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Training less threatening interpretations over the Internet: Does the number of missing letters matter?



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ABSTRACT

Background and objectives: Cognitive Bias Modification to reduce threat interpretations (CBM-I) trains individuals to resolve ambiguous scenarios via completion of word fragments that assign benign meanings to scenarios. The current study tested: 1) whether Internet-based CBM-I can shift interpretations to be more positive/less negative, and 2) whether varying the number of letters missing in the word fragments (assumed to increase task difficulty) moderates CBM-I's effects.

Methods: Participants ($N = 350$) completed a brief online version of CBM-I, followed by assessments of interpretation bias, fear of negative evaluation, and anticipatory anxiety. Participants were randomly assigned to 1 of 5 conditions: control (half of scenarios ended positively, half negatively), or 4 positive conditions (all scenarios ended positively, but word fragments varied on number of letters missing, from 0 to 3).

Results: Relative to the control condition, all positive conditions led to more positive/less negative interpretations. When analyses were re-run with only a highly socially anxious subset of the sample ($n = 100$), conditions in which the final word of scenarios was missing 0, 1, or 2 letters led to more positive/less negative interpretations compared to the control condition, but the condition missing 3 letters did not differ from the control condition. There were no differences between conditions on other outcome measures.

Limitations: Training was brief, and an unselected sample was used.

Conclusions: Results suggest a brief Internet-based CBM-I paradigm can shift interpretation bias, but not necessarily other anxiety-relevant outcomes. Making the task too difficult may blunt effects for highly socially anxious individuals.

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Cognitive models of anxiety suggest that anxious individuals interpret ambiguous information in a negative or threatening way (Clark & Beck, 2010). This negative interpretation bias is theorized to maintain, and potentially cause, anxiety disorders. To test this theorized connection between interpretation bias and anxiety, researchers have developed computerized paradigms to directly shift the way individuals interpret ambiguous information, called Cognitive Bias Modification for Interpretations (CBM-I; Mathews & Mackintosh, 2000). CBM-I for anxiety trains participants to interpret ambiguous information in a less threatening way through conditioning paradigms. For example, a common CBM-I paradigm repeatedly presents individuals with ambiguous scenarios, which

end in word fragments that, when completed, disambiguate the scenarios in a benign way (Mathews & Mackintosh, 2000). Training is expected to increase positive and reduce negative interpretations, and reduce anxiety symptoms.

Several lab-based studies have found that CBM-I can successfully modify interpretations to be more positive and less negative across diverse anxious samples (see meta-analyses by Hallion & Ruscio, 2011; Menne-Lothmann et al., 2014). Moreover, a growing number of studies have demonstrated that shifting interpretations via CBM-I leads to a subsequent shift in anxiety levels, providing support for the causal claim in cognitive models of anxiety (see MacLeod & Mathews, 2012). However, not all CBM-I studies have produced promising results. Some have not changed bias, and others have produced shifts in unexpected directions (e.g., Fox, Mackintosh, & Holmes, 2014; see Hallion & Ruscio, 2011). Further, there is evidence of publication bias, such that nonsignificant findings are often not published (Hallion & Ruscio). Results have

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been particularly mixed in the few studies that have attempted to shift interpretation bias over the Internet. For example, in a study comparing various online treatments for depression, seven brief sessions of Internet-based CBM-I significantly increased positive interpretation bias and reduced depressive symptoms (Williams, Blackwell, Mackenzie, Holmes, & Andrews, 2013). On the contrary, another Internet-based study found that eight brief CBM-I sessions for anxiety shifted interpretations to be more positive and less negative (relative to a control condition); however, both the control and CBM-I conditions led to similar changes in anxiety and depression symptoms, and in subjective distress (Salemink, Kindt, Rienties, & van den Hout, 2014). Taken together, these results suggest that while CBM-I may one day be an efficacious treatment for psychopathology, it is important first to improve the reliability of CBM-I effects, and determine if the Internet is an appropriate way to disseminate CBM-I.

One possible way to increase the strength of CBM-I can be drawn from the memory and learning literature. According to desirable difficulty theories (e.g., Bjork, 1994, 1999; Pyc & Rawson, 2009), memory is improved when the learning process is relatively difficult, so that participants are challenged, but only to a point where they can still succeed. Consequently, it is possible that increasing the difficulty of the learning process in CBM-I tasks may lead to stronger training effects on bias and subsequent anxiety (see Hertel & Mathews, 2011). For instance, needing to actively generate benign resolutions when information is ambiguously threatening, versus passively reading a benign resolution, may be an example of a desirable difficulty. In fact, evidence demonstrates that CBM-I is more likely to affect subsequent mood and anxiety in response to a stressor when participants are asked to generate the emotional meanings of scenarios (i.e., complete word fragments), as opposed to when participants complete an easier version of CBM-I, in which they passively read the scenarios (i.e., there are no word fragments; e.g., Hoppitt, Mathews, Yiend, & Mackintosh, 2010; Mathews & Mackintosh, 2000). However, a recent study suggests that modifying CBM-I to be much more active, such that participants generated their own positive interpretations of ambiguous scenarios via a microphone, did not improve mood as effectively as traditional CBM-I (Rohrbacher, Blackwell, Holmes, & Reinecke, 2014), suggesting this issue requires further testing. In the current study, we test whether relatively more active training should be more effective than more passive training at changing interpretation bias and reducing anxiety, and extend prior work by varying the difficulty of completing the CBM-I task.

The current study evaluates whether a single Internet-based session of CBM-I that targets social anxiety-relevant interpretations can shift interpretations, fear of negative evaluation, and anticipatory social anxiety in a large, unselected sample. Participants were randomly assigned to 1 of 5 conditions: a control condition that is not designed to train positive interpretations (50% of scenarios end positively, 50% end negatively), a positive condition that does not involve active generation of emotional meaning of scenarios (all scenarios end positively, and scenarios do not include word fragments), or three positive conditions that vary the number of letters missing in the word fragments that resolve the emotional meaning of the scenarios, from 1 to 3). Following CBM-I, participants completed measures of interpretation bias, fear of negative evaluation, as well as anticipatory anxiety. We hypothesized that all positive training conditions would lead to more positive/less negative interpretations, relative to the control condition. Further, we predicted that all positive conditions that include a word fragment would lead to less fear of negative evaluation and anticipatory anxiety, based on prior findings that active resolution of word fragments (versus passive reading) led to greater changes in mood (Hoppitt et al., 2010; Mathews & Mackintosh,

2000). Finally, we predicted that increasing the amount of active generation needed to complete fragments, by increasing the number of letters missing from fragments, would lead to stronger CBM-I effects on all outcome measures.

Finally, the study included baseline measures of social anxiety symptom severity and interpretation bias to explore whether these individual differences would moderate who benefits the most from CBM-I. One possibility was that training effects would be strongest for people with a *high* level of baseline interpretation bias or symptom severity, given more opportunity to see training effects (i.e., room for improvement). Alternatively, training effects might be strongest for people with *low* baseline bias or symptom severity. Less severe symptoms may be less engrained and more malleable. Also, these individuals have already shown some aptitude for making relatively healthy interpretations, so their interpretation bias might be more amenable to change with a brief training program (i.e., capitalizing on a strength versus addressing a deficit). Given mixed prior empirical findings (e.g., Micco, Henin, & Hirshfeld-Becker, 2014, and Salemink & Wiers, 2011, found moderation by baseline interpretation bias, but Steinman, 2010, did not), these analyses are exploratory. We also assessed training effects in just the highly socially anxious subset of our sample in line with more traditional tests of the clinical utility of training.

1. Methods

1.1. Participants

Three hundred and fifty participants (64.9% female) were recruited over the Internet, via Amazon.com's Mechanical Turk (mTurk), in exchange for \$0.40.¹ Participants reported citizenship from 16 countries, with the majority of participants (92.9%) reporting U.S. citizenship. Participants' ages ranged from 18 to 64 ($M = 35.44$, $SD = 12.28$). Ethnicity was reported as: 6.9% Hispanic or Latino, 86.6% not Hispanic or Latino, and 6.6% unknown or not reported, and race was reported as: 77.7% White, 9.4% Black, 4.9% Asian, 4.0% as more than one race, and 4.0% as other or unknown.

1.2. Materials²

1.2.1. Baseline social anxiety symptoms

The Social Interaction and Anxiety Scale (SIAS; Mattick & Clarke, 1998) is a 20-item questionnaire that assesses reactions to a variety of social situations. In the SIAS, participants rate how characteristic 20 statements are of them (e.g., "I have difficulty talking with other people") on a Likert scale. The SIAS has good psychometric properties (Rodebaugh, Woods, Heimberg, Liebowitz, & Schneier, 2006). The SIAS was administered at the beginning of the study to evaluate baseline social anxiety, both to check that the CBM-I conditions did not differ at baseline and to check whether severity of social anxiety symptoms moderated training effects. In the current sample, Cronbach's alpha was .94, suggesting excellent reliability.

1.2.2. Cognitive Bias Modification for Interpretations (CBM-I) task

Participants were asked to read and imagine themselves in a series of 36 scenarios (adapted from Mathews & Mackintosh, 2000). Each scenario was related to a social situation, and was designed to remain ambiguous until the final word of the scenario.

¹ Although 403 participants gave informed consent, only 350 participants are included in analyses. We excluded participants that dropped out of the study prior to being randomized to a CBM-I condition ($n = 53$).

² This study was part of a larger study evaluating effects of CBM-I on information processing bias outcomes. For a full list of measures, please contact the first author.

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