Editorial for the Special Issue on Cognitive Bias Modification Techniques: An Introduction to a Time Traveller's Tale

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At the time of writing (December, 2013), a search for cognitive bias modification (CBM) in SCOPUS yields 113 results. Tellingly, the earliest of the articles found by this rather crude search appear in 2009, clustering around the special issue on CBM in the *Journal of Abnormal Psychology* that year (Koster et al. 2009). While the term CBM had been used in the literature prior to this, and in fact research into CBM (albeit not always using this exact term) had been steadily gathering momentum since the first studies were published in 2000, there has clearly been an explosion in research on CBM in the years since. What has happened in this period? Over the past 4 years, CBM research has been on an exciting journey, with many twists and turns, ups and downs. This special issue seeks to provide an overview of this journey, and a glimpse of the road-or roads-ahead. But where to begin? The journey did not start in 2009, nor even a decade earlier when the dominant CBM paradigms were first described. To fully make sense of this journey, and all the twists in this travellers' tale, we must go back further still.

Once upon a time ... during the cognitive era of psychology ... researchers embarked on the great adventure of exploring the 'cognitive landscape' of emotional pathology ... an extremely challenging landscape.... After a few years, the first landmarks were established: cognitive biases in emotional disorders. But what did they signify? It

seemed that such selective information-processing biases were crucial factors in the etiology, maintenance, and relapse of various types of emotional disorders. Hence, many cognitive theories built on this discovery in order to account for emotional pathology (e.g., Beck 1987; Beck and Clark 1997; Clark and Wells 1995; Eysenck 1997; Mathews and MacLeod 2005; Mogg and Bradley 1998; Rapee and Heimberg 1997; Wells and Matthews 1994; Williams et al. 1997).

Cognitive biases reflect a general processing advantage for disorder-relevant information. The findings of cognitive-experimental research indicate that emotional disorders are (roughly) characterized by three types of biases, i.e., biases in attention, interpretation, and memory. To illustrate, depressed or anxious individuals are, compared to healthy individuals, more likely to attend to negative cues, interpret ambiguity in a more negative manner, and selectively recall negative information (for a review, see Mathews and MacLeod 2005). According to the assumptions put forward by cognitive theories, the functional relationship between biases and emotional pathology can be described as follows: Biases are accompanied by various dysfunctional cognitions, which in turn activate dysfunctional emotional and behavioral responses. Due to the reinforcing connection between cognitions, emotions, and behavior, a 'psychopathological downward spiral' becomes activated in vulnerable individuals, possibly resulting in anxiety- or depression-related symptoms.

In parallel to the development of measures to assess biases in attention, interpretation, and memory, researchers started to investigate whether it is also possible to modify biased cognitive processes. This work was motivated by the question of the causal nature of these biases: while there were many empirical demonstrations of the association between emotional pathology and cognitive biases, it

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remained unclear whether such biases also causally contribute to the development of emotional disorders. Prospective longitudinal studies are one way to provide some insight into this matter. For example, Woud et al. (2014) showed that a panic-related interpretation bias is predictive of new onsets of panic disorder. Moreover, studies conducted with risk groups can provide valuable information as well. To illustrate, Schneider et al. (2002) found that children of parents who suffered from a panic disorder exhibited a panic-related interpretation bias, but only after they had been primed with panic-relevant but not with panic-irrelevant material. In addition, this interpretation bias was a predictor for the later onset of anxiety disorders in those children.

Despite the importance of findings from such longitudinal studies, causality cannot be established with such designs. Only experimental studies provide an adequate operationalization of the causal hypothesis issue, by demonstrating that cognitive biases can indeed be modified, and that the induced changes influence subsequent levels of psychopathology (for a stepwise approach to examine the psychopathologic typology of a causal risk factor, see Kraemer et al. 1997). Towards this aim, paradigms that had initially been used to assess cognitive biases were transformed into ‘training paradigms’. That is, participants were exposed to an experimentally established contingency between the disorder-relevant cue and a response, with the aim of modifying the participants’ information-processing via learning of the trained contingency (Koster et al. 2009).

The earliest training studies concerned the modification of interpretation biases (Grey and Mathews 2000; Mathews and Mackintosh 2000) and attentional biases (MacLeod et al. 2002). Studies aiming to modify interpretation biases have most often used variants of the scenario-based training paradigm developed by Mathews and Mackintosh (2000). In this approach, the assessment task applied by (Eysenck et al. 1991) was transformed into a training paradigm. Here, participants are presented with ambiguous sentences that end in a to-be-completed word fragment. The participants’ task is to complete the word fragment, and this then produces an outcome consistent with, for example, a functional or dysfunctional interpretation. To investigate whether such systematic training leads to training-compatible differences in interpretation, a recognition test follows. During this test, participants are presented with novel ambiguous sentences followed by four interpretations of each sentence. Participants have to rate how close in meaning each interpretation is to the original sentence. Making use of such a procedure, Mathews and Mackintosh (2000) showed that positively trained participants indeed endorsed the positive interpretations more than the negative ones, and vice versa for negatively trained participants. Moreover, results showed that the

trained interpretation bias causally affected self-reported anxiety in a training-compatible manner: Positively trained participants reported a decrease whereas negatively trained participants reported an increase in levels of anxiety, respectively (for similar results, see e.g., Salemink et al. 2007; Yiend et al. 2005). In addition, Wilson et al. (2006) reported training-compatible effects on anxiety when participants were confronted with a stressor after the training.

In relation to the modification of attentional biases, the approach developed by MacLeod et al. (1986) served as the basis for developing a training paradigm. Here, a word pair appears on the screen, for example, one negatively and one positively valenced word. Following the word pair, a dot is presented and participants are required to respond to that probe. In the training variant of this paradigm, for half of the group, the dot always replaces the negative word, for the other half, the dot always replaces the positive word. As such, the former group is systematically trained to attend to negative cues, whereas the latter group is systematically trained to avoid negative cues. To investigate whether such training leads to training-compatible differences in attention, noncontingent assessment trials are presented. Results of MacLeod et al. (2002), for example, showed the expected training effects, i.e., faster responses when the probe replaced the valenced word it had consistently replaced during the training. However, the critical finding again concerns the effect on emotional reactivity following a stressor: Participants who were trained to attend threat reported more distress than participants who were trained to avoid threat (for reviews of additional CBM studies on interpretation and attention, see e.g., Beard 2011; Beard et al. 2012; Hallion and Ruscio 2011; Hertel and Mathews 2011; MacLeod and Mathews 2012; Van Bockstaele et al. 2013).

In sum, research of the past decades has established the association between emotional pathology and cognitive biases. Moreover, there is accumulating evidence demonstrating that cognitive biases are of causal influence on emotional pathology. CBM procedures provide an exciting tool in this context. According to MacLeod and Mathews (2012), research on CBM is characterized by three main targets. First, CBM procedures can be used to further investigate the causal nature of cognitive biases in emotional psychopathology. Second, manipulating cognitive biases makes it possible to examine their underlying mechanisms. Third, CBM has the potential to become an instrument of great clinical value, from a therapeutic as well as preventative perspective. Hence, investigating its clinical potential is of great importance.

The general aim of this special issue is to present the latest findings in the area of CBM research in order to advance our present understanding of CBM effects, from both a fundamental and an applied perspective. By this, we

continue the ‘CBM journey’ started by the special issue in the *Journal of Abnormal Psychology* in 2009 (Koster et al. 2009), which mainly aimed to provide an introduction to the central idea underlying CBM techniques. Many new studies appeared since 2009, and a range of issues were explored and addressed, for example, the potential (neural) mechanisms underlying CBM training effects (e.g., Browning et al. 2010; Heeren et al. 2013; Hoppitt et al. 2010), and variables moderating the training’s effect, from psychological factors (e.g., Salemink and Wiers 2012), to gene polymorphisms (Fox et al. 2011). Moreover, new clinical domains have been targeted, for example (analogue) post traumatic stress disorder (e.g., Schoorl et al. 2013; Woud et al. 2012) or developmental psychopathology (e.g., Bar-Haim et al. 2011; Lau et al. 2012; Vassilopoulos et al. 2013), and the preventative effects of CBM have also started to receive interest (e.g., de Hullu et al. 2014). In addition, CBM procedures have been extended by training procedures targeting the induction and modification of functional and dysfunctional approach avoidance tendencies (e.g., Becker et al. 2014; Rinck et al. 2013; Wiers et al. 2011), and standard experimental designs have been supplemented by single-case (e.g., Blackwell and Holmes 2010; Kruijt et al. 2013) and qualitative (e.g., Beard et al. 2012) methodologies. Finally, researchers have started to examine the effects of CBM procedures in conjunction with, or in comparison to, other psychological interventions such as internet-delivered cognitive behavioural therapy (e.g., Boettcher et al. 2014; Bowler et al. 2012; Månsson et al. 2013; Williams et al. 2013).

The studies of this special issue are presented in the order that the different CBM trainings evolved. Hence, the first studies concern CBM—interpretation (CBM-I) training. Next, CBM—attention and memory trainings will follow (CBM-A, CBM-M). Finally, an approach avoidance training study will be presented (CBM-AA). In line with this classification, the specific aim of the special issue was to present the reader with the novel developments within each type of CBM procedure. Therefore, studies were selected that either applied well-established CBM procedures in new populations or tested the effectiveness of adapted versions of well-established CBM procedures. Moreover, our intention was to select studies that tested generalization effects of CBM training: The past has relatively robustly shown that it is possible to modify biased cognitive processes, but little is known about the generalization of those effects. Hence, studies were chosen that investigated the transfer of CBM training effects.

The section on CBM-I training procedures starts with two studies that both employed a rather traditional, i.e., scenario-based, CBM-I training. However, both studies applied the training to relatively unexplored samples. For example, the study by Micco et al. (2014) trained depressed

adolescents and young adults, whereas Beadel et al. (2014) trained individuals scoring high in obsessive–compulsive beliefs. Moreover, the latter study also addressed a methodological aspect and investigated the trajectories of change processes over the course of the CBM-I training, including the assessment of cognitive and physiological responses. The study by Clarke et al. (2014) also focused on gaining a better understanding of CBM-I training effects. This study used the variant of the CBM-I paradigm that Holmes and Mathews (2005) developed to exploit the powerful effect of mental imagery on emotion. The original scenario-based CBM-I paradigm did include the instruction to participants to imagine themselves in the training scenarios, but in the imagery-focused CBM-I developed by Holmes and Mathews (2005) the mental imagery component is a central focus of the training, and is enhanced by providing prior instruction in mental imagery and by auditory presentation of the training scenarios. Using such an imagery-based CBM-I procedure, Clarke et al. (2014) investigated which training element is responsible for the observed training-congruent changes in interpretations, the ambiguity or the emotional content of the imagined scenarios. The study of Torkan et al. (2014) extends the imagery-based CBM-I procedure to a clinical and new cultural setting, testing its effects in treatment-seeking individuals with major depression in Iran. Moreover, it investigated the importance of the imagery instructions and examined whether the repeated practice in using mental imagery would lead to increased imagery vividness. Finally, two studies are included that used new variations of CBM-I procedures. Yiend et al. (2014) tested a CBM-Error (CBM-E) training procedure in a sample of clinically depressed individuals. They investigated whether such training is capable of modifying depression-related cognitive errors and interpretations, and whether it influences mood and resilience to stress. Daches and Mor (2014) applied a novel CBM procedure in the context of rumination, namely an adapted version of the negative affective priming task (NAP), which specifically targeted the inhibition of negative stimuli.

The section on CBM-A training procedures contains three studies. The study by Grafton et al. (2014) aimed to advance our understanding of CBM-A training effects and investigated whether CBM-A is still effective when participants are informed about the training contingency. The effect of such a manipulation was tested twice, once regarding the modification of attentional biases, and once regarding anxiety-related responses to a stressful experience. Arditte and Joormann (2014) addressed the question of which individual difference variables determine the effectiveness of CBM-A, i.e., they tested for whom and how CBM-A works. Specifically, they tested the moderating role of rumination in attention training effects.

Finally, Enock et al. (2014) tested a new way of delivering CBM-A, building on recent developments to provide CBM training via the internet. In their study, participants engaged in daily CBM-A sessions across a four week period, delivered via their smartphone.

In terms of studies on CBM-M, there is one contribution by Vrijnsen et al. (2014), which used a new paradigm. This study investigated whether memory biases can be manipulated by means of a cued recall training paradigm, and whether such training affects emotional reactivity to a stressor. Last but not least, Asnaani et al. (2014) applied a CBM-AA procedure in a clinical sample. Their study targeted the modification of dysfunctional avoidance tendencies in individuals with social anxiety disorder.

To summarize, this special issue provides the reader with an overview of the CBM journey of the past 4 years, including (1) studies that advance our understanding of mechanisms underlying CBM training effects, (2) new research findings following the application of well-established CBM procedures in new populations and adapted versions of well-established CBM procedures, and (3) new insights regarding the (clinical) transfer effects of CBM procedures. Given the broad scope of this special issue, we believe that the presented studies will be interesting to both fundamental and applied researchers as well as (research-minded) clinicians. Experts Fox et al. (2014, this issue) have written an intriguing commentary that discusses the past perspectives, present findings and future applications of CBM training procedures. Within this ‘Time Traveller’s Tale’, Bundy Mackintosh will be the ‘long traveler’ given her pioneering work at the beginning of the CBM research field. She will be interviewed by Marcella L. Woud, the ‘starting traveler’, and this interview will provide a summary of Bundy’s experiences, perceptions and opinions regarding the CBM research field. Elaine Fox will be the ‘critical traveler’. She already contributed to the JAP special issue in 2009. Hence, she will discuss which questions the special issue of 2009 raised and which questions the special issue of 2014 answered. Finally, Emily A. Holmes will be the ‘future traveler’. She will address the issue of how findings obtained in lab settings can be transferred to the therapeutic practice, including topics such as transfer and generalization effects. We warmly invite you to travel with us on this exciting CBM journey.

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Conflict of Interest Marcella L. Woud and Eni S. Becker declare that they have no conflict of interest.

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