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How can we enhance cognitive bias modification techniques? The effects of prospective cognition

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ABSTRACT

Background and objectives: Cognitive bias modification for interpretation, a computerized program which manipulates biased interpretations, has shown therapeutic promise, including evidence that negatively biased interpretations can be reduced, leading to corresponding improvements in symptoms. Cognitive bias modification for cognitive errors (CBM-errors) is a second generation CBM-I procedure which manipulates seven types of cognitive error and is especially relevant to depressive cognition. The aim of this study was to investigate whether the effects of the CBM-errors manipulation would be enhanced by adding a component facilitating prospective cognition to help embed and extend newly acquired interpretations.

Methods: A sample of 80 volunteers completed a single session experiment. With a pretraining-posttraining design, we compared the effects of enhanced CBM-errors (targeting cognitive errors plus prospective cognition) with standard CBM-errors (targeting cognitive errors without prospective cognition), on interpretations of new material and mood.

Results: Significant differences between enhanced and standard CBM-errors revealed that enhanced positive training was more effective at decreasing negative interpretations compared to the standard procedure.

Limitations: Extending the current investigation to a sample dysphoria or depression is needed for an appropriate next step.

Conclusion: The findings serve as 'a proof of principle' for the potential of prospective cognition to enhance the effects of CBM-errors and other similar CBM procedures. Further work to enhance the effectiveness of CBM procedures is needed.

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1. Introduction

Changing cognitive bias is considered a powerful therapeutic mechanism for mood disorders. Cognitive Bias Modification that targets interpretation biases (CBM-I) is a computerised experimental method for modifying the interpretation of emotionally ambiguous information, and has shown promising therapeutic effects in subclinical and clinical disorders (Blackwell & Holmes,

2010; Lang, Blackwell, Harmer, Davison, & Holmes, 2012; Lang, Moulds, & Holmes, 2009; Lester, Mathews, Davison, Burgess, & Yiend, 2011; Yiend, Lee, et al., 2014; Yiend, Parnes, Shepherd, Roche, & Cooper, 2014). The core concept of CBM-I is to train people to interpret emotionally ambiguous information in a consistent direction, and CBM-I usually aims to shift spontaneously negative interpretations towards more benign or positive alternatives (Mathews & Mackintosh, 2000). The additional evidence that CBM-I can elicit mood, symptom and stress response changes has piqued interest in the development of CBM-I as a potential therapeutic tool.

Original versions of CBM-I were devised by Mathews and colleagues (Grey & Mathews, 2000; Mathews & Mackintosh, 2000). For example, Grey and Mathews (2000) trained unselected participants to interpret an ambiguous homograph (e.g., stroke, batter) in

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either a threatening or a positive way, and found that practice in disambiguating these words resulted in similar interpretations being made when responding to previously unseen words. Similar results were found in a study using more naturalistic material in the form of short emotionally ambiguous text passages related to social anxiety (Mathews & Mackintosh, 2000). In this and subsequent studies using this method, researchers have found training-congruent interpretations are applied to new ambiguous materials, as well as effects on state anxiety, response to stress (e.g. Wilson et al., 2006) and symptom reduction (Amir & Taylor, 2012).

Cognitive Bias Modification targeting cognitive errors (CBM-errors), was developed from the previously described text method. CBM-errors differs from previous versions of CBM targeting interpretation, in two main ways. First, the approach differs conceptually in that it broadens the content and cognitive processes targeted by training to go beyond interpretation of emotional ambiguity which are used by earlier versions of CBM for interpretation (CBM-I). This is because CBM-errors was specifically designed to manipulate the cognitive error categories originally identified by Beck, known to be prevalent in depression, and targeted during cognitive therapy (Lester et al., 2011). Second, the method seeks to improve the face validity of CBM content to reflect the full range and type of cognitive errors typically targeted in therapy. Thus, items were not experimenter generated (as in previous CBM-I methods), but instead, were developed from specific exemplars generated in the clinic by clinicians practising CBT and their patients (see Lester et al. for full details). Thus CBM-errors includes content which targets the 7 categories of cognitive errors identified by Beck and colleagues (Beck, Rush, Shaw, & Emory, 1979); selective abstraction, minimization, magnification, black and white thinking, personalization, overgeneralization and arbitrary inference (please see Yiend, Lee, et al., 2014; Yiend, Parnes, et al., 2014 for examples of modification items). A recent meta-analysis of CBM studies, however, indicated that the effect sizes of CBM are smaller than previously reported (Hallion & Ruscio, 2011). In a subsequent study using CBM-errors in clinically depressed groups Yiend, Lee, et al. (2014), Yiend, Parnes, et al. (2014) found that a single session of CBM-error training increased positive interpretations but there was no significant change in mood or emotional reactivity to a stressor. As such, one of the key questions in CBM research generally, and for CBM-errors in particular, is what factors could enhance its efficacy? Investigating factors that enhance CBM effects could have significant therapeutic implications and is being called for throughout the field (Fox, Mackintosh, & Holmes, 2014).

We chose to focus on depression in the current study because CBM studies in depression are lacking although there is convincing evidence of a negative interpretive bias in depression (Lawson, MacLeod, & Hammond, 2002; Wisco & Nolen-Hoeksema, 2010). In addition the long term outcome of depression treated in primary care is worse than previously thought (Yiend, Merritt, Burns, Lester, & Paykel, 2009) suggesting that developing new, low cost, widely accessible and effective interventions for depression is an increasing priority for services.

Several previous studies have already attempted to examine factors which might contribute to the efficacy of the CBM procedure. For example, the transfer effect of CBM training was larger in conditions requiring active generation and selection of emotional meanings, compared to passive exposure during CBM-I training (Hoppitt, Mathews, Yiend, & Mackintosh, 2010). Others have demonstrated that using imagery rather than semantic-verbal processing during CBM-I training is more effective in producing emotional change (Holmes, Lang, & Shah, 2009). However, none of these studies has examined the role of prospective (i.e. directed towards the future rather than the present) cognition in the effects of CBM-I.

Positive prospective cognition includes a tendency to expect favourable and hopeful life outcomes, and this is characteristic of healthy people who show optimistic biases about the future (Weinstein & Klein, 1996). In contrast, depressed and dysphoric people show a lack of positive expectations about the future (MacLeod & Salaminiou, 2001), and this is associated with suicidal ideations (Holmes, Crane, Fennell, & Williams, 2007; Williams et al., 1996). MacLeod and Byrne (1996) examined the number of positive and negative future events generated by people with anxiety only, anxiety and depression and healthy controls. Only those with depression, as well as anxiety, showed reduced anticipation of future positive experiences, whereas as both groups showed greater expectation of future negative experiences compared to controls. Similarly, MacLeod, Tata, Kentish, and Jacobsen (1997) found that a lack of positive future cognitions, but not an excess of negative future cognitions was observed in depressed patients. Miranda, Fontes, and Marroquín (2008; Miranda and Mennin, 2007) provided supporting evidence that a lack of positive future expectations was associated with depression but not generalized anxiety disorder. Holmes, Lang, Moulds, and Steel (2008) also found that a highly dysphoric group appeared to show less vivid positive prospective imagery than a low dysphoria group. In line with previous evidence regarding the relationship between prospective cognition and emotional well-being, research proposes that cognition with a future time perspective might influence cognitive bias information processing (see Demeyer & De Raedt, 2014 for a review). That is, future time perspective cognitions, related to specific goals and motivational preferences lead to a preference toward positive information and away from negative information (Carstensen & Mikels, 2005). Demeyer and De Raedt (2014) found limited evidence that a more expansive future time perspective was related to avoidance of negative information. Similarly, the Reconstructive Memory Model (RMM) and Valuation Model (VM) explain that repetitive practice of positive future-oriented scenarios (RMM) might promote attribution of lower risk estimates and allocation of processing resources to positive-oriented stimuli, which increases expectations for occurrence of the events one practice (VM) (Miloyan, Pachana, & Suddendorf, 2014). Based on previous findings, it seems that prospective cognition/imagery might play a key role in emotional well-being and information processing.

The research reviewed above suggests that a deficit in positive prospective cognition might be specifically associated with depression and cognitive bias. When we think about the future, we mentally project ourselves forward to events using imagery (Suddendorf & Corballis, 2007). This suggests that adapting CBM techniques to include the induction of positive prospective cognitions with imagery could be one way of improving the efficacy of CBM for depression. In the present study we set out to investigate this by comparing an adapted version of CBM-errors, designed to promote prospective cognitions using imagery, with the previously reported standard CBM-errors procedure, that focuses on the modification of 'present moment' cognitive errors alone. Any differential effect between standard CBM-errors and enhance CBM-errors would therefore be attributable to the added component of generating prospective cognition. Before applying prospective cognition component to clinically depressed population, as a first step, we included a non-clinical population. Any beneficial findings regarding prospective cognition may serve as a proof of principle evidence for future clinical adaptation of CBM paradigm using prospective cognition, especially for depressed population. Our design contrasted positive and negative training directions in a non clinical sample, therefore including four training groups in total: standard positive (SP), standard negative (SN), enhanced positive (EP), and enhanced negative (EN). Based on previous findings on

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