



Online visual search attentional bias modification for adolescents with heightened anxiety and depressive symptoms: A randomized controlled trial



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ABSTRACT

Anxiety and depression, which are highly prevalent in adolescence, are both characterized by a negative attentional bias. As Attentional Bias Modification (ABM) can reduce such a bias, and might also affect emotional reactivity, it could be a promising early intervention. However, a growing number of studies also report comparable improvements in both active and placebo groups. The current study investigated the effects of eight online sessions of visual search (VS) ABM compared to both a VS placebo-training and a no-training control group in adolescents with heightened symptoms of anxiety and/or depression ($n = 108$). Attention bias, interpretation bias, and stress-reactivity were assessed pre- and post-training. Primary outcomes of anxiety and depressive symptoms, and secondary measures of emotional resilience were assessed pre- and post-training and at three and six months follow-up. Results revealed that VS training reduced attentional bias compared to both control groups, with stronger effects for participants who completed more training sessions. Irrespective of training condition, an overall reduction in symptoms of anxiety and depression and an increase in emotional resilience were observed up to six months later. The training was evaluated relatively negatively. Results suggest that online ABM as employed in the current study has no added value as an early intervention in adolescents with heightened symptoms.

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Anxiety and depression are highly prevalent disorders in youth and have enduring negative consequences for social and academic functioning and mental health (Woodward & Fergusson, 2001). Since adolescence is a period of increased vulnerability for the development of these disorders, as well as a period of increased brain plasticity, prevention and early intervention are particularly important in this age group (Crone & Dahl, 2012; Haller, Cohen Kadosh, Scerif, & Lau, 2015). In order to reach a larger number of at-risk adolescents, low-barrier and low-cost interventions are necessary. Online cognitive training, like Attentional Bias Modification (ABM) training, could be such a candidate intervention, as adolescents would be able to complete the intervention 24/7 and without the help of a therapist.

Attentional bias modification training was first developed to test the causal role of an attentional bias for negative information in emotional vulnerability (MacLeod, Rutherford, Campbell,

Ebsworthy, & Holker, 2002). Earlier research had already provided a large body of evidence for cross-sectional and prospective relations between such an attentional bias and emotional vulnerability or emotional disorders (for reviews, see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van Ijzendoorn, 2007; Cisler & Koster, 2010; Platt, Waters, Schulte-Koerne, Engelmann, & Salemink, 2016; Puliafico & Kendall, 2006; van Bockstaele et al., 2014). Biases in attention also affect later stages of information processing, like interpretation and memory (Everaert, Duyck, & Koster, 2014), and thus seem to be a core process underlying negative cognitions in anxiety and depression.

As manipulating attentional bias indeed led to changes in emotional responding, a growing body of research has focused on ABM as a potential intervention to reduce or prevent psychopathology such as anxiety and depression (Woud & Becker, 2014). These studies have provided mixed results, ranging from large reductions in clinical symptoms of anxiety to null-findings on both attentional bias and emotional outcome measures (for meta-analyses, see Cristea, Kok, & Cuijpers, 2015; Heeren, Mogoșe, Philippot, & McNally, 2015; Linetzky, Pergamin-Hight, Pine, &

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Bar-Haim, 2015; Mogoş, David, & Koster, 2014). Important to note is that most null-findings on cognitive and emotional outcomes occur. That is, when no change in attentional bias has been obtained, emotional effects are generally also absent, while a successful manipulation of attentional bias tends to result in a change in at least some emotional outcome measures (MacLeod & Clarke, 2015; MacLeod & Grafton, 2016). This seems to suggest that manipulating attentional bias could be an effective intervention to reduce emotional vulnerability, but that the optimal paradigms and circumstances for changing attentional bias have yet to be found.

The most promising findings have been obtained in adult samples with (sub)clinical social anxiety, mainly in studies where training was performed in the laboratory (Linetsky et al., 2015; Mogoş et al., 2014). As noted before, one of the great advantages of ABM compared to traditional (face-to-face) interventions is the possibility to deliver the training via the internet. However, attempts to employ ABM online have been less successful in changing attentional biases and symptomatology (e.g., Boettcher, Berger, & Renneberg, 2012; Carlbring et al., 2012), and more research on this delivery method is necessary (Mogoş et al., 2014). It has been argued that online studies perform worse, due to a lack of experimental control or lack of social exposure (Boettcher et al., 2013; Kuckertz et al., 2014). However, a recent study directly comparing in-lab ABM training with training at home found no differences between active and placebo groups in both settings (Carleton et al., 2015), suggesting that the online environment is not the sole explanation for recent null findings.

Compared to the adult literature, ABM research in adolescents is relatively scarce, and studies up till now have also provided mixed evidence (for a meta-analysis, see Cristea, Mogoş, David, & Cuijpers, 2015; for a review see Lowther & Newman, 2014). That is, changes in attentional bias are often observed, but effects on mental health seem inconsistent or limited. However, note that most studies included in this meta-analysis and review focused on clinical samples. Given the increased vulnerability but also plasticity during adolescence, research on prevention or early intervention is particularly relevant here (Crone & Dahl, 2012; Haller et al., 2015). Two studies on ABM as an early intervention for adolescents with heightened levels of social anxiety, did not find beneficial effects on attentional bias or social anxiety compared to placebo (Fitzgerald, Radwon, & Dooley, 2016; Sportel, de Hullu, de Jong, & Nauta, 2013). Note that these studies, as well as most studies included in the meta-analysis and review mentioned above, used a dot-probe training paradigm.

The dot-probe training (MacLeod et al., 2002) is the most often used ABM paradigm. Here, participants have to respond to a probe that replaces a neutral or positive stimulus that is paired with a negative stimulus, thus encouraging less attention to negative information. However, findings in youth samples have been mixed (Cristea et al., 2015b) and subjective evaluations are quite negative, as participants experience the task as boring and miss a clear rationale (Beard, Weisberg, & Primack, 2011). The visual search training is an alternative paradigm, in which participants have to search for the only positive stimulus (e.g. smiling face) amongst a grid of multiple negative stimuli (e.g. rejecting faces) (Dandeneau & Baldwin, 2004). This task aims to train both engagement with positive information and disengagement from negative information. It could be considered a more explicit task, as strategic search processes seem to be involved. This could make the task more intuitive and potentially more engaging for participants. However, the precise mechanisms assessed and trained with the visual search task compared to the dot probe task are still largely unknown.

In several studies with this paradigm (Dandeneau & Baldwin, 2004; 2009; Dandeneau, Baldwin, Baccus, Sakellaropoulou, & Pruessner, 2007), positive effects have been observed on

attentional bias, self-esteem and both self-report and physiological indices of stress-reactivity, but in a dysphoric sample, a single session had no effect on attentional bias (as assessed with the dot-probe task) or mood state (Kruitj, Putman, & van der Does, 2013). Visual search training has also been employed in youth samples, and reductions in attentional bias and anxiety were observed in a small sample of unselected adolescents (de Voogd, Wiers, Prins, & Saleminck, 2014). In a recent large scale online RCT in unselected adolescents, visual search training also led to a large reduction in attentional bias, but here no effects on emotional functioning were observed compared to placebo (de Voogd, Wiers, et al., 2016). As in several (online) studies of dot-probe ABM (e.g. Boettcher et al., 2012; Carlbring et al., 2012), a significant reduction in symptoms was observed, but both in the active and placebo condition. In contrast, in two studies in clinical samples, positive effects on anxiety have been observed in the visual search training specifically (Waters, Pittaway, Mogg, Bradley, & Pine, 2013; Waters et al., 2015), though note that only one of these studies included an active control group (Waters et al., 2013). These findings suggest that visual search ABM might be particularly suited for youth already high in symptomatology.

Improvements in both active ABM and placebo groups could be interpreted in various ways. First, it might simply reflect an effect of time, thus indicating a natural decline in symptoms or regression to the mean (cf. Sportel et al., 2013). Second, it could also reflect placebo effects, that is, demand effects, or effects of positive expectations and increased attention. Third, and probably most intriguing, the placebo condition used in such studies might unintentionally also be an effective training. For example, emotional effects might also be obtained with neutral or even attend-negative training, probably by increasing attentional control (cf. Chen, Clarke, Watson, MacLeod, & Guastella, 2015; Heeren, Mogoş, McNally, Schmitz, & Philippot, 2015; Klumpp & Amir, 2010). However, mere practice effects might also explain these improvements (Heeren, Coussemont, & McNally, 2016). To disentangle the effects of a placebo training and of time alone, long-term studies including both a placebo and a no-training control group are essential.

Finally, it is important to assess which cognitive processes are affected by ABM. According to the combined cognitive bias hypothesis (Everaert, Koster, & Derakshan, 2012; Hirsch, Clark, & Mathews, 2006), negative biases in information processing, like attentional bias, but also interpretation and memory biases, may influence each other and interact in predicting emotional problems. For example, it has been found that attentional biases operate during the interpretation of ambiguous information, with negative biases in the latter predicting depressive symptoms (Everaert, Grahek, & Koster, 2016). The extent to which ABM is able to also affect other cognitive processes might thus be an important factor in fostering (durable) change in emotional vulnerability. A previous study on dot probe ABM has shown positive effects on interpretation bias (White, Suway, Pine, Bar-Haim, & Fox, 2011), but another study did not find a relation between individual differences in change in attentional bias and change in interpretation bias (Everaert, Mogoş, David, & Koster, 2015). Both studies employed single-session training and the latter did not observe an attentional bias effect at the group level. Whether multi-session ABM, or visual search ABM in general, could affect other cognitive processes is still unknown.

In the current study, adolescents with heightened symptoms of anxiety and depression were randomized to eight online sessions of either visual search or placebo training, or to a no-training control group. Primary outcomes of anxiety and depressive symptoms, and secondary outcomes of self-esteem, perseverative negative thinking, and social-emotional and behavioral problems were

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