism for change remains unclear. Theoretically, there is good reason to believe that CBT, CBMI and ABMT would be efficacious in reducing anxiety as these interventions aim to challenge or modify the atypical cognitions that are related to anxiety. Therefore, the changes in cognition induced by these therapies provide a plausible mechanism for reducing anxiety levels.

The current review consistently found that CBT interventions reduced anxiety levels. This effect was likely to be a product of the intervention (not time) because it was not observed in the control groups. This is consistent with existing research (e.g., Cartwright-Hatton, et al., 2004). Studies have found that the reduction in anxiety is sustained (and on some occasions further improved) three months following the intervention. Whilst the evidence in the review indicates that anxious individuals' anxiety levels reduced in response to CBT, their level of anxiety at post-intervention remained significantly higher than non-anxious individuals. This suggests that anxious individuals' anxiety levels declined in response to CBT intervention, but the intervention did not completely eliminate symptoms. There is evidence to suggest that CBT interventions also improved anxious individuals' interpretation bias (i.e., there were an increased number of positive interpretations of ambiguous scenarios) and one study identified increases in positive interpretation biases were associated with reductions in anxiety. Some literature has considered the changes in attentional biases that result from CBT, however the findings are contradictory. There was evidence to suggest that those who experienced a reduction in anxiety (following CBT intervention) could be identified by their attentional bias for threat prior to CBT, however the direction of this bias (towards or away from threat) appears contradictory. Few studies have considered the association between changes in anxiety and changes in attentional bias, the available literature does not suggest a strong association although these studies are based on small sample sizes.

Consistent with research on adult samples (e.g., Bowler, et al., 2012), the evidence from this review indicates that CBMI interventions effectively induced the intended

interpretation bias (positive or negative). The change in positive and negative interpretation biases induced by CBMI interventions was significantly greater than any observed change in the active control groups over the same time period. The studies found that the effect of CBMI on anxiety levels was not consistent; only some (4/10) studies documented that CBMI studies altered anxiety levels. For those studies which changes in anxiety were observed, the effect of CBMI on anxiety was a product of intervention (not time) as no significant changes in anxiety were observed for control groups. The inconsistent effect of CBMI on anxiety may be explained by the small effect size; this review and existing literature (e.g., Bowler, et al., 2012) highlights that CBMI has a small effect on anxiety, and therefore, the effect of CBMI on anxiety is unlikely to be found in studies with small sample sizes (Machin, Campbell, Tan, & Tan, 2011). To explore differences between two groups where α=.05, it is proposed almost 400 participants would be required to identify a small effect (Cohen, 1992). In this review, all except one study employed fewer than 100 participants; one study employed 120 participants. This may also explain the inconsistent associations between change in anxiety and change in interpretation biases over the course of the intervention. Studies that examined the association between change in anxiety and change in interpretation biases reported mixed findings; most of the studies report that reductions in negative interpretation biases were associated with reductions in anxiety whilst one reported no significant association. Studies have not considered the effects of CBMI on anxiety levels beyond one week after the intervention and therefore, it is not possible to comment on the longevity of these effects. In addition, studies have not explored the effect of CBMI interventions on attentional biases, prohibiting an understanding of the effect of change in interpretation bias on attentional biases.

The majority of research found that ABMT interventions induced attentional biases in the intended direction (towards or away from threat); this finding is consistent with existing reviews of ABMT (e.g., Hakamata, et al., 2010). There is also evidence to suggest that induced attentional biases were generalised to unfamiliar stimuli. Consistent with Hakamanta et al (2010), there was also some evidence to suggest that ABMT reduced anxiety levels when an attentional bias away from threat was induced. However, the evidence suggests that this effect was not sustained nine months after the intervention. Some evidence suggests that ABMT caused the greatest reduction in

anxiety for those with the highest levels of anxiety prior to intervention and this is likely to be because the highly anxious individuals had the greatest scope for improvement in symptoms. Some studies (2/3) also found a reduction in anxiety for the active control groups, indicating that the effect of ABMT might be a product of time rather than a consequence of the induced attentional bias. There was also evidence to suggest that increases in attentional biases towards threat (induced by ABMT) led to increases in anxiety (in response to a stressor). This suggests that ABMT (which induced an attentional bias) had effects beyond attention (i.e., it had broader effects on anxiety). However for ABMT designed to train attention away from threat, no associations between changes in attentional biases and changes in anxiety were observed. Research has not considered the effect of ABMT on interpretation biases, prohibiting an understanding of the relationship between changes in attentional biases and their effect on interpretation biases.

This review aimed to consider the effects of CBT, CBMI and ABMT on anxiety, attentional biases and interpretation biases. The evidence suggests that CBT significantly reduced anxiety, whereas the effects of CBMI and ABMT on anxiety were less consistent. This review aimed to explore whether attentional biases and/or interpretation biases play a causal role in changes in anxiety. Consistent with existing literature, attentional biases towards threat and negative interpretation biases were found to change in response to an intervention which aims to specifically target the bias; ABMT for attentional biases and CBMI for interpretation biases (Bowler, et al., 2012; Hakamata, et al., 2010). Furthermore, the evidence suggests that inducing attentional biases towards threat via training leads to an increase in anxiety levels, supporting the notion that attentional biases cause anxiety (Derakshan & Eysenck, 2009; Eysenck & Derakshan, 2011; Eysenck, et al., 2007). However, the review also found that inducing attentional biases away from threat via training does not consistently result in a decrease in anxiety levels, suggesting the relationship between anxiety and attentional biases may not be reciprocal (Crick & Dodge, 1994). The evidence for interpretation biases is also not clear and in contrast with the theoretical proposition that interpretation biases are a causal factor underlying anxiety (A. T. Beck & Clark, 1997; Crick & Dodge, 1994); changing an individual's interpretation bias does not consistently result in changes in anxiety.

The available evidence partially supports the notion that cognition is biased by anxiety (Crick & Dodge, 1994). There is some evidence to suggest that reductions in anxiety (induced by CBT) are associated with reductions in negative interpretation biases. This is consistent with the idea that anxiety is linked to biases in the interpretation stage of processing (Crick & Dodge, 1994). There is insufficient evidence to establish if encoding stages of processing (i.e., attentional biases) are biased by anxiety. Research in the field has explored the association between changes in anxiety (that result from CBT) and attentional biases at pre-test, however the relationship between changes in anxiety and changes in attentional bias has received limited consideration. This prevents an understanding of the hypothesised causal relationship between anxiety and attentional biases.

The available evidence also prohibits an understanding about whether attentional and interpretation stages of processing are reciprocally related. If we assume that changes in one stage of cognition are likely to affect changes in another, then changes in cognition (induced by CBMI or ABMT) should cause changes in their target areas of cognitive change (i.e., CBMI should change interpretation biases) and also changes in other areas of cognition (i.e., attentional biases). However, it is not possible to explore this association because existing research has not considered the relationship between inducing changes in one cognitive bias (i.e., attentional or interpretation) and the subsequent impact on the other areas of cognition.

Limitations and Future Research

Any positive findings should be viewed in light of a number of methodological limitations that could potentially have led to biases in the reporting of outcomes. In particular, no CBT studies randomly allocated anxious participants to intervention or wait-list control groups, making it unclear if changes at a group level were the product of the intervention or due to systematic differences between participants that influenced group allocation. Furthermore, few studies blinded participants and experimenter. The most stringent test of an improvement in symptoms of psychopathology is to consider whether it was reported by an individual who was blind to group assignment within a randomised design and were those rating the anxiety levels were blind to group assignment. There is limited information to identify the longevity of the effects of these

interventions; few studies considered the maintenance of anxiety reduction and/or changes in cognitive biases weeks or months following the intervention.

The findings from this review should be generalised with caution. Most CBT and ABMT studies selected participants based on predetermined characteristics (e.g., anxiety level and absence of a pervasive developmental disorder), whereas CBMI studies had liberal inclusion criteria (typically including all ranges of anxiety). Without further exploration of the effects of CBT and ABMT for these other populations, it is difficult to ascertain if the findings can be generalised more broadly. In addition, the effect of CBMI on individuals with high/clinical levels of anxiety should not be assumed to be the same as those with average anxiety and therefore this requires further research.

The quality assessment process highlighted a number of limitations that applied across all types of intervention. Details about the population from which participants were selected and participant's compliance to the treatment protocol were often not reported. This makes it difficult to ascertain whether those that were recruited into the study could be characterised in a way that made them distinguishable from those that were not recruited into the study (e.g., motivation, severity of symptoms, etc). It is also difficult to establish whether positive treatment effects indicate that the interventions would potentially be efficacious and suitable for the entire population of anxious individuals or whether the treatment effects are specific to a sub-population of motivated individuals. It is also unclear whether the studies were sufficiently powered to detect an effect since the studies rarely reported power calculations to determine an appropriate sample size.

The approach of this literature review also limits the conclusions that can be drawn. Firstly, this review considers only published studies in academic or professional journals, this increases the possibility of a publication bias in the results, which could lead to an inflated proportion of the studies showing positive treatment effects. Also, the review does not consider therapies focussing on alternative psychopathology (e.g., depression), whilst the two are highly comorbid, the effects on depression will require consideration elsewhere.

There are a number of important future directions that would be of interest in this area of research. Further research is necessary to allow a comprehensive understanding

of the effect of therapies on different stages of cognition. This research should consider the relationships between changes in all three outcomes; anxiety, attentional bias and interpretation bias. Most current research considers the effect of interventions on outcomes within the same stage of cognitive processing (e.g., the effect of ABMT on attentional biases). However, to allow an understanding of the reciprocal relationship between the different stages of cognition, intervention studies should consider the impact of intervention on different stages of cognition, specifically the impact of CBMI on attentional biases and ABMT on interpretational biases. Further research would benefit from considering the role of attentional control on attentional and interpretation stages of cognition as this may help to explain some inconsistencies in the literature. Further studies would also benefit from following up outcome measures weeks, months and/or years after the intervention to explore the longevity of effects.

Chapter 2: Exploring the Impact of Cognitive Behavioural Therapy on Symptoms of Psychopathology, Components of Attentional Biases and Attentional Control

Anxiety is one of the most common psychiatric mental health disorders (Green, et al., 2005), with between 2.5 and 5% of children having a diagnosis (Rapee, et al., 2009). Anxiety disorders are highly comorbid with other areas of psychopathology (Seligman & Ollendick, 1998) and they impair children's functioning more broadly; academic achievement (Woodward & Fergusson, 2001) and social functioning (Essau, et al., 2000). Anxiety disorders in childhood often persist into adulthood and can place children and adolescents at risk for other emotional disorders in adulthood, including depression (Last, Perrin, Hersen, & Kazdin, 1996). Researchers recognise that prevention and early intervention is fundamental for addressing elevated anxiety (Dadds, et al., 2000).

CBT is the non-pharmacological intervention of choice for anxiety disorders (National Insitiute of Mental Health, 2009). It focuses on eliciting and challenging individual's misinterpretations (Mobini & Grant, 2007). More specifically, CBT teaches skills relating to affect (e.g., recognition of physiological responses to emotions), cognition (e.g., identification and modification of maladaptive thoughts) and encourages gradual exposure to the feared situation or stimuli (Kingery, et al., 2006). There is substantial evidence supporting the use of CBT to reduce anxiety in children and young people (Bögels & Siqueland, 2006; Cartwright-Hatton, et al., 2004; Compton et al., 2004; In-Albon & Schneider, 2012; Ishikawa, et al., 2012; Legerstee, et al., 2010). Moreover, positive effects (i.e., reductions in anxiety) are sustained over time following intervention (Bögels & Siqueland, 2006; Ishikawa, et al., 2012; Rodgers & Dunsmuir, 2013). However, few of these studies recruit control groups, and if they do, the control groups tend to have typical levels of anxiety (e.g., In-Albon & Schneider, 2012). This is important as reductions in anxiety for highly anxious individuals may be a product of time, not intervention (Nauta, Scholing, Emmelkamp, & Minderaa, 2003). A review identified that the remission rate for anxiety in response to CBT intervention is greater (57%) than the remission rate for wait-list controls (35%; Cartwright-Hatton, et al., 2004), highlighting the efficacy of CBT but also the natural reduction in anxiety levels over time.

Although CBT is effective and commonly used to reduce anxiety, the precise mechanism of therapeutic change (understanding how the therapy works) or its broader benefits are unclear (Compton, et al., 2004). Understanding the mechanism of therapeutic change can allow a basis for maximising treatment effects and ensuring critical features of therapy are used in practice, thus improving outcomes for patients (Kazdin & Nock, 2003). Possible mechanisms of change can be identified from a range of approaches, including theoretical models.

Theoretical models of anxiety have focussed on attention as a factor that causes and maintains elevated levels of anxiety. Attentional Control Theory (ACT) proposed that anxiety is associated with impairments in attentional biases and attentional control (Eysenck & Derakshan, 2011; Eysenck, et al., 2007). According to ACT, anxious individuals have poor top-down control (i.e., attentional control) and show increased influence of the stimulus driven (i.e. bottom-up) attentional system. Poor attentional control is comprised of difficulties flexibly re-allocating attention (shifting), filtering out task irrelevant stimuli (inhibition) and monitoring information within working memory. In addition, poor attentional control is argued to persist in the absence of threat; anxious individuals attend to a broad range of stimuli in order to enhance threat detection. This imbalance of processing (poor attentional control and heightened stimulus driven cognition) is suggested to underpin anxious individual's attentional bias towards threat-related stimuli. Consistent with this proposition, several studies have found associations between anxiety and attentional biases. A growing body of research has found that threat-related attentional biases are specific to anxiety (Mogg & Bradley, 2005); most anxious individuals selectively attend towards threat-related information (Bar-Haim, et al. 2007; Cisler & Koster 2010; Waters, et al. 2012) and a some attend away from threat (Cowart & Ollendick, 2011; Legerstee, et al., 2010; Legerstee, et al., 2009; Waters, et al., 2012; Wiener, et al., 2012). Research has also found that elevated anxiety levels are associated with poor attentional control (Susa, Pitică, Benga, & Miclea, 2012); anxious individuals have difficulty shifting their attention (Goodwin & Sher, 1992; Olafsson, Smari, et al., 2011).

Several paradigms have been developed to explore selective attention to threat. For example, Koster, et al. (2006) measured anxiety levels and used the dot-probe paradigm to indicate the direction of participant's attention for threat. Participants were presented with threat-neutral trials (half congruent and half incongruent) and neutral-

neutral trials. Participant's vigilance and difficulties disengaging from threat were calculated. Vigilance for threat was calculated by subtracting RTs for neutral-neutral trials from RTs to respond to a probe when it replaces a threat stimulus in a threat-neutral trial (negative scores indicated a vigilance towards threat). Disengagement was calculated by subtracting RTs for neutral-neutral trials from RTs to respond to a probe when it replaces a neutral stimulus in threat-neutral trials (positive scores indicated difficulties disengaging from threat-related stimuli). They found some evidence for increased vigilance for threat and difficulties disengaging from threat for individuals with elevated levels of anxiety (compared to those with low anxiety).

Some researchers have explored the use of attentional biases prior to intervention to identify the efficacy of different treatment types. For example, Legerstee, et al (2010) found that anxious individuals with attentional biases towards threat are more likely to respond to individual CBT and individuals with attentional biases away from threat are more likely to respond to group CBT. Whilst this information suggests attentional biases at a single time point are associated with changes in anxiety, it does not allow an understanding of the changes between attentional processes and anxiety.

CBT interventions can also be used to explore the relationship between anxiety and attentional processes. As indicated in the literature, CBT interventions reduce highly anxious individual's anxiety levels. Typically, researchers obtain measures of anxiety before and after the intervention, by obtaining measures of attentional biases and attentional control at the same time points it will be possible to track changes in anxiety levels and the association with changes in attentional processes. This information will highlight whether attentional biases are variable depending on an individual's anxiety level, or if they are unchanged by alterations in emotional state. If attentional biases are found to be associated with changes in anxiety, they may be part of the mechanism of change for CBT.

Several studies have considered whether attentional biases can be changed via intervention studies. In-Albon and Schneider (2012), for example, assessed the changes in attentional biases that result from CBT intervention. They delivered 16 sessions of CBT to 31 clinically anxious children aged between eight and 13 years. The participant's attentional biases were measured using eye-tracking apparatus before and after CBT intervention. They found that after the intervention, anxious participant's

level of anxiety and attentional biases reduced to a level similar to non-anxious controls. However, Waters et al. (2008) used the dot-probe paradigm before and after CBT intervention with clinically anxious children aged between eight and 13 years. They found no significant changes in attentional biases (for happy or threat-related stimuli) compared to non-anxious controls.

Aims and Hypotheses

The aim of the current study was to use a randomised control design to explore the impact of intervention on anxiety symptoms and attentional biases to threat in an intervention group versus passive (anxious) control group. Because further research has found links between anxiety and attention more generally, the study also looked at whether a CBT intervention increases attentional control. The specificity of the intervention could not be assumed because it was a newly developed programme, therefore the impact of the intervention on symptoms of psychopathology more broadly (depression, anger, disruptive behaviour and self-concept) were also considered before and following CBT intervention. Before the intervention, it was hypothesised that high levels of anxiety would be associated with difficulties disengaging from threat, heightened vigilance towards threat and poor attentional control. The study looked at changes from pre-intervention to post-intervention and pre-intervention to follow up (10-12 weeks after the intervention). It was further hypothesised that reductions in anxiety would be associated with reductions in attentional biases for threat related stimuli and increases in attentional control. As poor attentional control is associated with increased biases towards threat, poor attentional control was expected to be associated with a high vigilance for threat and difficulties disengaging from threat.

Method

Design

This study used a time lagged design to compare changes across time. Children were randomly allocated to receive the CBT intervention (Group 1) or the wait-list control group (Group 2). The wait-list control group received the intervention after post-test assessment for the first intervention group and, as a second stage of analysis, their data was included with the intervention group in order to consider changes over time following CBT in the entire sample. There were two independent variables; the intervention and time. The intervention variable had two levels (CBT and no CBT) and time had four levels (baseline, pre-intervention, post-intervention and follow-up). There

was one primary outcome (anxiety) and two secondary outcomes (attentional control and attentional bias) and one collection of additional measures (broader symptoms of psychopathology).

Participants

Prior to the study, a power calculation using G*Power version 3 (Faul, Erdfelder, Lang, & Buchner, 2007) identified that this study needed to include at least 15 participants. This calculation was based on the assumption that the intervention will reduce anxiety levels and achieve an effect size at least as great as a similar intervention (Lyneham, Abbott, Wignall, & Rapee, 2003) which was delivered in the same school the year before this study (*d*=1.04), when anxiety was measured using the Spence Children's Anxiety Scale (Spence, 1998). The calculations are based on 95% power and 5% significance level.

To identify participants who were eligible for the intervention, year seven (N=187) and eight (N=181) students at a secondary school in England were screened using an online version of the Spence Children's Anxiety Scale (SCAS). All participants in the final sample satisfied the following criteria: (*i*) in year seven or eight; (*ii*) not receiving psychotherapy from another service; (*iii*) had school attendance above 85%; (*iv*) did not have a formal diagnosis of a pervasive developmental disorder. Information on the school records was used to determine participant's eligibility to be included in the study. Participants were not excluded because of levels of depression, behavioural difficulties, specific learning difficulties (e.g., reading difficulties) or intelligence. Of the 368 students in year seven and eight, 128 were excluded from the sample; 102 did not consent to completing the screening measure, 2 were in year nine, 9 were receiving psychotherapy from another service, 11 had attendance below 85% and 4 had a diagnosis of a pervasive developmental disorder. This resulted in a population of 240.

From the 240 students, the 16 most anxious students were selected. Student's total anxiety scores from the SCAS were summed and ranked. The parents of the 16 most anxious students were contacted by letter and telephone inviting their child to participate in the project. They were informed about the nature of the intervention, how their child was identified and that the intervention might benefit their child. The parents were also invited to contact the Educational Psychologist, via the school, with further questions. Where parental consent could not be obtained the next most anxious student

was invited to participate. Ten parents did not provide consent and, therefore, the final sample included the top 26 (/240) most anxious students from the population.

Five girls and 11 boys agreed to participate. Prior to completing the measures at T1, participants were briefed about the nature of the group, the content of the sessions and their right to withdraw at any point. All participants agreed to participate, they were aged between 11 years and 8 months and 13 years 4 months (M=12 years 6 months; SD= 7.08 months). The SCAS identified all participants had elevated (*t* score above 60) levels of anxiety. Two participants (one in the intervention group and one in the control group) had high scores (*t* scores above 70). The participant with high level anxiety in the control group, dropped out after session four of the intervention; therefore, his data formed part of the data set as a member of the control group but was not available for inclusion following intervention, see Table 2.

All participants received two vouchers for participation in the research. They received one voucher at the end of post-intervention measurements and one at the end of the follow-up measurements.

At the follow-up measurements participants were debriefed. They were told about the nature of the study, the reasons for each measurement and the questions the study hoped to explore. They were also given the opportunity to remove their data from the dataset, no participants opted for this.

Table 2

Sample Characteristics at Screening

	Group One	Group Two Waitlist	Group Two Intervention
Number of participants	8	8	7
Age Years: Months (SD)	12:9 (6.52)	12:2 (6.30)	12:2 (7.48)
Sex, N male	6	5	4
SCAS Mean Total Score (SD)	67.87 (3.60)	69.63 (12.57)	65.29 (2.93)
N with high levels of anxiety	1	1	0
N with elevated levels of anxiety	7	7	7

Note. SCAS=Spence Children's Anxiety Scale

The Intervention

The therapists followed a CBT programme developed by an Educational Psychology Service in England. This targeted programme was developed to meet a local need; to reduce demands on external services via early identification and intervention in school. The programme aimed to reduce anxiety levels for highly anxious students in year seven and eight of secondary school. The programme comprised of amended activities from existing evidence based CBT programmes (Barrett, 1998; Lyneham, et al., 2003), the activities and metaphors were amended to make them appropriate for teenagers in England. This programme consisted of: (*i*) building rapport; (*ii*) identifying emotions, thoughts related to behaviour and the inter-relationship between them; (*iii*) challenging negative thoughts; (*iv*) planning graded exposures to feared stimuli; (*v*) exploring self-presentation through body language; (*vi*) relaxation techniques; (see Table 3).

This method of intervention is a valid way to reduce highly anxious individual's anxiety levels. In the year prior to his research, the Educational Psychology Service employed a similar CBT programme (Lyneham, et al., 2003) and found that participant's anxiety levels (measured using the Spence Children's Anxiety Scale) significantly reduced over the intervention (from M=65.52, SD=9.46 to M=47.15, SD=16.29), $t(32)=5.99$, $p=.01$. Furthermore, participants with higher levels of anxiety prior to intervention had the greatest reduction in anxiety in response to the intervention; anxiety levels prior to the intervention significantly predicted the extent of

the change in anxiety levels, $F(1, 31)=6.01$, $p=.02$, $r^2=.40$, with higher scores predicting a greater reduction in anxiety.

Table 3
Components of the Intervention Organised by Session

Session Number	Content
1	Rapport building, setting the ground rules and an introduction to anxiety.
2	Identification of automatic and unhelpful thoughts. Relaxation task: Muscle relaxation
3	Introduction of critical thinking (considering the evidence for and against a thought). Relaxation task: Mindfulness
4	Re-visit individual critical thinking task and identification of personalised rewards. Relaxation: Guided visualisation
5	Design a stepladder to break down steps to overcome an anxiety provoking situation. Relaxation task: Breathing techniques
6	Development of personalised positive self-talk phrases. Relaxation: Mantra.
7	Role-play to act being passive, assertive and aggressive.
8	Review and recap the intervention content.

Each session lasted 1 hour. The sessions were delivered in school, during lesson time by an Educational Psychologist and a second year Trainee Educational Psychologist (the researcher). Both groups had a different Educational Psychologist assigned to deliver the intervention, the same Trainee Educational Psychologist supported both groups. One Educational Psychologist had a doctoral degree and had been practicing as an Educational Psychologist for 1 year 9 months at the time of the intervention. The other Educational Psychologist had a masters degree in Educational Psychology and had been practicing as an Educational Psychologist for 7 years and 9 months. Both Educational Psychologists delivering the programme were involved in the writing of the intervention programme and had delivered a similar intervention the year before. At the time of the intervention the Trainee Educational Psychologist was in the second year of a doctoral degree in Educational Psychology. The trainee assisted the delivery of the sessions and did not have an active role in the writing of the programme.

Programme adherence was checked by the researcher. A checklist of session content was completed at the end of the sessions. All of the sessions delivered the prescribed content.

Overall participants' attendance to the intervention sessions averaged 92.25% (M=7.38; SD=1.04). In Group 1, the attendance rate was 98.5%; one participant did not

attend one session. In Group 2, the attendance rate was 83.88%; three participants missed one session and two participants missed three sessions.

The intervention also included one parent session for each group between session four and six. The parental sessions were run by the Educational Psychologist and the Trainee Educational Psychologist. The session consisted of (*i*) an introduction from the psychologists; (*ii*) an outline of the purpose of the sessions and research; (*iii*) details of why/how their child was selected; (*iv*) a description of the content of the sessions; (*v*) an outline of the purpose of home tasks; (*vi*) an opportunity for parents to ask questions. Five parents from Group 1 and one parent from Group 2 attended the parent sessions.

Measures

Anxiety.

Spence Children's Anxiety Scale (Spence, 1998). This questionnaire is a reliable and valid measure of anxiety for children and adolescents (Spence, Barrett, & Turner, 2003). In this study the SCAS was used as a screening tool to identify participants based on their self-reported anxiety level. The measure consists of 44 items, 38 of which reflect specific symptoms of anxiety and the remainder are filler questions. Respondents were asked to rate the degree to which they experience each symptom; never, sometimes, often and always. Responses to the 38 specific symptoms questions were scored (ranging from 0 for never and 3 for always) and summed to give a total anxiety score (/114). Higher scores indicate a greater degree of anxiety. Subscales for types of anxiety can be calculated, however for the purposes of this study only the total anxiety score was calculated.

Beck Youth Inventories (BYI; J. S. Beck, Beck, & Jolly, 2005)[1]. These inventories were devised and used to measure children and adolescents self-report of psychopathology. The five inventories examine different areas of psychopathology (anxiety, depression, anger, disruptive behaviour and self-concept). Participants completed the inventories in a randomised order. Each inventory consisted of 20 questions. Respondents were asked to describe how frequently each item had been true

[1] The Spence Children's Anxiety Scale was not available for this research because it was collected by the Educational Psychology Service for their evaluation of the intervention.

for them during the past 2 weeks; never, sometimes, often, always. The participant's responses for each inventory were scored ranging from 0 (for never) to 3 (for always) and summed to give a total score (/60). Higher scores indicate a greater degree of psychopathology, except for the self-concept inventory where lower scores indicate a greater degree of psychopathology.

The BYI has good psychometric properties. It is a reliable and valid measure of psychopathology (J. S. Beck, et al., 2005; Steer, Kumar, Beck, & Beck, 2001). In this study each inventory had high consistency at Time 1; self-concept (α=.91), anxiety (α=0.90), depression (α=.90), anger (α=.92) and disruptive behaviour (α=.89).

Strengths and Difficulties Questionnaire – Parent (SDQ; Goodman, 2001). This measure was used to measure parental report of the effects of the CBT intervention on children's psychological attributes (including anxiety). The measure has good psychometric properties supporting its use (Goodman, 2001). The SDQ was designed for children aged four to 16 years and consists of 25 items. Respondents were asked to indicate if each item was not true, somewhat true or certainly true. The items were scored and summed for subscales of emotional symptoms (5 items), conduct problems (5 items), hyperactivity and inattention (5 items), peer relationship problems (5 items) and pro-social behaviour (5 items), with a maximum score of 10 for each subscale. The first four subscales were summed to give an overall difficulty score (/40). Higher scores indicate greater psychopathology for all subscale scores, except pro-social behaviour where lower scores indicate greater psychopathology.

Attentional bias.

Dot-probe task. This measured children's attentional bias for threat-related stimuli (angry faces) and pleasant stimuli (happy faces). Each trial consisted of the same sequence; a fixation cross for 500ms, two horizontally presented faces for 500ms, the probe until the participant responded and then a blank screen for 1000ms. The facial stimuli were expressions of angry, happy and neutral faces from the NimStim set of facial expressions (Tottenham et al., 2009). The pictures were 165x256 pixels in size and the probes were 8 pixels in diameter. The participants were asked to press the key corresponding to the orientation of the probe (horizontal or vertical dots). The orientation of response buttons was counterbalanced within groups across participants and alternated across time.

Participants completed 10 practice trials before the 120 experimental trials. Participant's RTs to press the keys were recorded for experimental items (not practice items). The experimental trials consisted of 24 trials with angry faces on the left and neutral faces on the right, 24 trials with angry faces on the right and neutral faces on the left, 24 neutral-neutral trials, 24 trials with happy faces on the left and neutral faces on the right, 24 trials with happy faces on the right and neutral faces on the left. The probe appeared in each location with equal frequency for each set of trials. Eight random sequences of the trials were created and these were randomly allocated to each participant at each time point. RTs were used to compute the components of the participant's attentional bias for both emotional valances (angry and happy). The components of selective attention (i.e., vigilance or disengagements to threat) were examined using RTs by incorporating neutral-neutral trials, as proposed by Koster, et al, (2004). Vigilance towards threat-related stimuli was calculated by subtracting neutral-neutral trials from congruent angry trials. Negative scores indicate a greater vigilance towards threat stimuli (compared to neutral-neutral stimuli) and positive scores indicate an avoidance of threat. Participant's difficulty to disengage from threat stimuli was calculated by subtracting neutral-neutral trials from incongruent angry trials. Positive scores indicated attention was directed towards the threat-related picture and indicated the participant has difficulties to disengage attention away from threat-related stimuli. The same calculations were conducted with happy stimuli to identify the participant's components of selective attention for positive emotion.

Attentional control.

Computerised Stroop task. This task was used to measure participant's ability to inhibit task related stimuli and focus on top-down processing. A computerised version of the Stroop task (Stroop, 1935) was used. The Stoop task is a valid and reliable test of inhibition (Friedman & Miyake, 2004) .

The computerised Stroop task consisted of trials with the following sequence; a fixation cross for 500ms, presentation of the stimulus until the participant responded and then a blank screen for 1000ms. Participants were instructed to respond by using one of four response keys to identify the printed colour of the word (yellow, green, red or blue). Four orientations of the response keys were created and randomly allocated within each group across participants and time. The participant's RTs to press the keys were recorded. Stimuli were font size 56.7pt in Times New Roman.

The task involved congruent, incongruent and neutral tasks. Congruent trials presented colour words in a consistent font colour (e.g., 'blue' printed in blue). Incongruent trials presented colour words in an inconsistent font colour (e.g., 'blue' printed in red). Neutral trials required the identification of the printed colour of crosses. Participants completed 12 practice trials and 108 experimental trials. The practice trials consisted of 4 congruent, 4 incongruent and 4 neutral trials. The experimental trials consisted of 36 congruent trials (4 stimuli repeated 9 times), 36 incongruent (12 stimuli repeated 3 times) and 36 neutral trials (18 stimuli repeated twice).

RTs were used to compute participant's attentional control. The mean RT for congruent trials was subtracted from the mean RT for incongruent trials to identify the Stroop effect. Greater scores indicate more difficulty inhibiting the incongruent information (i.e., poor attentional control).

Attentional Control Scale for Children (ACSC; Derryberry & Reed, 2002). This questionnaire was used to measure participant's general capacity to control attention (shifting and focussing). The items on the ACSC are equivalent to the Attention Control Scale (Derryberry & Reed, 2002), although the wording of the items has been altered to make it appropriate for use with children and adolescents. The ACSC is a 20 item self-report questionnaire with a maximum score of 80. Items were scored using a 4-point scale with participants indicating how often they experienced the descriptor; never, sometimes, often and always. The measure can be used to identify subscales of attentional focussing and shifting, however for the purposes of this study only the total score was calculated. A higher score indicates a greater level of attentional control. The ACSC is a reliable and valid measure of attentional control (Olafsson, Smári, et al., 2011), in this study the ACSC total score had good consistency at Time 1 (α=.74).

Procedure

Ethical approval and Research Governance was obtained from the University of Southampton, England. All students attended a state funded Secondary School in England. All parents of children in year seven and eight were sent a flyer about the screening and offered an opportunity to opt-out. No parents opted out of the screening. The screening took place over two consecutive days; seven weeks prior to the intervention for Group 1 and 15 weeks prior to the intervention for Group 2.

Selected participants were randomly allocated to one of two groups; the intervention (Group 1) or the wait-list control (Group 2). Group 1 completed pre-intervention measures between six and eight days prior to intervention (at Time 1; T1). They received the CBT programme over eight weeks and completed post-intervention measures five days after the intervention (at Time 2; T2). Follow-up measures were completed between 10 and 11 weeks after the intervention (at Time 3; T3). Group 2 completed baseline measures between eight and 10 weeks prior to intervention (at T1) and pre-intervention measures six to seven days prior to the intervention (at T2). Between baseline and pre-intervention measures, Group 2 received no intervention. After pre-intervention measures they received the intervention over nine weeks (one week of school holidays) and completed post-intervention measures one day after the intervention (at T3). Follow-up measures were completed between 11 and 12 weeks after the intervention (at Time 4; T4). Participants were fully debriefed at follow-up.

For Group 1, pre-intervention, post-intervention and follow-up measurements were collected at T1, T2 and T3 respectively. For Group 2, pre-intervention measures were taken at T2 (after the wait-list control), post-intervention measures at T3 and follow-up measures at T4. Table 4 illustrates the labels and use of measurements at each time point.

At each measurement point participants completed a number of measures. Participants completed the experimental measures first, then the questionnaires. The presentation of the experimental measures and questionnaires were randomised within groups, across participants and alternated across time. Participants completed the measures in randomly allocated pairs. The pairs were allocated within groups and remained the same for each time point. The researcher supervised the completion of the outcome measures with the participants, she was not blind to the purpose of the study, group allocation or the assessment time point.

Table 4

Timings of Measurements and the Corresponding Labels

Group	T1	T2	T3	T4
1	Pre	Post	Follow-up	-
2	Baseline	Pre	Post	Follow-up

Note. Post = Post-intervention. Pre= Pre-intervention. T1= Time 1. T2 = Time 2. T3= Time 3. T4= Time 4.

Results

Data Analysis.

Data from the SDQ was not interpreted because of a low response rate (see Appendix 3). Data for primary (anxiety), secondary (attentional control and attention to emotional stimuli) and additional measures (broader symptoms of psychopathology) were analysed using IBM SPSS 19.0 statistical software. Bonferroni corrections were used to account for multiple comparisons. Effect sizes were reported for statistically significant findings and those approaching statistical significance (McCartney & Rosenthal, 2000). In analyses where p>0.1, no *p*, *F* or *t* values are reported.

Data Cleaning.

For the dot-probe task, data was removed if a RT was less than 100ms (3.14%), the response was incorrect (7.29%) or the RT was greater than three standard deviations from the mean (for each participant at each time measurement for each trial condition and emotion; 1.38%).

For the Stroop task, data for one participant (in Group 1) was excluded due to self-reported colour blindness. Data was removed if the participant's RT for a trial was less than 100ms (0.57%), the response was incorrect (4.34%) or the RT was greater than three standard deviations from the mean (for each participant at each time measurement for each trial condition; 1.4%).

Performance at Time 1

Independent samples *t*-tests were used to explore group differences in primary, secondary and additional outcome measures at T1. Means, standard deviations and ranges for outcome measures are summarised in Table 5.

Anxiety. At T1, both groups had mean scores of anxiety within the moderately elevated range on the BYI. An examination of individual scores revealed that three

participants in Group 1 reported extremely elevated levels of anxiety (*t* score of 70+), three reported moderate levels of anxiety (*t* score between 60 and 69) and two reported average levels of anxiety (*t* score below 55). In Group 2, five participants reported moderate anxiety levels, one reported mildly elevated levels of anxiety (*t* score from 55 to 59) and two reported average levels of anxiety. There was a significant correlation between anxiety scores from the BYI and the SCAS (which was completed five weeks earlier for screening; r=.54, p=.02)[2]. The analysis identified no significant difference between groups in scores on the BYI (ns).

Attentional Bias. A 2 (emotion; happy, threat) x 2 (trial type; congruent, incongruent) ANOVA was used to understand basic task performance for the dot-probe task across participants at T1. The analysis identified a significant main effect of emotion ($F(1,15)=8.13$, $p=.012$, $\eta\rho^2=.35$) and no significant main effect of trial type (ns). Post hoc tests identified a significantly greater RT in trials containing threat-related stimuli (M=857.75; SD=174.70), compared to trials containing happy stimuli (M=807.71, SD=144.38). A significant interaction was found between emotion and trial type for the dot-probe task ($F(1,15) = 9.01$, $p=.009$, $\eta\rho^2=.38$). *T*-tests were used to explore this interaction, see Figure 1. Incongruent threat trials (M=888.54; SD=203.05) had significantly greater RTs than congruent threat trials (M=826.95; SD=140.78; $t(15)=2.44$, $p=.028$), indicating an attentional bias towards threat-related stimuli. Incongruent happy trials (M=788.94; SD=132.14) had significantly smaller RTs than congruent happy trials (M=826.49; SD=157.70; $t(15)=-2.20$, $p=.044$), suggesting an attentional bias away from happy stimuli. Incongruent happy trials had significantly smaller RTs than incongruent threat trials ($t(15)=-3.58$, $p=.003$), indicating the participants were looking at the threat-related stimuli for longer before responding to the probe (compared to happy stimuli). There were no significant differences between congruent happy trials and congruent angry trials (ns).

RTs for the dot-probe task were used to calculate the scores for the components of attentional bias (vigilance and disengagement; see method). An examination of individual bias scores at T1 identified that eight participants had negative vigilance bias

[2] Two participants were excluded from the SCAS and BYI anxiety correlation calculation to ensure data was normally distributed for the correlation. These participants were the two highest scorers at screening, but scored lower than the group on the BYI anxiety subscale at time one, this pattern placed them as outliers, see Appendix 4.

scores for threat-related stimuli (i.e., they were vigilant for threat) and 10 participants had positive disengagement bias scores for threat-related stimuli (i.e., they had difficulty disengaging from threat). Individual bias scores at T1 for happy stimuli identified that 10 participants had negative vigilance bias scores (i.e., they were vigilant for happy stimuli) and seven participants had positive disengagement bias scores (i.e., they had difficulty disengaging from happy stimuli).

Four *t*-tests were used to explore group differences in attentional bias scores (vigilance and disengagement with happy and threat-related stimuli) at T1. The tests identified no significant differences between the groups (ns).

Attentional Control. For the Stroop task, a repeated measures ANOVA was used to consider RTs to the three trial types (congruent, incongruent and neutral). It was expected that participants would have longer RTs for incongruent trials compared to neutral or congruent trials. The analysis revealed that RTs for trial types significantly differed ($F(1.10, 15.46)=7.99$, $p=.011$, $\eta\rho^2=.36$). Post hoc analyses showed that RTs for incongruent trials (M=963.11, SD=263.56) were significantly greater than RTs for congruent trials (M=827.75, SD=114.32; $p=.038$) and neutral trials (M=838.14, SD=138.33; $p=.035$), see Figure 2. This suggests that the participants took longer to respond to incongruent trials (compared to neutral and congruent trials) and indicates that these task irrelevant stimuli interfered with participant's task performance. No significant difference was found between congruent and neutral trials (ns).

RTs were used to calculate the Stroop effect (the mean RT for congruent trials was subtracted from the mean RT for incongruent trials). The analysis identified that there were no significant differences between the groups scores of Stroop effect (ns), indicating that the groups had comparable levels of attentional control at T1. Analysis of the ACSC identified that there was no significant difference between groups in the self-reported level of attentional control (ns)

Broader Symptoms of Psychopathology. The analysis identified no significant differences between the groups on the additional subscales of the BYI (ns), suggesting Group 1 and 2 had similar levels of self-concept, depression, anger, disruptive behaviour at T1. Examination of the participant's individual scores indentified that two participants reported extremely elevated levels of depression, eight reported moderate levels and six reported average levels at T1. Two participants reported elevated levels of anger, two reported moderate levels, two reported mild levels

and 10 reported average levels at T1. For disruptive behaviour, two participants reported moderately elevated levels and 14 reported average levels. For self-concept, two participants reported above average levels (*t* scores above 55), two participants reported average levels (*t* score between 45 and 55), one reported levels lower than average (*t* score between 40 and 45) and the remainder (11) reported self-concept levels much lower than the average (*t* score below 40).

Correlation Between Scores. All outcome measures were correlated using Pearson's *R* to establish associations between the primary, secondary and additional measures at T1. Pearson's *R* values are shown in Table 6.

Table 6 (and Figure 3) shows that participants with elevated levels of anxiety were more likely to avoid (i.e., be less vigilant toward) angry faces. There were no other links with anxiety and disengagement with threat or components of attentional biases for happy stimuli. Anxiety levels were negatively associated with self-reported attentional control (ACSC total score) and self-concept, indicating that lower levels of anxiety were linked to higher levels of attentional control and self-concept. Disengagement with threat was negatively correlated with ACSC total scores, indicating disengagement difficulties from threat were associated with low self-report of attentional control. High levels of anxiety were also associated with higher levels of depression and anger, and these areas of psychopathology correlated with each other, suggesting higher levels of self-reported psychopathology was associated with higher levels in other areas. All symptoms of psychopathology (except disruptive behaviour) negatively correlated with scores of self-concept, suggesting that young people who report high levels of psychopathology are also likely to report low self-concept. Depression and vigilance for threat positively correlated indicating high depression was associated with low vigilance for or avoidance of threat-related stimuli.

Table 5

Descriptive Statistics for Each Group Showing Anxiety Levels, Attentional Biases, Attentional Control and Broader Symptoms of Psychopathology at Time 1 and Time 2

Variable	Group 1 (N=8)						Group 2 (N=8)					
	T1			T2			T1			T2		
	M	(SD)	Range	M	SD	Range	M	(SD)	Range	M	(SD)	Range
Anxiety	28.00	(12.25)	37	24.00	(3.55)	11	24.63	(10.24)	30	19.25	(11.36)	36
Bias for threat												
Vigilance	-26.14	(94.52)	303.08	52.31	(115.49)	333.46	-7.88	(59.02)	167.39	17.91	(50.87)	166.61
Disengagement	27.87	(103.44)	299.13	14.09	(59.78)	182.55	61.30	(128.93)	406.92	51.24	(141.08)	466.53
Bias for happy												
Vigilance	-53.91	(99.03)	278.79	45.33	(132.86)	400.51	18.95	(90.29)	237.39	36.52	(82.30)	245.97
Disengagement	-71.02	(105.01)	251.82	39.87	(125.20)	437.44	-39.03	(72.61)	215.04	47.85	(172.92)	560.59
Attentional control												
Stroop effect	117.01	(191.72)	543.21	76.81	(88.45)	279.73	151.42	(187.67)	577.07	52.89	(40.45)	105.77
ACSC	45.50	(7.41)	23	47.25	(9.19)	29	49.25	(8.63)	27	45.38	(13.20)	41
Psychopathology												
Self-concept	30.63	(10.70)	32	36.38	(17.24)	42	30.88	(12.45)	37	35.25	(12.17)	34
Depression	24.25	(11.50)	36	25.25	(12.97)	40	17.75	(7.40)	21	14.63	(8.25)	26
Anger	24.75	(13.89)	43	23.88	(7.51)	20	17.25	(60.9)	17	16.00	(10.38)	30
Dis. behaviour	8.88	(7.72)	20	9.63	(5.61)	16	5.13	(3.44)	10	6.63	(7.42)	23

Note. ACSC = Attentional Control Scale for Children; T1 = Time 1; T2 = Time 2. Dis = Disruptive.

Figure 1

Bar Chart with Error Bars Illustrating the Reaction Times to Different Emotional Stimuli (Threat, Happy and Neutral) for Each Trial Type (Incongruent, Congruent and Neutral) at Time 1

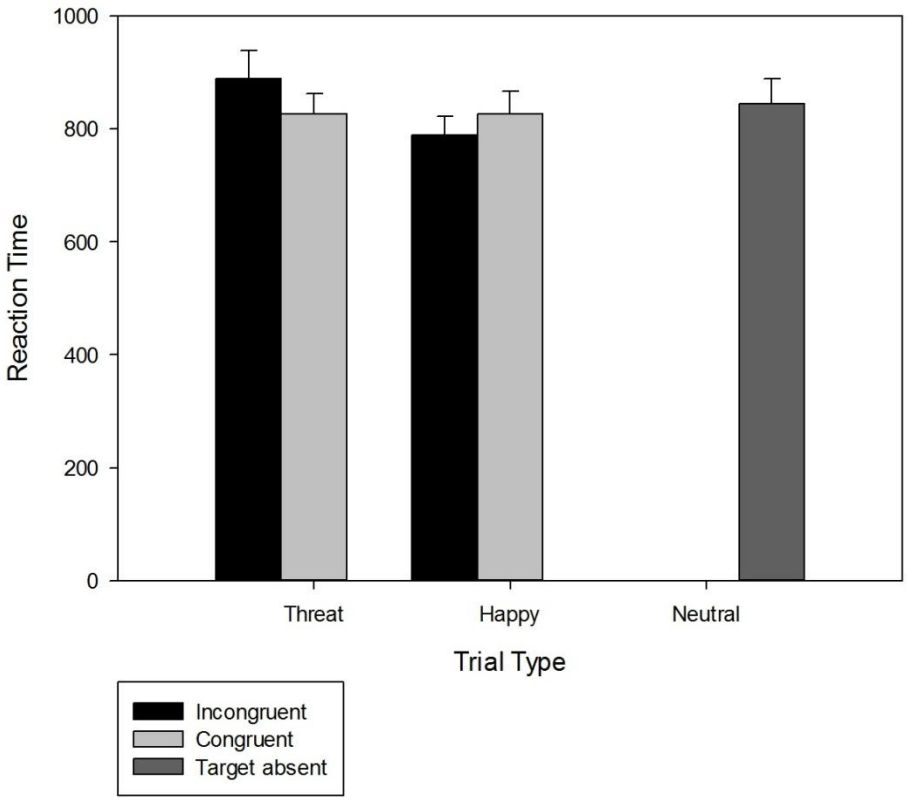


Figure 2

Bar Chart with Error Bars Illustrating the Mean Reaction Times to the Incongruent, Congruent and Neutral Stroop Trials at Time 1

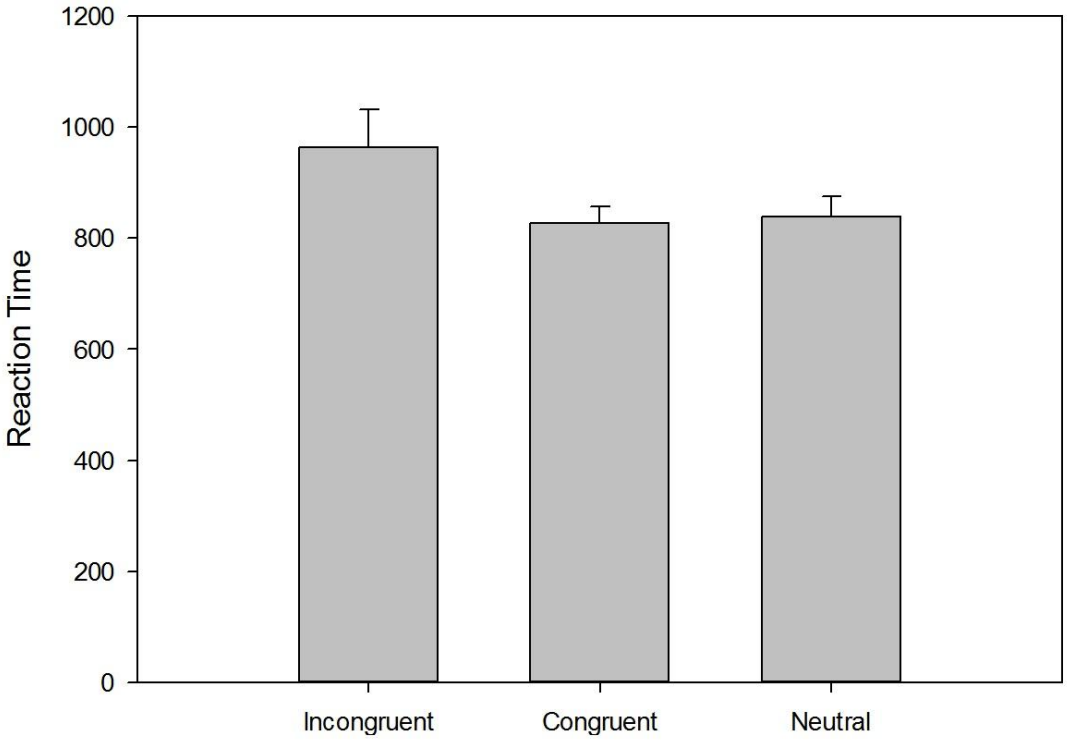


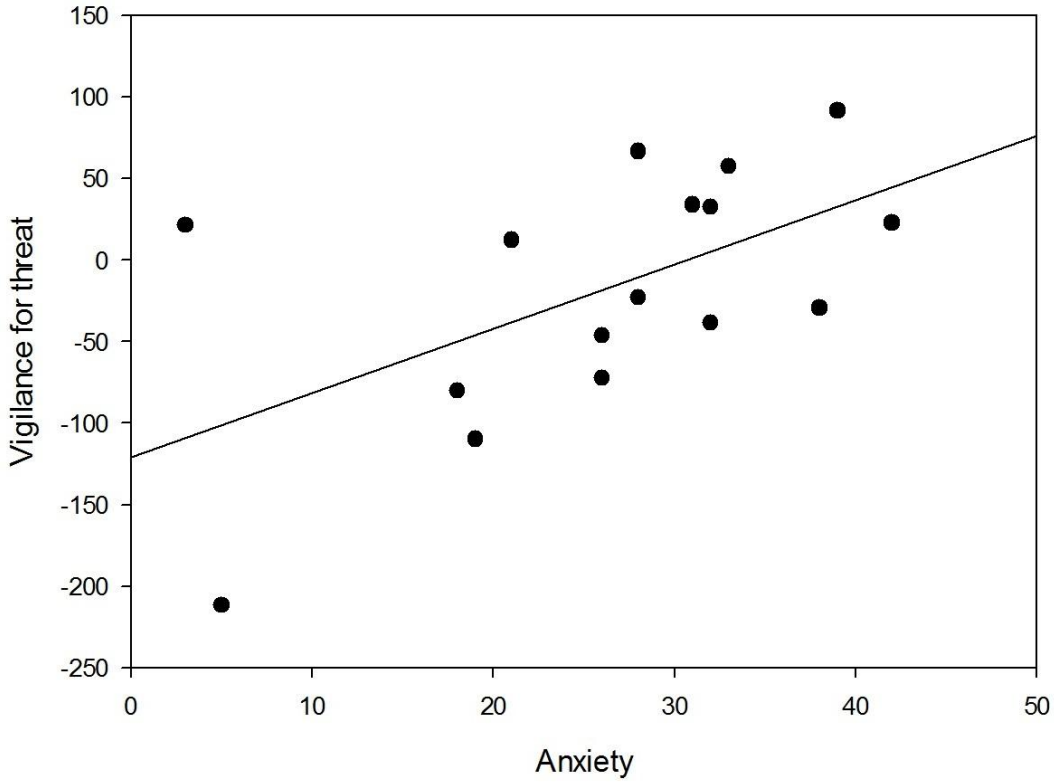
Table 6
Pearson's R *Values for Correlations Between Anxiety Levels, Attentional Biases, Attentional Control and Broader Symptoms of Psychopathology at Time 1*

	1	2	3	4	5	6	7	8	9	10	11
(1) Anxiety	1.00	.57*	.25	.24	.35	.07	-.61*	-.58*	.86**	.68**	.38
Bias for threat											
(2) Vigilance		1.00	.50*	.63**	.82**	.05	-.38	-.33	.54*	.35	.31
(3) Disengagement			1.00	.42	.42	-.33	-.47#	-.29	.25	.22	.16
Bias for happy											
(4) Vigilance				1.00	.74**	-.04	-.18	-.40	.29	.10	.04
(5) Disengagement					1.00	.01	-.14	-.37	.38	.12	.15
Attentional control											
(6) Stroop effect						1.00	-.04	-.18	.14	.02	-.08
(7) ACSC							1.00	.21	-.47#	-.18	.05
Broader symptoms of psychopathology											
(8) Self-concept								1.00	-70**	-.57*	-.36
(9) Depression									1.00	.86**	.62**
(10)Anger										1.00	.77**
(11) Disruptive Behaviour											1.00

**= p<.01; *=p<.05; #= p<.10; ACSC = Attentional Control Scale for Children. High anxiety score = greater level of anxiety. Low vigilance score = greater vigilance difficulties. High disengagement score = greater disengagement difficulties. High Stroop effect = more difficulty inhibiting task irrelevant stimuli. High ACSC score = greater attentional control. Low self-concept score = lower self-concept. High depression score = greater level of depression. High anger score = greater level of anger. High disruptive behaviour score = greater behavioural difficulties.

Figure 3

Scatter Plot with a Regression Line for the Correlation between Anxiety Levels and Vigilance for Threat



Between Group Comparisons of the Impact of the Intervention

In order to understand the impact of the intervention, analyses were carried out to explore change (from pre-intervention to post-intervention) in the primary, secondary and additional measures. A 2 group (1 and 2) x 2 time (pre-intervention and post-intervention) mixed ANOVA was used to compare changes in outcome measures between groups. The means and standard deviations for outcome measures across T1 and T2 are illustrated in Table 5.[3]

Anxiety. The analysis identified no significant effect of group (ns). The effect of time approached significance ($F(1,14)=4.32$, $p=.057$, $\eta\rho^2=.24$) and examination of the means (see Table 5) identified that anxiety declined over time. A non-significant interaction between group and time was found, see Figure 4 (ns).

Attentional Bias. Two 2 (group) x 2 (time) mixed ANOVAs were used to compare changes between groups in vigilance and disengagement for each emotion (happy and threat-related stimuli). The analysis of threat-related components of attentional bias identified no significant effect of group for vigilance or disengagement bias scores (ns), the same was found for the analysis of components of attentional biases of happy stimuli. No significant effect of time was found for disengagement with threat or vigilance for happy stimuli (ns). The effect of time on disengagement with happy stimuli was significant ($F(1,14)=5.43$, $p=.035$, $\eta\rho^2=.28$) and examination of the means identified an increase in bias scores for disengagement with happy stimuli from T1 to T2. This suggests participants experienced greater difficulty disengaging from happy stimuli at T2 (compared to T1). The effect of time approached significance for vigilance for threat-related stimuli ($F(1,14)=3.35$, $p=.088$). Exploration of the means identified an increase in threat vigilance scores from T1 to T2, indicating that

[3] A stepwise regression was conducted to explore whether measurements prior to intervention identified participants who experienced a change in anxiety levels in response to the intervention. For changes in anxiety from pre to post intervention, the participant's anxiety level prior to intervention was significantly associated with change in anxiety, $F(1,12)=11.89$, $p=.01$, $r^2=.50$; high anxiety predicted the greatest reduction in anxiety. For changes in anxiety from pre to follow-up, participant's anxiety level and self report of attentional control (Attentional Control Scale) predicted changes in anxiety, $F(2,11)=15.61$, $p=.01$, $r^2=.74$; high anxiety and poor attentional control predicted the greatest reduction in anxiety. Participant's vigilance for threat, disengagement with threat related stimuli and attentional control (measured by the Stroop task) prior to intervention did not predict changes in anxiety (ns).

participants became less vigilant over time. There was no significant interaction between group and time for either emotion type (ns)[4].

Attentional Control. Results revealed no significant changes in Stroop effect across time and between groups (ns). There was also no significant time by group interactions (ns) for the Stroop effect. There were no significant changes in total ACSC scores across time or between group, and no significant time by group interactions (ns).

Broader Symptoms of Psychopathology. The analysis identified no significant effects of group (ns). It identified a significant increase in participants' report of self-concept over time ($F(1,14)=7.72$, $p=.015$, $\eta\rho^2=.36$), indicating that both groups reported increased self-concept over time. There were no other significant differences in scores across time or group for the broader symptoms of psychopathology (ns). There were no significant interactions between scores across group and time (ns).

Within Group Comparisons of the Impact of Intervention. A repeated measures ANOVA was used to examine of the impact of intervention over time. In this analysis, the groups were collapsed for measurements taken at pre-intervention, post-intervention and follow-up (see method and Table 4). See Table 7 for means and standard deviation scores by outcome measure and pre-intervention, post-intervention and follow-up.

Anxiety. The analysis identified that there was a significant change in anxiety over time ($F(2,28)=10.14$, $p=.002$, $\eta\rho^2=.42$). Post hoc analyses identified a significant reduction in anxiety from pre-intervention to post-intervention ($p=.050$), pre-intervention to follow-up ($p=.002$) and post-intervention to follow-up ($p=.003$).

Attentional Bias. Four repeated measures ANOVAs identified no significant differences in components of attentional bias (vigilance and disengagement) for happy or threat-related stimuli across time (ns).

Attentional Control. Two repeated measures ANOVAs were used to explore differences in the Stroop effect and ACSC total scores across time. Analysis of the Stroop effect and ACSC revealed no significant change in attentional control across time (ns).

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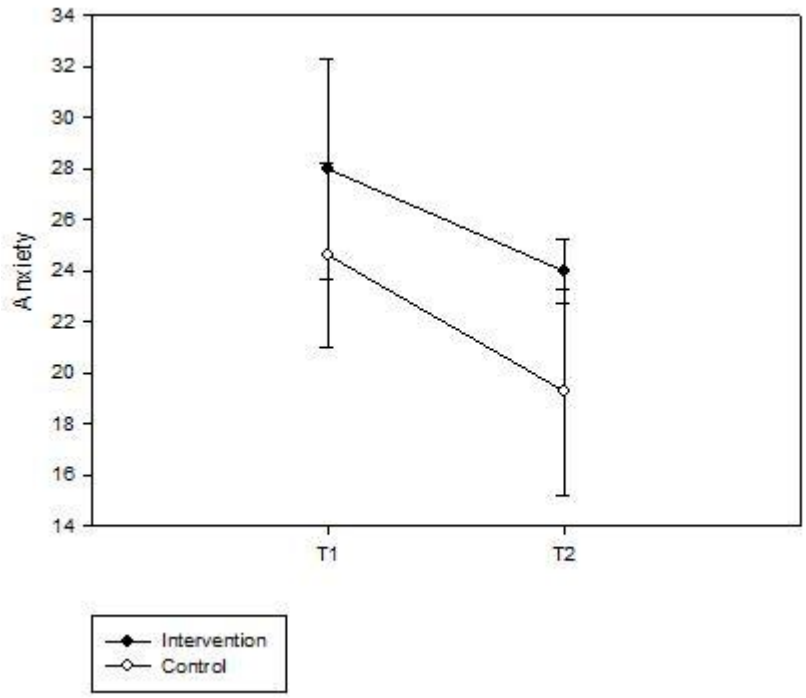
[4] Two 2(group) x 2(time) x 2 (emotional valance) mixed ANOVAs were used to compare differences in vigilance and disengagement with different emotional valances (happy and threat). No significant differences were found (ns).

Broader Symptoms of Psychopathology. Four repeated measures ANOVAs were used to explore differences in depression, anger, disruptive behaviour and self-concept over time. The analysis identified significant differences in anger over time ($F(2,26)=4.02$, $p=.029$, $\eta\rho^2=.22$). Post hoc analyses identified a decline in anger scores that approached significance from pre-intervention to follow-up ($p=.073$), no significant changes in anger scores were observed from pre-intervention to post-intervention or post-intervention to follow-up. This suggests the intervention improved participant's self-report of anger (to a non-significant level) and their self-report of anger continued to reduce after the intervention. No significant differences were identified in other areas of psychopathology across time (ns)

Figure 4

Line graph with Error Bars for the Difference in Anxiety Levels across Groups (Intervention and Control) and Time (Time 1 and Time 2)



Note. T1=Time 1; T2=Time 2; Intervention N=8; Control N=8.

Table 7

Means and Standard Deviations for Anxiety Levels, Attentional Biases, Attentional Control and Broader Symptoms of Psychopathology at Pre-Intervention, Post-Intervention and Follow-up.

Outcome	Pre (N=15)		Post (N=15)		FU (N=15)	
	M	(SD)	M	(SD)	M	(SD)
Anxiety	25.07	(11.22)	19.47	(8.29)	14.67	(7.81)
Bias for threat						
Vigilance	-4.68	(79.44)	56.34	(122.60)	26.72	(145.00)
Disengagement	41.65	(123.10)	18.49	(182.25)	23.47	(88.05)
Bias for happy						
Vigilance	-13.34	(101.40)	37.49	(107.92)	72.92	(124.82)
Disengagement	-15.92	(155.50)	13.27	(133.76)	51.26	(162.16)
Attentional control						
Stroop effect	85.14	(137.61)	102.72	(82.78)	82.05	(113.53)
ACSC	43.73	(8.05)	48.67	(9.19)	48.40	(7.39)
Broader psychopathology						
Self-concept	31.47	(10.02)	36.80	(14.70)	34.40	(12.79)
Depression	20.60	(10.17)	7.53	(13.96)	15.73	(11.10)
Anger	21.53	(12.21)	18.40	(9.55)	14.80	(9.11)
Disruptive behaviour	8.07	(7.55)	6.93	(5.44)	6.80	(3.76)

Note. ACSC, = Attentional Control Scale for Children; FU = Follow-up. Post= Post-intervention. Pre = Pre-intervention.

Correlations Between Change Scores. Change scores for outcome measures were calculated and correlated to understand whether changes in one measure were associated with change in other measures. For change scores from pre-intervention to post-intervention, means at pre-test were deducted from means at post-test. For change scores from pre-test to follow-up, means at pre-test were deducted from means at follow-up. For anxiety, positive change scores indicated an increase in anxiety over time, positive vigilance change scores identified a reduction in vigilance over time and positive disengagement change scores showed an increase in disengagement difficulties over time. For the Stroop effect, a positive score indicated increased difficulties inhibiting task irrelevant stimuli (i.e., a reduction in attentional control). Positive ACSC change scores indicated an increase in attentional control over time. Positive change scores for depression, anger and disruptive behaviour showed an increase in psychopathology over time, whereas for self-concept, positive change scores showed a reduction in self-concept. Pearson's R values were calculated to identify relationships in the change scores between the outcome variables.

Pre-intervention to post-intervention. Table 8 illustrates the correlations between change scores from pre-intervention to post-intervention. Changes in anxiety were associated changes in components of attention. Reductions in anxiety were associated with an increase in difficulties disengaging from threat. Changes in anxiety were not significantly associated with changes in vigilance for threat, attentional biases for happy stimuli or attentional control. Reductions in anxiety were associated with reductions in broader areas of psychopathology (depression and anger) and reductions in depression were associated with reductions in anger and reductions in anger were associated with reductions in disruptive behaviour , suggesting improvements in one area of psychopathology is associated with improvements in other areas. Changes in vigilance for threat and the Stroop effect were significantly correlated; reductions in vigilance for threat are associated with less difficulties disengaging from task irrelevant stimuli.

Pre-intervention to follow-up. Table 9 illustrates the correlations between change scores from pre-intervention to follow-up. Changes in anxiety were associated changes in components of attention; reductions in anxiety were associated with less difficulties disengaging from happy stimuli. Reductions in anxiety were also associated with reductions in depression. Changes in anxiety were not significantly associated with changes in components of attentional biases for threat or vigilance for happy stimuli.

Reductions in anxiety were associated with increased self-report of attentional control. Reductions in anxiety were associated with reductions in broader areas of psychopathology (depression and anger) and depression and anger scores significantly correlated.

Table 8

Pearson's R Values for Correlations Between Change Scores of Anxiety, Attentional Biases, Attentional Control and Broader Symptoms of Psychopathology (from Pre-Intervention to Post-Intervention)

	1	2	3	4	5	6	7	8	9	10	11
(1) Anxiety	1.00	.09	-.61*	.33	.42	-.04	-.30	-.16	.54*	.86**	.35
Bias for threat											
(2) Vigilance		1.00	.21	.63*	.79**	-.46#	.25	.15	-.09	.10	.02
(3) Disengagement			1.00	.01	.01	-.33	.26	.51#	-.49	-.59*	.12
Bias for happy											
(4) Vigilance				1.00	.65**	-.23	.15	.34	.21	.20	-.13
(5) Disengagement					1.00	-.39	-.04	.26	.28	.35	.03
Attentional control											
(6) Stroop effect						1.00	-.01	.20	-.01	-..6	-.20
(7) ACSC							1.00	.44	-.36	-.25	-.31
Broader symptoms of psychopathology											
(8) Self-concept								1.00	-.42	-.41	-.19
(9) Depression									1.00	.75**	-.26
(10) Anger										1.00	.49#
(11) Disruptive behaviour											1.00

Note. **= p<.01; *=p<.05; #=p<.01; ACSC, Attentional Control Scale for Children. Positive anxiety change scores = increase in anxiety. Positive vigilance change scores = reduction in vigilance. Positive disengagement change scores = increase in disengagement difficulties. Positive Stroop change score = increased difficulties inhibiting task irrelevant stimuli. Positive ACSC change scores = increase in attentional control. Positive change scores for depression, anger and disruptive behaviour = increase in psychopathology. Positive change scores for self-concept = reduction in self-concept.

Table 9

Pearson's R Values for Correlations Between Change Scores of Anxiety, Attentional Biases, Attentional Control and Broader Symptoms of Psychopathology (from Pre-Intervention to Follow-up)

	1	2	3	4	5	6	7	8	9	10	11
(1)Anxiety	1.00	.14	.16	.24	.48#	.05	-.51#	-.29	.83**	.76**	.34
Bias for threat											
(2)Vigilance		1.00	.69**	.50#	.30	-.59*	-.02	.36	.22	.10	.19
(3)Disengagement			1.00	-.08	-.17	-.61*	-.33	.18	.06	.15	.27
Bias for happy											
(4) Vigilance				1.00	.59*	-.22	.16	.46#	.36	.18	.05
(5) Disengagement					1.00	.35	.04	.09	.66**	.50#	.04
Attentional control											
(6) Stroop effect						1.00	.39	-.06	.02	.13	-.05
(7)ACSC							1.00	.51*	-.60*	-.39	-.25
Broader symptoms of psychopathology											
(8) Self-concept								1.00	-.31	-.31	-.32
(9) Depression									1.00	.81**	.35
(10) Anger										1.00	.55*
(11) Disruptive behaviour											1.00

Note. **= p<.01; *=p<.05; #=p<.01; ACSC, Attentional Control Scale for Children. Positive anxiety change scores = increase in anxiety. Positive vigilance change scores = reduction in vigilance. Positive disengagement change scores = increase in disengagement difficulties. Positive Stroop change score = increased difficulties inhibiting task irrelevant stimuli. Positive ACSC change scores = increase in attentional control. Positive change scores for depression, anger and disruptive behaviour = increase in psychopathology. Positive change scores for self-concept = reduction in self-concept.

Discussion

This study aimed to explore the impact of CBT intervention on changes in symptoms of anxiety, attentional biases and attentional control. Further exploratory analyses also consider whether the CBT intervention had broader benefits to reduce symptoms of psychopathology more widely (including anger, depression, disruptive behaviour and self-concept). Further analyses allowed a consideration of between group differences (intervention vs. wait-list control) at two time points for all measures. In addition, analyses allowed some consideration of within group differences at pre-intervention compared to post-intervention and at follow-up. The study also considered the associations between variables before the intervention and it investigated whether changes in key variables following the intervention were associated.

This study found that at a single time point prior to intervention (T1), anxiety levels and components of attentional processing were associated. Elevated levels of anxiety were associated with an avoidance of threat-related stimuli and low self-reported attentional control. High levels of anxiety were also associated with high levels of anger and depression, and low self-concept. Furthermore, low self-reported attentional control was associated with attentional biases (i.e. difficulties disengaging from threat-related stimuli).

Consideration of differences between the intervention and wait-list control group illustrated an effect of time, not intervention. Findings highlighted trend level reductions in self-reported anxiety over time, and this positive change was evident for both groups (intervention and control). The comparison also highlighted that over time participants had greater difficulty disengaging from happy stimuli, they tended to be less vigilant for threat and had an increased self-concept; these positive changes were evident for both groups.

Within group differences were identified over the course of the intervention. Comparisons between pre-intervention, post-intervention and follow-up identified that self-reported anxiety reduced over the course of the intervention and anxiety levels continued to decline following the intervention. In addition, participant's anger levels reduced from pre-intervention to follow-up.

Over time, reductions in anxiety were associated with changes in attentional biases, attentional control and broader areas of psychopathology. In the short-term

(over eight to nine weeks; from pre-intervention to post-intervention) reductions in anxiety were associated with an increase in difficulties disengaging from threat. This association was not sustained over the long-term (over 18 to 21 weeks; from pre-intervention to follow-up). In the long-term, reductions in anxiety were associated with a reduction in difficulties disengaging with threat and improvements in self-reported attentional control. In the short-term, improvements in the participant's inhibition of task irrelevant stimuli (i.e., greater attentional control) were associated with reductions in vigilance for threat from and this association was stronger over a longer duration (pre-measures to follow-up). Over the short and long-term, reductions in anxiety were associated with reductions in depression and anger.

The associations between outcome measures at a single time point were consistent with the notion that elevated levels of anxiety are associated with poor attentional control and attentional biases for threat (Eysenck & Derakshan, 2011; Eysenck, et al., 2007) and that attentional biases for threat-related stimuli are specific to anxiety disorders (Mogg & Bradley, 2005). Whilst the findings suggest that anxiety and attentional biases are associated, the direction of the attentional bias associated with high anxiety levels (i.e., avoidance of threat-related stimuli) contradicts the majority of existing literature based claims that anxious children have attentional biases towards threat (Bar-Haim, et al., 2007; Cisler & Koster, 2010; Waters, et al., 2008). This finding is consistent with a minority of studies which have identified that some anxious individuals have attentional biases away from threat (Cowart & Ollendick, 2011; Legerstee, et al., 2010; Legerstee, et al., 2009; Waters, et al., 2012; Wiener, et al., 2012). Consistent with existing literature, elevated levels of anxiety were also associated with low attentional control (Goodwin & Sher, 1992; Olafsson, Smari, et al., 2011; Susa, et al., 2012). Low levels of attentional control were also associated with greater difficulties disengaging from threat, supporting claims that poor top-down control of cognition is associated with attentional biases towards threat (Eysenck & Derakshan, 2011; Eysenck, et al., 2007). The associations between outcome measures at a single time point were also consistent with the notion that areas of psychopathology are highly comorbid (Seligman & Ollendick, 1998); elevated levels of anxiety were associated with high levels of anger and depression, and low self-concept.

Comparisons of differences between the intervention and wait-list control group showed no benefit of the intervention, but did highlight a significant effect of time; anxiety levels tended to reduce over time. This undermines the integrity of the effect of CBT on anxiety levels documented in existing literature (e.g., Bögels & Siqueland, 2006; In-Albon & Schneider, 2012; Ishikawa, et al., 2012). However, most of these studies did not utilise an anxious control group. This methodological limitation prohibits an understanding of the effect of time. It is possible that those with high anxiety levels have less stable anxiety levels which are likely to reduce over time. This proposition is supported by the findings of this study, the 35% remission rate for anxious control groups (Cartwright-Hatton, et al., 2004) and a minority of studies that document reductions in anxiety levels over time (e.g., Nauta, et al., 2003). The lack of group effect for intervention on anxiety levels may also be due to the attentional biases of participants and the intervention used in this study. In this study, high anxiety was associated with an attentional bias away from threat, and those with attentional biases away from threat are more likely to respond to individual CBT (Legerstee et al. 2010). Therefore, it is possible that this intervention was not suited to these individuals. The findings of this study also highlight that participant's vigilance for threat-related stimuli decreased over time. Research has found significant reductions in attentional biases towards threat for participants who responded (i.e. had a reduction in anxiety in response to) group CBT (In-Albon & Schneider, 2012). However, few studies in this area recruit a control group, thus prohibiting an understanding of the effect of time (e.g., Legerstee, et al., 2010; Legerstee, et al., 2009). In-Albon and Schneider (2012) recruited a non-anxious control group and found anxious participant's vigilance for threat reduced following CBT (compared to a non-anxious control group) and they did not find an effect of time. However, as with anxiety levels, it is possible anxious individual's attentional biases are not as stable as non-anxious individuals.

Comparisons between pre-intervention, post-intervention and follow-up support the notion that anxiety levels reduce over the course of CBT intervention (Bögels & Siqueland, 2006; Compton, et al., 2004; In-Albon & Schneider, 2012; Ishikawa, et al., 2012; Legerstee, et al., 2010; Waters, et al., 2012) and anxiety levels continue to decline following the intervention (Bögels & Siqueland, 2006; Ishikawa, et al., 2012; Rodgers

& Dunsmuir, 2013). However, the significant effect of time (highlighted by the comparisons between the intervention and control group) undermines this proposal.

Regardless of the mechanism of change for anxiety levels (time or intervention), changes in anxiety were associated with changes in attentional biases, attentional control and broader areas of psychopathology. These findings are broadly consistent with the proposition that increased levels of anxiety are the result of reduced top-down processing and increased bottom-up processing (Eysenck & Derakshan, 2011; Eysenck, et al., 2007). In the long-term, improvements in anxiety were associated with improvements in self-reported attentional control (i.e. top-down processing). This suggests that reductions in anxiety are associated with increases in attentional control, although the association requires time to develop to a significant level. This indicates that attentional control is not a static (trait) characteristic of anxious individuals and therefore although existing research indicates that high levels of anxiety are associated with poor attentional control (Goodwin & Sher, 1992; Olafsson, Smari, et al., 2011; Susa, et al., 2012) these characteristics are changeable. Furthermore, improvements in attentional control (Stroop effect) were associated with greater vigilance for threat-related stimuli, highlighting that an improvement in top-down processing is associated with reductions in bottom-up processing, as identified in ACT. The findings of this study suggest that reductions in anxiety were associated with improvements (i.e. reductions) in depression and anger levels, suggesting that changes in one area of psychopathology are associated with improvements in other areas of psychopathology.

Changes in attentional control did not concur across different methods of measurement. Significant changes in self-reported attentional control were found to correlate with changes in anxiety. However findings from the Stroop task were not associated with changes in anxiety or changes in self-reported attentional control. This suggests differences between self-reported attentional control (shifting and focussing) and experimental measures of inhibition of task-irrelevant stimuli.

Limitations and Future Research

The results of this study should be considered in light of a number of limitations. Whilst the power analysis identified the number of participants in this study was sufficient to identify the effect of CBT on anxiety, the limited number of participants may have led to insufficient power to detect the effect of CBT on attentional bias and/or

attentional control (which may have a smaller effect size) and thus resulted in type II error. The results of this study should also be generalised with caution due to the small sample size. This study is based on a sample of 16 (of the 26 most anxious) participants that consented to participate and it is possible that those who were recruited into the study could be characterised in a way that made them distinguishable from those that were not recruited into the study (e.g., motivation, severity of symptoms, etc). Also, reports of psychopathology were based on self-report and unable to be triangulated with parental report, therefore findings may not reflect other's perceptions (e.g., parents, school staff) of changes that result from the intervention.

Further research is necessary to consider how attentional processes change over the life course of anxiety and establish their malleability in response to intervention. Whilst this study documents changes in attention are associated with changes in anxiety, further research is necessary to explore if the findings are reliable and can be generalised across different populations. Future research should continue to explore the stability of anxious children's anxiety levels over time and intervention studies should maximise opportunities to employ anxious wait-list control groups. In addition, further research should consider differences and similarities between experimental and questionnaire based measures of attentional control.

Word count: 20,245

Appendices

Appendix 1

Two separate searches were conducted in each database: the first search was broad in scope and designed to detect the full range of relevant interventions; the second search was narrow in scope and designed to detect research with specific techniques or training programs that were known to the authors. Search terms were combined with either an **AND** or an **OR**.

Where possible, searches were restricted exclude published studies of adults (18+ years).

1. PsychInfo (via EBSCO; 1981-2012): The search results were filtered by age (childhood, birth – 12, and adolescence, 13-17), and source type (all journals only). The following terms were searched in the "all text" field.

Attention OR cognitive OR cognitive behaviour OR bias OR interpretation OR cognitive behaviour therapy* ***AND;***

Training OR intervention OR treatment OR therapy OR modification ***AND;***

Anxiety

The above search resulted in 2591 results.

2. Medline (via EBSCO): The search results were filtered by age (all child, 0-18) and published language (English only). The following terms were searched in the "all text" field.

Attention OR cognitive OR cognitive behaviour OR bias OR interpretation OR cognitive behavior therapy* ***AND;***

Training OR intervention OR treatment OR therapy OR modification ***AND;***

Anxiety

The above search produced 2875 results.

3. Embase (via Ovid; 1980-2012): The search results were filtered by publication type, only journal articles were selected.

Attention OR cognitive OR cognitive behaviour OR bias OR interpretation* ***AND;***

Training OR intervention OR treatment OR therapy OR modification ***AND;***

*Child OR adolescen** ***AND;***

Anxiety

The above search produced 4758 results.

4. Web of Science 1970-2012

Attention OR cognitive OR cognitive behavior OR cognitive behaviour OR bias OR interpretation* ***AND;***

Training OR intervention OR treatment OR therapy OR modification ***AND;***

*Child OR adolescen** ***AND;***

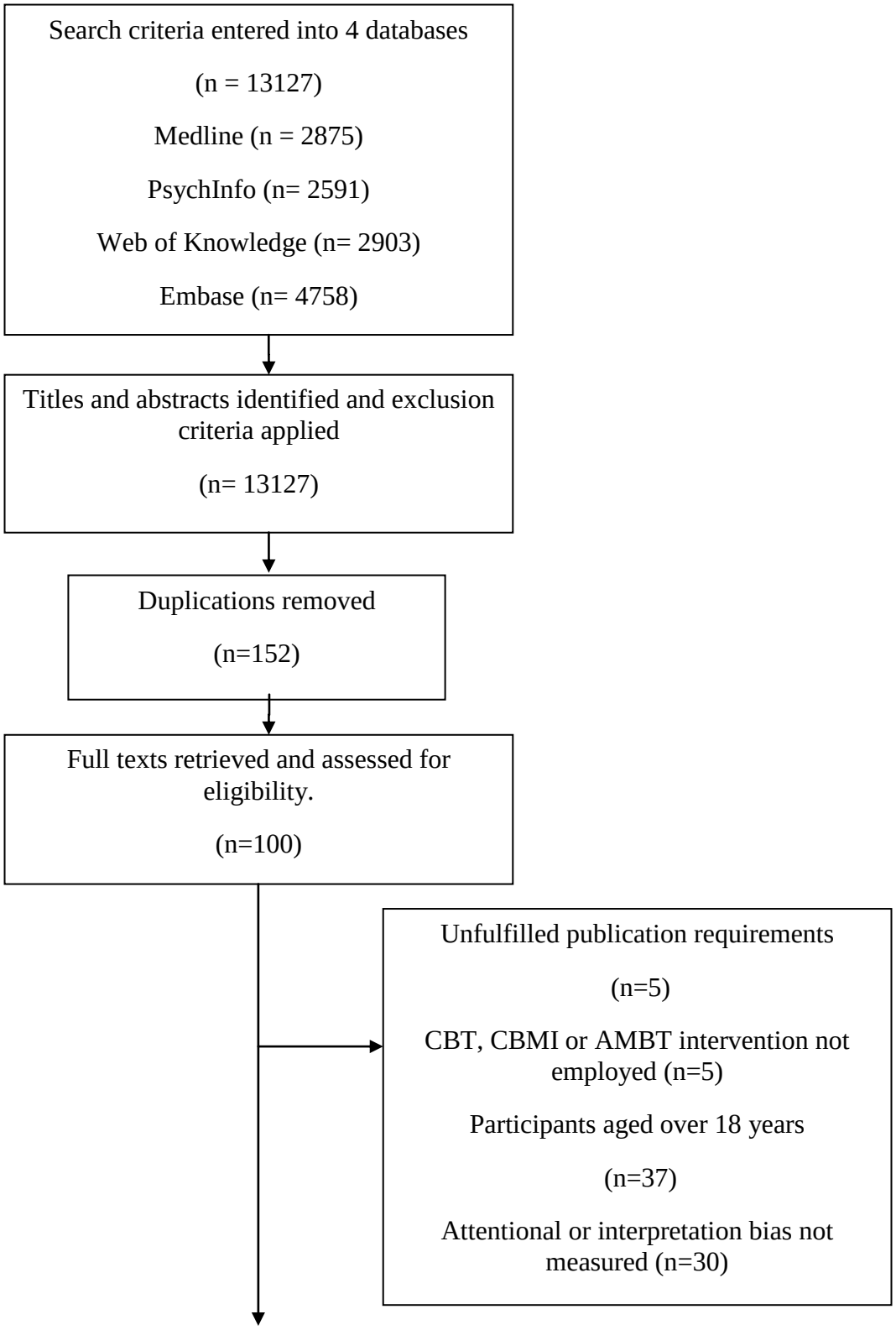
Anxiety

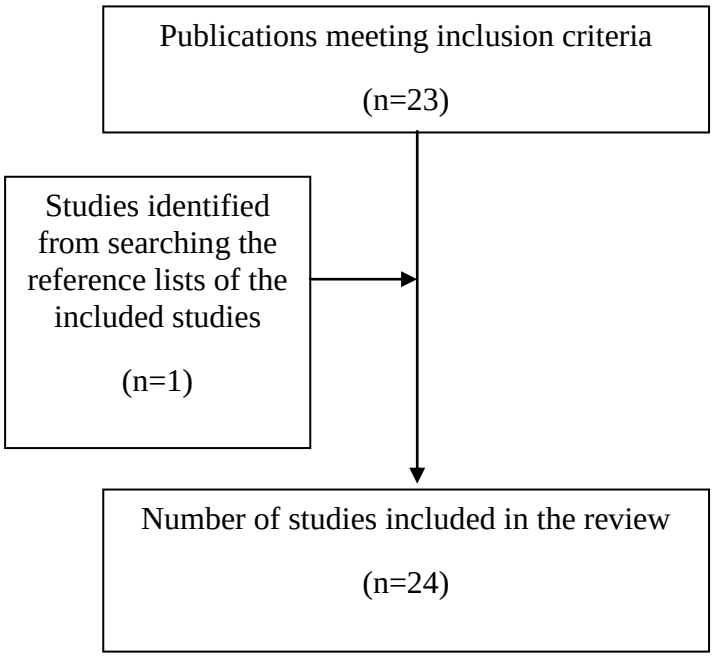
The above search produced 2903 results.

Appendix 2

Figure 5

Illustration of the Systematic Literature Review Paper Selection Process





Following the screening of titles and abstracts, 152 papers were identified as relevant and retrieved in full text. After reading titles, abstracts and full texts where necessary, 129 (/152) papers were excluded for the following reasons:

1. 52 were duplication of records.
2. 37 were based on data from adult participants.
3. 30 did not include outcome measures related to attentional or interpretation bias.
4. Five did not use CBT, CBMI or ABMT.
5. Five did not fulfil publication requirements.

Reference lists from the included studies were manually searched and one further study was included. Therefore, this review includes 24 studies.

Appendix 3

Table 10

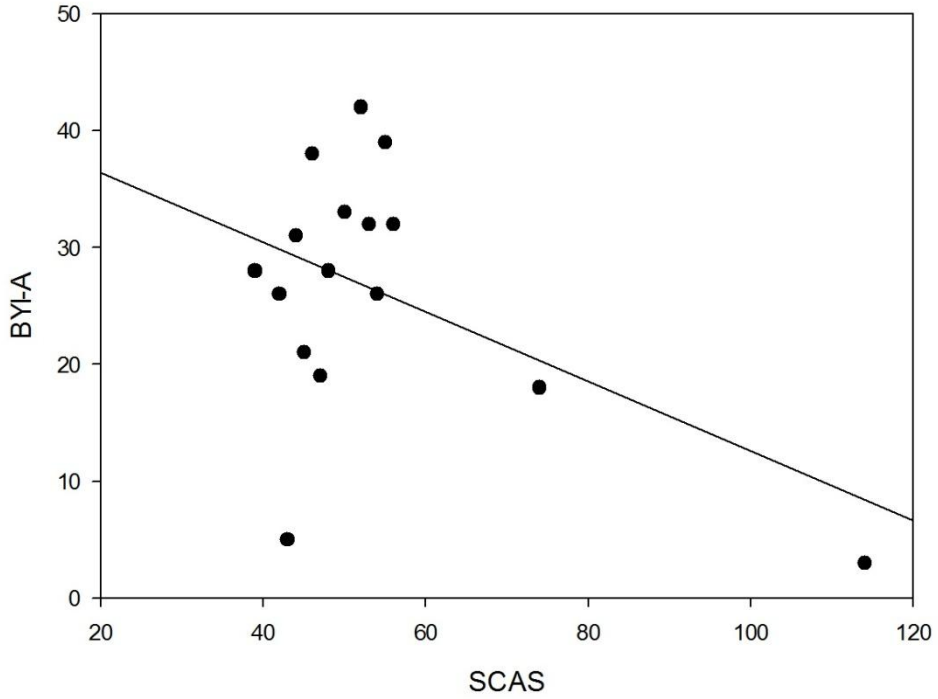
Parents report of Strengths and Difficulties Questionnaire Scores at Baseline, Pre-Intervention, Post-Intervention and Follow-up

Sub-scale	Group	Baseline		Pre		Post		Follow-up	
		M	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)
Proportion Completed	1	-		4/8		5/8		0/8	
	2	4/8		6/8		1/7		0/7	
Total Score	1	-		4.25	(1.71)	0.60	(0.55)	-	
	2	0.00	(0.00)	0.33	(0.52)	1.00		-	
Emotional Symptoms	1	-		6.00	(2.71)	3.20	(3.35)	-	
	2	4.25	(3.77)	2.67	(2.88)	0.00		-	
Conduct Problems	1	-		2.75	(3.40)	0.80	(1.10)	-	
	2	1.75	(1.71)	1.50	(1.38)	1.00		-	
Hyperactivity	1	-		4.50	(3.42)	1.00	(1.00)	-	
	2	3.50	(0.58)	3.17	(0.98)	3.00		-	
Peer Problems	1	-		5.75	(4.03)	3.00	(2.45)	-	
	2	2.00	(2.71)	2.00	(2.80)	6.00		-	
Pro-Social Behaviour	1	-		9.5	(1.00)	9.80	(0.45)	-	
	2	8.75	(1.26)	9.17	(1.60)	10.00		-	

Appendix 4

Figure 6

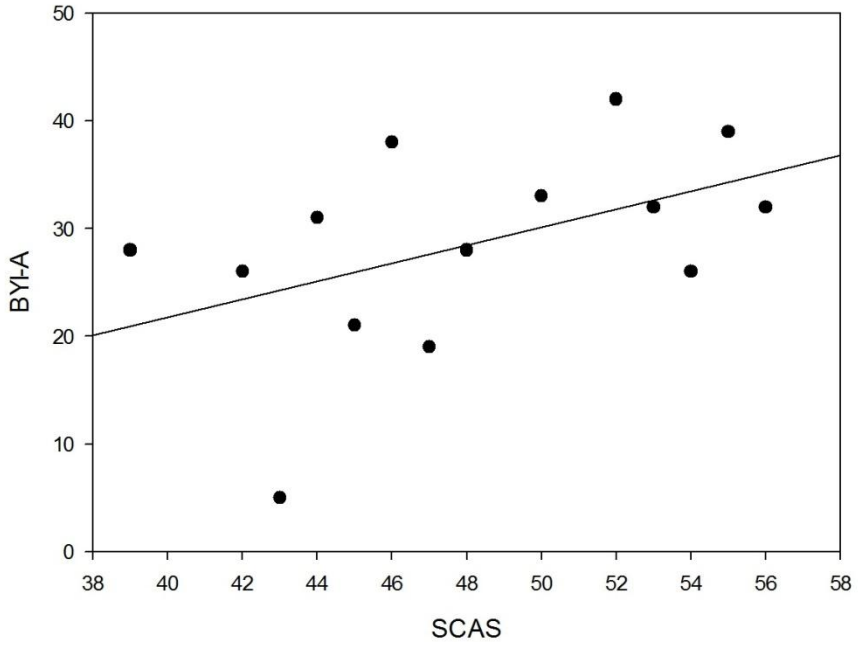
Scatter Plot with a Regression Line Illustrating the Correlation Between Anxiety Scores at Screening (Measured with the Spence Children's Anxiety Scale) and Anxiety Scores for all Participants at Time 1 (Measured with the Beck Youth Inventory for Anxiety)



Note. BYI-A = Beck Youth Inventory for Anxiety; SCAS = Spence Children's Anxiety Scale

Figure 7

Scatter Plot with a Regression Line Illustrating the Correlation Between Anxiety Scores at Screening (Measured with the Spence Children's Anxiety Scale) and Anxiety Scores at Time 1 (Measured with the Beck Youth Inventory for Anxiety) with Outliers Removed (N=2)



Note. BYI-A = Beck Youth Inventory for Anxiety; SCAS = Spence Children's Anxiety Scale

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