Emotion recognition and emotional theory of mind in chronic fatigue syndrome


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Background: Difficulties with social function have been reported in chronic fatigue syndrome (CFS), but underpinning factors are unknown. Emotion recognition, theory of mind (inference of another’s mental state) and ‘emotional’ theory of mind (eToM) (inference of another’s emotional state) are important social abilities, facilitating understanding of others. This study examined emotion recognition and eToM in CFS patients and their relationship to self-reported social function.

Methods: CFS patients (n=45) and healthy controls (HCs; n=50) completed tasks assessing emotion recognition, basic or advanced eToM (for self and other) and a self-report measure of social function.

Results: CFS participants were poorer than HCs at recognising emotion states in the faces of others and at inferring their own emotions. Lower scores on these tasks were associated with poorer self-reported daily and social function. CFS patients demonstrated good eToM and performance on these tasks did not relate to the level of social function.

Conclusions: CFS patients do not have poor eToM, nor does eToM appear to be associated with social functioning in CFS. However, this group of patients experience difficulties in emotion recognition and inferring emotions in themselves and this may impact upon social function.

Keywords: chronic fatigue syndrome; fatigue social cognition; theory of mind; empathy; emotion; mentalisation; social function

Introduction

Chronic fatigue syndrome (CFS) is a disorder characterised by persistent, medically unexplained fatigue with associated somatic symptoms such as joint and muscle pain, headaches and sleep problems (Fukuda et al., 1994). It is chronic and fluctuating and related to cognitive as well as physical difficulties (Afari & Buchwald, 2003). Consequently, CFS is associated with severely disrupted quality of life.
life (Anderson & Ferrans, 1997) and enduring functional impairment (Joyce, Hotopf, & Wessely, 1997). The illness is multifaceted and the biopsychosocial model recognises that factors across physical, social, behavioural and psychological domains contribute to its aetiology (Harvey & Wessely, 2009; Wessely, 2001). These variables interact, particularly in maintaining the disorder. Cognitive models of CFS suggest that maintenance may be particularly driven by psychological factors such as beliefs about the illness and attribution of symptoms to physical over emotional or psychological causes, leading to behaviours such as inactivity (Deale, Husain, Chalder, & Wessely, 2001; Prins et al., 2001; Surawy, Hackmann, Hawton, & Sharpe 1995; Wessely, David, Butler, & Chalder, 1989). Patients enter a vicious cycle in which physical attributions lead to reduced activity in order to lessen the symptoms, but which causes dysfunctional cognitions and results in standards (‘I must achieve high standards and be in control of emotions’) being unmet; this spurs patients on to a burst of activity resulting in some achievement but also a recurrence of fatigue symptoms and inability to perform at premorbid levels. As a result, beliefs around physical illness and the need for rest are reinforced, and this ultimately leads to beliefs of failure (Surawy et al., 1995).

Social problems are common in CFS and are often characterised by restricted activity and relationship difficulties (Wood & Wessely, 1999). These difficulties are recognised by patients with up to 90% of people with CFS describing feelings of isolation and alienation (Komaroff & Buchwald, 1991), and self-perceived incapacity in social functioning (Priebe, Fakhoury, & Henningsen, 2008). In a study comparing patients with CFS and those with rheumatoid arthritis (RA), the CFS group reported higher levels of impairment in social and role functioning, despite actual levels of functioning being similar in both groups (Moss-Morris & Chalder, 2003). Furthermore, the magnitude of social problems, such as the degree of poor social and communication skills, directly relate to the severity of CFS symptoms (Fukuda et al., 2010; Moss-Morris & Chalder, 2003). It appears that it is the quality of social interactions reported by CFS patients that represents a particular difficulty, as opposed to their duration or frequency (Prins et al., 2004). Furthermore, the numbers of problematic social interactions are predictive of treatment outcome (Prins et al., 2004) and are related to illness severity (Vercoulen et al., 1996). This suggests that poor social interaction may be an important maintaining factor in the illness and requires further investigation. These problems do not reflect a lack of desire for social success as there is typically a strong aspiration within CFS patients to socially achieve (van Geelen, Sinnema, Hermans, & Kuis, 2007). It is therefore unclear as to what factors may exactly contribute to negative social experiences in CFS.

Generally, human social behaviour is underpinned by a variety of mental processes known as social cognition (Adolphs, 1999). The abilities comprising social cognition have been broken down into five key component factors: (1) acquisition of socio-affective values and responses, (2) recognising and responding to socio-affective stimuli, (3) ‘embodied’ simulation or low-level mental state inference, (4) high-level mental state/trait inference and (5) context-sensitive regulation (Ochsner, 2008). Factors involving recognising and inferring in others or responding to others (i.e. factors 2–4) may be particularly important in underpinning the success of our social experiences. Indeed, recognition of emotion in others (factor 2) is reported to be a significant predictor of social functioning (McGlade et al., 2008). Moreover, abilities of theory of mind (ToM; inference of another person’s thoughts,
beliefs or intentions) and ‘emotional’ theory of mind (eToM; inference of another’s feelings) associated with factor 4 are reported to be the key to successful social interaction (Baron-Cohen & Belmonte, 2005). ToM and eToM enable the perception and interpretation of social cues and facilitate the understanding of other people and their perspectives (Ochsner, 2008). They build on emotion recognition abilities, but are sensitive to more subtle information and require higher-levels of cognitive processing. In addressing (e)ToM it should be noted that networks and processes involved in understanding the mental states of self and others are closely connected (Mitchell, Banaji, & Macrae, 2005) and impaired eToM may apply to self, others or both domains.

Poor emotion recognition and eToM are evident in disorders characterised by impaired social skills such as autism spectrum disorders (ASD) (Baron-Cohen, Leslie, & Frith, 1985) and psychosis (Brune, 2005). Given the importance of emotion recognition and eToM to social interaction and communication and its conceptualisation as a core feature of disorders characterised by poor social ability (Baron-Cohen & Belmonte, 2005), this ability may be relevant to the problems observed in CFS. Indeed, there is some evidence using the Level of Emotional Awareness Scale (LEAS) to indicate that patients with somatoform disorders have significantly lower levels of awareness of both own or other’s emotions (Subic-Wrana, Bruder, Thomas, Lane, & Kohle, 2005). Several studies (Johnson, Lange, Tiersky, Deluca, & Natelson, 2001; van de Putte, Engelbert, Kuis, Kimpen, & Uiterwaal, 2007) have also documented high levels of alexithymia in people with CFS indicating difficulties in identifying one’s own emotions. However, the ability to recognise emotions in others and the eToM abilities of CFS patients in particular have not been studied to date.

This study examined emotion recognition and eToM in CFS in order to explore whether poor emotion recognition or eToM may underpin the difficulties with social functioning and interaction reported to be associated with the illness.

Methods

Participants

Chronic fatigue syndrome

Forty-five adult CFS patients (35 females) were recruited from one of the two specialist units for CFS (Kings’ College Hospital/SLaM or Poole Hospital NHS Foundation Trust). Diagnosis was confirmed by trained clinicians specialising in CFS using the definition of CFS set by the United States Centre for Disease Control and Prevention (Fukuda et al., 1994).

CFS patients were excluded for poor literacy, non-fluency in English, history of head injury, co-morbid illness (aside from anxiety or depression) or unsuitability for outpatient treatment.

Healthy controls

Fifty healthy controls (HCs) (41 females) were recruited from advertisements and personal contacts. Exclusion criteria were poor literacy, non-fluency in English, history of head injury or mental illness. HC participants were also excluded for scores in the CFS caseness range on the Chalder Fatigue Scale (FS) (i.e. score >4),
DSM IV axis I disorder or family history of CFS, which led to the exclusion of nine females from the original 59 screened.

**Procedure**

After informed consent was obtained, tasks were completed in a random order during an hour-long meeting with a researcher.

**Measures**

Participants from all groups completed the following measures.

**Demographic and clinical information**

*Demographic questionnaire.* Age, educational background and medical history were obtained using self-report questionnaires.

*Structured clinical interview for axis I disorders: research version* (SCID; First, Spitzer, Gibbon, & Williams, 1997). The SCID is a semi-structured interview used to assess presence of axis I disorders. Answers are rated 1 (absent), 2 (subthreshold) or 3 (threshold). Any 3-point rating resulted in exclusion from the HC group. Psychometric properties are generally good across axis I disorders (Zanarini et al., 2000).

*Hospital Anxiety and Depression Scale* (HADS; Zigmond & Snaith, 1983). The HADS is a self-report measure consisting of 14 items, seven tapping depression and seven anxiety. Items assess feelings and behaviour during the previous week and are scored 0–3, leading to a maximum of 21 for each subscale. Sensitivity and specificity of the HADS is sufficient to detect caseness and severity of anxiety and depression within a wide range of psychosomatic, psychiatric and healthy populations (Bjelland, Dahl, Haug, & Neckelmann, 2002). Separate anxiety and depression subscales are maintained during all HADS analyses herein, as opposed to using the overall HADS scores.

*Chalder Fatigue Scale* (FS; Chalder et al., 1993). The FS is a self-report measure of physical and mental fatigue comprised of 11 items. Participants report condition over the last month compared with usual or if they had been tired for a long time compared to how they felt when they were last well. Level of energy the same or better than usual is scored 0, whereas more fatigue than usual is scored 1. Total scores above four are indicative of CFS.

The measure is reported to have sound reliability and consistency (Cella & Chalder 2010; Chalder et al., 1993). Furthermore, significant associations between FS scores and ratings of CFS according to the criteria set by the United States Centre for Disease Control and Prevention (Fukuda et al., 1994) have been reported in a community sample (Taylor, Jason, & Torres, 2000).
National Adult Reading Test-Revised (NART; Nelson & Willison, 1991). The NART is a widely accepted measure of premorbid IQ. Participants read aloud 50 words checked for correct pronunciation. The number of errors indicate estimated full-scale IQ. Demonstrated to highly correlate with more recent and detailed IQ tests, the NART is considered to be a valid estimate of IQ for research purposes (Bright, Jaldow, & Kopelman, 2002). A measure of IQ was included because performance on some eToM measures has been shown to correlate with intelligence (Golan, Baron-Cohen, Hill, and Golan, 2006) and it was therefore considered important to ensure that the groups were matched for IQ.

Work and Social Adjustment Scale (WSAS; Nelson & Willison, 1991). The WSAS is a self-report scale measuring patients’ perspectives on the degree to which an illness has affected their function. It is comprised of five questions relating to work, home management, social leisure, private leisure and ability to form and maintain relationships. Scores are rated from 0 (not at all affected by my illness) to 8 (severely affected by my illness) leading to a maximum overall score of 40. A review of the use of the WSAS indicates that it has good psychometric properties, supporting its broad use in clinical research (Mundt, Marks, Shear, & Greist, 2002). We chose this measure for its brevity and simplicity and because it addressed several domains.

Assessment of social cognition

(1) Reading the mind (RM) tasks. Originally developed for use in ASD research, these are forced-choice emotion recognition and emotion inference tasks. The versions of tasks were revised by the original research group to improve sensitivity and these have undergone testing by the authors to verify that correct responses are chosen by the majority of HC samples. The use of an ‘emotion taxonomy’ (Baron-Cohen, Golan, Wheelwright, & Hill, 2004) ensured that foils and correct responses were of similar complexity and difficulty to reduce response bias. A definition handout was made available for each task to ensure that all response options were understood.

Emotion recognition – reading the mind in the eyes (RME) (revised) task (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). The RME measures ability to recognise complex emotional and mental states from the eye region of the face. Forty-six black and white images of both male and female eyes are individually shown on a computer screen. The first 10 items require participants to judge gender. The remaining 36 pictures are presented with four emotion words. The participant chooses the response best describing the person’s thought or feeling.

Basic eToM – reading the mind in the voice (RMV) task (Golan, Baron-Cohen, Hill, & Rutherford, 2007). The RMV is a basic eToM task measuring ability to infer complex emotion and mental states using singular content and contextual information (content and intonation of single spoken sentences taken out of context). The task runs using DMDX experimental software (Forster & Forster, 2003) on a laptop computer. Four emotion word options are displayed continuously during 25 audio items, each played once. Participants choose the word best describing the speaker’s feelings. Items are randomly presented and preceded by two practice items. Response times are recorded.
Complex eToM – reading the mind in films (RMF) (Golan et al., 2006). The RMF task is an advanced eToM task measuring ability to infer complex emotional and mental states expressed during interactions between characters in short film clips. The task requires inference of a particular character’s feelings based on several pieces of content and contextual information that must be integrated to achieve correct response. Run using DMDX software (Forster & Forster, 2003) on a laptop computer, the RMF includes 22 short clips and one practice item taken from three feature films. Participants choose which of the four given emotion words best describes the protagonist’s feelings by the end of the scene. The options include three foils, chosen to have some resonance with the scene (e.g. language content), but not matching all aspects (e.g. not body language). Therefore, participants have to perceive and integrate all details of the scene in order to select appropriately. Response times are recorded.

Scoring of RM tasks: RM tasks result in three scores: (i) accuracy: one point for each correctly chosen response; (ii) response time (RMV and RMF); and (iii) valence bias: five independent raters appraised all response options and defined them as reflecting positive, negative or non-emotional/cognitive states. In cases of disagreement, the most popularly endorsed category was assigned, however, Kappa scores indicate good inter-rater reliability (kappa = 0.7, p < 0.001). Bias towards inaccuracy for a particular valence was investigated by splitting the total score into sub-totals of positive (n = 22), negative (n = 50) or non-emotional (n = 11) mental states correctly identified.

(2) Level of Emotional Awareness Scale (LEAS; Lane, Quinlan, Schwartz, Walker, & Zeitlin, 1990). The LEAS consists of 20 written hypothetical social scenarios, 10 in each of two sections (LEAS-A and LEAS-B) enabling measurement at two time points where required. Scenarios are described in a few sentences and involve two characters; oneself and a specified other (e.g. friend). The participant must imagine and free-name how they and the other person would be feeling in written answers. Each scenario generates two individual scores (self and other) and these give rise to a third global score. Scoring is based on emotional language in written answers and described as levels ranging from 0 (non-emotional) to 3 (specific emotions). A manual gives an extensive glossary of words and associated scores. Participants can achieve level 4 overall for ‘self’ or ‘other’ responses where their answer includes two or more words depicting different emotions scored at level 3. Level 4 for both ‘self’ and ‘other’ gives rise to a global score at level 5, provided emotions described for ‘self’ and ‘other’ are distinct. Where a level 5 is not achieved, the highest of the other subscales is carried across. Maximum global scores of 50 and ‘self’ or ‘other’ scores of 40 are possible. Participants were randomly allocated LEAS-A or LEAS-B, so that they could be followed up post-treatment if required. Two raters (A.O. and D.H.) independently scored 30 responses with good inter-rater reliability (self: kappa = 0.6, p < 0.000; other: kappa = 0.7, p < 0.000; global: kappa = 0.6, p < 0.000).

(3) Music task (Laukka & Juslin, 2007). This task measures participants’ ability to recognise emotion conveyed in a short melody played on the electric guitar (Mozart’s Piano Sonata in A Major). Twenty-seven versions are played with varying tempos, volume, emphasis and phrasing, to convey happiness, sadness, fear, anger or no
emotion (neutral). Participants choose which emotion was expressed. Psychometric
data on the music task has not been published; however, task scores are consistent
with the ability to recognise emotion from voices within samples suggesting it is a
valid measure of emotion recognition (Laukka & Juslin, 2007). This non-
interpersonal task was included as a control to assess whether any deficits in
reading emotion were limited to interpersonal stimuli or reflective of global
impairment.

**Analysis**

Most variables failed to fulfil assumptions for parametric analysis and required non-
parametric Mann–Whitney $U$ tests to assess main effects of group. Since distribution
of reaction times for eToM tasks (RMV and RMF) were significantly skewed, a log
transformation reduced skewness before group comparisons were made, however,
variables remained non-normally distributed. NART and RMV scores met
parametric assumptions and therefore group differences were examined using $t$-tests. All tests were two-tailed with significance set at $\alpha = 0.05$. Cohen’s $d$
effect sizes are reported and defined as small ($d < 0.20$), medium ($0.30 \leq d < 0.8$) and
large ($0.8 \leq d$).

Two-tailed non-parametric Spearman’s rank correlation coefficient ($r_s$) investig-
ated relationships between task performance and demographic details or symp-
tomatology. Again all tests were two-tailed with significance set at $\alpha = 0.05$, although
Bonferroni corrections applied to LEAS correlations set significance at $\alpha = 0.016$
($p < 0.05/3$ subscales).

**Results**

Table 1 summarises group demographic, clinical and experimental task scores and
details group statistics.

**Participant characteristics**

Participants were matched for IQ and age. CFS patients had on average 2 years
fewer education than HCs and this difference reached significance ($U = 515.0$,
$p < 0.01$, $d = 0.42$).

**Clinical characteristics**

CFS participants had significantly higher levels of anxiety ($U = 520.5$, $p < 0.000$,
$d = -0.87$), depression ($U = 329.5$, $p < 0.000$, $d = -1.4$) and fatigue ($U = 162.5$,
$p < 0.000$, $d = -2.3$) than HCs. CFS participants had greater scores on the WSAS
than HCs ($U = 15.5$, $p < 0.000$, $d = -4.1$), indicating greater difficulties with daily
and social function.
Social cognition tasks

(1) RM tasks accuracy (total score)

(i) Accuracy (total score)

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(ii) Reaction time (s)

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(2) LEAS

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(3) Music task

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Emotion in music

Note: CFS: chronic fatigue syndrome; HC: healthy controls; NART: National Adult Reading Task; HADS: Hospital Anxiety and Depression Scale; WSAS: Work and Social Adjustment Scale; eToM: emotional theory of mind; LEAS: Level of Emotional Awareness Scale.

Social cognition tasks

(1) RM tasks

(i) Accuracy. The CFS group had significantly lower emotion recognition (RME) scores than HCs \(U = 814.0, p = 0.02, d = -0.50\). There were no group differences on eToM tasks (RMV and RMF).

(ii) Time taken to infer emotions in voice and film clips. CFS participants took significantly longer than HCs to respond on the RMV task \(U = 427.0, p = 0.02, d = -0.56\), but not on the RMF task.

(iii) Valence. The CFS group was significantly poorer at recognising or inferring negative states \(U = 822.5, p = 0.03, d = -0.47\). Within individual tasks, these group differences were specifically evident when required to recognise negative emotions in the eyes \(U = 849.0, p < 0.05, d = -0.43\).
(2) Level of Emotional Awareness Scale
CFS participants were significantly poorer than HCs at inferring emotions in themselves \( [U = 661.0, p < 0.01, d = -0.56] \), but were no different at inferring emotions in others. Overall, LEAS global scores indicated that CFS participants had significantly poorer global emotional awareness scores than HCs \( [U = 695.0, p < 0.03, d = -0.49] \).

(3) Music task
There were no significant group differences in the ability to identify basic emotions expressed in music.

Relationships between demographic variables and social cognition
A summary of correlation coefficients for the CFS group is provided in Table 2.

Age
Age significantly correlated with emotion recognition (RME) scores across the whole sample and within both groups (CFS: \( r_s = -0.4, p < 0.01 \); HC: \( r_s = -0.3, p = 0.02 \)).

IQ
IQ correlated with eToM tasks across the sample (RMV: \( r_s = 0.23, p < 0.05 \); RMV: \( r_s = 0.26, p < 0.05 \)).

Education
Number of years in education correlated with the overall level of emotional awareness across the whole sample (LEAS global: \( r_s = 0.20, p < 0.01 \)).

Relationships between clinical variables and social cognition
Anxiety and depression
There were no correlations between anxiety and depression and social cognition task performance, including when performance was split by valence.

Fatigue symptoms
Emotion recognition ability (RME) negatively correlated with the level of fatigue \( (r_s = -0.22, p < 0.05) \), indicating that greater levels of fatigue were associated with poorer emotion recognition. When the groups were examined separately, this significance was lost. There were no significant correlation between fatigue and positive or negative emotion identification within groups or across the whole sample, although a correlation between fatigue and ability to identify negative emotion in the CFS group approached significance \( (r_s = -0.29, p = 0.07) \).
Table 2. Correlations between demographic, clinical and experimental task scores within the CFS group.

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<th>RME</th>
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<th>Music Task</th>
<th>LEAS self</th>
<th>LEAS other</th>
<th>Age</th>
<th>IQ</th>
<th>Education (years)</th>
<th>HADS anxiety</th>
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<th>Chalder Fatigue Scale</th>
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<td>HADS Depression</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.02</td>
<td>0.03</td>
<td>-0.11</td>
<td>0.06</td>
<td>-0.04</td>
<td>-0.13</td>
<td>0.38*</td>
<td>0.15</td>
</tr>
<tr>
<td>Chalder Fatigue Scale</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>-0.22</td>
<td>0.00</td>
<td>-0.22</td>
<td>0.18</td>
<td>-0.24</td>
<td>-0.36*</td>
<td>0.23</td>
<td>-0.05</td>
</tr>
<tr>
<td>Age of illness onset</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.56**</td>
<td>-0.33</td>
<td>-0.12</td>
<td>-0.23</td>
<td>-0.10</td>
<td>-0.15</td>
<td>0.76**</td>
<td>0.16</td>
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<tr>
<td>Total WSAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>-0.16</td>
<td>-0.22</td>
<td>-0.03</td>
<td>-0.26</td>
<td>-0.19</td>
<td>0.36*</td>
<td>-0.07</td>
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</table>

Notes: Significant correlations highlighted in bold; RME: reading the mind in the eyes; RMV: reading the mind in the voice; RMF: reading the mind in films; LEAS: Level of Emotional Awareness Scale; HADS: Hospital Anxiety and Depression Scale; WSAS: Work and Social Adjustment Scale.

*Indicates correlation is significant at 0.05 level.

**Indicates correlation is significant at 0.01 level.
Illness factors

Within the CFS group, age of illness onset correlated with emotion recognition ability (RME: $r_s = -0.56$, $p < 0.001$) and one task of eToM (RMV: $r_s = -0.33$, $p < 0.05$).

Social functioning

Self-reported social functioning significantly correlated with CFS symptoms ($r_s = 0.73–0.78$, all $p < 0.000$), thus increased fatigue was linked to greater daily and social functional impairment. There were also links between social function and performance on social cognition tasks. All questions of self-reported social function (WSAS) negatively correlated with the ability to imagine one’s own emotions (LEAS Self: $r_s = -0.33$ to $-0.38$, all $p < 0.003$) and with emotion recognition measured by the RME tasks ($r_s = -0.23$ to $-0.32$, all $p < 0.03$), thus poorer performance on these tasks was related to greater functional impairment. Scores on the WSAS question five were significantly negatively correlated with the ability to imagine other people’s emotional state (LEAS other: $r_s = -0.27$, $p < 0.015$), indicating that poorer ability to identify emotions in others was linked to greater impairment in the ability to form and maintain close relationships. eToM scores (RMV and RMF) did not relate to social functioning. Correlations did not hold within individual groups and this perhaps reflects a lack of power within smaller samples.

Discussion

This study sought to examine social cognition in CFS participants as compared with a healthy adult sample. It employed social cognition tasks ranging in complexity of measurement, including forced-choice tasks measuring complex emotion-state recognition (RME task), basic eToM (RMV task) and advanced eToM (RMF task). It also addressed reflective ability to infer emotional mental states in both self and in others (LEAS).

CFS participants were poorer than HCs on tasks of complex emotion-state recognition (RME task) and when required to attribute emotion in self (Level of Emotional Awareness ‘self’ Scale), but had no difficulties with tasks of eToM for others (RMV, RMF task and Level of Emotional Awareness ‘other’ Scale), suggesting that ability to infer emotional states experienced by other people was intact. No differences were observed when recognising emotion in music, implying that difficulties may be limited to interpersonal experiences.

Findings using the Level of Emotional Awareness eToM task and RME emotion recognition task are also consistent with previous research indicating poor performance in patients with a range of psychosomatic disorders on the same tasks (Bydlowski et al., 2005; Harrison, Sullivan, Tchanturia, & Treasure, 2009; Oldershaw, Hambrook, Tchanturia, Treasure, & Schmidt, 2010; Russell, Schmidt, Doherty, Young, & Tchanturia, 2009; Subic-Wrana et al., 2005). The present study adds to this previous research base by demonstrating that difficulties inferring emotion may specifically exist in CFS, but that they are limited to inference of self-emotion and recognition of emotion in the faces of others.

The finding that people with CFS have difficulties identifying their own emotions in the hypothetical social situations posed in the LEAS fits with previous self-report
findings of alexithymia in CFS (Johnson et al., 2001; van de Putte et al., 2007). It also appears to be in keeping with the biopsychosocial model of CFS which suggests that people with CFS have a bias towards illness interpretations, construing symptoms as physical, rather than emotional (Dendy, Cooper, and Sharpe, 2001). In particular, CFS patients have been found to be less likely than either HCs or multiple sclerosis patients to interpret physical sensations as negative emotional states (Dendy et al., 2001). The biopsychosocial model of CFS proposes that expression of negative emotions in early life was met with unsympathetic responses, leading to a learnt reappraisal and suppression of emotion in the future (Surawy et al., 1995). This is in keeping with recent findings of negative beliefs about the experience and expression of emotion in CFS (Hambrook et al., in press; Rimes & Chalder, 2010). The somatic appraisal of emotion reinforces illness beliefs and associated behaviours (such as inactivity), contributing to the maintenance of CFS (Surawy et al., 1995). A greater tendency to apply illness interpretations is shown to predict poorer outcome (Joyce et al., 1997) and treatment that includes elements to teach patients to challenge somatic attributions and enhance sense of control over the illness has been shown to be effective (Prins et al., 2001).

Participants were only impaired at recognising emotions from the eyes of others (RME task), and not in eToM ability to infer emotional or mental states in others (RMV and RMF tasks). Although these tasks all relate to emotional states in others, differences between these abilities exist (Ochsner, 2008); ability to recognise emotions in eyes relies on amygdala-driven threat processing (Adolphs, Baron-Cohen & Tranel, 2002) which has been proposed to be specifically affected in CFS (Gupta, 2002), while eToM for others is a cognitive ability related to frontal lobe function (Ochsner, 2008) which has been shown to be unaffected in CFS (Majer, Welberg et al. 2008). In addition to demonstrating that eToM in CFS is not significantly different to eToM in HCs, this study found no relationship between social functioning and eToM. Therefore, poor eToM does not appear to underpin the social difficulties observed in people with CFS, despite this link in other disorders. However, there were consistent negative associations between WSAS ratings, emotion recognition and ability to infer emotion for the self. The fact that CFS patients performed poorly on emotion recognition and self-emotion inference indicates that these factors may, at least in part, be contributing to global CFS functional impairment. Emotion recognition may be particularly important for CFS populations given that poorer emotion recognition ability in this study was also significantly related to greater levels of fatigue. The notion that emotion recognition ability is a factor in social functioning in ill CFS samples is in keeping with previous research indicating that emotion recognition ability specifically predicts social functioning in other populations (McGlade et al., 2008).

It has been proposed that the WSAS is sensitive to illness severity (Mundt et al., 2002) and this was replicated in the present study, with greater fatigue related to greater overall functional impairment. Furthermore, the correlation of performance on the LEAS ‘other’ scale with only the question of self-reported ability to form and maintain social relationships, indicates that both measures are specifically sensitive to the factors they purport to measure. A key interpretation of this is that reflective eToM for others, as measured by the LEAS ‘other’ subscale, has a direct influence on ability to maintain social relationships across both groups and may generally be relevant to relationship difficulties. However, the lack of deficits on the ‘other’
subscale of the LEAS in this CFS sample suggests that it is not an important factor in the social difficulties observed in this particular illness.

**Limitations**

This study is limited by the cross-sectional design. The tasks were limited by a lack of control components (except for gender identification on the RME) to elucidate whether deficits were specific to eToM or reflected basic impairments in understanding or perceiving stimuli. The CFS participants had fewer years of education than controls which may have limited findings, although both groups had a substantial number of years in education and a relationship between years of education and experimental findings was only evident for global LEAS score. It could be argued that given higher levels of anxiety and depression in the CFS group, these factors could mediate or moderate findings, especially given that poor eToM is associated with major depression (Lee, Harkness, Sabbagh, & Jacobson, 2005). Yet, no relationships between mood variables and eToM scores were found, despite relationships between fatigue symptoms and emotion recognition being observed.

A limitation of the WSAS is that the questions are quite general. They describe the degree to which various functional domains have been affected by the illness and do not tap specific aspects such as the quality of social interaction, which may be a more important factor in CFS (Prins et al., 2004). It could also have been beneficial to include an independent measure of social functioning as there may be discrepancies between self-reported and actual levels of function (Moss-Morris & Chalder, 2003).

**Research implications**

Further research should explore links between a broader range of social function variables, with particular focus on their links to emotion recognition and identification of one’s own emotions, thus clarifying how and to what degree such factors should be accommodated in future CFS illness and treatment models. With larger samples more sophisticated analysis could have been employed (e.g. path analysis/structural equation modelling) to examine the ability of emotion recognition to predict social functioning and fatigue in CFS.

**Clinical implications**

This study suggests that the ability to recognise emotions in others is impaired and may lead to poorer psychosocial functioning. Therefore, psycho education regarding this difficulty, and teaching individuals how to better recognise emotions in others may be of benefit. Difficulty inferring self-emotions is in keeping with the biopsychosocial model of CFS and may indicate that work to improve acceptance and understanding of one’s emotions is beneficial. There is evidence from randomised controlled trials that CBT reduces fatigue and improves functioning (Price, Mitchell, Tidy, & Hunot, 2009). It is possible that CBT also changes people’s ability to recognise emotions in self and others but this has not been evaluated specifically. Similarly, ‘third wave’ cognitive-behavioural therapies, such as
acceptance and commitment therapy (e.g. Hayes, Luoma, Bond, Masuda, & Lillis, 2006) and compassion focussed therapies (e.g. Gilbert, 2005), may also be of benefit to people with CFS.

Conclusion

CFS patients evidenced poor emotion-state recognition and poor attribution of emotion in self, which is consistent with previous research documenting higher levels of alexithymia in this population. Performance on these tasks relates to self-reported daily and social functioning. Ability to infer emotions in others appears intact and not associated with difficulties in social functioning experienced by CFS patients.

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