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A randomized controlled trial of attention bias modification training for socially anxious adolescents

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ABSTRACT

The current study aimed to examine the efficacy of attention bias modification (ABM) training to reduce social anxiety in a community-based sample of adolescents 15–18 years. The study used a single-blind, parallel group, randomized controlled trial design (Clinical Trials ID: NCT02270671). Participants were screened in second-level schools using a social anxiety questionnaire. 130 participants scoring ≥24 on the Social Phobia and Anxiety Inventory for Children (SPAI-C) were randomized to the ABM training (n = 66)/placebo (n = 64) group, 120 of which completed pre-, post-, and 12-week follow-up data collection including threat bias, anxiety, and depression measures. The ABM intervention included 4 weekly training sessions using a dot-probe task designed to reduce attention bias to threatening stimuli. ABM training did not alter the primary outcomes of attention bias to threat or social anxiety symptoms raising questions about the efficacy of ABM as an intervention for adolescents.

Cognitive bias modification (CBM) has been proposed as a potential means to alter dysfunctional patterns of attention and interpretation in anxiety disorders such as social anxiety disorder (SAD). SAD is characterised by a fear/anxiety in social situations in which an individual may be exposed to scrutiny by others. Research on novel interventions for anxiety disorders, including SAD, has recently begun to consider the effect of altering maladaptive cognitive biases which may maintain symptoms of anxiety.

Cognitive theories propose that selective attention to negative cues enhances anxiety and research has shown that anxious individuals selectively attend to threat-related information in their environment (Hallion & Ruscio, 2011). CBM for attention bias appears to alter cognitive vulnerability to anxiety, as indexed by emotional measures administered following training (Beard, 2011). Variations of the dot-probe task designed by MacLeod, Mathews, and Tata (1986) have commonly been used as a means of attention bias modification (ABM) to reduce symptoms of social anxiety.

To date, reviews and meta-analyses have focused on the efficacy of CBM training with varying degrees of support (see Cristea, Kok, & Cuijpers, 2015; Cristea, Mogoaşe, David, & Cuijpers, 2015; Hakamata et al., 2010; Heeren, Mogoaşe, Philippot, & McNally, 2015; Mogoaşe, David, & Koster, 2014). Some have focused on CBM for attention bias, while others have reviewed studies on CBM for both attention and interpretation biases. Earlier meta-analyses reported favourable results (e.g. Hakamata et al., 2010); however, more recent meta-analyses and reviews have called for further research on the efficacy of this method before promoting CBM as a clinical treatment (e.g. Cristea, Mogoaşe et al., 2015; Heeren et al., 2015).

Hakamata et al. (2010) meta-analysis concluded that attention bias modification (ABM) treatment is effective in reducing threat-related attention bias, and anxiety with a medium effect size. A more recent meta-analysis by Mogoaşe et al. (2014) concluded that ABM has a smaller therapeutic effect on anxiety than previously reported.

Heeren et al. (2015) found that ABM produced a reduction in SAD symptoms and attention bias with small effect sizes; however, similar to Hakamata et al. (2010) they state that effects were moderated by characteristics of the ABM training. For example, in contrast to Hakamata et al. (2010) and Beard, Sawyer, and Hofmann (2012) a left-right display was more effective than a top-bottom display. ABM showed no effect on SAD symptoms at 4-month follow-up.

Cristea, Kok, et al. (2015) conducted a meta-analysis on both attention and interpretation bias CBM methods. For social anxiety, ten RCTs were included, and no significant difference was observed for CBM compared with a control group. Seven of the included RCTs

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reported data from clinical samples and again, results revealed no significant CBM effects.

To date, research employing CBM interventions has focused on adult populations. There is a scarcity of research using ABM training with non-clinical adolescent samples. Research suggests that attention bias towards threat may be casually implicated in the development of anxiety (MacLeod & Mathews, 2012), therefore, reducing attentional bias through ABM training may be an ideal focus for early intervention with adolescents.

Sportel, de Hullu, de Jong, and Nauta (2013) compared internet-based CBM and school-based cognitive behavioural therapy (CBT) interventions which aimed to reduce social anxiety in adolescents. No significant group difference in attention bias to threatening faces was observed over time. Cristea, Mogoaşe et al. (2015) carried out a meta-analysis of 23 CBM studies which included adolescents. Nine of the studies related to attention training tasks and results showed no effect of CBM training on mental health but moderate effects on the targeted biases.

Recent research with patients with post-traumatic stress disorder (PTSD) has examined attention bias variability (ABV) and suggests greater variability in attention bias is associated with this disorder, i.e. fluctuations in attention bias with attention patterns switching between a bias towards and away from threat (Naim et al., 2015). In a related study, ABM training was found to have no effect on ABV in PTSD (Bandura-Brack et al., 2015). ABV has yet to be explored in SAD. The present study adds to the ABM literature by examining the efficacy of an ABM training protocol, developed by the Tel-Aviv University and the National Institute of Mental Health (TAU-NIMH ABMT) Initiative, to reduce sub-clinical symptoms of social anxiety in adolescents. There is a lack of research examining ABM in non-clinical adolescent populations. Therefore, a key aim of the present study was to examine the efficacy of ABM as a potential early intervention strategy among a community-based sample of adolescents.

1. Method

1.1. Study design and setting

The study protocol is available on www.clinicaltrials.gov (ID: NCT02270671). The study took place within Irish second-level schools and employed the ABM treatment protocol available from Tel-Aviv University and the National Institute of Mental Health (TAU-NIMH ABMT). The study employed a parallel group RCT design, reported in line with CONSORT 2010 guidelines.

1.2. Sample size

Using G*Power 3.1, the sample size was determined as 124 based on: a medium effect size of 0.3, alpha of 0.025, power of 0.8, a repeated measures within-between interaction: 2 (Randomization) X 2 (Gender) X 3 (Pre-, Post-, Follow-up). To account for attrition, we aimed to recruit 130 participants (65 per condition).

1.3. Participants and recruitment

Second-level schools close to the institution were contacted to gain permission to recruit students in 4th and 5th year (equivalent to USA grades 10 and 11). Schools were randomly selected based on the Irish Department of Education and Skills 2014 published list for the Leinster region. Invitation letters were sent to 49 schools, with 14 schools agreeing to participate (28.57%). Approximately 2,900 students were invited to take part, from which 545 (22%) participants provided written assent and parental consent. A number of participants ($n = 12$) were excluded based on the criteria outlined below and a number of others were absent on the day of screening ($n = 36$).

Participants were enrolled into the RCT if they scored ≥24 on the Social Phobia and Anxiety Inventory for Children (SPAI-C, Beidel, Turner, & Morris, 1998, 2000) total score, which was based on the 75th percentile in the overall sample ($n = 497$; see Fig. 1). Of the 497 participants screened for suitability to participate in the RCT, 130 students were initially enrolled in the study, following two dropouts and one additional exclusion a final sample of 127 participants ($M = 15.94$, $SD = 0.69$) were included (see Table 1). Data were collected between September 2014 and May 2015 and the RCT took place approximately six weeks after screening (range: 1–11 weeks).

1.4. Inclusion and exclusion criteria

Adolescents, 15–18 years, who scored above a cut-off of ≥24 on the SPAI-C (Beidel et al., 1998, 2000) were invited to participate in the RCT. Participants were excluded if they scored <24 on the SPAI-C, declined to participate, did not provide written parental consent, or if their parent reported that the participant had a diagnosed mental disorder or were seeing a mental health professional.

2. Procedure

Ethical approval was granted by the institution's ethics committee. Participants were informed that while all students who returned the necessary parent consent and student assent forms would complete a questionnaire in class during the first phase of the study (screening), a small number of participants would be randomly selected to take part in the second phase of the study (RCT). Participants were randomly assigned to either the ABM/placebo training group. Group assignment was counterbalanced within schools and gender. School gatekeepers, parents/guardians, and participants were blinded to participants' group assignment. Researchers involved in data collection were blinded to results from the RCT until data collection was complete. Participants were debriefed and informed of group assignment upon completion of all training and data collection at 12-week follow-up.

Data collection for the RCT took place during school hours by trained researchers using a standardised protocol. The ABM/placebo training intervention consisted of 4 sessions, once per week for 4 weeks, delivered on laptops supplied by the researchers. Participants completed training and data collection sessions in small groups of two/three with a member of the research team present at all times. Pre-, post-, and 12-week follow-up data were collected. Pre-intervention threat bias measurements and questionnaire data were collected from each participant immediately before the first training session and post-intervention data were collected immediately after the fourth session. A battery of standardised questionnaires was also administered at pre-, post-, and 12-week follow-up.

2.1. Computer-based training protocol

2.1.1. The dot-probe attention task and stimuli

The training programme was based on the dot-probe task originally conceptualised by MacLeod et al. (1986) and supplied by the TAU-NIMH ABMT Initiative (http://people.socsci.tau.ac.il/mu/anxietytrauma/research/). Both the ABM and placebo groups were given the same task instructions. In the dot-probe task pairs of stimuli are briefly presented together on a computer screen followed by a small visual probe which appears in the location vacated by one of the stimuli. The participant must respond as quickly as possible to indicate the location of the probe without

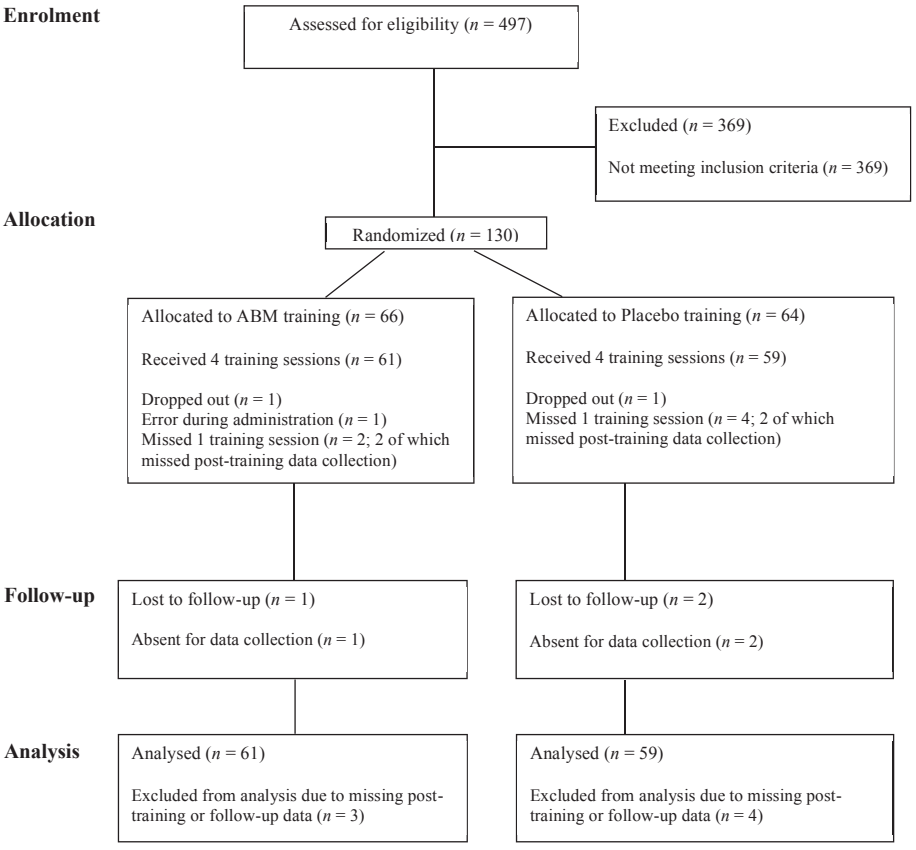

Fig. 1. CONSORT 2010 flow diagram.

Table 1
Demographic information for participants.

	Screening		RCT	
	n	%	*n*	%
Gender				
Total	497	100	127	100
Male	294	59.2	54	42.5
Female	203	40.8	73	57.5
Age				
15	134	27.0	33	26.0
16	270	54.3	69	54.3
17	90	18.1	24	18.9
18	2	0.4	1	0.8
19	1	0.2	0	0
Year				
4th year (TY)	303	61.0	67	52.8
5th year	194[a]	39.0	60[b]	47.2
Ethnicity				
White	449[c]	90.3	118	92.9
Black	8	1.6	2	1.6
Asian	14	2.8	3	2.4
Irish Traveller	0	0	0	0
Other	4	0.8	1	0.8
Unknown	22	4.4	3	2.4

Note.
[a] 44 of which did not do Transition Year (TY) and 150 did TY. TY is optional in some Irish schools.
[b] 22 of which did not do TY and 38 did TY.
[c] The majority of whom were born in Ireland ($n = 363$, 73%).

compromising accuracy. Response times to different stimulus categories can indicate the distribution of a participant's attention, either towards or away from threatening stimuli.

Stimuli were face photographs of 20 individuals taken from the NimStim stimulus set (Tottenham et al., 2009) with the exception of one female taken from the Matsumoto and Ekman stimulus set (Matsumoto & Ekman, 1989). Photographs of 10 males and 10 female made up the stimulus set which included two different pictures of each individual, depicting an angry facial expression or a neutral facial expression. The face pairs were randomly divided into two sets, A and B. Set assignment was counterbalanced within ABM and placebo training groups, with participants tested at pre-, post-, and 12-week follow-up using a threat bias measurement with one set, and administered either ABM/placebo training with the other set.

The dot-probe task was run using E-Prime 2 Software Package (PST, Pittsburgh, PA). Fig. 2 illustrates a single trial in the dot-probe task. The target-probe, to which participants were instructed to respond, was an arrow head pointing either left of right (<or >) which appeared at the location previously occupied by one of the photographs. Participants were instructed to indicate the direction in which the arrow head was pointing via a mouse using their dominant hand. The target-probe remained on screen until the participant responded and was followed by an inter-trial interval of 500 ms.

2.1.2. ABM/placebo training

The ABM/placebo training sessions consisted of 160 trials of the dot-probe task, 120 of which contained angry-neutral face pairs and 40 of which contained neutral-neutral face pairs. In the ABM training condition the target appeared in the neutral-face location on all angry-neutral trials. In the placebo training condition, angry-face location, probe location, and actor were all fully counterbalanced in presentation. Probe-type was not counterbalanced but

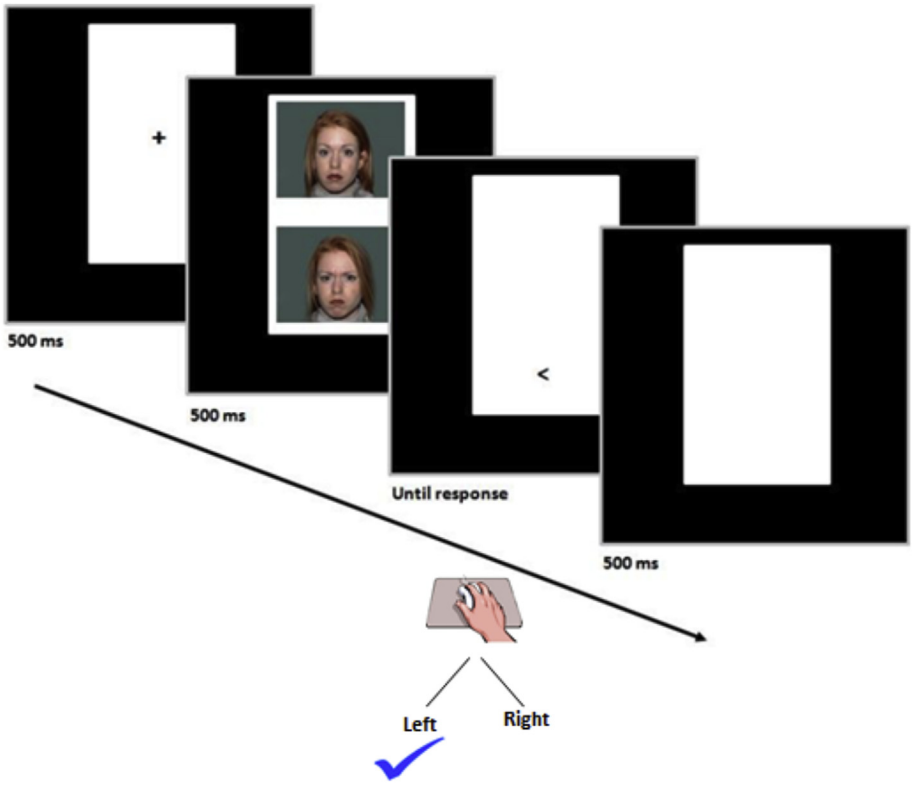

Fig. 2. Example of a single trial from the threat bias measurement task.

appeared with equal probability for angry-face location, probe location, or actor. ABM/placebo training sessions took 7 min for participants to complete and were divided into four blocks of 40 trials. If a participant's accuracy fell below 70% in a block a warning appeared at the following break slide reminding the participant not to compromise their accuracy. If a participant's accuracy remained above this threshold, no subsequent instructions accompanied the break slide.

2.2. Primary outcome measures

2.2.1. Threat bias measurement

The threat bias measurement consisted of 120 trials of the dot-probe task, 80 of which contained angry-neutral face pairs and 40 of which contained neutral-neutral face pairs and took 5 min to complete. Angry-face location, probe location, probe type, and actor were fully counterbalanced across all trials. Participants were instructed to respond as quickly as possible without compromising accuracy. In instances where participants responded with less than 70% accuracy on the first 10 trials a warning displayed on screen and the researcher re-briefed the participant and restarted the threat bias measurement. Attention bias variability was also calculated.[1]

2.2.2. The Social Phobia and Anxiety Inventory for Children (SPAI-C)

The SPAI-C (Beidel et al., 1998, 2000), a 26-item, self-report measure, explored anxiety in social situations. Responses were indicated using a 3-point Likert scale from 0 = *never or hardly ever* to 2 = *most of the time or always* with scores ranging from 0 to 52. Following piloting, "scared" was replaced by "nervous" (as previously altered by Storch, Masia-Warner, Dent, Roberti, & Fisher, 2004). SPAI-C total scores were generated in line with the manual.

2.3. Secondary outcome measures

2.3.1. The screen for child anxiety related emotional disorders (SCARED)

The SCARED (Birmaher et al., 1997), a 41-item self-report measure, has five subscales, four of which map onto DSM-IV-TR anxiety disorders: Generalized Anxiety Disorder (GAD); Panic Disorder (PD); Separation Anxiety Disorder; and Social Phobia (SP). The fifth subscale elicits feelings of school-related anxiety (SA). Scores range from 0 to 82; while scores >25 may be indicative of an anxiety disorder.

2.3.2. The brief fear of negative evaluation-revised (BFNE-R)

The BFNE-R (Carleton, McCreary, Norton, & Asmundson, 2006), a 12-item, revised version of the BFNE (Leary, 1983), was used to elicit respondents' fear of negative evaluation. It comprises the original 12 items with revisions to the four reverse-worded items (items 2, 4, 7, 10).

2.3.3. The revised child anxiety and depression scale – major depressive disorder (RCADS-MDD)

The major depressive disorder subscale of the RCADS (Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000), a 10-item subscale, explored symptoms of MDD as characterised by the DSM-IV. A score of 11 or higher has been shown to optimise sensitivity and specificity for the prediction of MDD (Ebesutani et al., 2012).

[1] ABV reflects the within-session variability in attention bias. The calculation is based on calculating bias over successive 10-trial moving windows, and then getting the standard deviation of these scores. Finally, we divide by the subject's mean RT for the session to eliminate the inherent association between mean and SD.

2.4. Data clean-up and statistical analyses

Threat bias measurement data were cleaned before analysis using an Analysis Tool (v2.0) supplied by the TAU-NIMH ABMT Initiative (Abend, Pine, & Bar-Haim, 2014). Trial reaction times (RTs) shorter than 150 ms/longer than 2000 ms or in which an incorrect response was made were removed. Z-scores were calculated per trial type (angry-neutral or neutral-neutral) and valence of face preceding the probe (angry or neutral). Trials with z-scores greater than 2.5 were removed. Using data from trials in which angry-neutral face pairs were presented, threat bias scores were then calculated for each participant by subtracting the mean reaction time (RT) for trials in which the probe appeared behind the angry face from the mean RT for trials in which the probe appeared being the neutral face. Therefore, threat bias measurement scores >0 indicated a bias towards threat, i.e. angry faces.

3. Results

3.1. Missing data

A CONSORT diagram illustrating the flow of participants through the trial is shown in Fig. 1. Two participants completed three of the four training sessions (placebo condition), i.e. 75% of training, and for these data, the intention-to-treat (ITT) approach was used when analysing post-intervention and follow-up data, using the last data point carried forward method (Waters et al., 2014). The final sample consisted of 120 participants, with 59 in the placebo group and 61 in the ABM group.

3.2. Statistical overview

Group differences at baseline were analysed. Treatment outcome data were analysed using ANOVAs. For all outcome measures, separate analyses were conducted to compare the ABM and placebo groups from pre-to post-to follow-up using 2 Group (ABM Training, Placebo) x 2 Gender (Males, Females) x 3 Time (Pre-, Post-, Follow-up) repeated measure ANOVAs. The False Discovery Rate (FDR) was used to control for type 1 error in analyses where multiple ANOVAs were conducted (Benjamini & Hochberg, 1995) and the p value was set at 0.025.

3.3. Baseline characteristics

Means and standard deviations for the outcome measures at each assessment point are shown in Table 2. Preliminary analyses indicated that participants in the ABM and placebo training groups did not differ significantly on the outcome measures at baseline. The placebo group scored significantly lower on the SCARED Panic Disorder subscale [(M = 7.41(SD = 4.98) versus M = 9.51(SD = 6.05), F (118) = 2.592, p = 0.040)] and on the SCARED School Avoidance subscale [(M = 1.93 (SD = 1.83) versus M = 2.74(SD = 2.41) compared to the ABM training group (F (118) = 9.483, p = 0.041)]. Chi-square analyses revealed that there was a balanced distribution by key demographics across conditions.

3.4. Group differences in study outcomes

A 2 × 2 × 3 repeated measures ANOVA examined the effects of two between-subjects factors (Group; Gender) and one within-subject factor (Time) on all of the outcome measures – see Table 3. Statistical significance was at $p < 0.025$.

3.5. Primary outcomes

3.5.1. Threat bias measurement

There was no significant Time × Training interaction for threat bias measurement or threat bias variability.

3.5.2. SPAI-C total

There was a significant main effect of Time on SPAI-C total score, suggesting an overall reduction in social anxiety over time, but there was no Time × Training interaction. There was a significant main effect of Gender, where females had higher scores on the SPAI-C total score compared to males.

3.6. Secondary outcomes

3.6.1. SCARED total

Similar results were yielded, with a significant main effect of Time on SCARED total score, where social anxiety scores reduced over time, but there was no Time × Training interaction. There was a significant main effect of Gender, where females scored higher on the SCARED total score compared to males.

3.6.2. SCARED subscales

There was a significant main effect of Time on SCARED GAD, Social Anxiety, and Separation, but there was no Time × Training interaction for any of these subscales. There was a significant main effect of Gender on SCARED Panic, Separation, and School Avoidance subscales, where females scored significantly higher than males on these subscales.

3.6.3. BFNE-R

There were no significant Time, Training, or interaction effects on fear of negative evaluations.

3.6.4. RCADS-MDD

There was a significant effect of Gender on the RCADS-MDD, where females scored higher on symptoms of depression compared to males. There was no Time × Training interaction.

3.7. Covariates

To control for baseline group differences on the SCARED PD and SA subscales all analyses were re-run with PD and SA as covariates. Results remained the same, with the exception that there was no effect of Gender on SPAI-C total score, SCARED total scores, or the RCADS-MDD.

3.8. Post-hoc analyses

Post-hoc analyses were conducted to examine whether anxiety effects were shown for the subgroup who reported a reduction in threat-related attention bias from pre to post to follow-up (which was 26.7% (n = 32)). Post-hoc analyses showed no significant training effects on primary or secondary outcomes.

The screening phase was conducted ≈6 weeks prior to the RCT. We re-ran our analyses with those participants who remained above the cutoff on the SPAI-C at both screening and on the first day of testing (78.3%, n = 94). Our results were in line with those reported for the overall sample.

4. Discussion

The hypothesized advantages of ABM were not demonstrated; ABM did not modify attention biases in adolescents with subclinical levels of social anxiety. Recent ABM studies targeting SAD

Table 2
Demographic information of the participants in the RCT at baseline.

		ABM ($n = 61$) % (n)	Placebo ($n = 59$) % (n)
Gender	Female	61 (36)	55.7 (34)
	Male	39 (23)	44.3 (27)
Ethnicity	White	96.6 (57)	96.6 (56)
	Black	1.7 (1)	0 (0)
	Asian	1.7 (1)	1.7 (1)
	Other	0 (0)	1.7 (1)
School year	4th year	50.8 (31)	49.2 (29)
	5th year	49.2 (30)	50.8 (30)
School disadvantaged status (DEIS)	Non-DEIS	82 (50)	84.7 (50)
	DEIS	18 (11)	15.3 (9)
Use of mental health services	Yes	13.1 (8)	22 (13)
	No	86.9 (53)	78 (46)
Highest educational level of mother	Junior Certificate	12.7 (7)	9.8 (5)
	Leaving Certificate	21.8 (12)	19.6 (10)
	Qualified tradesperson	3.6 (2)	0 (0)
	College/University degree	38.2 (21)	39.2 (20)
	Professional degree	5.5 (3)	13.7 (7)
	Other	18.2 (10)	17.6 (9)
		M (SD)	*M(SD)*
Outcome Measures	Pre- SPAI	31.49 (7.53)	29.15 (7.47)
	SCARED Total	39.46 (13.81)	36.05 (12.31)
	SCARED Panic*	9.51 (6.05)	7.41 (4.98)
	SCARED GAD	12.48 (3.93)	12.47 (3.88)
	SCARED Social	10.54 (2.81)	9.80 (2.69)
	SCARED Separation	4.20 (3.45)	4.44 (3.20)
	SCARED School Avoidance*	2.74 (2.41)	1.93 (1.83)
	BFNE-R	31.80 (9.67)	31.29 (10.38)
	RCADS-MDD	12.84 (7.31)	11.64 (5.99)
	Threat bias measurement	−0.06 (19.03)	4.01 (28.35)

Note. *$p < 0.05$. Threat bias measurement scores were calculated by subtracting the mean RT for trials in which the probe appeared behind the angry face from the mean RT for trials in which the probe appeared being the neutral face for trials in which angry-neutral pairs were presented.

support our findings and have neither successfully modified biased attention nor impacted clinical symptoms (e.g. Boettcher et al., 2013; Bunnell, Beidel, & Mesa, 2013). Meta-analyses argue that more RCTs should be published before conclusions can be derived on the efficacy of ABM and that studies reporting negative findings should be particularly encouraged (Cristea, Kok et al., 2015; Mogoaşe et al., 2014).

We failed to successfully manipulate attention biases, the proposed causal mechanism of change, and, failed to observe any impact on social anxiety. It has been argued that an exclusive focus on attention bias towards threat in the case of social anxiety may be premature. Boettcher et al. (2013) unexpectedly found that the procedure intended to train attention towards threat cues produced a significant decrease in social fears, relative to the control condition. Further research is warranted to test whether ABM works through facilitating disengagement from threat-related stimuli or through attentional avoidance, which could contribute to social anxiety (Cisler & Koster, 2010).

4.1. Strengths

This study was one of the largest RCTs examining ABM training in adolescents with minimal attrition rates (7.7%). The study was registered as a clinical trial, recommended by Emmelkamp (2012). The placebo condition was tightly matched with the treatment condition in all parameters except the training contingency. This study did not explicitly inform participants about the attentional contingency in the task, supported by Grafton, Mackintosh, Vujic & MacLeod (2014). Participants were blind to the purposes of this study and randomization.

4.2. Limitations

First, the experimenters were not blinded to randomization, and this could have had some degree of unintentional effect on the way in which the training was delivered to the groups. Further studies should conduct a triple-blinded trial. Second, the current trial involved one ABM session per week over four weeks. The intervals between each training session may have been too far apart for participants' implicit learning of the intended contingencies between threat cues (avoid threat stimuli) and target location (direct attention to neutral stimuli). Using G*Power, our sample was large enough to find medium effects but not small to medium effects (significant small effects would require $n = 200$).

Research has shown the reliability of the dot-probe task to assess attention biases to be poor (Staugaard, 2009). Recent research has shown that a visual search-based assessment was more reliable than a visual probe task (Van Bockstaele, Salemink, Bogels, & Wiers, 2015) and has reported beneficial effects among adolescents with social anxiety (e.g. Voogd, Wiers, Prins, & Salemink, 2014). Thus, the use of a visual search task may have been a better choice of task in changing attention biases among adolescents.

Certain conditions such as lighting and noise could not be controlled for in our study to the same extent as in a laboratory, which may have added to the unreliablity of the task. Despite the lack of rigorously controlled conditions, this study was conducted in a quiet classroom in each school, participants completed the training task in small groups, and the researcher ensured that silence was maintained during the training.

We excluded young people with mental health diagnoses as they may have been receiving an intervention elsewhere or had another diagnosis which may have affected our outcomes, e.g. mood disorder, autism. There is a scarcity of research examining ABM training in a non-clinical adolescent population. We excluded adolescents with mental disorders as this trial aimed to examine the efficacy of ABM as a potential early intervention strategy.

The use of a vertical presentation in the probe task is another

Table 3
Means and standard deviations of symptom and attention bias measures at pre-intervention, post-intervention, and 12-week follow-up by condition (ABM/placebo training).

	Pre- M(SD)	Post- M(SD)	Follow-up M(SD)	Results
SPAI-C Total				
ABM	31.03 (7.34)	30.67 (8.22)	29.74 (9.10)	Time: F (2, 224) = 7.094, $p < 0.001$, eta^2 = 0.060
Placebo	29.00 (7.45)	29.24 (7.89)	27.12 (8.89)	**Gender: F(1,112) = 5.076, p = .026, eta^2 = 0.043**
				Training: F (1,112) = 3.028, p = ns
				Time x Training: F (2,224) = 1.926, p = ns
SCARED Total				
ABM	38.64 (13.12)	37.49 (14.37)	35.41 (14.59)	Time: F (2,228) = 9.244, p = 0.000, eta^2 = 0.075
Placebo	36.05 (12.31)	35.05 (13.95)	33.71 (14.78)	**Gender: F(1,114) = 16.223, p = .000, eta ^{2} = .125**
				Training: F (1,114) = 1.427, p = ns
				Time x Training: F (2,228) = 0.097, p = ns
SCARED Panic				
ABM	9.15 (5.80)	9.14 (6.12)	8.61 (6.16)	Time: F (2,228) = 0.388, p = ns
Placebo	7.41 (4.98)	7.05 (5.76)	7.73 (6.02)	**Gender: F(1,114) = 14.821, p = .000, eta^2 = 0.115**
				Training: F (1,114) = 3.112, p = ns
				Time x Training: F (2,228) = 1.62, p = ns
SCARED GAD				
ABM	12.32 (3.90)	12.07 (4.12)	11.61 (4.62)	Time: F (2,228) = 4.330, p = 0.014, eta^2 = 0.037
Placebo	12.47 (3.88)	12.29 (3.80)	11.80 (4.10)	Gender: F (1,114) = 3.975, p = 0.049, eta^2 = 0.034
				Training: F (1,114) = 0.007, p = ns
				Time x Training: F (2,228) = 0.049, p = ns
SCARED Social				
ABM	10.53 (2.81)	9.75 (3.33)	9.59 (3.31)	Time: F (2,228) = 13.715, p = 0.000, eta^2 = 0.107
Placebo	9.80 (2.69)	9.47 (3.28)	8.76 (3.68)	Gender: F (1,114) = 3.012, p = ns
				Training: F (1,114) = 2.243, p = ns
				Time x Training: F (2,228) = 1.174, p = ns
SCARED Separation				
ABM	4.02 (3.30)	3.80 (3.32)	3.34 (3.23)	Time: F (2,228) = 8.075, p = 0.001, eta^2 = 0.071
Placebo	4.44 (3.20)	4.24 (3.35)	3.59 (3.36)	**Gender: F(1,114) = 6.158, p = .015, eta^2 = 0.051**
				Training: F (1,114) = 0.563, p = ns
				Time x Training: F (2,228) = 0.178, p = ns
SCARED School Avoidance				
ABM	2.63 (2.34)	2.75 (2.32)	2.25 (2.08)	Time: F (2,228) = 3.137, p = 0.045, eta^2 = 0.027
Placebo	1.93 (1.83)	2.00 (1.97)	1.83 (1.83)	**Gender: F(1,114) = 35.445, p = .000, eta^2 = 0.237**
				Training: F (1,114) = 5.067, p = 0.026, eta^2 = 0.043
				Time x Training: F (2,228) = 0.752, p = ns
BFNE-R				
ABM	31.67 (9.69)	31.50 (10.88)	30.60 (11.21)	Time: F (2,230) = 1.120, p = ns
Placebo	31.29 (10.38)	32.73 (13.72)	31.36 (11.83)	Gender: F (1,115) = 1.900, p = ns
				Training: F (1,115) = 0.013, p = ns
				Time x Training: F (2,230) = 0.382, p = ns
RCADS-MDD				
ABM	12.82 (7.37)	13.30 (7.78)	12.57 (7.76)	Time: F (2,230) = 3.358, p = 0.037, eta^2 = 0.028
Placebo	11.64 (5.99)	12.71 (6.23)	11.88 (6.86)	**Gender: F(1,115) = 7.416, p = .007**
				Training: F (1,115) = 0.834, p = ns
				Time x Training: F (2,230) = 0.275, p = ns
Threat bias measurement				
ABM	−0.056 (19.02)	1.72 (17.07)	2.27 (18.29)	Time: F (2,232) = 0.010, p = ns
Placebo	4.01 (28.35)	1.77 (17.65)	1.17 (15.94)	Gender: F (1,116) = 0.30, p = ns
				Training: F (1,116) = 0.122, p = ns
				Time x Training: F (2,232) = 0.586, p = ns

limitation as there is evidence that the use of a left-right display is more effective (Beard et al., 2012). Another limitation is that the task used to measure whether bias changed closely resembled the task used for training. Lau (2013) recommend that pre- and post-training measures of attention bias differ in their similarity to the training task to minimise demand effects.

5. Conclusions

This study found that ABM conducted with adolescents with sub-clinical symptoms of social anxiety yielded non-significant effects on threat-related attention bias and symptoms. Our findings suggest that future studies should concentrate on laboratory-based investigations in an effort to uncover the experimental parameters under which maladaptive attention biases can be reliably altered.

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