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A School-Based Comparison of Positive Search Training to Enhance Adaptive Attention Regulation with a Cognitive-Behavioural Intervention for Reducing Anxiety Symptoms in Children

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Abstract

Many children experience anxiety but have limited access to empirically-supported interventions. School-based interventions using brief, computer-assisted training provide a viable way of reaching children. Recent evidence suggests that computer-delivered 'positive search training' (PST) reduces anxiety in children. This multi-informant, randomised controlled trial compared classroom-based, computer-delivered PST ($N = 116$) to a classroom-based, therapist-delivered cognitive-behavioural intervention (CBI) ($N = 127$) and a curriculum-as-usual control condition (CAU) ($N = 60$) in 7–11 year old children. Primary outcomes were child and parent report of child anxiety symptoms. Secondary outcomes were child and parent report of child depressive symptoms and child attention biases. Outcomes were assessed before and after the interventions, and six- and 12-months post-intervention. Teacher report of children's social-emotional functioning was assessed at pre- and post-intervention. As expected, compared to CAU, children receiving PST and the CBI reported greater anxiety reductions by post-intervention and six-month follow-up but, unexpectedly, not at 12-month follow-up. Partially consistent with hypotheses, compared to CAU, parents reported greater anxiety reductions in children receiving PST, but not the CBI, at 12-month follow-up. Contrary to expectation, there was a pre- to post-intervention increase in threat attention bias in PST compared to the other conditions, with no significant differences at follow-up. In support of hypotheses, teachers reported higher post-intervention social-emotional functioning in Year 5 students receiving the CBI but, unexpectedly, lower post-intervention functioning in students receiving PST. There were no effects on depressive symptoms. Further research is needed on strategies to maintain long-term benefits and determine preventative versus early intervention effects.

Keywords Cognitive-behavioural therapy · Positive search training · Anxiety · Attention · Children

Introduction

Anxiety is among the most common mental health problems affecting children and adolescents (i.e., youth) (Costello et al. 2005). Given the debilitating concurrent consequences (Ezpeleta et al. 2001; Verduin and Kendall 2007; Essau et al. 2014) and negative impact on later functioning (Mendlowicz and Stein 2000; Pine et al. 1998), low cost interventions that can reach large numbers of children are vitally important. Cognitive-behavioural therapy (CBT) is the most effective psychological intervention for reducing anxiety symptoms in children (see Dowell et al. 2018) and has been implemented in universal, school-based trials given that schools are ideal settings for reaching many children in need (Owens and Murphy 2004). Most of these school-based CBT programs (e.g., Barrett et al. 2006; Essau et al. 2012; Waters et al. 2015a) are generally time- and resource-intensive interventions delivered over 8–16 weeks. However, effect sizes are often small (Werner-Seidler et al. 2017) and many children may be too young to fully benefit from the cognitive skills offered in CBT, especially when delivered in group-based classroom settings (Waters et al. 2009; Farrell et al. 2012).

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The application of a brief, computer-assisted intervention to children within school settings offers a potentially beneficial intervention approach to reducing anxiety symptoms in children that is low cost and easily implemented within classroom settings. One such approach, computer-based attention bias modification training (ABMT), was first developed based on experimental evidence that anxious adults tend to disproportionately direct their attention to threat-related stimuli relative to non-anxious peers (see Bar-Haim et al. 2007; Van Bockstaele et al. 2014 for reviews), although a recent review suggests that the evidence is inconsistent in anxious individuals (Mogg et al. 2017). The aim of the original version of ABMT was to train attention away from threat stimuli towards neutral stimuli (threat-avoidance training) to offset anxiety, often using adaptations of the visual probe paradigm (e.g., MacLeod et al. 2002). However, the evidence of anxiety-reducing effects of threat-avoidance training has been mixed for both anxious adults and children, with meta-analyses and systematic reviews raising questions about the consistency of its effects (Cristea et al. 2015a, b; Mogoase et al. 2014; Mogg et al. 2017). Moreover, preliminary evidence suggests that ABM-threat-avoidance training using the visual-probe task (combined with interpretative bias training) is ineffective in reducing anxiety in school settings (de Hullu et al. 2017; Sportel et al. 2013).

Positive-search-training (PST) was developed as an alternative attention regulation intervention. PST involves training individuals to preferentially focus attention on positive stimuli, while ignoring negative/threat stimuli, via computer-assisted programs. PST uses a visual-search task, which presents an array of pictures on each trial (e.g., 9 pictures arranged in a 3×3 array or 16 pictures in a 4×4 array). Participants are required to search for a positive/nonthreat target picture embedded among negative/threat distractor pictures (e.g., search for happy face in an angry crowd). Dandeneau et al. (2007) were among the first to train adult participants to search matrices for one smiling face embedded amongst disapproving faces. In the control condition, participants searched for a particular flower embedded among other flowers. Participants in the 'attention to positive' condition experienced significant reductions in physiological and self-reported stress responses, relative to participants in the control condition. This 'standard' version of PST using emotional faces has been employed in youth samples, and reductions in attention bias and anxiety have been observed in a small sample of non-clinical adolescents (i.e., participants were recruited from schools and were not selected on the basis of their anxiety scores) (De Voogd et al. 2014). In a subsequent school-based study using a larger sample of selected non-clinical adolescents, eight sessions of online standard PST reduced attention bias (assessed on a visual-search task), but not emotional symptoms, compared to the control-training condition (De Voogd et al. 2016). Furthermore, in another recent school-based study of adolescents with heightened symptoms of non-clinical anxiety or depression, attention bias to threat (assessed on a visual-search task) was reduced by standard PST compared to control-training and no-training conditions, with stronger attention effects for participants who completed more training sessions. However, there were no significant differences between training conditions in their effects on symptoms of anxiety and depression or emotional resilience, assessed up to 6 months later (De Voogd et al. 2017).

In contrast to these studies with selected non-clinical adolescent samples, three studies with clinical samples of anxious children between 7 and 12 years of age found positive effects on anxiety following differing types of PST. In one of these studies, Waters et al. (2013) found that significantly more clinically anxious children were diagnosis-free following 12 sessions of standard PST involving searching for a happy face among angry distracting faces, compared to control training (searching for a bird among flowers). In the two subsequent studies of enhanced PST, anxious children aged 7 to 12 years were explicitly told that the goal of training is to learn skills of increasing attention to positive and calm information, which can be used in challenging situations. Enhanced PST also included 1) multiple positive and calm/nonthreat target-pictures (e.g., children playing, book, armchair) and negative/threat distractor-pictures (e.g., hospital inpatient, aggressive dog, house on fire) to support generalization, 2) the encouragement of repeated self-verbalization of attention-search goals to consolidate learning (e.g., "look for good," "look for calm"), and 3) flexible switching between these goals across different blocks of trials (e.g., look for good in one block, look for calm in another block, and then look for both good and calm cues in a subsequent block of trials; with picture arrays varying in size, number of targets and distracters, and spacing of stimuli across trial blocks) (Waters et al. 2015c, 2016). Significantly more anxious children were diagnosis-free following home-delivered enhanced PST, compared to a waitlist control, at post-treatment and 6- and 12-month follow-up assessments. The intervention was also rated positively by parents and children in terms of learning and satisfaction. Thus, enhanced PST, which explicitly promotes goal-directed attention strategies of focusing on adaptive, positively-oriented stimuli, whilst inhibiting attention to threat distractors, may be a promising computer-assisted intervention for application within the school setting. Moreover, of school-based interventions trialled to date, as cognitive-behavioural programs, but not ABM-threat avoidance training, have been found to be modestly effective (de Hullu et al. 2017; Werner-Seidler et al. 2017), it is also important to determine PST's efficacy relative to cognitive-behavioural interventions given the potential for PST to be time and resource efficient.

Therefore, the broad aim of the present study was to compare classroom-based, enhanced PST (delivered on laptops without therapist assistance) relative to a classroom-based, manualised cognitive-behavioural intervention (CBI; delivered by a clinical psychologist trained in cognitive behavioural therapy) and a curriculum-as-usual (CAU) control condition. Based on the available evidence to date from studies of PST to treat anxious children (Waters et al. 2013, 2015c, 2016) and school-based studies of CBIs (Werner-Seidler et al. 2017), the main hypothesis was that computer-delivered, enhanced PST and a clinician-delivered CBI would be more effective in reducing children's self-reported and parent-reported anxiety symptoms (primary outcomes) compared to the CAU condition and that these improvements would be found at (i) post-intervention, (ii) 6-month follow-up and (iii) 12-month follow-up, relative to pre-intervention (i.e., short-, medium- and long-term intervention effects). The impact of PST and CBI on children's self-reported and parent-reported depression symptoms and attention bias for emotional faces, as well as teacher-reported child socio-emotional functioning from pre- to post-intervention only, were also examined (secondary outcomes). It was hypothesized that PST and CBI would produce greater declines in child depressive symptoms, as well as greater improvements in teacher report of social-emotional functioning and greater changes in attention biases for emotional stimuli, relative to the CAU condition, with these changes evident at (i) post-intervention, (ii) 6-month and (iii) 12-month follow-up, each relative to pre-intervention. Additional analyses also examined whether changes in anxiety symptoms during the interventions were associated with changes in orienting attention to threat, which would be expected if threat attention bias plays a contributory role in causing and maintaining anxiety symptoms (MacLeod and Clarke 2015).

Method

Participants

Participants were 303 of 405 school children (75% participation rate) in Years 3, 4, and 5 at a local primary school (see CONSORT diagram in Fig. 1). Participating children were

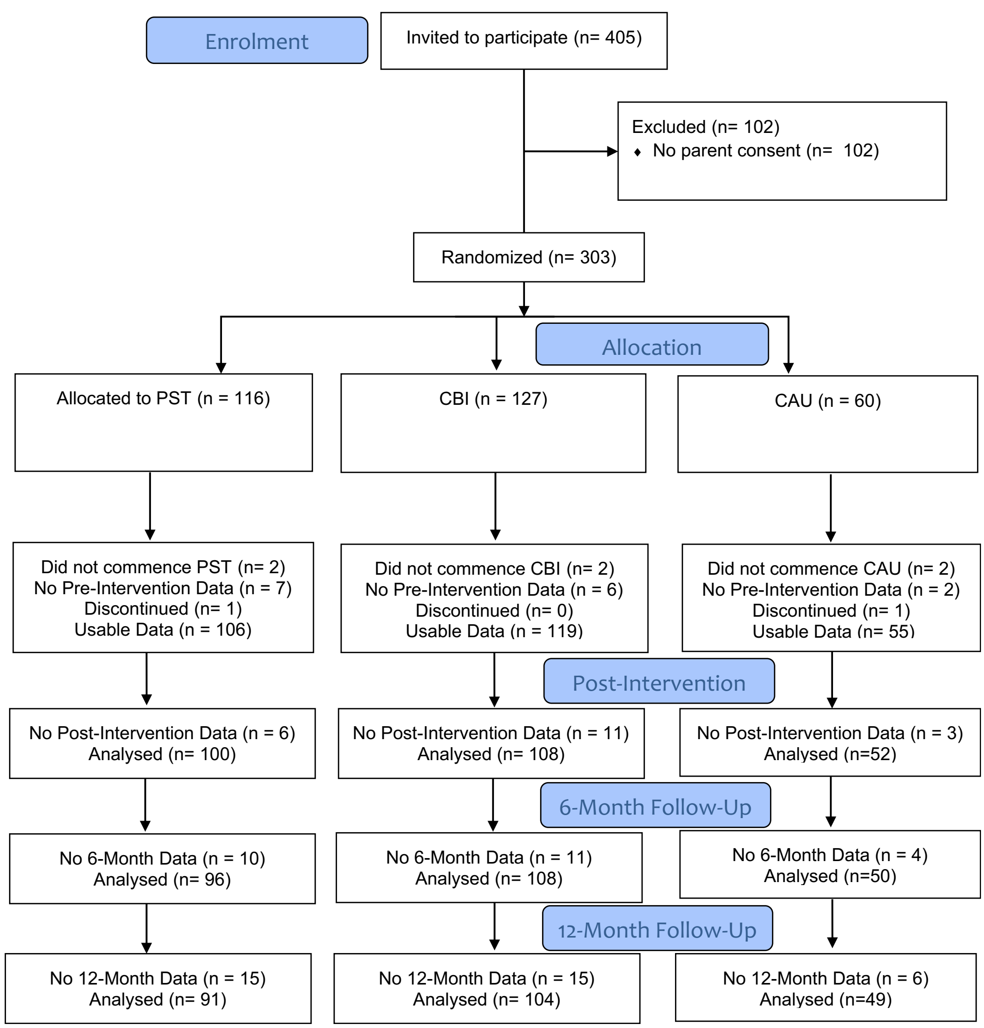

Fig. 1 CONSORT flow diagram of participants through the study (based on child outcome measures: SCAS_C; SMFQ_C; attention bias data)

between 7 and 11 years of age (Mean = 9.1, SD = 1.0) (156 male; 147 female), more than 89% were born in Australia, while the remainder of children were born in New Zealand, Asia and Europe. More than 86% of children lived with parents who were married, 6% had parents who were divorced, and 8% had parents who were either separated, widowed, living in de facto arrangements or never married. More than 76% of mothers and 88% of fathers were employed in the workforce.

Children were in 15 classrooms: 5 from each of Years (i.e., Grades) 3, 4, and 5. Classrooms were randomly assigned to one of three conditions (PST; CBI; CAU) within each year with the exception of the CAU which was absent for Year 4 (see below). The number of classrooms per condition were Year 3 (PST = 1; CBI = 2; CAU = 2), Year 4 (PST = 3; CBI = 2), and Year 5 (PST = 2; CBI = 2; CAU = 1). The number of children in each classroom with parental consent to participate ranged from 13 to 27 (Mean = 20.2 children). The total numbers of allocated participants for PST, CBI, and CAU were 116 (59 boys; 57 girls), 127 (65 boys; 62 girls), and 60 (29 boys; 31 girls), respectively. Parents and teachers also completed questionnaires, with sample sizes of 95 for PST, 107 for CBI, and 47 for CAU for parent report and 106 for PST, 118 for CBI, and 54 for CAU for teacher report.

Measures

Primary Outcome Measures: Anxiety Symptoms The Spence Children's Anxiety Scale, Child and Parent version (SCAS-C & SCAS-P, respectively; Spence 1998) are 39-item (parent report measure) and 45-item (child self-report measure; 6 positive filler items) measures with 4 response options for each item (0 = never true to 3 = always true). Items are summed to yield total scores reflecting symptom severity, and the measures possess sound psychometric properties. Mean SCAS-P total scores of 14.2 and 31.8, and mean SCAS-C total scores of 18.8 and 32.2 are reported for non-clinical and clinically-anxious children, respectively (Nauta et al. 2004; Spence 1998). The SCAS-P and SCAS-C were completed at pre- and post-intervention and at 6- and 12-month follow-up assessments. Cronbach's α ranged between 0.83 and 0.92 across time-points.

Secondary Outcome Measure: Depressive Symptoms The Short Mood and Feelings Questionnaire, Parent and Child versions (SMFQ-P and SMFQ-C, respectively; Angold et al. 1995) were used to assess children's depressive symptoms. Both versions of the SMFQ comprise 13 items which ask the respondent to rate the child's feelings and actions (0 = not true; 1 = sometimes true; 2 = always true) over the preceding two-week period. A score of 8 or more is considered significant (Angold et al. 1995). The SMFQ-P and SMFQ-C were completed at pre- and post- intervention and at 6- and 12-month follow-up assessments. Cronbach's α ranged between 0.84 and 0.90 across time-points.

Secondary Outcome Measure: Attention Bias The visual probe task was used to assess attention bias for threat (angry) and positive faces. It was programmed in Java and presented on school laptops with 16 in. colour monitors and students completed the task as a group within their classrooms. Briefly, the task stimuli included grey-scaled photographs of 64 pairs of faces (half adult male, half adult female), each face pair was the same person and each photograph illustrated an emotional expression (happy, angry, and neutral). The task consisted of 80 trials, 32 trials were happy-neutral face pairs and 32 trials were angry-neutral face pairs, and 16 trials comprised of neutral-neutral face pairs. The facial stimuli were the same as those utilised in prior paediatric studies (e.g. Monk et al. 2006; Pine et al. 2005; Waters et al. 2008a, b; Waters et al. 2012).

Each trial began with a fixation cross presented in the centre of the screen for 500 ms, which was followed by the presentation of a face pair for 500 ms. The face-pair was replaced with an asterisk (probe) for 1100 ms in the spatial location previously occupied by one of the faces. For emotional face trials (i.e. angry – neutral, happy – neutral pairs), the emotional face and the asterisk were presented equally on the left or right side of the screen, therefore for half of the trials, the probe was presented in the same spatial location as the emotional face (congruent trials), and for the other half of the trials the probe was presented in the opposite spatial location as the emotional face (incongruent trials). Participants were required to immediately, and as accurately as possible, indicate the spatial location of the probe (left or right) using the corresponding computer keys. The task began with 10 practice trials, followed by one block of 80 trials.

Secondary Outcome Measure: Socioemotional Functioning at School Teachers completed 8 items to evaluate to what extent each statement related to each child being assessed. Items related to the extent to which (1) the child felt good about themselves, (2) had a negative way of looking at things, (3) wanted to play and interact with other children, (4) was anxious or worried about things, (5) was picked on by other children, (6) was sad or depressed, (7), had a positive outlook on things, (8) was engaged in school and learning. Response options ranged from 0 (not at all true) to 3 (always true). Items were reverse scored as required and summed with higher scores indicating higher teacher reports of student well-being. Cronbach's α was 0.72 at pre- and 0.75 at post-intervention.

Teacher Evaluations of the Programs

A customised 8-item teacher evaluation of the program condition assigned to their class was completed by teachers at the end of the two programs. The items asked teachers to evaluate (1) how engaged the class was in the program, (2) how enthusiastic the class was about completing the program, (3) how well the class concentrated on the tasks at hand during the program, (4) how much the class enjoyed the program, (5) how effective they considered the program to be, (6) how applicable the program was for a wide range of children in their classroom, (7) the extent to which teachers assisted with the program and (8) how much teachers encouraged the use of strategies between sessions. Response options ranged from 0 (not at all) to 7 (very much). The 8 items were averaged, with higher scores indicating that teachers gave a more positive evaluation of either PSI or CBI. Cronbach's α was 0.77.

Intervention Conditions

Positive Search Training (PST) Enhanced PST implemented in this RCT was identical to that used by Waters et al. (2015c) and Waters et al. (2016). Briefly, the enhanced PST training (programmed in Java) was installed on school laptops with headphones and microphones provided by the research team. PST was delivered in a classroom-based format and consisted of eight 30 min sessions conducted twice weekly over 4 weeks. Picture stimuli depicted a wide range of emotionally pleasant, negative and neutral stimuli to form a database of over 375 pictures. Each session consisted of nine blocks of trials (four blocks of 20 trials, four blocks of 26 trials, one block of 40 trials; total 224 trials). Each trial consisted of either a 3×3 or 4×4 picture array containing unpleasant distractor images (e.g., house on fire, person in hospital) and between one and three positive targets, which are either 'good' targets (e.g., happy children; cute animals) or 'calm' targets (e.g., a vase; a book). Half the trials in each block were 3×3 picture arrays, the other half were 4×4 arrays; and in half the trials, pictures were closely grouped together and in the other half they were spaced apart to promote search over a varying visual field. Trials were randomly ordered within each block.

At the start of the program, children received instructions that the program was designed to help them learn important skills, namely, to 'look for good', to 'look for calm', to 'use both options' and to 'never give up' doing this. Children were informed that they would see picture panels showing a mixture of good, calm and unpleasant pictures, and to use the mouse to click on a good or calm picture. Feedback (pleasant tone) was given on each trial for correct detection of positive and calm cues, and then the next trial was presented. Children completed six practice trials. Prior to each block, children received instructions about which type of and how many target pictures (i.e., good or calm) would be shown in each picture panel and that they were to click on one target. Then each attention-search strategy was presented over the headphones with a jingle and children repeated the jingle out loud. Attention-search goals (e.g., look for good or calm) varied between blocks of trials to encourage cognitive flexibility. In the final block of 40 trials, children received instructions to 'use both options' of 'look for good' and 'look for calm' by clicking on one good and one calm target in each picture panel. They were told that there would be more picture panels in this final game because it was important to 'never give up' using these attention-search strategies even when circumstances are challenging.

Children completed one of three short intermission games after blocks two and six in each session. The three computer games involved (i) popping balloons which triggered one of the four jingles to play over the headphones, (ii) clicking on happy face icons among various emotional face icons as they cascaded down the screen; or (iii) remembering between two and four happy cartoon faces and then clicking on the correct faces when they reappeared amongst distracting faces.

After each session, children said out loud what they were learning and answered four treatment-rating questions. RT and number of mouse clicks to correctly detect targets for all 224 trials, plus the treatment ratings and verbalization data were recorded in output files and sent back to the project coordinator (for further task details, see Waters et al. 2015c).

Cognitive Behavioural Intervention The CBI was based on the Take Action Program, which is designed for the treatment of clinical anxiety in children between 4 and 12 years of age (see Waters et al. 2008c, 2009; Waters et al. 2015a, b; Waters et al. 2017). The acronym "ACTION" was used to identify the program modules. Although most school-based CBIs are delivered via weekly sessions over 8–12 weeks, the CBI in the present study was matched to PST on the number and duration of each session and the duration of the program phase overall by being delivered in a classroom-based format over eight 30 min sessions conducted twice weekly over 4 weeks. The program included (a) psycho-education about anxiety and bodily reactions associated with being anxious ("be Aware"); (b) training in relaxation techniques to cope with anxiety provoking situations ("keep Calm"); (c) identifying anxious self-talk and assisting children to use coping statements and calm thoughts in the place of threatening self-talk ("Think strong thoughts"); (d) between-session graded exposure to challenging or anxiety-provoking situations ("Initiate action"); (e) the development of "strength" cards; the use of "strength" sayings, problem-solving skills, the identification of a "strong team" (i.e., supportive others in the child's life), and social skills training involving therapist modelling, participant role-plays and behavioural experiments of strategies to increase the likelihood of desirable social interactions (e.g., friendly greetings and interaction skills, confident non-verbal behaviour) and to manage challenging social interactions (e.g., instruction in three skills for communicating assertively including strategies for dealing with bullying ("use my Options"); in addition to relapse prevention and maintenance skills ("Never stop taking action"). Children received individual workbooks containing session handouts and homework exercises to complete between sessions. The completion of the homework tasks was checked at the start of each session by the therapists, and a tick mark was placed in each child's workbook as a form of reinforcement for homework completion.

Children were given psycho-educational handouts after each session to give to their parents. The handouts were designed to keep parents informed about what children were learning during the CBI sessions and to provide practical parenting strategies. However, active parental involvement in the program was not requested. Information provided to parents included (a) psycho-education about child anxiety, (b) general parenting strategies for managing child anxiety and improving the parent-child relationship, (c) coverage of the Take Action modules children completed each session, along with parent strategies for assisting their child to learn these techniques, (d) promotion of positive parental coping, and (e) training in communication and problem-solving skills.

Procedure

This study was approved by the Griffith University Human Research Ethics Committee and the Education Department Ethics Committee. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. A letter was sent home from the School Principal informing parents that all classes in the year level would be participating in the study and that parents could decide whether to provide consent for completion of the pre-, post- and follow-up assessments.

Pre-Assessment Phase After the letter from the Principal had been circulated to families, children were given a research study information sheet, consent form, a family information sheet and the questionnaire to take home to parents. Children whose parents provided written consent returned the completed forms in a sealed envelope to a box in their classroom. Research assistants visited each class to collect completed forms, and students in the class in which the most consent forms were returned (irrespective of whether parents gave consent) were given stationery items as a gesture of appreciation. Research assistants returned to each class within 1 week of collecting consent forms to administer the questionnaires with children during class time and provide teachers with the questionnaires on each child in his/her class. Within the same week, the research assistants visited each class a second time and students completed the visual probe task on school laptops as a group within the classroom setting. Teacher questionnaires were collected 1 week later and teachers were given chocolates in appreciation for their time.

Active Intervention Phase Allocation to condition (PST; CBI; CAU) was undertaken at the classroom level based on a computer-generated randomization schedule (randomization.com). To avoid curriculum clashes with national assessments for Year 3 and 5 students, the active intervention phase was completed by Year 4 in Term 2, Year 3 in Term 3 and Year 5 in Term 4. At the request of the school, all classes in Year 4 were randomised to either PST or CBI and Years 3 and 5 were randomised across all three conditions.

PST This training program was delivered in children's classrooms by a research assistant with a three-year degree in psychology. The research assistant used the schools' portable laptop supply to provide each child in the class with a laptop onto which PST had been installed and headphones and microphones had been connected. The research assistant gave children a scripted explanation about how to find, open and complete PST on the laptop during the first session. Then children fitted the headphones, connected the microphone to the collar of their shirt and commenced the program during 30 min sessions held twice weekly. The research assistant had no further interaction with children while they completed PST. After children completed the program, the research assistant instructed them to close the laptop and wait quietly until other children had finished. Teachers were present during the sessions but had no involvement in the delivery of PST. The research assistant followed a detailed administration manual and was required to complete a PST Session Checklist within the manual after each session. The same independent assessor who attended each CBI session also attended each PST session and completed the PST Session Checklist to ensure adherence to the administration procedures and consistency across classes. The research assistant received weekly supervision with the first author. Administration adherence was checked during supervision and were found to be very high ranging from 95 to 100% across sessions.

CBI The CBI was delivered in children's classrooms by a registered clinical psychologist with postgraduate training in clinical psychology, CBIs and the Take Action Program specifically. Each class included a co-facilitator who was one of eight clinical psychology postgraduate interns in their second year of training on external placement. Classroom teachers were present at all times during the sessions but had no involvement in the delivery of the CBI to their class. Facilitators followed a detailed manual and were required to complete a CBI Session Checklist within the manual after each session. An independent assessor in the form of a school-based administration officer with no involvement in this study attended each session and also completed the CBI Session Checklist to ensure adherence to the manual and consistency across classes. Facilitators received weekly group supervision with the first author. Treatment adherence using both the therapist and independent assessor checklists was reviewed during weekly supervision. Adherence to the program content was high, ranging from 94%–98% across sessions.

CAU Children assigned to the CAU condition continued with their regular class timetable during the time that children in the PST and CBI were active in their respective programs.

Post-Assessment and 6-Month and 12-Month Follow-up Assessments

Two research assistants (blinded to condition) visited each classroom 1 week after the active phase was completed and at the 6- and 12-month follow-up times to administer the questionnaires and visual probe task with children in a group-based format during class time. Teachers also completed the questionnaire about each child at the post-intervention assessment but not at follow-ups given that children had changed classes and teachers the following year.

Response Definitions, Data Screening and Statistical Analyses

Missing Data For attention biases, reaction-times (RTs) were excluded from trials with errors, and if RTs were < 200 ms, >1100 ms, and then >3 SD above the participant's mean RT. A participant's data from a time-point were not included if more than 50% of trials were missing. On average, RTs were missing from 6.5% of trials at T1 and 6.7% of trials at T2, 8.4% of trials at T3, and 5.3% of trials at T4 for CAU, 8.4% of trials at T1 and 12.2% of trials at T2, 8.5% of trials at T3, and 11.9% of trials at T4 for PST, and 10.3% of trials at T1 and 9.1% of trials at T2, 7.8% of trials at T3, and 6.1% of trials at T4 for CBI.

Child self-report data were excluded if the participant had no T1 data (i.e., pre-intervention assessment) (PST: $n = 9$; CBI: $n = 8$; CAU: $n = 4$) or if they had T1 data but no subsequent data (i.e., post-intervention assessment or follow-up) (PST: $n = 1$; CBI: $n = 0$; CAU: n = 1) (see CONSORT diagram in Fig. 1).[1] Thus, 280 children with pre-intervention SCAS_C, SMFQ_C and attention bias data were included in the analyses of these measures, with 16% of data missing at random from these participants across post-intervention to 12-month follow-up (see Fig. 1). Of 249 children with parent-report measures at pre-intervention (PST = 95; CBI = 107; CAU = 47), there was considerably more missing parent data by 12-month follow-up (44%) due to parents not returning measures despite repeated follow-up calls, emails and reminder letters. For the teacher report measure, 97% of the data were available over pre- and post-intervention assessments (PST = 106; CBI = 118; CAU = 54).

For all analyses, all non-missing values at each time-point on each measure were used given that the Linear Mixed Model (LMM) software does not require the repeated measures data to be balanced across assessments and estimation software uses maximum likelihood or residual maximum likelihood, which Baraldi and Enders (2010) recommend as a "state-the-art" method for dealing with missing values when these are missing at random as it is a less complex approach than multiple imputation (see Tables 2 and 3 for sample sizes at each time-point).[2] Square root transforms of SCAS_C total scores, SMFQ_C total scores, SCAS_P total scores and SMFQ_P total scores were used as the DVs in analyses as they gave standardised residual errors that did not demonstrate trends in their spread about zero indicating homogeneity of variance, which was not the case for the untransformed DVs or a log-transform of each DV. Standardised residuals for threat bias (Tbias) and happy bias scores (Hbias) indicated homogeneity of variance, so scores were not transformed for analyses. There were no significant differences between conditions in the amount of missing data on any measure.

Primary Data Analyses Data were analysed using LMM (see Diggle et al. 2002; Hudson et al. 2015; Pinheiro and Bates 2004) to account for the nested study design, with students within classrooms and times of measurement within students. The lme function from the nlme package (Pinheiro et al. 2013) in R (R Core Team 2015) was used. The base model included fixed effects of condition (i.e., PST, CBI, CAU), child gender, assessment time-point (Time) (i.e., pre, post, 6-month, 12-month), and the Condition × Time interaction. Two random effects, Classroom and Participant within Classroom, were also specified.[3]The main model notation for LMM is as follows: (a) spherical covariance and dummy variable

[1] CONSORT diagram depicts participant numbers based on the primary outcome measure of SCAS_C.

[2] MAR requires that the probability of being missing, considering only the case of missing values in the dependent variable (DV), is not related to the underlying missing value of the DV. Since testing directly whether the data is MAR is not possible since the missing values are obviously unobserved, some support from the MAR for this study can be gained if the proportion of missing values does not vary significantly across Intervention factor by Time factor combinations. This was tested using a binomial/logit generalized linear model (GLM) for proportion of missing values using the test of independence for a three-way (i.e. "present vs missing" x Intervention x Time) contingency table.

[3] For the four time-points, this base LMM assumes spherical covariance between TIME with 3 variance parameters estimated by Residual Maximum Likelihood (REML) (i.e. the "REML" option of lme) of Class, Participant, and Residual variance parameters. In addition, two additional LMMs with the above fixed effects but with more general error models were fitted. First, the most general error model, the full unstructured between-TIME covariance matrix, was fitted in addition to the Class random effect and residual variances and gives an additional 5 covariance parameters to be estimated compared to the base LMM. Second, a continuous-time autoregressive (CAR) error term (Diggle et al. 2002; Pinheiro and Bates 2004) was used to replace the 6 parameters in the general repeated measures variance structure (i.e. "unstructured" in lme) with a single CAR parameter (phi). The REML log-likelihood was used for likelihood-ratio tests (REMLRT) of the improvement in fit for each of these more general error model terms compared to the base model. Visual inspection of plots of standardised residuals for the base model against values of the dependent variable were used to determine if the assumption of homogeneity of variance was reasonable and whether a transformation such as square root or log transform was required to stabilise the residual variance. Also, standardised residuals greater than 4 or less than −4 were considered for exclusion as outliers.

specification in the LMM for repeated measures analysis - eq. 6.4.1 of Diggle et al. (2002) (b) CAR covariance - eq. 4.2.4 of Diggle et al. (2002) or section 5.27 of Pinheiro and Bates (2004) and (c) unrestricted variance-covariance matrix – eq. 5.24 of Pinheiro and Bates (2004).

The main hypotheses of interest were tested by the interaction term (Condition × Time), in that changes from pre- to post-intervention in measures for each of PST and CBI relative to the changes in the CAU values at a class and individual level (i.e., the LMM combines estimates at these two levels) were tested by single degree of freedom contrasts that were represented by a single parameter with estimates and their standard errors used to construct approximate (i.e. asymptotic) t-tests. These t-tests are reliable given their large number of degrees of freedom. For the Condition factor, there were four contrasts of interest, including two default contrasts comparing PST vs CAU, and CBI vs CAU; and two reverse Helmert contrasts comparing the average of PST and CBI vs CAU, and PST vs CBI. The Time factor used three default contrasts, i.e. post- vs pre-intervention, 6-month vs pre-intervention, and 12-month vs pre-intervention. Two separate LMMs were fitted using the default and reverse Helmert contrast parameters for the Condition factor in each model. Note that these were pre-planned comparisons, so Bonferroni adjustments were not required.[4]

Combined-Across Years (i.e., School Grades) Analysis To simplify inferences, the effect of Year (i.e., grade level 4, 5, or 6) as a fixed effect was tested as a main effect and as interactions with each of Condition and Time, and the three-way interaction of Year × Condition × Time. If Year and its interactions were found not to be statistically significant, the analyses and inferences were based on pooled data across school year levels and the analyses involving Year were not reported. Where Year and its interactions were found to be significantly influential, the results of analyses including the effect of Year are reported. Due to the absence of the CAU condition in Year 4 students, two datasets were constructed and analysed. In the first dataset, all CAU data were removed and models were tested with the Condition factor comparing only PST and CBI. In the second dataset, all Year 4 student data were removed to allow a comparison of PST, CBI and CAU in Year 3 and Year 5 students.

Using Pre-Assessment Values as Covariates To confirm the results were not due to differences in response to condition based on pre-intervention levels, analyses were also completed using pre-intervention assessment measures entered as a covariate. The effect of the default contrast in Time was applied directly to each DV after creating "differenced DVs" by subtracting individual measures at post- from pre-intervention, 6-months from pre-intervention, and 12-months from pre-intervention. The pre-intervention value of the DV was used as a covariate in a LMM of this differenced DV, with the covariate denoted DV_pre, and fitted as a main effect, and in second, and third order interactions with Condition and Time.[5] The difference between each of the CBI and corresponding CAU means at time points post-intervention, 6-months and 12-months corresponds to the three parameters in the default contrast for CBI, and similarly for PST versus CAU. The overall test used was the Wald statistic to be compared to a chi square.

Results

Control Analyses

There were no significant differences in the proportion of boys and girls in PST and CBI relative to CAU, both $\chi^2 < 0.23$, p's > 0.82, and in PST relative to CBI, $\chi^2 = 0.22$, $p = 0.89$. There also were no significant differences between PST and CBI in the average number of sessions completed (PST: $M = 7.81$; $SD = 0.22$; CBI: $M = 7.56$; $SD = 0.35$), session duration (PST: $M = 29.12$; $SD = 1.22$; CBI: $M = 28.75$ min; $SD = 1.06$) and independently-rated therapist adherence to assigned condition (PST: $M = 98.66$; $SD = 0.19$; CBI: $M = 97.95$; $SD = 0.22$), all t's < 1.46, p's > 0.14. There also were no significant

[4] Supplementary analyses were performed to determine whether PST and the CBI had a preventative effect (i.e., prevented increasing symptoms) or an early intervention effect (i.e., prevented growth of symptoms in those experiencing symptoms). This included re-fitting the LMM to the post-intervention, 6-month, and 12-month SCAS-C data using differences in the outcome variable of post- minus pre-intervention as was carried out for the DV_Pre covariate analysis (see below in main text) except that this covariate was dropped as a predictor variable. The resultant random participant effect estimates were modelled for trend with DV_Pre using cubic smoothing splines. Further, a "growth curve" approach was fitted to the above data with random participant-level intercept and slope LMM using Time_i as a continuous variable combined with treatment main effect and Time_i by treatment interaction as additional terms. Trends in random effect slope estimates with DV_Pre were also modelled using cubic smoothing splines. Using these analyses, an "intervention" hypothesis was tested by the detection of a significant and decreasing trend with DV_Pre for higher levels of this variable (i.e., "intervention"), however, rejection of the null hypothesis did not obtain an adequate level of statistical support. The "prevention" hypothesis is more difficult to test since prevention is indicated by a lack of a significant positive trend with DV_Pre for low values of this variable, and as a result, acceptance of this hypothesis could be due to low power to detect a positive trend.

[5] Since DV_Pre is continuous, to test if its effect was linear or not, the model was fitted as a Generalized Additive Mixed Model (GAMM) (Wood 2006) with cubic smoothing splines in DV_Pre fitted for each level of the INT factor. The mgcv R-package (Wood 2004, 2006, 2011) function gamm was used with the same error structure as the base LMM used for the non-differenced DV. If any of the three smoothing splines (i.e one for each level of INT) were significantly different from a no-trend model component and in addition, the spline was close to linear, the GAMM was replaced with the LMM described above. To compare the results of this model directly with the Default contrasts in the LMM for the non-differenced DV, the estimated mean from the fitted LMM for each time point and INT factor level was constructed with adjustment for the overall average value of DV_Pre.

differences between conditions on pre-intervention anxiety, depression, or attention bias measures, all F's < 1.25, p's > 0.19.

As only two children had provided pre-intervention data, but subsequently did not commence the intervention phase (see Fig. 1), differences between children who did and did not commence the intervention phase were not examined. For parent-reported data, separate Condition (PST, CBI, CAU) x Parent Data (present; absent) ANOVAs on each measure for children whose parents did versus did not provide pre-intervention measures revealed a significant Parent Data main effect, with children of parents who did not return pre-intervention measures found to be significantly older (M = 10.4 years; SD = 0.7) compared to children of parents who returned the measures (M = 9.1; SD = 0.1), $F(1, 280) = 36.75$, $p < 0.001$, $\eta_p^2 = 0.11$. There were no other significant age effects, and no significant differences on other measures between children with and without parent data, all F's < 0.31, p's > 0.73. Comparisons of pre-intervention differences on child-, parent-, and teacher-reported measures between children who did versus did not complete the post-intervention and follow-up assessments revealed no significant differences, all F's < 1.23, p's > 0.41.

Primary Outcome Measures

Child Self-Reported Anxiety Symptoms (SCAS_C) Figure 2 displays predicted means and single standard error (SE) bars from fit of the base LMM with an additional main effect of Gender to SCAS_C total scores on the square root transformed scale using Year 3, 4, and 5 data combined (also see Tables 1 and 2). The Gender main effect was significant, with boys reporting lower transformed SCAS_C total scores compared to girls with an estimate of −0.382 (SE = 0.153, p = 0.01) (see Table 2, middle panel D). Although the Gender x Condition x Time interaction was not significant, the Gender main effect was retained in the base model for all DVs whether statistically significant or not. As predicted, a significant Condition × Time interaction was found for several contrasts for child-reported anxiety. On average, there was greater anxiety reduction in the PST and CBI conditions from pre- to post-intervention compared to CAU, and this was maintained at 6-month-follow-up when pre-treatment anxiety was controlled (see Table 2, upper panels A-B). However, these differences were no longer significant at the 12-month follow-up (see Table 2, upper panel C). As displayed in Fig. 2 and Table 2 (middle panels A-C), the reverse Helmert contrasts indicated that the difference in reduction in SCAS_C total scores between the two programs, PST versus CBI, was not significant for all three of the post-assessments.

Table 2 (lower panels A-D) displays the effect of using SCAS_C total scores at pre-intervention as a covariate in the analyses. After controlling for pre-assessment SCAS_C total scores, PST and CBI evidenced significantly greater reductions in SCAS_C total scores compared to CAU at post-intervention assessment and the 6-month but not the 12-month follow-up, suggesting that level of self-reported child anxiety at pre-intervention did not affect comparative outcomes for the active conditions.

Parent Reported Child Anxiety Symptoms (SCAS_P) Figure 3 displays predicted means and single standard error (SE) bars from fit of the base LMM with an additional main effect of Gender to SCAS_P total scores on the square root transformed scale using Year 3, 4, and 5 data combined (also see Table 1 and Table 3). The Gender main effect was not significant (0.27, $t(129)$, −1.58, p = 0.12) and there was no significant

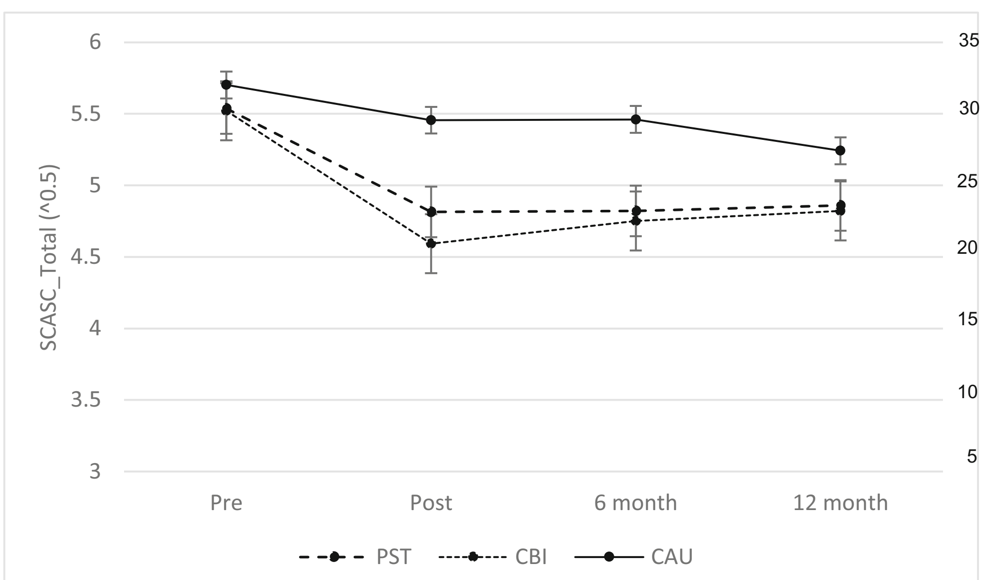

Fig. 2 Child-reported anxiety symptoms (SCAS_C) as a function of intervention condition (PST, CBI, CAU) and Time. Predicted means and single SE bars from fit of the LMM to SCAS_C total scores on the square root transformed scale using Year 3, 4, and 5 data combined. Untransformed scale is shown on right hand ordinate axis (PST: N's range from 106 to 91; CBI: N's range from 119 to 104; CAU: N's range from 55 to 49 across time-points)

Table 1 Square root transformed means (and SE) for each primary and secondary outcome measure

Measure	PST				CBI				CAU			
	Pre	Post	6-month	12-month	Pre	Post	6-month	12-month	Pre	Post	6-month	12-month
SCAS_C[a]	5.54 (0.22)	4.81 (0.22)	4.82 (0.22)	4.86 (0.23)	5.52 (0.22)	4.59 (0.22)	4.75 (0.22)	4.82 (0.22)	5.70 (0.30)	5.46 (0.30)	5.46 (0.30)	5.24 (0.30)
SCAS_P[b]	4.04 (0.19)	3.44 (0.19)	3.29 (0.19)	2.90 (0.19)	4.25 (0.18)	3.83 (0.18)	3.75 (0.18)	3.58 (0.17)	4.13 (0.28)	3.85 (0.27)	3.65 (0.26)	3.91 (0.26)
Tbias[a]	−0.57 (4.47)	10.10 (4.64)	4.11 (4.69)	2.51 (5.21)	4.46 (4.13)	−6.54 (4.28)	−0.23 (4.46)	4.89 (4.57)	4.88 (6.07)	−14.37 (6.46)	−3.71 (6.79)	2.36 (6.76)
Hbias[a]	7.06 (4.76)	7.38 (4.99)	2.68 (4.93)	−0.06 (4.76)	9.91 (4.87)	5.84 (4.76)	4.29 (4.55)	0.30 (4.40)	5.83 (7.21)	10.32 (7.24)	9.48 (6.89)	−10.21 (6.48)
SMFQ_C[a]	1.81 (0.17)	1.73 (0.170)	1.34 (0.17)	1.55 (0.17)	1.63 (0.17)	1.45 (0.17)	1.35 (0.17)	1.22 (0.17)	1.61 (0.23)	1.45 (0.23)	1.56 (0.23)	1.28 (0.24)
SMFQ_P[b]	1.07 (0.15)	0.96 (0.15)	1.18 (0.15)	0.92 (0.15)	1.29 (0.14)	0.93 (0.14)	1.08 (0.14)	1.04 (0.14)	1.17 (0.22)	0.92 (0.22)	1.07 (0.21)	1.08 (0.21)

SCAS_C Spence Children's Anxiety Scale; Child Report, *SCAS_P* Spence Children's Anxiety Scale; Parent, *T-bias* attention bias scores for angry relative to neutral faces, *T-bias* attention bias scores for happy relative to neutral faces, *SMFQ_C* Short Mood and Feelings Questionnaire; Child, *SMFQ_P* Short Mood and Feelings Questionnaire; Parent

[a] = (PST: N's ranged from 106 to 91; CBI: N's ranged from 119 to 104; CAU: N's ranged from 55 to 49 across time-points)

[b] = (PST: N's ranged from 95 to 45; CBI: N's ranged from 107 to 44; CAU: N's ranged from 47 to 20 across time-points)

Gender × Condition × Time interaction ($p > 0.10$) (see Table 3, middle right panel D).

There was a significantly greater reduction in parent-reported child anxiety from pre-intervention to 12-months for children in the PST condition relative to CAU, although the contrasts were non-significant for post- v pre-intervention, and 6-months v pre-intervention (see Table 3, upper panel C). None of the contrasts for the comparison between CBI and CAU were significant. Moreover, the significant Reverse Helmert contrasts at 12-months relative to pre-intervention shown in Table 3 (middle panels A-C) reflects the greater decline in SCAS_P scores for PST compared to CBI. Results did not change when using pre-assessment SCAS_P total scores as a covariate (Table 3, lower panels A-D), suggesting that level of parent-reported child anxiety at pre-intervention did not affect comparative outcomes for the active programs.

Secondary Outcomes

Child Self-Reported Depressive Symptoms (SMFQ_C) There were no significant effects of the active programs on SMFQ_C scores (see Table 1).

Parent-Reported Child Depressive Symptoms (SMFQ_P) There were no significant effects of the active programs on SMFQ_P scores (see Table 1).

Child Threat Bias Figure 4 displays the predicted means and single standard error (SE) bars from fit of the base LMM using Year 3, 4, and 5 data combined. From Table 4 (upper panels A-C), it can be seen that the change in threat bias (Tbias) for PST relative to the CAU between pre- and post-intervention was positive and significant ($p < 0.05$), whereas there was no corresponding significant short-, medium-, or long-term effect for CBI relative to the CAU. The change in Tbias for PST relative to CBI was also positive and significant for the post- vs pre-intervention comparison (Table 4, middle panels A-C). Results were the same when using pre-intervention Tbias as a covariate, suggesting that pre-intervention Tbias did not affect comparative outcomes for the active programs (Table 4, lower panels A-D).

Child Happy Bias There were no significant effects of the active programs on children's happy bias scores (see Table 1).

Teacher Report of Child Social-Emotional Functioning Figure 5 displays the predicted means of the teacher-reported child social and emotional wellbeing for pre- to post-intervention for each condition for Years 3, 4, and 5 separately as Year level was found to influence outcomes (also see Table 5). The base LMM was fitted with main effects of the Year factor and the two-level Time factor (pre- and post-intervention) along with their interaction and a main effect of Gender. The Wald test of the interaction was significant ($\chi^2(7) = 81.2$, $p < 0.001$) and the parameter estimate for each of the 7 combinations showed that this was due to the improvement in teacher-reported child social-emotional functioning from pre- to post-intervention for Year 5 children receiving CBI (3.22, $t(267) = 4.69$, $p < 0.001$) combined with

Table 2 Descriptive information from the linear mixed model comparisons of child threat attention bias scores (SCAS-C) as a function of condition and time, including the year level and gender fixed effects, and with pre-intervention SCAS-C total scores as a covariate

SCAS-C	Value	TIME (Def)	A. Post vs. Pre		B. 6-month FU vs. pre		C. 12-month FU vs pre		D. Year level analysis	
		INT (Def)	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	3 & 4 & 5	3 & 5
		Estimate	−0.679*	−0.475*	−0.529*	−0.477*	−0.325	−0.219	2.120	5.960
No of Observations	1031	SEE	0.221*	0.224*	0.223*	0.227*	0.225	0.230	6	6
Contrast DF	743	*p*	.002	0.034	0.018	0.036	0.149	0.340	0.908	0.428
Variance (SEE)		INT (RHelm)	CBI & PST vs CAU	PST vs CBI	CBI & PST vs CAU	PST vs CBI	CBI & PST vs CAU	PST vs CBI	Gender Analysis	
Class	0.356 (0.344)	Estimate	−0.577*	0.205	−0.503*	0.053	−0.272	0.106	2.483	
Partic	1.171 (0.052)	SEE	0.203*	0.182	0.206*	0.183	0.208	0.187	6	
Resid	0.936 (0.026)	*P*	0.005	0.259	0.015	0.774	0.190	0.571	0.870	
		Default	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	SCAS-C Pre	
SCAS-C Pre covariate		Estimate	−0.661*	−0.459*	−0.578*	−0.526*	−0.415	−0.298	12.050	
No of Observations	752	SEE	0.210*	0.213*	0.212*	0.216*	0.214	0.219	6	
Contrast DF	461	*P*	0.002	0.032	0.007	0.015	0.053	0.174	0.061	

RHelm Reverse Helmert, *SCAS-C* Spence Children's Anxiety Scale; Child Report

*$p < 0.05$

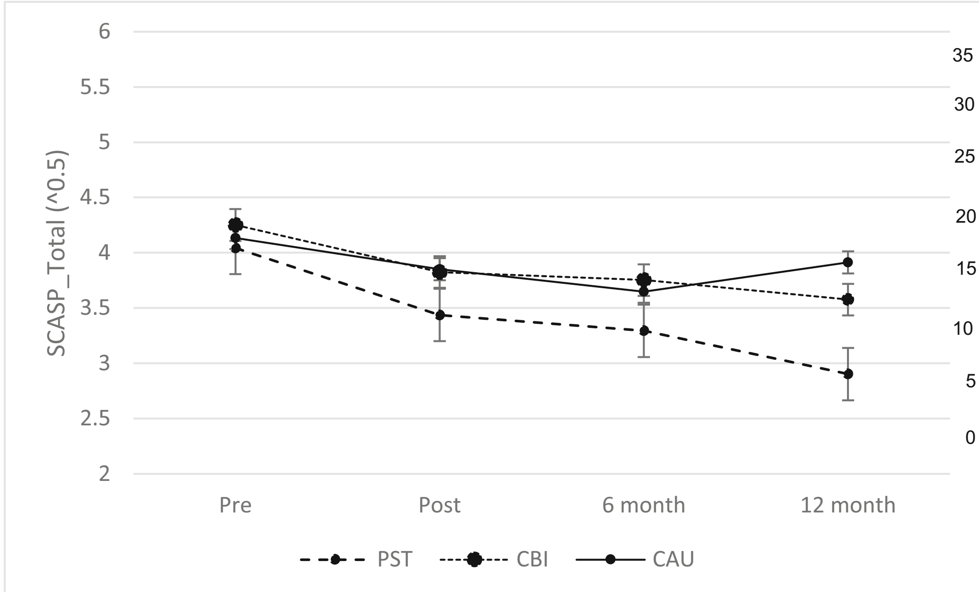

Fig. 3 Predicted means and single SE bars from fit of the LMM to SCAS_P total scores on the square root transformed scale using Year 3, 4, and 5 data combined. Untransformed scale is shown on right hand ordinate axis (PST: N's ranged from 95 to 45; CBI: N's ranged from 107 to 44; CAU: N's ranged from 47 to 20 across time-points)

the decline in teacher-reported child outcomes from pre- to post-intervention for the Year 5 children receiving PST (−1.74, $t(267) = 2.50$, $p < 0.025$). Significant results were the same from the LMM with the Year × Condition × Time interaction along with main effects and lower level interactions fitted to the dataset excluding the CAU condition.

Teacher Evaluations of Assigned Condition

Teachers from classes receiving either PST or CBI rated the programs as moderately positive overall (PST: $M = 5.25$; $SD = 1.33$; CBI: $M = 5.38$; $SD = 0.65$). There were no significant differences in teachers' evaluations of the active program assigned to their class, $t(10) = 0.20$, $p = 0.84$.

Associations Between Anxiety Symptoms and Threat Attention Bias

There were no significant relationships between pre-intervention SCAS-C anxiety scores and threat or happy bias scores, or between group changes in SCAS-C anxiety scores and changes in threat bias scores between pre- and post-intervention, either across the whole sample, or in the PST, CBI or CAU conditions separately (all r's < 0.10, $p > 0.25$).

Discussion

The present study revealed several key findings that were consistent with hypotheses. First, in accord with hypotheses, PST and CBI produced significantly larger declines in child self-reported anxiety from pre- to post-intervention and 6-month follow-up compared to the CAU condition, with no significant differences observed between the two active conditions. However, differences between PST/CBI and CAU were no longer significant at the 12-month follow-up. Second, in partial support of hypotheses, relative to the CAU condition, PST but not the CBI condition, resulted in significant declines in parent-reported child anxiety symptoms from pre-intervention to the 12-month follow-up, although results should be interpreted cautiously given the modest parent response rate. Unexpectedly, threat attention bias significantly increased from pre- to post-intervention in the PST condition relative to the CBI and CAU, but differences at the follow-up assessments were not significant. There were no significant changes in children's self-reported or parent-reported depressive symptoms or attention bias scores for happy faces. Finally, partially as expected, teachers rated Year 5 children in the CBI condition as significantly higher but, unexpectedly, rated those in the PST condition as significantly lower, in social-emotional wellbeing from pre- to post-intervention compared to the other year levels. However, differences were not significant relative to the CAU condition.

The finding that the CBI produced significant reductions in child self-reported anxiety symptoms compared to the CAU condition replicates prior studies finding significant declines in children's self-reported anxiety symptoms following the same classroom-based CBI employed in the present study (Waters et al. 2015a). Findings also extend those of Waters, Groth et al. by observing that these differences were sustained at the six-month follow-up. Moreover, the finding that classroom-delivered, enhanced PST also significantly reduced children's anxiety symptoms at pre-intervention and six-month follow-up extends prior studies of standard PST and enhanced PST, which found significantly greater declines in anxiety

Table 3 Descriptive information from the linear mixed model comparisons of child threat attention bias scores (SCAS-P) as a function of condition and time, including the year level and gender fixed effects, and with pre-intervention SCAS-P total scores as a covariate

SCAS-P	Value	TIME (Def)	A. Post vs Pre		B. 6-month FU vs Pre		C. 12-month FU vs Pre		D. Year level analysis	
		INT (Def)	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	3 & 4 & 5	3 & 5
		Estimate	−0.144	−0.324	−0.014	−0.265	−0.455	*-0.920	1.03	7.96
No of Observations	527	SEE	0.255	0.260	0.299	0.304	0.288	* 0.288	6	6
Contrast DF	373	*P*	0.573	0.213	0.963	0.384	0.109	* 0.001	0.985	0.240
Variance (SEE)		INT (RHelm)	CBI & PST vs CAU	PST vs CBI	CBI & PST vs CAU	PST vs CBI	CBI & PST vs CAU	PST vs CBI	Gender analysis	
Class	0.065 (5.360)	Estimate	−0.234	−0.180	−0.134	−0.251	* -0.687	*−0.465	8.439	
Partic	0.956 (0.176)	SEE	0.238	0.198	0.279	0.230	* 0.264	*0.216	6	
Resid	0.686 (0.299)	*P*	0.325	0.363	0.618	0.275	* 0.010	*0.032	0.208	
		Default	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	SCAS-P Pre	
SCAS-P Pre covariate		Estimate	−0.125	−0.354	0.033	−0.298	−0.423	* -0.953	4.86	
No of Observations	382	SEE	0.277	0.279	0.283	0.284	0.286	* 0.287	6	
Contrast DF	225	*P*	0.652	0.207	0.906	0.294	0.141	* 0.001	0.562	

RHelm Reverse Helmert, *SCAS-P* Spence Children's Anxiety Scale; Parent Report

*$p < 0.05$

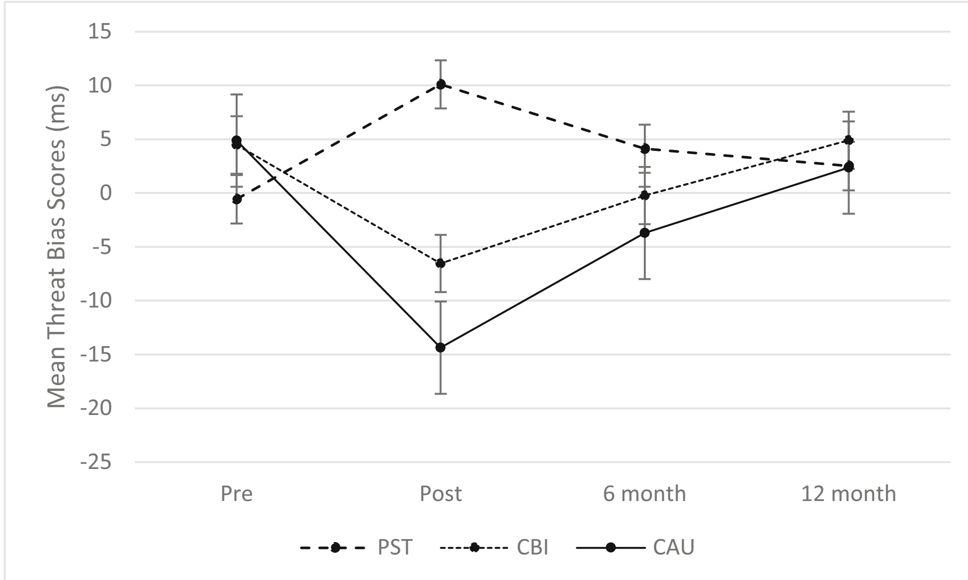

Fig. 4 Attention bias to threat (Tbias) as a function of intervention condition (PST, CBI, CAU) and Time. Predicted means and single SE bars from fit of the LMM to Tbias using Year 3, 4, and 5 data combined (PST: N's range from 106 to 91; CBI: N's range from 119 to 104; CAU: N's range from 55 to 49 across time-points)

symptoms in high anxious adolescents and clinically anxious children relative to waitlist and active control conditions (De Voogd et al. 2014; Waters et al. 2013; Waters et al. 2015c; Waters et al. 2016). Indeed, in the present study, children's self-reported reductions in anxiety symptoms during the active programs (i.e., from pre- to post-intervention) of the magnitudes of 8.6 and 7.8 points for CBI and PST respectively are comparable to pre- to post-CBI reductions of 7.02 points observed in our prior classroom-based comparison of the same CBI intervention relative to curriculum-as-usual within the same school (Waters et al. 2015a). However, it was also observed that the beneficial effects of PST and the CBI on child-reported anxiety symptoms were no longer significant at the 12-month follow-up. Figure 2 clearly demonstrates that this loss of significance was due to declines in anxiety symptoms in the CAU condition at the long-term follow-up. As only the CBI condition was re-assessed at 12-months in Waters, Groth et al., and a 12-month long-term follow-up has not been included in prior studies of enhanced PST, it is not possible to compare the present results with prior findings regarding natural declines in children's anxiety over time. It is therefore important that further studies are conducted that include long-term follow-up assessments of both active and control conditions. It may also be beneficial in future studies to assess other dimensions of emotional functioning that might improve and persist over time following enhanced PST and CBIs, including positive affect, coping ability, and approach-related behaviours. It would also be useful to establish whether longer duration programs, booster sessions and reminders to utilise intervention strategies after the active programs, strengthen intervention effects beyond natural changes in anxiety over time during late childhood. For example, children who received PST may benefit from intermittent reminders following the program to continue using the attention regulation strategies of 'look for good' and 'look for calm', and to 'never give up' applying them in a wide variety of situations.

It is also notable that anxiety reductions following standard PST are not consistently found in non-clinical samples. Two prior large-scale, school-based studies with non-clinical samples of adolescents found that standard PST did not outperform ABM-threat avoidance training, an attention training control condition, or a waitlist control condition (De Voogd et al. 2016, 2017). In contrast, as noted earlier, prior studies with anxious 7- to 12-year-old children found that standard PST and the enhanced version of PST used in the present study were effective in reducing anxiety symptoms, relative to attention training control conditions and/or waitlist conditions (Waters et al. 2013, 2015c, 2016). There are a number of methodological differences between these studies, including participants' clinical status and age, and the type of training task involved (i.e., standard or enhanced PST). Standard PST involves visual-search training for positive faces embedded among negative faces (e.g., De Voogd et al. 2014, 2016, 2017; Waters et al. 2013); whereas enhanced PST explicitly trains goal-directed attention strategies of attending to positive and calm information, and ignoring negative/threatening distracting information while also using varying targets and array configurations, and learning and memory consolidation strategies (Waters et al. 2015c, 2016). Therefore, given several methodological differences between studies, it is possible that clinically anxious youth may benefit more from PST (both standard and enhanced versions) than non-clinical samples. Alternatively, children may be more responsive to explicit

Table 4 Descriptive information from the linear mixed model comparisons of child threat attention bias scores (Tbias) as a function of condition and time, including the year level and gender fixed effects, and with pre-intervention Tbias total scores as a covariate

Threat bias	Value	TIME (Def)	A. Post vs Pre		B. 6-month FU vs Pre		C. 12-month FU vs Pre		D. Year level analysis	
		INT (Def)	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	3 & 4 & 5	3 & 5
		Estimate	8.247	* 20.920	3.898	13.282	2.948	5.600	6.350	5.581
No of Observations	926	SEE	10.244	* 10.505	10.516	10.719	10.554	10.970	6	6
Contrast DF	650	*P*	0.421	* 0.004	0.711	0.216	0.780	0.610	0.385	0.472
Variance (SEE)		INT (RHelm)	CBI & PST vs CAU	PST vs CBI	CBI & PST vs CAU	PST vs CBI	CBI & PST vs CAU	PST vs CBI	Gender analysis	
Class	0.004 (24.50)	Estimate	* 19.083	* 21.673	8.590	9.385	4.274	2.652	4.109	
Partic	5.82 (0.76)	SEE	* 9.534	* 8.185	9.773	8.303	9.853	0.867	6	
Resid	41.19 (0.03)	*P*	* 0.046	* 0.008	0.379	0.259	0.665	0.760	0.662	
		Default	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	CBI vs CAU	PST vs CAU	Tbias_Pre	
Tbias_Pre covariate		Estimate	7.308	* 24.627	1.567	8.354	2.011	−0.370	4.597	
No of Observations	664	SEE	7.636	*7.828	8.001	8.121	8.068	8.445	6	
Contrast DF	378	*P*	0.339	*0.002	0.844	0.304	0.803	0.965	0.596	

RHelm Reverse Helmert, *Tbias* attention bias scores for angry relative to neutral faces

*$p < 0.05$

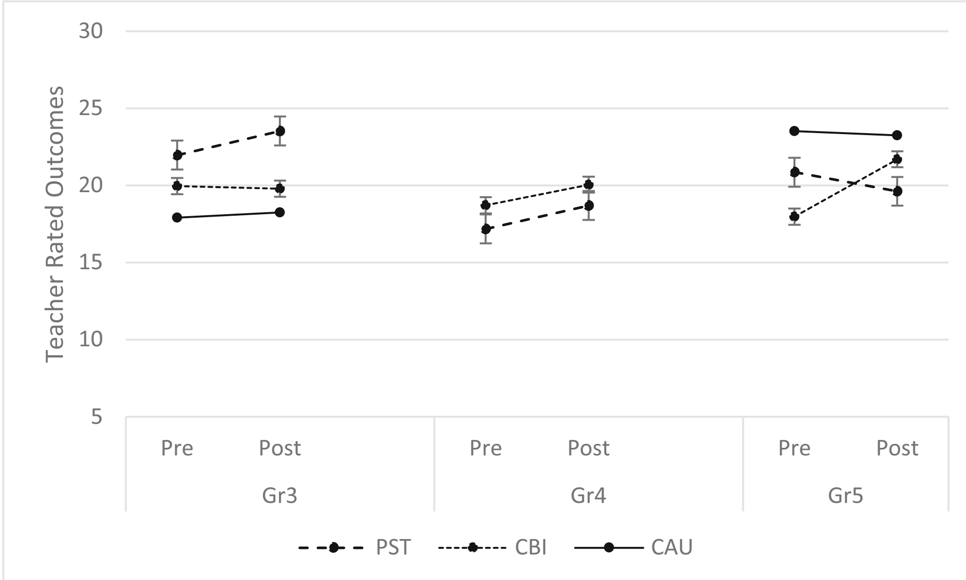

Fig. 5 Predicted means and single SE bars from fit of the LMM to teacher-reported social-emotional wellbeing scores for Condition by Year at Pre- and Post-assessments (PST: $N = 106$; CBI: $N = 118$; CAU: $N = 54$ at pre- and post-intervention assessments)

forms of positively-oriented attention regulation interventions (i.e., enhanced PST) than adolescents. Additionally, enhanced PST utilised in the present and prior studies may be more efficacious than standard PST in reducing anxiety symptoms in non-clinical and clinical samples of youth (e.g., Waters et al. 2015c, 2016). Follow-up research to the present study, which compares the efficacy of enhanced PST with standard PST in reducing anxiety symptoms in children and adolescents, and also examines their effects in both clinical and nonclinical samples, would elucidate these possibilities.

For the parent-report measure of child anxiety symptoms, favourable outcomes following enhanced PST but not CBI (relative to the CAU control condition) were found at the 12-month follow-up. Conclusions are made cautiously given that almost half of the SCAS_P data were missing due to a modest parental response rate. However, of note is that our prior study comparing classroom-based CBI with a CAU control condition also found no significant differences in parent-reported child anxiety symptoms (Waters et al. 2015a). Prior studies of standard PST in non-clinical adolescents did not assess parent-report of change in youth anxiety symptoms (De Voogd et al. 2014, 2016, 2017). However, previous studies of standard and enhanced PST in clinically anxious children found greater reductions in parent-reported child anxiety symptoms following PST relative to control training and waitlist conditions (Waters et al. 2013, 2015c, 2016). In the latter studies, parents were involved in the program that their children received (e.g., encouraging regular practice of PST training sessions at home). In the present study, parents received more information about the CBI than the PST training (i.e., handouts were sent home to parents in the CBI condition) and therefore any differences may be expected to be in favour of the CBI condition. Instead, the present findings suggest that parents of children receiving classroom-based PST may have noticed more anxiety declines in their children than parents of children receiving classroom-based CBI by 12-month follow-up. As the mechanisms underlying this unexpected difference between PST and CBI outcomes at 12-month follow-up are unclear, findings require replication before firm conclusions can be made.

Table 5 Means (and SE) for teacher-reported social-emotional wellbeing as a function of year level and condition

	Year 3		Year 4		Year 5	
	Pre	Post	Pre	Post	Pre	Post
PST ($N = 106$)	21.96 (2.21)	23.52 (2.21)	17.17 (1.33)	18.69 (1.33)	20.85 (1.61)	19.61 (1.61)
CBI ($N = 118$)	19.95 (1.63)	19.77 (1.63)	18.70 (1.57)	20.04 (1.56)	17.96 (1.61)	21.69 (1.60)
CAU ($N = 54$)	17.89 (1.61)	18.24 (1.61)	–	–	23.52 (2.21)	23.23 (2.21)

The findings that teacher evaluations of children's social-emotional functioning improved following the CBI but declined following PST among Year 5 children was partially consistent with expectations of improved evaluations of children in both active conditions compared to the CAU. These findings should be interpreted cautiously for several reasons. First, given differences in the format of administration of PST and the CBI (computer vs therapist), there were substantial differences between conditions in teachers' exposure to the content of the two programs. Second, given CBT is a well-known intervention whereas PST is a novel intervention for children's anxiety symptoms, there is the potential for differences in teachers' prior knowledge of CBT compared to PST to influence outcome expectancies (Borkovec and Costello 1993; Meyer et al. 2002; Safren et al. 1997; Sotsky et al. 1991). Teachers of the CBI classes could hear and observe the content of sessions being delivered by the facilitator and all teachers of these classes reported prior knowledge of cognitive-behavioural therapy for treating children's anxiety. In contrast, PST was completed on computers without input from the research assistant and all teachers of these classes reported being unaware of the program prior to this study. Although one might argue that these differences confound results, they reflect important differences in the implementation and perceptions of the efficacy of these programs that can inform further research. Moreover, such differences between conditions in teacher exposure to the intervention content and outcome expectancies cannot account for why differences in teacher evaluations of student social-emotional wellbeing changed significantly from pre- to post-intervention in the Year 5 students only. The finding of improved teacher ratings of wellbeing in the Year 5 CBI classes is consistent with the view that CBIs are often considered more effective for older than younger children (see Waters et al. 2009). On the other hand, perhaps some features of enhanced PST are less effective for older than younger children and teachers' observations of student reactions to the training influenced their evaluations. For example, given that PST makes use of catch-phrases expressed as melodic jingles and repeated practice of the search strategy, perhaps such features are less engaging for older than younger children and teachers' evaluations were influenced by student reactions to this form of training. Further research could address these possibilities by having teachers leave the classroom during sessions, and examining whether adapting some of the features of PST to be more engaging for older children might enhance outcomes.

An unexpected finding in the present study was a short-term effect of PST on threat attention bias, which showed a relative *increase* from pre- to post-intervention for PST which was not observed in the other conditions. There were no significant differences between the active programs' effects on attention bias for positive stimuli. Moreover, the effect of PST, relative to the other conditions, on increasing threat attention bias appeared to be an immediate effect observed post-training, as differences between conditions were not observed at follow-up assessments. Prior evidence of effects of PST on threat attention bias is mixed, and depends on the measure used to assess changes in attention bias. For example, de Voogd et al. (2014) found declines in anxiety symptoms and threat attention biases following standard PST when attention bias was assessed with a visual search task similar to that used in training. In their later two studies, declines in attention biases were again found on the visual search task, but not the dot-probe task, following standard PST; however, reductions in anxiety were found across all training conditions irrespective of changes in attention bias (De Voogd et al. 2016, 2017). Waters et al. (2013) found that standard PST reduced anxiety and increased attention bias towards happy faces, but did not modify attention bias for angry faces assessed using the dot-probe task. Waters et al. (2015c) also found that enhanced PST reduced anxiety in the absence of changes in attention biases (attention bias was not examined in Waters et al. 2016). The present findings add to these prior inconsistent results. Furthermore, in the present study, supplementary analyses indicated that reduction in child-reported anxiety during the active program period was unrelated to change in threat attention bias. Together, these findings further challenge the view that anxiety reduction depends on reducing attention bias, as assessed on the dot-probe task, which is an established measure of orienting to threat (MacLeod and Clarke 2015; for further discussion see Mogg et al. 2017).

Although the dot-probe task is the most widely used measure of attention bias in the ABM literature and therefore was an important inclusion in order to compare outcomes with prior studies, the combined findings across standard and enhanced PST studies suggest that the dot-probe task is not sensitive to the changes in cognitive mechanisms underpinning PST. It is helpful to distinguish between measures of attention bias in orienting to threat versus measures of attention bias reflecting the ability to inhibit the processing of threat distractors (Mogg and Bradley 2016). The dot-probe task is designed to index attention orienting to threat by assessing response times to probes which replace briefly presented threat and neutral stimuli; thus, the dot-probe task indexes attention orienting to the spatial location of threat. Enhanced PST is designed to increase attention control by explicitly training attention to positive stimuli and inhibiting attention to threat distractors. The present results suggest that future studies of PST should include tasks that assess cognitive control processes that may be targeted through this form of training such as threat-distractor inhibition using the emotional Stroop task (Reinholt-Dunne et al. 2009) or the visual search interference task (Waters and Lipp 2008).

The present findings must be considered in the context of study limitations. First, reliance on self-report and non-blinded parent- and teacher-reports is a limitation as outcomes may be influenced by intervention expectancies as discussed above in relation to teacher-reported outcomes. It will be important to include independent clinician-rated diagnostic assessments in future studies. Second, the high rate of missing parent-report data was a limitation. Considering possible ways to increase parent participation will be important in future research, such as involving parents more directly in the intervention. Third, we used a customised teacher-report measure because we wanted a short, easily administered measure that teachers could quickly complete for every child in their class on several occasions. Future studies should replicate this study using a standardised teacher-report measure.

The present findings are encouraging in that enhanced PST was found not to differ from evidence-based CBI in reducing child self-reported anxiety symptoms (post-intervention and up to 6 months follow-up), relative to the CAU control condition. These findings have implications for future research. This includes studying both child and adolescent samples to determine whether enhanced PST is effective in reducing anxiety symptoms across the age-range of youth, and also the inclusion of a wider range of attention measures (if time permits within busy classroom schedules) to assess changes in attention processes which may be more closely linked to mechanisms underlying enhanced PST (i.e., threat distractor inhibition, attention control, as well as assessing threat-related orienting). As classrooms are busy settings with constraints on time, this might involve conducting assessments over two sessions or in small groups. Although the computer program of PST was identical to that of Waters et al. (2015c) and Waters et al. (2016), the procedure for administering the program differed from earlier studies in several ways (e.g. parental involvement, individual vs group format, school vs home setting). Future studies should evaluate whether effects are stronger with greater integration of PST across school and home settings. Finally, the present study concentrated on population-average effects across 3 year levels of primary school age children. Further studies with larger samples are required to ensure an adequately powered analysis of individual participant responses to both PST and the CBI relative to a CAU condition based on pre-intervention child anxiety scores. This would enable a thorough analysis of preventative effects (i.e., preventing an increase in symptoms) versus intervention effects (i.e., reducing symptoms in those with elevated symptoms) of both PST and the CBI.

In summary, the present study found that PST and CBI produced significant short- and medium-term declines in child reported anxiety symptoms (i.e., post-intervention and 6-month follow-up) relative to the standard classroom curriculum. Given that PST is a brief intervention (25 min per session) delivered via computer over 3–4 weeks, it may be a viable option for targeting anxiety symptoms as part of broader student wellbeing strategies within schools. Unexpected short-term changes in attention bias towards threat on the dot-probe task following PST indicate the need for additional attention outcome measures, which may be more sensitive to changes in underlying cognitive control processes modified by PST (e.g., threat distractor inhibition). Together, the results encourage further school-based studies with larger samples of both children and adolescents to determine PST's efficacy as a prevention versus intervention program at the individual participant level as well as population-average levels. Given that PST is brief, computer-delivered and does not require therapist support, it may be a feasible approach that could be delivered in the school setting to target children's anxiety symptoms.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures were approved by the Grifith University Human Research Ethics Committee, therefore complying with the ethical standards of the 1964 Helsinki declaration and its later amendments.

Informed Consent Parents provided written informed consent for children's participation throughout the study prior to the first assessment.

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