Attention bias modification for youth with social anxiety disorder

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Background: Attention bias modification treatment (ABMT) targets threat-related attention biases in anxiety disorders. Most clinical trials of ABMT have focused on adults or small samples of youth. The current randomized controlled trial (RCT) examines ABMT efficacy in youth with social anxiety disorder (SAD) and tests possible moderators of treatment outcomes. Method: Sixty-seven youth with SAD were randomly assigned to ABMT or attention control training (ACT) conditions. Anxiety severity was measured at baseline, posttreatment, and 3-month follow-up. ClinicalTrials.gov name and identifier: Attention bias modification treatment for children with social anxiety, NCT01397032; http://www.clinicaltrials.gov. Results: Both ABMT and ACT induced significant reductions in clinician and self-rated social anxiety (p < .001). An additional reduction was observed at the 3-month follow-up in clinician-rated anxiety symptoms (p = .03). Moderation effects were nonsignificant for the clinician-rated anxiety outcome, but age moderated self-reported anxiety. Older but not younger children, showed significant reduction in anxiety following ABMT relative to ACT (p < .001). Individual differences in attention control also moderated ABMT's effect on self-reported anxiety (p = .05). Children rated by their parents as lower on attention control benefited more from ABMT than those rated higher on attention control. Baseline attention bias did not moderate anxiety (p = .17).

Conclusions: Despite significant reductions in social anxiety, no specific evidence for ABMT was found relative to a control condition. Age and attention control moderated ABMT effects on self-reported SAD symptoms, with clinical effects for older relative to younger children and for those with lower attention control. These results highlight the need to consider developmental influences in the implementation of ABMT protocols. Keywords: Adolescence; anxiety; attention; treatment trials.

Introduction

Social anxiety disorder (SAD) commonly emerges in childhood and afflicts about 5% of youth (e.g., Kashdan & Herbert, 2001). Cognitive-behavioral therapies and pharmacotherapy are effective treatments; however, only a few patients receive them, rendering novel and more disseminable treatments desirable (Beesdo, Knappe, & Pine, 2009; Wang et al., 2005). Attention Bias Modification Treatment (ABMT) is a computer-based treatment, which targets aberrant threat-related attention in anxiety (Bar-Haim, 2010). Specifically in SAD, most findings reflect difficulty to disengage attention from threats (Amir, Elias, Klumpp, & Przeworski, 2003; Heeren, Lievens, & Philippot, 2011). Such over dwelling on social threats is thought to maintain biased perception of the social environment (Heeren et al., 2011). Here, we present a RCT of ABMT for SAD.

Typical ABMT protocols use the dot-probe task (MacLeod, Mathews, & Tata, 1986) to redirect attention away from threats. Specifically, neutral and threat stimuli appear, followed by a probe at the location of the neutral rather than threat stimulus. Participants discriminate the shape of the probe as quickly and accurately as possible. This creates contingencies between the neutral stimuli and target location, facilitating change in attentional patterns (Bar-Haim, 2010).

The RCTs of ABMT in adults show evidence of efficacy in SAD (e.g., Amir et al., 2009; Heeren, Reese, McNally, & Philippot, 2012; Schmidt, Richey, Buckner, & Timpano, 2009), with small-to-medium effects (e.g., Hakamata et al., 2010; Linetzky, Pergamin-Hight, Pine, & Bar-Haim, 2015; Mogoase, David, & Koster, 2014). In children, ABMT efficacy has been tested as a stand-alone intervention (Eldar et al., 2012; Waters, Pittaway, Mogg, Bradley, & Pine, 2013), as well as an adjuvant to cognitive-behavioral therapy (CBT; for example, Britton et al., 2013; Shechner et al., 2014). ABMT studies on pediatric anxiety typically included youth with a mix of anxiety disorders. This heterogeneity in diagnoses might introduce measurement errors affecting clinical outcome. Recent evidence indicates content specificity of attention biases in anxiety (Pergamin-Hight, Naim, Bakermans-Kranenburg, van Ijzendoorn, & Bar-Haim, 2015), suggesting that it may be important that the threat stimuli used in ABMT protocols be specifically relevant to a specific targeted disorder. Such content matching is lacking in samples with mixed disorders. Thus, although comorbidity does exist, in an attempt to reduce variability in types of anxiety disorders, the present...
study included children with SAD as a primary diagnosis. Beyond the need for work specifically on SAD in youth, data in adults (Amir, Taylor, & Donohue, 2011; Lowther & Newman, 2014) suggest a need to examine potential treatment moderators in youth. Therefore, we examined age, attention control, and baseline threat-related attention bias as potential moderators of treatment outcome.

Prior research suggests that age influences attention bias and anxiety (Pine, 2007; Pine, Helfinstein, Bar-Haim, Nelson, & Fox, 2009), however no prior research examined age moderation of ABMT outcome in youth. ABMT is based on the ability of patients to learn implicit contingencies between threat location and target location (Abend, Pine, Fox, & Bar-Haim, 2014), an ability that matures with age (Casey, Tottenham, Liston, & Durston, 2005). Attention control refers to the capacity to monitor and shift attention (Rueda, Posner, & Rothbart, 2004). We explored attention control as a moderator because prior research suggests that this capacity influences anxiety and coping (Derryberry & Reed, 2002; Eysenck, Derakshan, Santos, & Calvo, 2007; Henderson, Pine, & Fox, 2014; Susa, Pitică, Benga, & Miclea, 2012). Finally, pretreatment threat-related attention bias was explored as a moderator because it is typically assumed that reduction in anxiety following ABMT results from change in attention bias. Thus, patients with a greater baseline threat bias may benefit more from ABMT. For example, SAD patients who show more difficulty disengaging from threat might benefit more from ABMT protocol directing attention away from the threat. Previous research on this issue suggests that socially anxious individuals with pretreatment attention bias show greater reductions in anxiety following ABMT both when using supraliminal presentations (Amir et al., 2011), and subliminal presentations (Maoz, Abend, Fox, Pine, & Bar-Haim, 2013).

This study examined moderators of ABMT efficacy in pediatric SAD. We expected: (a) ABMT to produce greater reduction in anxiety relative to attention control training (ACT); (b) age to moderate ABMT efficacy, with greater effects observed in older children; (c) attention control capacity to moderate ABMT efficacy, with greater effects in participants with better attention control; and (d) baseline threat-related attention bias to moderate ABMT outcome, with greater effects in patients with larger attention bias toward threat.

Methods

Participants

Figure 1 illustrates participant flow. The study was advertised in newspapers: 350 applicants were screened, of which 128
were assessed in-person; 34 did not meet inclusion criteria, an additional 27 applicants declined participation. The 67 eligible and willing participants (mean age = 12.67 years, SD = 3.08, Range 6-18, 43% male) were randomized to either ABMT (n = 31; mean age = 12.71 years, SD = 3.11, 64% male) or ACT (n = 36; mean age = 12.2 years, SD = 3.08, 50% male). Four participants (three ABMT, one ACT) discontinued treatment or failed to complete posttreatment assessments. An additional nine (three ABMT, six ACT) declined participation or were not available for the 3-month follow-up assessment. Table 1 presents sample characteristics.

Inclusion criteria were: (a) primary DSM-IV diagnosis of SAD, with primary determined as SAD being the main complaint and primary source of dysfunction; and (b) being 6-18 years old. Exclusion criteria were: (a) suicidal ideation; (b) reported substance abuse or dependence; (c) current or past schizophrenia or current major depression; (d) any concurrent treatment; and (e) psychotherapy in the past 6 months.

As expected, the sample exhibited clinical levels of social anxiety, in accord with prior research (e.g., Beidel, Turner, & Morris, 1995), reflecting a spectrum of social anxiety severity within the clinical range (ADIS severity score of 4-8). Major depression was an exclusion criterion, which might have led to a somewhat lower depression-related impairment in the current sample relative to samples (e.g., Roelofs et al., 2010; Smucker, Craighead, Craighead, & Green, 1986). The present sample also exhibited substantial comorbidity including generalized anxiety disorder (46.27%), separation anxiety disorder (23.8%), specific phobias (32.83%), obsessive-compulsive disorder (0.09%), selective mutism (0.07%), panic disorder (0.07%), ADHD (29.85%), learning disabilities (12%), oppositional defiant disorder (0.04%), dysthymia (10%) or past episode of major depression (9%), and enuresis (0.02%). The ABMT and ACT conditions did not differ in social anxiety levels, t(65) = 0.99, p = .32 or in distribution of comorbidity, χ² > 0.5 for all the comorbid disorders.

The intended sample size reflected prior reports. The effect size in one meta-analysis of ABMT in anxiety was medium (d = 0.51, Hakamata et al., 2010), suggesting that N = 70 participants yielded 80% power.

Psychiatric interview and questionnaires

Anxiety Disorders Interview Schedule for DSM-IV. The Anxiety Disorders Interview Schedule (ADIS) (Silverman & Albano, 1996) was used to assess diagnoses according to DSM-IV criteria, and was administered by clinical psychologists trained to 85% reliability criterion with a senior psychologist. SAD symptom severity rated by the independent clinician based on child and parents’ ADIS interviews served as the primary outcome. Severity was rated on a scale ranging from 0 (no functional interference) to 8 (severe functional interference). Clinical level severity is rated as 4 or higher on this scale.

The Social Phobia and Anxiety Inventory. Child self-reported social anxiety was assessed using the The Social Phobia and Anxiety Inventory (SPAI) (Beidel et al., 1995), a 26-item questionnaire with sound psychometrics (Beidel, 1996). Cronbach’s α in the present sample was .95. Total SPAI score served as secondary outcome.

Child Depression Inventory. Child depressive mood was assessed using the Child Depression Inventory (CDI) (Kovacs, 1981), a 27-item questionnaire. The CDI score is the sum of all items, after correction of reversed items, with higher scores representing more depressive symptoms. Cronbach’s α in the present sample was .87.

Revision of the Early Adolescent Temperament Questionnaire. The attention subscale of the Revision of the Early Adolescent Temperament Questionnaire (EATQ-R) (Ellis & Rothbart, 2001) short form of the parent report version was used to index children’s attention control ability. The attention subscale measures the capacity to focus and shift attention with acceptable psychometrics (Ellis & Rothbart, 2001). The mean score of the six items of the attention subscale was used, with higher scores representing better attention control. Internal consistency using Cronbach’s α was .68.

Attention bias measurement and modification

These procedures followed the standard protocol for ABMT of the Tel Aviv University – National Institute of Mental Health ABMT Initiative, http://people.socsci.tau.ac.il/mu/anxiety-trauma/research/.

Dot-probe stimuli and procedures. The face stimuli were photographs of 20 different individuals (10 male, 10 female), each individual contributing two pictures depicting angry and neutral expressions. Each participant was tested pre- and post ABMT or ACT with one set of faces, and trained with another set. In each trial, a fixation cross was presented (500 ms), followed by a pair of angry-neutral or neutral-neutral faces of the same individual (500 ms), one above the other,

| Table 1 Baseline group characteristics and estimated marginal means (with standard error) of outcome measures for the attention bias modification treatment (ABMT) and the attention control training (ACT) groups |
|---------------------------|---------------------------|---------------------------|---------------------------|
|                            | ABMT N = 31               | ACT N = 36                | Between groups statistics (tp) |
| Demographics              |                           |                           |                            |
| Age                       | 12.71 (3.11)              | 12.27 (3.08)              | 0.58 (.56)                 |
| Gender (M/F)              | (20/11)                   | (18/18)                   |                            |
| Cognitive moderators      |                           |                           |                            |
| Attention bias            | -7.84 (29.22)             | -1.65 (33.69)             | -0.78 (.43)                |
| Attention control         | 3.24 (0.63)               | 3.06 (0.70)               | 1.06 (.29)                 |
| Outcome measures at baseline |                         |                           |                            |
| Clinician-rated anxiety (ADIS) | 5.77 (0.23)          | 5.89 (1.26)               | -0.37 (.71)                |
| Self-reported anxiety (SPAI) | 57.49 (4.33)        | 58.61 (4.25)              | -0.18 (8.85)               |

SPAI, Social Phobia and Anxiety Inventory; ADIS, Anxiety Disorders Interview Schedule.

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followed by an arrowhead target-probe at the location of one of the faces (presented until response).

**Attention bias assessment.** The assessment task contained 120 trials (80 angry-neutral, 40 neutral-neutral). Angry face location, probe location, probe type, and actor were fully counterbalanced. Attention bias was the differences in reaction times to targets at the angry-face, relative to neutral-face location in the angry-neutral presentations.

**ABMT and ACT.** Each ABMT/ACT training session consisted of 160 trials (120 angry-neutral, 40 neutral-neutral). In the ABMT condition, the target appeared at the location of the neutral face in all angry-neutral trials, thereby creating a contingency between task demands (target discrimination) and neutral face location. In the ACT condition, all presentation elements were fully counterbalanced as in the measurement task, including targets appearing with equal probabilities at the locations of the angry and the neutral faces. Thus, the ACT condition did not direct participants’ attention to any type of stimulus.

**Procedure**

Baseline assessment included the ADIS interviews and questionnaires probing child anxiety, depression, and attention control. Children completed the dot-probe task and were randomized to either ABMT or ACT, using a computer-generated list of random numbers. An independent researcher dispensed coded numbers for either the ABMT or ACT condition. Children received eight training sessions delivered twice a week over 4 weeks at Tel-Aviv University. Participants, research staff, and the independent clinical evaluators were blind to group assignment. All baseline measures were readministered at posttreatment, and at the 3-month follow-up assessments. Parents provided written informed consent for participation in the study, and children provided either written consent or assent for participation. The study was conducted from May 2011 until April 2014, with approval of the university’s Institutional Review Board. ClinicalTrials.gov identifier NCT01397032.

**Data analysis**

To test whether random assignment had generated similar group characteristics, we conducted Chi-Square tests for categorical variables and t-tests for continuous variables comparing the ABMT and ACT groups on demographic and all dependent measures at baseline.

Treatment effects were tested using Generalized Estimating Equations (GEE) as described by Zeger et al. (Zeger & Liang, 1986; Zeger, Liang, & Albert, 1988), which has been recommended for clinical-trial data (Vens & Ziegler, 2012). GEE accounted for correlated repeated measurements and accommodates missing data under the missing-at-random assumption, by computing estimated marginal means and thus serves as an intention-to-treat analysis strategy which includes data from all participants who were randomized and provided at least one data point. To represent within-subject dependencies in the models, we specified an unstructured correlation matrix that specifically estimates the correlations.

The overall effects of ABMT relative to ACT on clinician-rated and self-reported anxiety symptoms were estimated using models containing main effects of group (ABMT vs. ACT), time, and their interaction terms. To test for treatment effects we modeled symptom change from baseline to posttreatment. To test for maintenance of treatment effects over time we modeled symptom change from posttreatment to 3-month follow-up. Time-by-group interaction terms tested the treatment effect hypothesis of greater decrease in social anxiety symptoms over time for the ABMT group relative to the ACT group.

To test for treatment moderation effects by age, attention control, and baseline attention bias we tested three separate models, one for each moderator, in which the interaction between treatment condition, time, and the moderator of interest were modeled (see Amir et al., 2011; Kraemer, Wilson, Fairburn, & Agras, 2002, for a similar analytic framework). Significant three-way interaction terms indicated differential effects of treatment as a function of the moderator.

To facilitate interpretation of the results the continuous moderators were centered at the grand mean prior to analyses.

To graphically represent the nature of significant three-way interactions, we allocated participants based on median split for age (younger vs. older youth, Median = 13.08 years) and attention control (higher vs. lower, Median = 3.17). We used post hoc HDL contrasts to probe the sources of significance in the interactions. Finally, to gauge the effect sizes rendered in this study, we calculated Cohen’s ds for main outcomes based on the estimated means and standard errors from the GEE analysis.

**Results**

**Overall change in clinical outcomes**

Figure 2 illustrates results of the GEE models.

For the primary outcome of clinician-rated social anxiety, a main effect of time was found (Wald $= 21.33, b = -0.76, SE = 0.21, p < .001$, Cohen’s $d = 0.58$), reflecting reductions in social anxiety regardless of treatment condition. No other main or interaction effects were significant, all $p$s > .50. This reduction in SAD severity from pre- to posttreatment was followed by further reduction in anxiety severity from posttreatment to 3-month follow-up, Wald $= 4.51,$

![Figure 2](image-url)
A decrease in the secondary outcome of self-reported social anxiety was also observed from pre- to posttreatment regardless of treatment condition, $Wald = 20.30, b = -11.83, SE = 4.45, p < .001$, Cohen’s $d = 0.54$. The improvement in symptoms across conditions was maintained at a 3-month follow-up, as indexed by the absence of change in self-reported anxiety from posttreatment to follow-up, $Wald = 2.42, b = 3.20, SE = 3.09, p > .10$.

Taken together, these results provide no evidence of ABMT efficacy, relative to ACT, in the overall sample. This pattern remains the same when baseline depression (CDI) and number of comorbid disorders were covaried: main effects of time ($p < .001$), and a nonsignificant Time-by-Condition interaction ($p > .60$).

Participants’ performance on the dot-probe task improved from baseline to posttreatment assessment in terms of response latencies, $t(59) = 4.46, p < .001$, and accuracy $t(59) = -2.87, p = .06$, these changes, however, were not related to changes in social anxiety levels.

**Moderators of treatment outcomes**

Correlation between moderators and social anxiety level at baseline were nonsignificant for clinician-rated anxiety, $p > .30$. Self-reported anxiety positively correlated with age, $r = .35, p = .004$; and correlations with attention control and baseline attention bias were nonsignificant, $p > .10$.

**Primary outcome**

The GEE models testing moderation of clinician-rated social anxiety severity were all nonsignificant. Time-by-Treatment condition-by-Moderator interaction was nonsignificant for age, $Wald = 1.39, p = .80$, attention control, $Wald = 5.75, p = .20$, or baseline threat-related attention bias, $Wald = 7.11, p = .31$.

**Secondary outcome**

**Age.** There was a significant Time-by-Condition-by-Age interaction for child-reported social anxiety, $Wald = 29.90, p < .001$, indicating differential treatment effects for ABMT versus ACT as a function of age (Figure 3). Follow-up analyses showed that for older youth, there was no difference between treatment conditions at baseline, whereas at posttreatment participants in the ABMT condition reported significantly lower social anxiety than participants in the ACT condition, $p = .02$, Cohen’s $d = 0.48$. This difference reflected a mean change in the SPAI score that is 14.11 points larger for the ABMT relative to the ACT condition, whereas no group difference was observed among the younger youth ($p = .28$, Cohen’s $d = 0.09$).

To control for potential age-related differences in gender ratios and social anxiety severity, we also tested the model with these variables as covariates. The Time-by-Condition-by-Age interaction remained significant, $Wald = 16.21, p = .01$, ruling out the possibility that older children benefited more from ABMT only because they had greater potential for symptom reduction. Finally, models examining changes from posttreatment to follow-up did not reveal significant moderation effects of age (all $p > .05$).

**Attention control.** The GEE model testing moderation of attention control on reduction in self-reported social anxiety in each condition, revealed a significant Time-by-Condition-by-Attention control interaction, $Wald = 9.60, p < .05$, reflecting differential treatment effects as a function of individual differences in attention control (Figure 4). Post hoc analyses showed that, unlike our original prediction, for participants with lower attention control, only the ABMT condition resulted in significant symptom reduction from baseline to posttreatment ($p < .001$, Cohen’s $d = 1.00$), while the ACT condition did not ($p = .52$, Cohen’s $d = 0.33$). Posttreatment difference in self-reported anxiety between conditions also proved significant ($p = .001$, Cohen’s $d = 1.09$). For participants with higher attention control no differences between conditions were detected. GEE Models examining changes from posttreatment to follow-up did not yield significant moderation effects of attention control (all $p > .05$).

**Baseline threat-related attention bias.** The GEE model did not reveal moderation of treatment effects
In this study, age moderated youth’s self-reported social anxiety: older but not younger youth showed significant reduction following ABMT relative to ACT. This finding did not emerge for the primary outcome of clinician-rated social anxiety. This inconsistency in results might be due to specific characteristics that differentiate self- and clinician-ratings. First, the clinician severity rating scale used here is a single-item, 9-point scale reflecting the compiled impression formed by the clinician of the level of interference of a child’s social anxiety symptoms to his or her general functioning. In contrast, the total score of the self-reported measure (SPAI) reflects a richer index of the responder’s social anxiety that is based on numerous context scenarios and symptoms. It is possible that the more nuanced self-reported measure allows capture of treatment-specific moderation effects not detected by the more general clinician-based measure. Second, while the self-report measure relies exclusively on the child’s perception of his or her symptoms and their severity, the clinicians’ rating integrates both child and parent responses throughout the interview, responses known to sometimes poorly correspond (Krain & Kendall, 2000). Discrepancies between parent and child reports during the interview and the clinician’s overall integration of these responses might washout subtle treatment effects explaining the difference in moderation effects observed here. Finally, it might be that reports of older children are more refined relative to those of younger children, due to better language skills and greater self-awareness. This may enable older children to better detect change in inner experience or to better report such changes than younger children.

A recent meta-analysis (Mogoase et al., 2014) also found age to moderate the effect of ABMT procedures. However, in this meta-analysis, younger relative to older adults benefited more from ABMT (of the 43 samples included in this meta-analysis only two were of youth); in the current study, older relative to younger children benefited. Taken together these results may suggest an inverted U-shape pattern of age-related benefits from ABMT, with adolescents and young adults making the most out of this treatment. Indeed, ABMT is a rapid engagement task, requiring psychomotor and cognitive learning. These capacities mature and improve throughout childhood, reaching an optimal functionality in adolescence and early adulthood (Casey et al., 2005; Liu et al., 2014). It is therefore reasonable that ABMT would be most effective during this age period.

These findings also suggest that the ABMT protocols suitable for adults might not be readily applicable to young children, and highlight the need to develop alternative procedures better suited for use with children. Indeed, Kuckertz and Amir (2015) suggested that ABMT research should advance to developing and testing measurement...
and training tools that take into consideration participants’ unique characteristics (e.g. response latency, accuracy levels, rate of bias change). Normative and disorder-related data on the learning processes and performance in ABMT across age are still elusive and may be of great importance for the development of age-appropriate ABMTs for anxiety disorders.

Attention control also moderated self-reported treatment outcome. For participants with relatively poor attention control, ABMT resulted in greater reduction of social anxiety from pre- to posttreatment. Again, this moderation effect was not found for clinician-rated severity of social anxiety. Unexpectedly, although previous reports provided a theoretical framework and evidence for associations between low attention control, high anxiety, and attention bias toward threat (Lonigan & Vasey, 2009; Susa et al., 2012), the present finding essentially suggests that poor attention control may be associated with greater benefit from ABMT relative to ACT. Perhaps, when baseline attention control abilities are poor, gains from attentional training may be elevated through additional mechanisms that produce the anxiolytic effect. For example, it is possible that alongside the affect-related contingency being targeted in ABMT, general attention control is also trained during task performance. In such a case, participants with poorer attention control may benefit from a general cognitive control training embedded in the task, whereas this possible benefit may be at a ceiling in participants with high attention control ability. Alternatively, anxiety reduces the efficiency of general attentional processes, and anxious individuals may use compensatory strategies such as exerting extra effort in task performance or increasing use of shifting and inhibition functions (Derakhsh, Ansari, Hansa, Shoker, & Eysenck, 2009; Deraksh & Eysenck, 2009). Thus, it is possible that participants with the combination of high social anxiety and poor attention control increase investment in task performance to compensate for these deficiencies relative to their peers with high attention control, and thereby gain an enhanced clinical effect from ABMT.

The current results did not indicate a moderating role for baseline attention bias on the effect of treatment type on anxiety outcomes. There are several possible reasons for this null result. This finding could be seen in light of broader inconsistencies and variability regarding the reported mechanistic role of attention bias in ABMT effects. While some studies found associations between attention bias and change in treatment outcomes (Heeren et al., 2012; Waters et al., 2013), other studies with anxious youth did not (Riemann et al., 2013; Shechner et al., 2014), or else reported a failure to find associations between attention bias and symptom reduction (Eldar et al., 2012). This complexity highlights the need for additional and more refined research on the role of baseline attention bias in ABMT outcome. In addition, with concerns recently raised regarding limited reliability of the dot-probe index of attention bias (Cisler, Bacon, & Williams, 2009; Price et al., 2014), it may be useful to develop new ways to assess threat-related attention bias and its plasticity as a function of ABMT (e.g., Kuckertz & Amir, 2015; Naim et al., 2015; Zvielli, Bernstein, & Koster, 2014). Finally, it may be that the current sample size was underpowered to detect this moderation effect.

The findings of the current trial should be viewed in light of potential limitations. First, although the current sample size is larger than many prior studies of ABMT in youth, still it might lack sufficient power to detect some of the expected effects (Linetzky et al., 2015). Second, limited sample size did not allow testing of more elaborated interactions, for instance reflecting reciprocal influences of age and additional factors on ABMT results. Third, since both ABMT and ACT were similarly effective, it could be argued that both conditions reflect a spontaneous placebo improvement. This claim is somewhat weakened by the moderation effects by age and attention control that did differentiate the ABMT and ACT conditions. Nevertheless, future studies could consider a better control group that does not expose patients to threat faces or spatial attentional cueing at all. Fourth, the present study used threat relative to neutral faces as training stimuli. However, some research has indicated that socially anxious individuals might perceive ambiguous stimuli as threatening (e.g., Yoon & Zinbarg, 2007). Thus, it is possible that neutral faces carry mild threat to socially anxious youth due to their perceived ambiguity. Future studies may wish to assess the impact of use of different face stimuli in ABMT (e.g., happy-neutral) for SAD, and to examine ABMT in other specific anxiety disorders among youth. Finally, the moderation of clinical outcome by attention control relies on parents’ reports of their child’s trait-like behavior. Future studies may wish to examine attention control also with participant’s subjective self-reports (e.g., Derryberry & Reed, 2002; Muris, Meesters, & Rompelberg, 2007), and with objective performance measures of attention control such as the attention network task (Fan, Wu, Fossella, & Posner, 2001) or the Eriksen Flanker Task (Eriksen & Eriksen, 1974).

In conclusion, it appears that ABMT with the current protocol parameters may be most useful for older and less so for younger youth with anxiety. This result calls for adaptation of extant ABMT protocols to better match the needs of younger patients. Such adaptations should take into consideration developmental influences as well as individual differences in general cognitive capabilities.
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Key points

- Attention Bias Modification Treatment (ABMT) targets selective attention to threat, a cognitive mechanism of anxiety. Evidence suggest efficacy of ABMT in anxious adults and mixed samples of anxious children.
- This randomized controlled trial (RCT) examines ABMT efficacy and treatment effect moderators in youth with social anxiety disorder.
- While reduction in anxiety occurred regardless of treatment condition in the overall sample, results indicate that age and attention control moderated self-reported treatment outcomes. Older youth, as well as youth with poorer attention control, benefited more from ABMT relative to attention control training.
- The findings call for adaptation of ABMT protocols to better suite anxious youth and highlight the need to consider developmental influences as well as basic cognitive abilities in ABMT.

References


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