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Attention processes in chronic fatigue syndrome: Attentional bias for health-related threat and the role of attentional control

Ruihua Hou [a], Rona Moss-Morris [b,*], Anna Risdale [c], Jeannette Lynch [d], Preshan Jeevaratnam [a], Brendan P. Bradley [c], Karin Mogg [c]

[a] Clinical and Experimental Sciences, Faculty of Medicine, University of Southampton, Southampton, United Kingdom
[b] Health Psychology Section, Psychology Department, Institute of Psychiatry, King's College London, London Bridge, London SE1 9RT, United Kingdom
[c] Psychology, University of Southampton, Southampton, United Kingdom
[d] University of Southampton, Primary Medical Care, Aldermoor Health Centre, Southampton, United Kingdom

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ABSTRACT

Cognitive behavioural models of chronic fatigue syndrome (CFS) propose that attention processes, specifically, enhanced selective attention to health-threat related cues, may play an important role in symptom maintenance. The current study investigated attentional bias towards health-threat stimuli in CFS. It also examined whether individuals with CFS have impaired executive attention, and whether this was related to attentional bias. 27 participants with CFS and 35 healthy controls completed a Visual Probe Task measuring attentional bias, and an Attention Network Test measuring executive attention, alerting and orienting. Participants also completed self-report measures of CFS and mood symptoms. Compared to the control group, the CFS group showed greater attentional bias for health-threat words than pictures; and the CFS group was significantly impaired in executive attention. Furthermore, CFS individuals with poor executive attention showed greater attentional bias to health-threat related words, compared not only to controls but also to CFS individuals with good executive attention. Thus, this study revealed a significant relationship between attentional bias and executive attention in CFS: attentional bias to threat was primarily evident in those with impaired executive attention control. Taking account of individual differences in executive attention control in current intervention models may be beneficial for CFS.

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Introduction

Chronic fatigue syndrome (CFS) is characterised by recurrent or persistent disabling fatigue which has been present for at least 6 months (Fukuda et al., 1994). The psychological versus biological pathogenesis of the condition has been hotly debated. However, there is increasing consensus that CFS is multifaceted and heterogeneous in nature. The cognitive behavioural model of CFS attempts to incorporate this heterogeneity through describing the interaction between biological and psychosocial factors. The model suggests that factors such as genetics, high perfectionist tendencies, and/or a history of psychological distress predispose individuals to CFS. The initial symptoms are then precipitated through events such as an acute infection and/or stress. Cognitive and behavioural factors such as negative illness beliefs and all-or-nothing behaviour perpetuate the symptoms and associated disability (Moss-Morris, 1997; Moss-Morris & Petrie, 2003; Surawy, Hackman, Hawton, & Sharpe, 1995; Wessely, Butler, Chalder, & David, 1991).

The perpetuating factors are seen as key to the model and are the focus of successful treatments for CFS (Castell, Kazantzis, & Moss-Morris, 2011). There has also been considerable empirical support for the content of the illness cognitions hypothesised to be important in the maintenance of CFS, including negative beliefs about the consequences, timeline and controllability of the condition (Moss-Morris, 2005; Moss-Morris, Spence, & Hou, 2011). Little research has, however, been conducted into the cognitive processes that may develop or maintain particular cognitions or beliefs. It is believed that distortions or biases in cognitive processing (e.g., selective attention to health-threat information, negative bias in the interpretation of somatic information) may influence the

Abbreviations: CFS, chronic fatigue syndrome; ANT, Attention Network Test; VPT, Visual Probe Task; CDC, Centre for Disease Control; RT, reaction time; HADS, Hospital Anxiety and Depression Scale; SPSS, Statistical Package for Social Sciences; ANOVA, analysis of variance.

* Corresponding author.
E-mail address: rona.moss-morris@kcl.ac.uk (R. Moss-Morris).

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development of negative illness representations, thus maintaining the severity and duration of the symptoms (Moss-Morris & Petrie, 2003). Furthermore, there may be a reciprocal relationship between illness beliefs and cognitive biases, as illness beliefs may promote increased attentional focus on somatic symptoms (Deary, Chalder, & Sharpe, 2007).

Two methodologies have predominantly been used to investigate attentional bias across conditions; the modified Stroop task and Visual Probe Task (VPT; also called the dot-probe task). The modified Stroop task assesses the distracting effect of task-irrelevant threat information; however, interpretation of this effect can be complicated, as it may reflect increased attention bias towards threat cues and/or increased effort to suppress their processing (De Ruiter & Brosschot, 1994). The VPT instead provides a more direct measure of the allocation of visuospatial attention and has been widely used to assess attentional bias to a range of threat stimuli (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Lees, Mogg, & Bradley, 2005; MacLeod, Mathews, & Tata, 1986; Mogg & Bradley, 1998). It involves presenting a series of pairs of stimuli (e.g. a threat-related picture paired with a neutral picture; or a threat word paired with a neutral word) on a computer screen. Each stimulus pair is presented briefly (e.g. 500 ms), followed by a probe (e.g. arrow or dot). Participants are asked to respond to the probe as quickly as possible by pressing a response button. An attentional bias towards threat is reflected by faster response times to probes replacing threat cues than neutral cues. The exposure duration of the stimuli can be varied to examine the time-course and component processes of attentional biases. An attentional bias for relatively short-duration threat cues, such as 500 ms or less, is likely to reflect early processes involved in initial visual orienting (Bradley, Mogg, & Millar, 2000; Gamble & Rapee, 2009; Mogg, Garner, & Bradley, 2007); whereas longer stimulus durations, such as a second or more, are likely to be more sensitive to later strategic processes involved in maintenance of attention or avoidance (Cisler & Koster, 2010; Mogg & Bradley, 1998).

Attentional biases have been studied in a wide range of pathologies, including anxiety, depression, and chronic pain (e.g. reviews by Armstrong & Olatunji, 2012; Bar-Haim et al., 2007; Crombez, Van Ryckeghem, Eccleston, & Van Damme, 2013; Gotlib & Joormann, 2010; Mogg & Bradley, 1998; Schoth, Nunes, & Liossi, 2012). A bias in initial orienting may reflect rapid automatic capture of attention by salient stimuli, in the absence of detailed elaborative processing; whereas a bias in maintained attention may reflect more prolonged dwelling and rumination on personally relevant information. Anxiety is commonly associated with bias in initial orienting to threat; and depression with bias in maintained attention on information related to loss and sadness, although overlap in these patterns of bias is sometimes noted (e.g., reviews by Armstrong & Olatunji, 2012; Bar-Haim et al., 2007; Gotlib & Joormann, 2010). Chronic pain has been associated with bias for pain-related cues in both early and later aspects of attentional processes (Schoth et al., 2012); moreover, this attentional bias is not accounted for by anxiety or depression, and may operate primarily for stimuli related to the individual's pain-related concerns (Crombez et al., 2013). Across pathologies, attentional biases are likely to be found for information which has high personal salience, or relevance to the individual's disorder (e.g., Crombez et al., 2013; Hankin, Gibb, Abela, & Flory, 2010; Williams, Mathews, & MacLeod, 1996).

Few studies have investigated attentional bias in CFS. Using the modified Stroop task, Moss-Morris and Petrie (2003) failed to find an attentional bias for somatic words (e.g., sick, dizzy) in CFS individuals. In contrast, Hou, Moss-Morris, Bradley, Peveler, and Mogg (2008), using the VPT, demonstrated an attentional bias towards health-threat stimuli (words and pictures) in individuals with CFS compared to healthy controls. However, this study used a relatively small sample size (14 participants with CFS) and attentional bias was only assessed at a single duration (500 ms). More recently, Martin and Alexeeva (2010) used a modified exogenous cueing task and found no attentional bias to illness-related information in individuals with CFS, compared to healthy controls. They presented their stimuli for 100 ms, compared to 500 ms in the Hou et al. (2008) study, which led Martin and Alexeeva to suggest that the attentional bias in CFS may primarily occur at a later, more strategic stage of processing (which was not assessed with their 100 ms stimulus duration). However, the modified cueing task (which presents a single cue on each trial, rather than a pair of stimuli) has methodological complications which can make the interpretation of results unclear (see Mogg, Holmes, Garner, & Bradley, 2008, for details). Further research is needed to examine the time-course of attentional bias towards health-threat stimuli in a larger and well-defined CFS sample. Such research may help identify specific cognitive anomalies in CFS; e.g., whether or not attention is automatically captured by illness-related information, and whether individuals with CFS maintain their attention on such information (i.e., similar to the pattern of bias found in chronic pain, Schoth et al., 2012). In the longer term, it may also prove useful to assess the effects of treatment on such specific attentional biases, and to refine cognitive interventions to alter biases that may maintain or exacerbate CFS.

Although evidence of attentional bias in CFS is mixed, it has been established that CFS is associated with attentional deficits (Cockshell & Mathias, 2010; Dickson, Toft, & O'Carroll, 2009). A meta-analysis by Cockshell and Mathias (2010) indicated that CFS is associated with impaired attention, as well as other cognitive and psychomotor deficits, including impaired working memory and reaction time. Recent advances in cognitive neuroscience indicate that attention processes involve three distinct networks, which carry out the functions of maintaining a state of alertness and readiness to respond to incoming stimuli ('alerting' network); orienting to sensory events ('orienting'); and resolving conflict in processing among competing stimuli and responses ('executive' or 'attention control') (Fan, McCandliss, Fossella, Flaumbaum, & Posner, 2005; Posner & Rothbart, 2007). The executive attention system is important because it underlies a person's ability to focus attention on primary goal-relevant tasks, and to ignore irrelevant distracting information. Individuals vary in their ability to control their attention (i.e. it has trait characteristics; Posner & Rothbart, 2007). Thus, individuals with both CFS and poor executive attention control may be particularly susceptible to having their attention grabbed by task-irrelevant personally salient information, i.e., to show an attentional bias to health-related threat information. The alerting and orienting systems involve relatively automatic aspects of attention (e.g., automatic alerting effect of a warning cue; and automatic orienting towards a visual cue following its onset), while executive attention involves more 'top-down' goal-directed control processes. Previous research using other tasks suggests that alerting and orienting functions may not be impaired in CFS (Michiels, de Gucht, Cluydts, & Fischler, 1999), whereas deficits are more likely to be found on tasks involving executive attention (Cockshell & Mathias, 2010; Mizuno1 & Watanabe, 2013).

The primary aims of this study were to investigate in individuals with CFS, compared to healthy controls: (i) the specific characteristics of attentional bias towards health-related threat information; i.e., using both linguistic and pictorial stimuli to assess whether the bias generalises across stimulus modalities, and two stimulus durations (500 ms and 1250 ms) to assess the time-course of the bias, (ii) the functioning of three attention networks: executive attention control, alerting, and orienting, and (iii) whether attentional bias towards health-threat cues in CFS is related to poor executive

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