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Validation of a novel attentional bias modification task: The future may be in the cards

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ABSTRACT

Attentional bias modification (ABM) is a promising therapeutic tool aimed at changing patterns of attentional selectivity associated with heightened anxiety. A number of studies have successfully implemented ABM using the modified dot-probe task. However others have not achieved the attentional change required to achieve emotional benefits, highlighting the need for new ABM methods. The current study compared the effectiveness of a newly developed ABM task against the traditional dot-probe ABM task. The new person-identity-matching (PIM) task presented participants with virtual cards, each depicting a happy and angry person. The task encourages selective attention toward or away from threat by requiring participants to make matching judgements between two cards, based either on the identities of the happy faces, or of the angry faces. Change in attentional bias achieved by both ABM tasks was measured by a dot-probe assessment task. Their impact on emotional vulnerability was assessed by measuring negative emotional reactions to a video stressor. The PIM task succeeded in modifying attentional bias, and exerting an impact on emotional reactivity, whereas this was not the case for the dot-probe task. These results are considered in relation to the potential clinical utility of the current task in comparison to traditional ABM methodologies.

Anxiety disorders are the most common class of mental health problems, affecting an estimated 14–18% of people within their lifetime (Australian Bureau of Statistics, 2008; Kessler, Chiu, Demler, Merikangas, & Walters, 2005). Anxiety disorders severely impact day-to-day activities, and often contribute to social withdrawal (Rubin & Burgess, 2001). In addition to the considerable distress they cause individuals, anxiety disorders pose a huge burden on society with estimates suggesting that they cost the US more than $42 billion a year (Greenberg et al., 1999).

Cognitive models of psychopathology have long implicated biased attentional processing in anxiety dysfunction (e.g. Mathews & Mackintosh, 1998). This *attentional bias* for threat has been observed using a range of different paradigms, and across a wide range of sub-clinical and clinically anxious populations (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007). One of the most common methods of assessing attentional bias to threat is the dot-probe task (MacLeod, Mathews, & Tata, 1986), which measures attentional distribution between pairs of stimuli that differ in emotional valence, presented simultaneously on a computer screen (e.g. faces or words) for a brief duration (e.g. 500 ms). Participants are required to discriminate the identity of a probe that subsequently appears in the location of either the threatening or neutral member of the stimulus pair. An attentional bias to threat is revealed by disproportionate speeding to discriminate probes presented at the location of previously presented threatening stimuli, as compared to probes presented at the location of previously exposed neutral stimuli (MacLeod et al., 1986). Using this and similar paradigms, it has now firmly been established that elevated anxiety is associated with a tendency to preferentially allocate attention towards threatening information (Bar-Haim et al., 2007).

Further research has sought to determine the causal status of biased attention to threat by directly modifying such attentional bias, to assess the consequent impact on anxiety vulnerability. The key feature of attentional bias modification (ABM) paradigms is the introduction of a contingency into the task designed such that successful performance will be enhanced by adoption of the target pattern of attentional selectivity (MacLeod & Clarke, 2013). In the

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first implementation of this ABM approach, a contingency was introduced in the attentional probe task, such that selectively attending to stimuli of one particular valence would facilitate the probe discrimination response. To encourage greater attentional bias to threat, the probe was always shown at the location of the negative stimulus. In contrast, to encourage attentional bias away from threat, the probe was always presented at the location opposite the threat stimulus (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). The results showed that the intended attentional bias change was achieved, and that this had a consequent impact on emotional responding to a subsequent stress task. Specifically, when exposed to a stressor following ABM training, participants trained to adopt an attentional bias away from threat show an attenuated elevation of negative emotional state, compared to participants trained to adopt an attentional bias towards threat (MacLeod et al., 2002). This study, and many other subsequent studies employing this same ABM task, have confirmed that attentional bias to threat can be modified in this way (Hakamata et al., 2010), and have shown that when such attentional selectivity is successfully modified, this has a direct impact on emotional vulnerability (Clarke, Notebaert, & MacLeod, 2014; Hakamata et al., 2010; MacLeod & Mathews, 2012). In addition, several studies have shown that attentional bias to threat is significantly reduced after cognitive behavioural therapy (CBT), in a variety of anxious populations (for a review, see Tobon, Ouimet, & Dozois, 2011).

These findings highlighted the possibility that ABM may have significant therapeutic potential, and indeed there is now compelling evidence that this can be the case (Hakamata et al., 2010; MacLeod & Clarke, 2013; Mogoase, David, & Koster, 2014). Several researchers have successfully implemented extended attentional bias training in clinical settings to reduce emotional dysfunction. For example, Amir, Beard, Burns, and Bomyea (2009) delivered 8 sessions of ABM across 4 weeks to individuals with generalised anxiety disorder using the modified dot-probe task. Results showed that at the end of the four weeks, participants who completed the ABM training showed a reduced attentional bias to threat, and a reduction in self-reported and clinician-observed anxiety symptoms as compared to participants who completed a sham training (Amir, Beard, Burns, et al., 2009). Such results have been consistently shown in social anxiety disorder (Van Bockstaele et al., 2014; Woud & Becker, 2014), but also in generalised anxiety disorder (Schmidt, Richey, Buckner, & Timpano, 2009) and paediatric anxiety disorders (Bar-Haim, Morag, & Glickman, 2011; Rozenman, Weersing, & Amir, 2011).

However, not all studies have achieved such therapeutic benefits from delivering this probe-based ABM task (see for example Boettcher, Hasselrot, Sund, Andersson, & Carlbring, 2014; Boettcher et al., 2013; Carlbring et al., 2012; Neubauer et al., 2013; Rapee et al., 2013; Schoorl, Putman, & Van der Does, 2013). It is crucial to note that, whenever change in attentional bias has been assessed, it has consistently been found that the failure to achieve emotional benefits from this ABM procedure has reflected a failure to successfully modify attentional selectivity as intended. In contrast, when the ABM task has proven successful in attenuating attention to threat, so too it has consistently yielded emotional benefits (Clarke, Notebaert, et al., 2014). While this pattern confirms the therapeutic value of effective attentional bias modification, it suggests that the conventional probe-based ABM approach may not be the optimal procedure for achieving such bias modification. Several studies have modified the dot-probe training task in ways that were hypothesised to enhance attentional training, with mixed results. For example, Bernstein and Zvielli (2014) have added on-line feedback of participants' biased attention to a dot-probe training task, and showed that relative to an active placebo control, this attentional feedback awareness training modified attentional bias to threat and affected the rate of emotional recovery following a stressor. Enock, Hofmann, and McNally (2014) likewise innovated dot-probe ABM by delivering it via participants' smartphones. In spite of the many advantages this approach may offer, the results showed no difference in symptom reduction between participants in the active training conditions as compared to the control conditions. Other researchers have adapted other existing attentional bias assessment task to modify attentional bias (Dandeneau & Baldwin, 2004; Dandeneau, Baldwin, Baccus, Sakellaropoulo, & Pruessner, 2007), however these studies lack an appropriate control condition. Hence one important challenge for ABM research is to find new effective ways of changing patterns of attentional bias. Consequently, many researchers in this burgeoning field have called for the development and validation of new ABM tasks, which may ultimately be deployed in clinical settings (Bar-Haim, 2010; Beard, 2011; Clarke, Notebaert, et al., 2014; Hallion & Ruscio, 2011; Van Bockstaele et al., 2014).

While there has been growing recognition of the importance in moving beyond the dot-probe ABM task, to develop and validate new improved methodologies for directly modifying biased patterns of attentional selectivity, as yet this has not resulted in the expansion of ABM tasks necessary to allow comparison of different approaches. The aim of the current study was to develop a new ABM task, and compare its effectiveness to that of the traditional probe ABM task. This new task was based on the popular card game 'snap', in which a matching judgment needs to be made between two exposed cards. In the current task, this matching response concerned whether faces shown on the two cards were of the same person. In order to be able to train differential attentional responding emotional information, each card presented two faces, each of a different individual, one displaying a happy expression and one displaying an angry expression. To encourage development of an attentional bias away from threat, some participants were required to base their matching response solely on identities of the happy faces. Conversely, to encourage development of an attentional bias towards threat, other participants were instead required to base their matching response solely on the identities of the angry faces. Thus, in line with other ABM tasks, successful task performance would be enhanced by adopting a pattern of processing that favoured greater selective attention towards either the more positive or the more negative information contained in each display (MacLeod & Clarke, 2013).

The two specific aims of the current study were to determine whether this new person identity matching (PIM) ABM task: (i) can produce a change in attentional bias in line with the allocated attentional training condition of equal or greater magnitude to the attentional change elicited by the conventional dot-probe ABM task, and if so, (ii) impacts on emotional vulnerability to an equal or greater degree than does the conventional dot-probe ABM task. To investigate this, participants with mid-range levels of trait anxiety were allocated to one of four conditions: i. Dot-probe ABM configured to encourage attentional bias away from threat (attend-happy), ii. Dot-probe ABM configured to encourage attentional bias towards threat (attend-angry), iii. Person identity matching ABM configured to encourage attentional bias away from threat (attend-happy), iv. Person identity matching ABM configured to encourage attentional bias towards threat (attend-angry). To determine the effectiveness of the ABM tasks in modifying attentional selectivity, attentional bias to threat was measured before and after exposure to the ABM procedure, using the traditional dot-probe attentional bias assessment task. To determine the impact of the ABM tasks on emotional vulnerability, we compared the intensity of negative emotional reactions to a video stressor presented after participants completed these differing ABM conditions.