Attentional Bias Training in reducing symptoms of anxiety

Joanna Kłosowska[1], Agata Blaut[1], Borysław Paulewicz[2]

[1]Institute of Psychology, Jagiellonian University, Clinical Psychology Unit,
Institute of Psychology, Jagiellonian University
Head: prof. dr hab. W. Łosiak

[2]University of Social Sciences and Humanities, Faculty in Katowice
Head: prof. dr hab. K. Popiołek

Summary

Anxiety is related to attentional bias, i.e. a tendency to pay attention to threatening stimuli. This occurs both in individuals suffering from anxiety disorders, and in healthy individuals with elevated levels of trait anxiety. This article is an analysis of a research paradigm, used to modify attentional bias (CBM-A Cognitive Bias Modification – Attention). A growing number of studies indicate that with the help of computer methods such as a modified version of the dot-probe task we can train individuals to direct attention away from threatening stimuli, which in turn reduces symptoms of anxiety. This effect was observed in adults, adolescents and children suffering from social phobia, generalised anxiety disorder and subclinical symptoms of obsessive-compulsive disorder. Effectiveness of this method constitutes the evidence for attentional bias being among the causes of anxiety disorders. The article also analyses the still not completely clear mechanisms of CBM-A and limitations of this method.

Key words: cognitive therapy, cognitive bias training, anxiety, anxiety disorders

Attentional bias in anxiety and anxiety disorders

Fear and anxiety are natural adaptive reactions to a potential threat. Noticing and recognising signs of danger triggers cognitive, affective, physiological and behavioural processes which are essential to an organism's survival [1]. In case of inappropriate – e.g. excessive – activation, these processes can be conducive to development of disorders. The cognitive approach assumes that anxiety and emotional disorders are caused and persist partially due to preferential processing of threatening stimuli,

i.e. cognitive bias [2, 3]. This bias can manifest itself with a tendency for negative interpretation of situations and events (interpretive bias), better memory for threatening contents (memory bias) or with an increased tendency to notice threatening stimuli (attention bias) [4].

The tendency of anxious individuals to pay particular attention to threatening stimuli has been demonstrated in many studies [5]. This effect is observed in healthy individuals with an elevated level of trait anxiety, as well as in patients suffering from anxiety disorders. Attention bias has been observed, among others, in generalised anxiety disorder [6], posttraumatic stress disorder [7], specific phobias [8], panic disorder [9] or obsessive-compulsive disorder [10].

Attention biases are usually measured with computer tasks such as an emotional version of the Stroop task, visual search and dot-probe task [11]. The dot-probe task has so far been the most popular tool for the measurement and modification of attentional bias [12, 13]. This task involves a series of trials in which two stimuli (often a neutral and a threatening one) are simultaneously presented on a computer screen for a relatively short time (e.g. 500 ms). The stimuli can be words or images, such as photographs of faces expressing different emotions. These stimuli are immediately followed by an abstract target stimulus e.g. a dot appears in the location of one of the stimuli (Figure 1). It is assumed that an anxious individual will react sooner to the target stimulus if it appears in the location of a previously displayed negative stimulus (congruent position), due to the fact that a negative stimulus should more likely attract their attention. In the measurement version of this task the target stimulus occurs with equal probability in a congruent and in a non-congruent position,
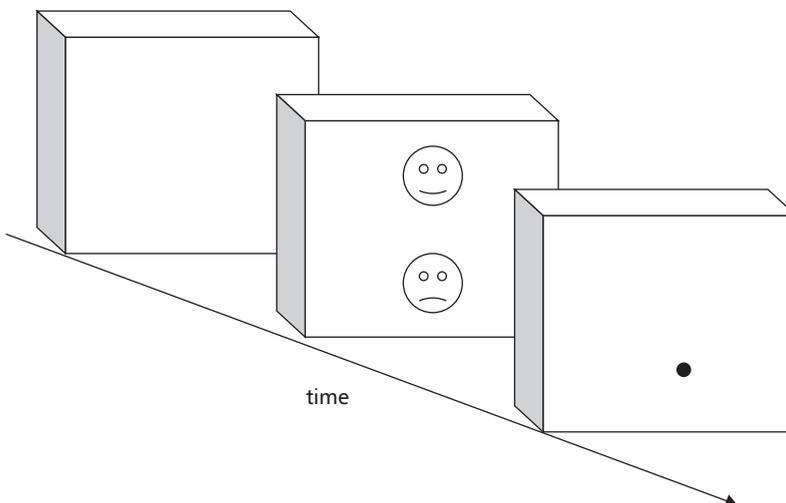

Figure 1. **Dot-probe task**

and the difference between mean reaction times to these presentations is an indicator of the direction and intensity of bias.

Influence of attentional bias on anxiety level and stress reactivity

As it has been mentioned before, cognitive models postulate that cognitive bias, and therefore attentional bias as well, is one of the factors responsible for the development and persistence of anxiety and emotional disorders. The bias is treated as an important factor in the aetiology and not merely a side effect of the disorder [14]. These assumptions underlie the cognitive-behavioural therapy which to a large extent focuses on change of cognitive bias [15]. It becomes apparent that the cognitive-behavioural therapy not only eliminates symptoms but also lowers attention bias towards threats in generalised anxiety disorder [16] and social phobia [17]. Moreover, reduced worrying which is a key characteristic in generalised anxiety disorder, correlates with reduction of attentionall bias [6]. These results indirectly suggest that reduction of symptoms of anxiety through therapy can, to some extent, be mediated by changes in attentional bias.

The pivotal study by MacLeod et al. [18] provided direct support of the thesis on the causative role of attentional bias in the development of anxiety. The study involved experimental manipulation of attentional bias and tested the consequences of such manipulation on emotions and stress reactivity. In order to teach tested individuals to specifically direct attention to negative stimuli a modified version of the dot-probe task was used. Some of the tested individuals – students with low and moderate levels of trait anxiety – were trained to direct attention to threatening stimuli. In this version of the dot-probe task a target stimulus always appeared in the location of a threatening stimuli. As a result of the training, tested individuals paid less attention to previously displayed neutral stimuli and more attention to negative ones. It became apparent that individuals in this group demonstrated more symptoms of anxiety than the control group exposed to the stressor of a difficult task performed under evaluation. This study indicated that when using a right method attentional bias can be modified and consequently, stressor reactivity, and therefore anxiety level, can be altered. However, if threat-related attentional bias can be increased and thus the increased level of anxiety can be induced, it should be possible to cause an adverse action, i.e. reduce anxiety by reducing the bias. The aforementioned publication brought about ongoing development of studies related to the efficacy of attentional training in reducing anxiety and anxiety disorders.

Attentional bias training in reducing anxiety – examples of studies.

Most studies related to Cognitive Bias Modification-Attention (CBM – A) use the above mentioned, modified version of the dot-probe task described by MacLeod et al. [18]. If an experimenter's objective is to induce a tendency to ignore or divert

attention from negative stimuli, the target stimulus is presented more often in the location of a neutral stimulus, and not in the location of a threatening stimulus. Thus ignoring negative stimuli or diverting attention away from them becomes beneficial to task performance. Tested individuals simply learn, consciously or not, that a target stimulus is likely to appear in the location of the previously displayed neutral stimulus and as a result of this they direct less and less attention to previously displayed negative stimuli. In control condition target stimulus appears with equal probability in location of negative and neutral stimuli. Studies on the efficacy of attentional training are carried out on clinical groups and healthy individuals with elevated anxiety levels. They can be one-time tests, which take several minutes, or they can involve several training sessions and last at least few days.

In one of the experiments [19] patients with social phobia were trained to divert attention away from faces expressing disgust. The study was composed of 8 sessions carried out within 4 weeks, and each session was composed of 160 trials. After the training 13 patients in the experimental group (n = 18) no longer met diagnostic criteria for social anxiety. In the control group (n = 18) 2 patients did not meet these criteria. In the test carried our 4 months later 9 individuals in the training group were still in remission, compared to 3 individuals in the control group. Amir et al. [20] also demonstrated that a training which involves diverting participants' attention away from faces expressing disgust can reduce symptoms of social anxiety in individuals with social phobia (n = 44). After the training half of the experimental group and only 3 individuals in the control group did not meet diagnostic criteria of this disorder. The differences between groups were still noticeable after 4 months.

Studies on patients with generalised anxiety disorder were also conducted [21]. They were trained to divert attention from threatening words. Because in generalised anxiety disorder threatening objects are very diversified, the experiment used individualised stimuli; they were words previously assessed by participants as negative. The training lasted 4 weeks and was composed of 8 sessions, 160 trials each. Half of the patients in the experimental group (n = 14) and only 2 participants in the control group (n = 15) did not meet diagnostic criteria of generalised anxiety. Similar results were achieved in a test composed of five sessions conducted in a sub-clinical group of students (n = 24) with a tendency to worry [22]. Half of them were assigned to the training group and half to the control group. In this test, participation in the training was associated with significant reduction of both attentional bias and symptoms of anxiety.

The efficacy of attention training was also tested in social phobias. 41 spider-fearful individuals [23] were tested, 20 of whom were subjected to a training in diverting attention away from images of spiders and directing it towards neutral stimuli (images of cows and birds). The training included 768 trials divided into 8 blocks. Intervention results were measured immediately after it ended, one day later and one week later. Anxiety and diversion levels were measured by self-description and a behavioural task in which the participants were asked to approach a cage with a tarantula. The training

reduced attentional bias towards threatening stimuli but the effect was still visible only one day after the training. Even though anxiety and spider avoidance measured by the behavioural task decreased in both the experimental and the control groups, the decrease of bias in the training group was not connected with significantly increased reduction of symptoms when compared to the control group. Another study, conducted on a subclinical group of spider-fearful students (n = 65) [24], also demonstrated change in attention bias towards images of spiders, however, no influence of the training on psychological, behavioural and physiological indicators of fear of spiders was demonstrated. These results may suggest a limited efficacy of the training in reducing symptoms of specific phobias.

Najmi and Amir [25] tested the efficacy of attention training in a group of individuals with subclinical obsessive-compulsive symptoms (n = 52). The authors assumed that after a training in diverting attention from words connected with contamination participants will more willingly approach anxiety-inducing contamination related stimuli. Experimental group (n = 26) demonstrated significant reduction of attention bias towards threatening stimuli; individuals in this group took significantly more steps in the direction of a threatening object when compared to control group.

The efficacy of a training in reducing the level of anxiety was demonstrated not only in adults with anxiety disorder but also in children and youths. Eldar et al. [26] tested the efficacy of attention training in 8-14 year-olds with anxiety disorder who were randomly assigned to three groups – a training one (n = 15) and two control groups: the placebo group and neutral group. In placebo group (n = 15) the same stimuli as in training group were used but target stimuli were presented with equal probability in location of threatening and neutral stimuli. In neutral group (n = 10) only neutral stimuli were presented. In the training group where participants were taught to divert attention away from threatening faces, reduction of attention bias was observed, as well as significant decrease in anxiety level both in children's declarations and their parents' descriptions. After the training, 5 children in the training group did not meet diagnostic criteria of anxiety disorder as compared to 2 children in the placebo group. In the additional control group, in which only the previously displayed neutral stimuli were used, no significant changes were observed, and all children still met the criteria of anxiety disorder. Rozenman, Weersing and Amir [27] conducted an attentional bias training on a group of 16 young individuals between 10 and 17 years of age diagnosed with anxiety disorder. The training included 12 15-minute sessions and took 4 weeks to complete. A significant reduction of anxiety and depression symptoms was observed, and 12 individuals did not meet diagnostic criteria of anxiety disorder after the intervention.

The mechanism of attentional bias training

Despite the growing number of studies on attentional bias training, the mechanism behind it remains unclear. One of the important questions is whether it affects automatic

attention processes (bottom-up processing) or more controlled, complex processes (top-down processing). Previous studies seem to demonstrate the latter. For instance Koster et al. [28] used three different exposure durations of emotional stimuli, i.e. 30, 100 and 1500 ms. Training effects were only observed in the longest exposure. These results may suggest that the training is more likely to affect later stages of threatening stimuli processing. A study by Browning et al. [29], using the neuroimaging method, demonstrated that attention training is associated with activation of frontal lobes responsible for controlled processing in response to emotional stimuli, however, it is unclear whether frontal activation is part of the process of training affecting attention and emotions, or merely a correlate of this procedure.

Another important question regarding the CBM-A mechanism pertains to the specificity of the dot-probe task and the nature of attention processes learnt during training. It is difficult to determine whether individuals tested in this procedure learn to divert attention away from specific stimuli (usually threatening ones), or to focus attention on specific stimuli (usually neutral, occasionally positive ones), or whether they learn both. In other words, the structure of this task makes the trained rule ambiguous. Heeren, Lievens and Philippot [30] attempted to determine whether therapeutic results of anti-negative training stem from an acquired tendency to focus attention on neutral stimuli, or to divert attention away from negative stimuli, or from both these processes. Two experimental conditions were of particular relevance – in the "disengagement" condition a negative stimulus was presented on one side of the screen, without an accompanying negative stimulus, and a target stimulus always appeared on the other side. In the "re-engagement" condition, the previously displayed stimulus was always neutral and replaced by a target stimulus presented in the same location. The repeated engagement condition proved to be the least efficient in reducing the level of stress reactivity. According to the authors, this means that training influences an individual's mood by evoking a tendency to divert attention away from negative stimuli. We can, however, doubt whether this is a proper way of measuring the mechanism of training efficacy. A dot-probe task is not a simple sum of two tasks with isolated stimuli. Results of this experiment do not answer the question whether the training based on a dot-probe task brings about a tendency to focus attention on neutral stimuli, they only indicate that perhaps an isolated negative stimulus is enough to achieve results similar to those achieved using the dot-probe task.

Some researchers indicate that perhaps the influence of training on anxiety is a result of a much more general mechanism, i.e. the fact that training increases non-specific attention control [31]. Arguments supporting this view have been provided by a study [31] in which students displaying a moderate level of anxiety were subjected to two types of training: some of them were taught to divert attention away from threatening stimuli, and some were taught to focus attention on those stimuli. The third group was a control group. The results indicated that both training groups, as opposed to the control group, demonstrated lower anxiety levels during the later task involving public

performance, and no significant differences were observed in anxiety level between the training groups. According to the authors, such results could indicate that the effects of CBM-A are the result of increased attentional control and not of diverting attention away from threatening stimuli, or of focusing attention on positive stimuli. Paulewicz, Blaut and Kłosowska [32] demonstrated that effect of attentional bias training (understand as decrease in bias) is stronger in case of individuals with better attentional control.

The theoretical importance of CBM-A is based mainly on the fact that this method allows for a direct, experimental testing of the hypothesis on the influence of attentional bias on emotional disorders. Therefore, it is important to compare the hypothetical mechanism of CBM-A training with the mechanisms of psychological therapies of anxiety disorders. Especially in the case of behavioural and cognitive-behavioural therapies, one of the basic methods of treatment is repeated exposure to anxiety-inducing stimuli. It is based on the assumption that systematic avoidance of threat-related stimuli, that occurs in many anxiety disorders, prevents individuals from getting to know that objects or situations which an individual fears so much can be hardly threatening in reality. We can therefore debate whether the tendency to divert attention from threatening stimuli acquired with CBM-A is not, in fact, contradictory to the idea of therapy through exposure. On the other hand, perhaps paradoxically, avoiding threatening stimuli in reality requires paying attention to them, as it is difficult to avoid something that was not detected in the first place. At this stage, it is impossible to answer these questions, however, it may well be the case that some forms of avoidance with respect to threatening stimuli is advantageous to an individual, whereas other forms are not [33].

Recapitulation

Since the MacLeod et al. [18] experiment many studies using the CBM-A paradigm have been published. Although many of the studies fail to demonstrate high efficacy of this method, and the mechanisms of CMB-A are still not well understood, it seems to be at least very promising, especially as a method of reducing anxiety and symptoms of anxiety disorders.

It should be emphasised that one of the basic advantages of CBM-A is its potential availability and very low cost. Such training takes place with the help of a computer and can be performed in the comfort of one's own house. It can be used by many individuals at a time, without the necessity to cover the expenses of typical forms of psychological intervention [34, 35]. It should be added that the efficacy of this type of therapeutic procedure can be, and indeed often is, measured using double-blind trial, (impossible in case of conventional psychotherapies), which provides stronger evidence of its true efficacy.

It should also be stressed that the efficacy of training in changing anxiety level has been demonstrated in children and young individuals [26, 27]. Bias training seems to

be an attractive method in this group. Computer is the basic contemporary tool used by young people for learning and entertainment, it can therefore become a natural and comfortable therapeutic tool for this group.

Obviously, this is not to say that CBM-A can replace psychological therapy. This method lacks such important elements as therapeutic relationship, flexibility or contact with another human being based on acceptance. It is easy to imagine, however, that CBM-A could constitute one of the elements of therapy, or be of some help in sustaining its results. Taking into account the fact that most people suffering from anxiety disorders do not undergo any form of psychological or pharmacological therapy [36], the availability of this type of non-invasive method seems valuable, although certainly its introduction for general use would be premature at this point.

References

1. LeDoux JE. *The emotional brain: The mysterious underpinning of emotional life*. New York: Simon & Schuster; 1996.

2. Beck AT, Clark DA. *An information processing model of anxiety: Automatic and strategic processes*. Behav. Res. Ther. 1997; 35(1): 49–58.

3. Blaut A, Paulewicz B. *Poznawcza podatność na depresję*. Psychiatr Pol. 2011; 45(6): 889–899.

4. Mathews A, MacLeod C. *Cognitive vulnerability to emotional disorders*. Annu. Rev. Clin. Psychol. 2005; 1: 167–195.

5. Bar-Haim Y, Lamy D, Pergamin L, Bakermans-Kranenburg MJ, van Ijzendoorn MH. *Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study*. Psychol. Bull. 2007; 113(1): 1–24.

6. Bradley BP, Mogg K, Millar N, White J. *Selective processing of negative information: Effects of clinical anxiety, concurrent depression and awareness*. J. Abnorm. Psychol. 1995; 104(3): 532–536.

7. Bryant RA, Harvey AG. *Processing threatening information in posttraumatic stress disorder*. J. Abnorm. Psychol. 1995; 104: 537–541.

8. Rinck M, Reinecke A, Ellwart T, Heuer K, Becker ES. *Speeded detection and increased distraction in fear of spiders: Evidence from eye movements*. J. Abnorm. Psychol. 2005; 114(2): 235–248.

9. Buckley TC, Blanchard EB, Hickling EJ. *Automatic and strategic processing of threat stimuli: A comparison between PTSD, panic disorder, and non-anxiety controls*. Cogn. Ther. Res. 2002; 26(1): 97–115.

10. Cisler JM, Olatunji BO. *Components of attentional biases in contamination fear: Evidence for difficulty in disengagement*. Behav. Res. Ther. 2010; 48(1): 74–78.

11. Cisler JM, Koster EHW. *Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review*. Clin. Psychol. Rev. 2010; 30(2): 203–216.

12. MacLeod C, Mathews A, Tata P. *Attentional bias in emotional disorders*. J. Abnorm. Psychol. 1986; 95(1): 15–20.

13. Hakamata Y, Lissek S, Bar-Haim Y, Britton JC, Fox NA, Leibenluft E. et al. *Attention bias modification treatment: A meta-analysis toward the establishment of novel treatment of anxiety*. Biol. Psychiatry 2010; 68(11): 982–990.

14. Blaut A, Paulewicz B, Szastok M, Prochwicz K, Koster E. *Are attentional bias and memory bias for negative worlds casually related?* J. Behav. Ther. Exp. Psychiatry 2014; 44: 293–299.

15. Beck AT. *Cognitive therapy and the emotional disorders*. New York: International University Press; 1976.

16. Mathews A, Mogg K, Kentish J, Eysenck MJ. *Effects of psychological treatment on cognitive bias in generalized anxiety disorder*. Behav. Res. Ther. 1995; 33(3): 293–303.

17. Mattia JL, Heimberg RG, Hope DA. *The revised Stroop color naming task in social phobics*. Behav. Res. Ther. 1993; 31(3): 305–313.

18. MacLeod C, Rutherford E, Campbell L, Ebsworthy G, Holker L. *Selective attention and emotional vulnerability: Assessing the casual basis of their association through the experimental manipulation of attentional bias*. J. Abnorm. Psychol. 2002; 111(1): 107–123.

19. Schmidt NB, Richey JA, Buckner JD, Timpano KR. *Attention training for generalized social anxiety disorder*. J. Abnorm. Psychol. 2009; 118(1): 5–14.

20. Amir N, Beard C, Taylor C, Klumpp H, Elias J, Burns M. et al. *Attention training in individuals with generalized social phobia: A randomized controlled trial*. J. Consult. Clin. Psychol. 2009; 77(5): 961–973.

21. Amir N, Beard C, Cobb M, Bomyea J. *Attention modification program in individuals with generalized anxiety disorder*. J. Abnorm. Psychol. 2009; 118(1): 28–33.

22. Hazen RA, Vasy MW, Schmidt NB. *Attentional retraining: A randomized clinical trial for pathology worry*. J. Psychiatr. Res. 2009; 43(6): 627–633.

23. Reese HE, McNally RJ, Najmi S, Amir N. *Attention training for reducing spider fear in spider-fearful individuals*. J. Anxiety Disord. 2010; 24(7): 657–662.

24. Van Bockstaele B, Verschuere B, Koster EH, Tibboel H, De Houwer J, Crombez G. *Effects of attention training on self-reported, implicit, physiological and behavioural measures of spider fear*. J. Behav. Ther. Exp. Psychiatry 2011; 42(2): 211–218.

25. Najmi S, Amir N. *The effect of attention training on a behavioral test of contamination fears in individuals with subclinical obsessive-compulsive symptoms*. J. Abnorm. Psychol. 2010; 119(1): 136–142.

26. Eldar S, Apter A, Lotan D, Perez-Edgar K, Naim R, Fox NA. et al. *Attention bias modification treatment for pediatric anxiety disorders: a randomized controlled trial*. Am. J. Psychiatry 2012; 169(2): 213–220.

27. Rozenman M, Weersing VR, Amir N. *A case series of attention modification in clinically anxious youths*. Behav. Res. Ther. 2011; 49(5): 324–330.

28. Koster EH, Baert S, Bockstaele M, De Raedt R. *Attentional retraining procedures: manipulating early or late components of attentional bias*. Emotion 2010; 10(2): 230–236.

29. Browning M, Holmes EA, Murphy, SE, Goodwin GM, Harmer CJ. *Lateral prefrontal cortex mediates the cognitive modification of attentional bias*. Biol. Psychiatry 2010; 67(10): 919–925.

30. Heeren A, Lievens L, Philippot P. *How does attention training work in social phobia: disengagement from threat or re-engagement to non-threat?* J. Anxiety Disord. 2011; 25: 1108–1115.

31. Klumpp H, Amir N. *Examination of vigilance and disengagement of threat in social anxiety with probe detection task*. Anxiety Stress Coping 2009; 22(3): 283–296.

32. Paulewicz B, Blaut A, Kłosowska J. *Cognitive effects of attentional training depend on attentional control*. Pol. Psychol. Bull. 2012; 43(4): 275–280.

33. Rachman S, Radomsky AS, Shafran R. *Safety behaviour: A reconsideration*. Behav. Res. Ther. 2008; 46(2): 163–173.

34. Boettcher J, Berger T, Renneberg B. *Internet-based attention training for social anxiety: A randomized controlled trial*. Cogn. Ther. Res. 2011; 36: 522–536.

35. MacLeod C, Soong LY, Rutherford EM, Campbell LW. *Internet-delivered assessment and manipulation of anxiety-linked attentional bias: Validation of a free-access attentional probe software package*. Behav. Res. Methods 2007; 39(3): 533–538.

36. Collins KA, Westra HA, Dozois DJA, Burns DD. *Gaps in accessing treatment in anxiety and depression: Challenges for the delivery of care*. Clin. Psychol. Rev. 2004; 24(5): 583–616.

Address: Agata Blaut
Institute of Psychology
Jagiellonian University
31-120 Kraków, Mickiewicza Street 3