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Effects of positive interpretive bias modification in highly anxious individuals

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ABSTRACT

Over the past 20 years evidence has accumulated that individuals suffering from anxiety tend to interpret ambiguous information as threatening. Considering the causal role of this interpretive bias in anxiety, it was recently established that modifying interpretive biases influences anxiety. This suggests that anxiety can be clinically treated by directly targeting this interpretive bias. The present study was designed to modify a negative interpretive bias in highly anxious individuals, and subsequently assess the hypothesized beneficial effects on clinical measures. High trait-anxious participants were randomly assigned to one of two conditions: a positive interpretational Cognitive Bias Modification (CBM-I) or a control condition ($n = 2 \times 17$). The program was offered online for eight consecutive days. Upon completing the program, participants who had followed positive CBM-I were less state and trait-anxious compared to the control group. Additionally, positively trained participants scored lower on a measure of general psychopathology (SCL-90). No effects were observed on social anxiety and stress vulnerability. The mixed pattern of findings renders them rather inconclusive, leaving interpretations of the potential therapeutic merits of CBM-I open for future research.

1. Introduction

There is overwhelming evidence that anxiety is associated with a maladaptive tendency to interpret ambiguous information in a threatening way (Amir, Foa, & Coles, 1998; Eysenck, Mogg, May, Richards, & Mathews, 1991; MacLeod & Cohen, 1993). The studies that yield these conclusions all have cross-sectional designs: anxious participants are compared to non-anxious control groups. As a result, a shortcoming of these studies is that they shed no light on the issue of causality. Does anxiety cause the interpretive bias? Or does the interpretive bias contribute to anxiety? Are anxiety and the interpretive bias mutually reinforcing and/or is a third variable driving both anxiety and the interpretive bias?

In order to resolve the question of causality, Mathews and Mackintosh (2000) developed a program designed to modify interpretive bias: Cognitive Bias Modification of Interpretations (CBM-I). Biases were modified by presenting a series of ambiguous social stories, each ending in a word fragment, to non-anxious participants (individuals with a mid range level of anxiety). Correct resolution of the fragment disambiguated the story either positively or negatively, depending on the assigned modification condition. Subsequently, Mathews and Mackintosh tested whether the modification of the interpretive bias resulted in a corresponding change in anxiety. A "recognition test" (see below) confirmed that CBM-I effectively induced an interpretive bias. Negatively trained participants interpreted new ambiguous information in a threatening way. Conversely, positively trained participants made more non-threatening interpretations. More importantly, CBM-I effected congruent changes in anxiety. Positively trained participants became less anxious, while negatively trained participants became more anxious. The main findings observed in this study were replicated various times (Mackintosh, Mathews, Yiend, Ridgeway, & Cook, 2006; Salemink, van den Hout, & Kindt, 2007b; Yiend, Mackintosh, & Mathews, 2005). Consequently, the data indicate that the interpretive bias plays a causal role in anxiety and that it can be modified through training.

All of the abovementioned studies trained individuals with a mean level of anxiety. It has thus been established that the interpretive bias is trainable and that it affects anxiety. Therefore, it seems that there would be clinical relevance in training individuals with high anxiety levels, such as patients suffering from an anxiety disorder, to interpret information positively.[1] An important first step was taken by Mathews, Ridgeway, Cook, and Yiend (2007), who performed a positive CBM-I study in an analogue sample of highly

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[1] Amir and Beard (2007, July) already performed a CBM program using participants with clinical levels of anxiety, though no formal paper is (yet) available.

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anxious community volunteers ($n = 39$). Half of the participants received training to interpret information in a positive way, while the other half was assigned to a test–retest control condition. Individuals in the positive group received four CBM-I sessions over a two-week period. Each session consisted of 100 stories. Along the course of the sessions, the stories became more positive; i.e. the first session involved stories with non-negative interpretations, while in later sessions the interpretations of these 100 stories became gradually more positive. Pre- and post-measurement of the interpretive bias showed that the positive CBM-I was successful: positive interpretations increased, while negative interpretations decreased. More importantly, the positive CBM-I resulted in a significant reduction in trait anxiety scores. Thus, this evidence supports the proposed beneficial effects of positive CBM-I on trait anxiety. No effects on state anxiety were found.

While results from the Mathews et al. study (2007) are encouraging, several issues demand clarification. First of all, the control group did not receive any training and was only tested twice. Consequently, it is unclear whether reported results are caused by the intervention or are due to mere exposure to valenced material, demand characteristics, etc. To rid the results of this ambiguity, a control *training* condition is warranted. Second, the measured effects on trait anxiety were moderate. While no effects were found on state anxiety, the changes observed on trait anxiety were relatively small (a decrease of 4.2 on the trait version of State-Trait Anxiety Inventory, STAI, Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). In order to ensure the CBM-I's clinical relevance, the effects should be larger. In Mathews et al.'s format, individuals were succumbed to a mere four training sessions in a two-week period. In other words, participants had more training-free days than training days. Participants may benefit from an intensified CBM-I, by having, for example, more training than training-free days, and/or by increasing the total number of different trials and sessions.

The present experiment was designed with two objectives in mind; to assess the robustness of previous findings, considering the effects of induced positive interpretations on the reduction of anxiety, and to optimize the CBM-I program. First of all, we ensured an intensive CBM-I program by developing an *eight-day* program, in which participants were not allowed to skip a single day. Second, we increased the total number of new trials. Each day consisted of 104 new trials. The total number of trials amounted to 832 (while four versions of 100 trials were presented in Mathews et al., 2007). Third, we developed a control training condition. Participants in this condition also received an eight-day program, but now half of the stories ended positively while the other half ended negatively. Thus, these participants were not trained to interpret information either positively or negatively, but were simply engaged in an intensive program for several days. A fourth aspect is that we decided to train participants in their own environment. An internet CBM-I program was developed that could be accessed at home. State and trait anxiety were measured by the same means as in the Mathews et al. study. However, to further explore the range of effects of an induced positive interpretive bias, we also assessed the effects on general psychopathology (SCL-90: Arrindell & Ettema, 1986; Derogatis, 1977) and social anxiety (Fear of Negative Evaluation, FNE: Watson & Friend, 1969). Furthermore, we examined whether interpretive bias causally modulates emotional vulnerability (the degree to which a stressor serves to aggravate a negative mood state). Therefore, participants had to perform a stress task after CBM-I to assess the degree to which participants differed in terms of their anxiety reactivity.

In sum, we designed the current study to examine whether reductions in negative interpretive bias in sub-clinically anxious individuals lead to congruent beneficial effects on mood. Pre-selected high trait-anxious individuals with higher than average negative interpretations received either the eight-day experimental condition of CBM-I (positive CBM-I) or the eight-day control condition. The following hypotheses were formulated, all of which were directional. The first hypothesis predicted that CBM-I would effectively induce positive interpretations in the experimental group when compared to the control group. Assuming that the interpretive bias modification would be successful, the second hypothesis stated that the positively trained group would become less anxious than the control group. Finally, it was also predicted that the general psychopathology scores of the positively trained group would decrease. Concerning the effects on emotional vulnerability, a hypothesis was formulated predicting that the positively trained group would be less reactive to stressors in comparison to the control group.

2. Method

2.1. Participants

In order to obtain a group of high trait-anxious participants with a negative interpretive style, we had to establish criteria for both high anxiety and negative interpretive bias. Following Yiend et al.'s example (2005), a score of 45 or higher on the trait version of the STAI (Spielberger et al., 1983) was set as a criterion for high anxiety. This represented the top 20% of a sample of 321 students who filled out the STAI trait questionnaire following a lecture (M trait anxiety = 37.4, SD = 8.7). To find a criterion for interpreting information negatively, we first assessed how students interpreted ambiguous information. A random sample of 40 students from the general student population completed the closed questions version of the Ambiguous Social Situation Interpretation Questionnaire (ASSIQ: Stopa & Clark, 2000) (see Section 2.2). The mean score for this sample of students was 1.56 (SD = 0.4), we therefore considered a score $\geq$1.57 higher than average for negative interpreting. This was the second criterion for inclusion. The combined criteria resulted in a sample of 36 highly trait-anxious participants who had above average scores on the negative interpretation of ambiguous information. During the experiment, the data of two participants had to be removed because they skipped a training day, yielding a final sample of 34. Of this sample six were male and their mean age was 21.3 years (SD = 2.1). Before the start of CBM-I, participants in the positive and the control group did not differ significantly for scores on the ASSIQ, $t(32) = -1.58$, STAI state, $t(32) = -0.31$, STAI trait, $t(32) = -0.20$, and SCL-90, $t(32) = -1.51$. The groups differed on the FNE scores, $t(32) = -2.48$, $p < .05$, participants in the positive CBM-I group had higher scores than participants in the control condition (respectively, 36.4, SD = 8.3 vs. 28.3, SD = 10.5). As a next step, pre-CBM-I FNE scores were examined in relation to changes in crucial dependent mood variables. Pre-FNE scores were significantly related to change in FNE, $F(1, 31) = 5.44$, $p < .05$, $\eta_p^2 = .15$. Those statistical analyses are, therefore, performed with pre-FNE scores as a covariate. As pre-FNE scores were not significantly related to other dependent mood questionnaires, Fs < 1.1, those analyses were conducted without correction for pre-FNE scores. All participants received course credits and a financial reimbursement.

2.2. Materials

2.2.1. CBM-I stimuli

To modify interpretive bias, participants were trained for 8 h: 1 h a day on eight consecutive days. Participants received 832 social stories in total, of which 104 were translated stories used by Mathews and Mackintosh (2000). The rest were designed