J. Behav. Ther. & Exp. Psychiat. 45 (2014) 186–195

Contents lists available at ScienceDirect

Journal of Behavior Therapy and Experimental Psychiatry

journal homepage: www.elsevier.com/locate/jbtep

Internet-based Cognitive Bias Modification of Interpretations in patients with anxiety disorders: A randomised controlled trial

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ARTICLE INFO

Article history:
Received 28 March 2013
Received in revised form
2 October 2013
Accepted 3 October 2013

Keywords:
Anxiety disorders
Cognitive Bias Modification of Interpretations
Internet-based

ABSTRACT

Background and objectives: Previous research suggests that negative interpretation biases stimulate anxiety. As patients with an anxiety disorder tend to interpret ambiguous information negatively, it was hypothesised that training more positive interpretations reduces negative interpretation biases and emotional problems.
Methods: In a randomised, double-blind placebo-controlled trial, patients with different anxiety disorders were trained online over eight days to either generate positive interpretations of ambiguous social scenarios ($n = 18$) or to generate 50% positive and 50% negative interpretations in the placebo control condition ($n = 18$) (Study 1).
Results: Positively trained patients made more positive interpretations and less negative ones than control patients. This training was followed by a decrease in anxiety, depression, and general psychological distress, but this effect was also observed in the control group. To get a better understanding of these unexpected results, we tested a 100% neutral placebo control group (Study 2, $n = 19$); now the scenarios described neutral, non-emotional situations and no valenced interpretations were generated. The results from this neutral group were comparable to the effects from the other control group.
Limitations: An advantage, but potentially also a disadvantage of the study is that CBM-I training was performed online with less control over the procedures and setting. In addition, the scenarios were not matched to the specific concerns of each patient and the training sessions were performed in close proximity to one another.
Conclusions: Compared to both control conditions, CBM-I had superior effects on interpretations, but not on emotions. The current findings showed the boundary conditions for CBM-I.

1. Introduction

Cognitive theories argue that patients with an anxiety disorder interpret potential threatening information as much more threatening than they are and this biased interpretation is held to be the pathogenic nucleus of the disorder (Beck, Emery, & Greenberg, 1985; Williams, Watts, Macleod, & Mathews, 1988). It is hypothesised that biased interpretations are causally related to anxious feelings and behaviour and experimental evidence supports this causal claim (Mathews & Mackintosh, 2000). Interpretation bias was modified using a scenario-based Cognitive Bias Modification for Interpretations (CBM-I) training and anxiety was affected subsequently. In the meantime these findings have been replicated several times (see for an overview Hallion & Ruscio, 2011).

There is overwhelming evidence that patients with an anxiety disorder have the tendency to interpret ambiguity in a threat-related way. That is, patients with a social anxiety disorder (SAD) interpreted ambiguous social scenarios as more negative than a non-anxious control group (Amir, Foa, & Coles, 1998), patients with a panic disorder (PD) were more likely to interpret bodily sensations as signs of threat than other anxiety disorder patients (Clark et al., 1997), and patients with Generalised Anxiety Disorder (GAD) interpreted ambiguous scenarios as more threatening than non-anxious controls (Butler & Mathews, 1983). In a prospective study, it was shown that interpretation of initial posttrauma symptoms predicted Posttraumatic Stress Disorder (PTSD) symptoms at six and nine months follow-up (Dunmore, Clark, & Ehlers, 2001).

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0005-7916/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.jbtep.2013.10.005

According to cognitive theories of psychopathology, it is important that treatments for anxiety disorders address these maladaptive processes. Cognitive Behavioural Therapy (CBT), for example, aims to alter those biased interpretations via cognitive restructuring and behavioural experiments. As biases in information processing are fast and more automatic processes, the use of verbal dialogue and explicit instructions might not be the optimal approach to change them (Beard, 2011). Furthermore, processing biases filter incoming information and may act as a barrier in CBT by hampering the activation of incongruent information (Baert, Koster, & De Raedt, 2011). A recent new development to change these processing biases in a different way is Cognitive Bias Modification (CBM). It is a computerised training consisting of "extensive practice on a cognitive task designed to encourage and facilitate the desired cognitive change" (p. 3, Koster, Fox, & MacLeod, 2009). In Cognitive Bias Modification of Interpretation (CBM-I), participants repeatedly practice more positive interpretations. Compared to CBT, CBM changes processing biases through practicing the desired process, and not through verbal instruction and explicitly challenging thoughts. Due to the different approach, CBM might have added value in the treatment of anxiety disorders.

There is accumulating evidence that CBM-I training has effects in non-anxious and highly anxious analogue samples. For example, four sessions of positive CBM-I training using scenarios provided to highly anxious individuals resulted in stronger reductions in trait anxiety scores ($d = 0.58$) compared to a test–retest control group ($d = 0.08$) (Mathews, Ridgeway, Cook, & Yiend, 2007). These effects were replicated in a study where (scenario-based) CBM-I sessions were increased from four to eight in a sample of highly anxious students with stronger reductions in trait anxiety and levels of psychological distress in the CBM-I training condition ($d = 0.29$ and 0.41 respectively) compared to a placebo control condition (scenarios had 50% positive and 50% negative outcomes, $d = 0.06$ and $d = -0.04$ respectively) (Salemink, van den Hout, & Kindt, 2009). Similar findings have been observed with different types of CBM-I paradigms (Amir, Bomyea, & Beard, 2010; Beard & Amir, 2008) and with different types of highly anxious analogues populations (Hirsch, Hayes, & Mathews, 2009; Steinman & Teachman, 2010; Teachman & Addison, 2008).

To the best of our knowledge, two studies actually examined the effects of CBM-I in a clinically anxious sample (Amir & Taylor, 2012; Hayes, Hirsch, Krebs, & Mathews, 2010) and two other studies tested a combined training of both attention and interpretation bias training (Beard, Weisberg, & Amir, 2011; Brosan, Hoppitt, Shelfer, Sillence, & Mackintosh, 2011). Hayes et al. (2010) investigated the effects of a single CBM-I session in GAD. Forty patients were randomly allocated to a positive interpretation bias training (homograph and scenario-based training) or a placebo control condition (both training paradigms contained 50% threatening interpretations). CBM-I successfully modified interpretations and individuals who had followed the positive training had fewer self-reported negative intrusive thoughts. However, there were no significant differences between the groups in change in self-reported anxiety following a worry period ($d_{\text{positive CBM}} = 0.03$ vs. deterioration in the placebo group $d_{\text{placebo}} = -0.19$). The lack of effects on anxiety might be, among other reasons, due to the fact that individuals were only trained once, whereas multiple sessions of training might be necessary to obtain emotional effects in a clinical sample. Amir and Taylor (2012) provided a 12 session interpretation training (based on Word–Sentence Association Paradigm, WSAP) to individuals with a generalised SAD. Training affected interpretations and, compared to a placebo control condition (receiving 50% positive and 50% negative feedback after endorsing threatening interpretations), participants who received the training were judged as less socially anxious by clinicians who were blind to treatment condition ($d = 1.95$ vs. 0.61). However, both conditions did not differ on change in self-reported social anxiety symptoms; both the training condition ($d = 1.23$) and the control condition ($d = 1.29$) displayed large reductions in self-reported social anxiety. These first findings in clinical samples seem to suggest that CBM-I is successful in modifying interpretations, but that it does not outperform the control condition with respect to self-reported anxiety. Regarding the two studies that examined CBM-I in combination with attention training in a clinical sample; Brosan et al.'s study (2011) did not include a control group, thus it is unclear whether the observed reduction in self-reported anxiety ($d_{\text{state anxiety}} = 0.81$, $d_{\text{trait anxiety}} = 1.12$) is the result of the intervention. Beard et al., 2011 compared the combined CBM training (eight sessions WSAP training) with a placebo condition (attention: probe replaced neutral and disgust faces with equal frequency; interpretation: words were not related to social, but to superficial aspects). A stronger reduction in self-reported anxiety was observed in the CBM condition ($d = 1.04$) compared to the placebo condition ($d = 0.20$). Even though this result is promising, it is hard to evaluate the role of interpretive bias training, as the effects could also be due to the attentional bias training. Up to now, the effects of CBM-I on self-reported anxiety in clinical populations seem more mixed than the effects in non-anxious and highly anxious analogue samples. Furthermore, little is known regarding the longevity of the effects as only Amir and Taylor (2012) included follow-up measures, though only in the CBM-I condition.

CBM-I training is a computerised training that has the possibility to be offered to participants via internet. Up to now, however, all published CBM-I studies with clinical samples have delivered the training in a laboratory or office setting with participants coming to that location to complete each training session (Amir & Taylor, 2012; Beard et al., 2011; Brosan et al., 2011; Hayes et al., 2010, but see Salemink et al., 2009 for an online CBM-I training in a highly anxious, but not clinical sample). This is surprising as repeatedly coming to a certain location might be a barrier for care. People living in remote areas, physically disabled patients with restricted mobility, or patients who are hesitant to seek face-to-face treatment might be better reached with internet-delivered therapies (Lange, van der Ven, Schrieken, & Emmelkamp, 2001). Thus internet-based treatment has the potential to increase availability, but also to facilitate dissemination. In addition, given the context sensitivity of training effects, online interventions are promising as they can be completed at home (Macleod, Koster, & Fox, 2009). Furthermore, E-mental health is a promising new area for treatment and studies have shown that internet-delivered CBT may be as effective as face-to-face CBT (e.g., Hedman et al., 2011). Finally, web-based interventions have the potential of being more cost-effective. Computerised CBM training paradigms seem ideal interventions to be provided online and this has been tested for *attentional bias* training (CBM-A). The first findings are however mixed; while it has been shown that attentional bias can be modified using an internet-delivered training (Macleod, Soong, Rutherford, & Campbell, 2007), another study revealed no superior effects of CBM-A on self-reported anxiety symptoms (Carlbring et al., 2012). The findings of online *interpretive bias* training in a highly anxious, non-clinical sample were promising (Salemink et al., 2009).

The aim of the present study was to examine the effectiveness of an internet-delivered CBM-I training in a clinical sample of patients with a broad range of anxiety disorders. In a randomised, double-blind placebo-controlled trial, patients with anxiety disorders were trained online to either generate positive interpretations of ambiguous social scenarios or to generate 50% positive and 50% negative interpretations in the placebo control condition. This placebo-control condition was developed to control for the effects