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Quantifiable change in functional brain response to empathic and forgivability judgments with resolution of posttraumatic stress disorder

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Abstract

Previous functional neuroimaging studies of posttraumatic stress disorder (PTSD) have mainly focused on symptom-provocation paradigms in combat-related PTSD. We sought to elucidate the effect of non-combat-related PTSD on the physiology of social cognition. Thirteen patients with PTSD underwent functional magnetic resonance imaging (fMRI) while they engaged in tasks that (i) involve speculation on another's intention, (ii) invoke empathy and (iii) involve making judgments of the forgivability of others' actions; each versus 'baseline' social reasoning judgments. A post-therapy fMRI scan followed a course of modified cognitive behavioural therapy. Post-therapy, we found increased activation in brain regions predicted on the basis of foregoing work in healthy subjects. These included significant left middle temporal gyrus activation in post-therapy response to empathy judgments and posterior cingulate gyrus activation in post-therapy response to forgivability judgments. The specific regions of the human brain activated by empathy and forgivability judgments changed with symptom resolution in PTSD. Time and therapy are likely contributory factors that lead to a degree of 'normalisation' of the neural response to these social cognition tasks.

Keywords: fMRI; Empathy; Forgiveness; PTSD

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1. Introduction

Some previous posttraumatic stress disorder (PTSD) studies have examined symptomatology following extreme everyday events, e.g., road traffic accidents (Blanchard and Hickling, 1998). Studies conclude that an individual's perception of an event, irrespective of its severity, strongly predicts progression to PTSD (Ehlers et al., 1998). Cognitive behavioural therapy (CBT) is effective at reducing many core symptoms (Tarrier et al., 1999), and potentially allows functional magnetic resonance imaging (fMRI) tracking of changes via a paradigm that activates relevant brain networks.

Previous event related potential (ERP) studies (McFarlane et al., 1993; Blomhoff et al., 1998) suggest that patients with non-combat-related PTSD may suffer from higher cognitive (non-trauma related) information-processing abnormalities. Functional neuroimaging studies (e.g., Rauch and Shin, 1997) have generally used symptom-provocation paradigms (auditory, visual and script-driven war-based paradigms) in combat-related PTSD. Non-combat-related PTSD is associated with a wide range of psychological difficulties, particularly social problems, the neural underpinnings of which we wished to study.

We have previously shown (Farrow et al., 2001) that our theory of mind (ToM) based empathy and forgivability judgment paradigms differentially activate left medial prefrontal cortex (BA 9/10), left anterior middle temporal gyrus (BA 21), left inferior frontal gyrus (BA 47), orbitofrontal gyrus (BA 11) and posterior cingulate gyrus/precuneus (BA 31/7) in a cohort of healthy subjects.

Activations previously reported in response to other ToM paradigms (e.g. Fletcher et al., 1995a), and evidence of the effectiveness of a short course of CBT at alleviating these (proposed) emotionally ToM based difficulties (Tarrier et al., 1999), suggested that a change in the distribution and/or magnitude of brain activations would accompany neuropsychological improvement.

We hypothesised that PTSD symptoms would affect emotional and social cognition processing and that these changes would i) lead to attenuated brain activation in regions thought to subserve social cognition and ii) be amenable to CBT, resulting in a 'normalisation' of brain activation.

2. Methods

2.1. Subjects

From January 2000 to July 2001, all patients admitted through the Accident and Emergency department of the Northern General Hospital, Sheffield, England, following a road traffic accident, assault or industrial accident were invited to participate. At 1- and 3-month post-'incident' postal follow-up, patients completed questionnaires including the Impact of Events Scale - revised (IoE-R — a short PTSD screening measure; Weiss and Marmar, 1996). Patients scoring ≥2.0 on two or more of the three IoE-R subscales (intrusion, avoidance and

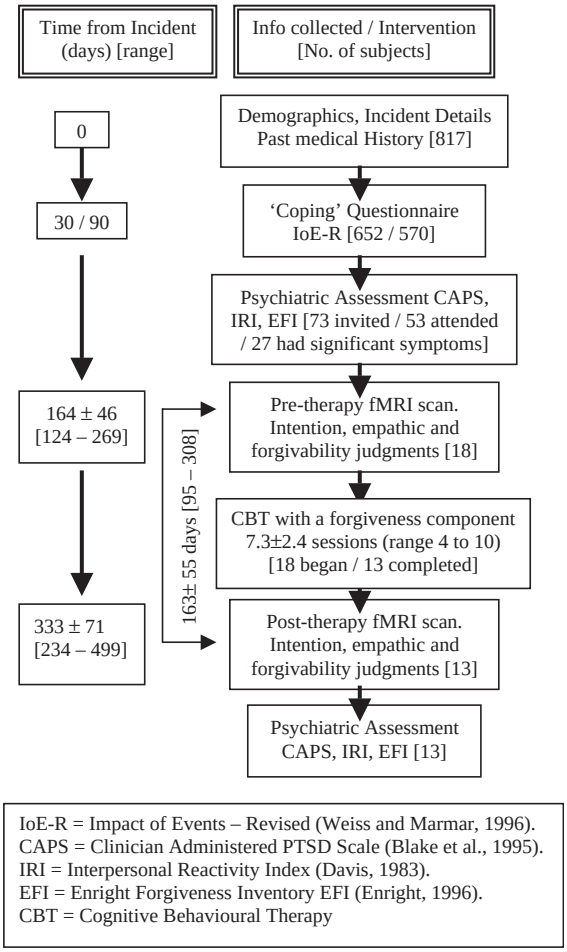

Fig. 1. Study flow chart detailing patient numbers at successive stages, relevant intervention and time between stages.