Emotional suppression in chronic fatigue syndrome (CFS): Experimental study

Katharine A. Rimes[1], Joanna Ashcroft[2], Lauren Bryan[3] and Trudie Chalder[3]

[1] Author for correspondence: Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, De Crespigny Park, London SE5 8AF, UK. Katharine.Rimes@kcl.ac.uk.

[2]Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London;

[2] Department of Psychological Medicine, Institute of Psychiatry, Psychology and Neuroscience, King's College London.

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Abstract

Objective: Emotional processing differences in chronic fatigue syndrome (CFS) have been reported but have rarely been investigated experimentally. This study used self-report, observer ratings and electrodermal responses to test hypotheses about emotion suppression and autonomic reactivity.
Methods: Eighty adults with CFS and 80 healthy controls (HC) watched a distressing film clip. Half of each group were instructed to suppress their emotions and half were told to express their feelings as they wished. Their reactions were filmed and rated by independent observers. Electrodermal activity (skin conductance response) was used as a measure of sympathetic nervous system arousal.
Results: CFS participants reported higher anxiety and sadness than the HC, both before and after the film. However, observers rated the CFS group as having lower emotional expression than HC in both emotional suppression and expression choice conditions. Beliefs about the unacceptability of negative emotions were associated with greater self-reported suppression. Electrodermal responses were greater in the CFS group than HC participants. Higher skin conductance responses were associated with larger post-task increases in fatigue in the CFS participants but not in the HC.
Conclusions: CFS participants had lower observer-rated emotional expression than HC, despite greater distress and higher autonomic arousal. This may have implications for their ability to access social support at times of stress. As the degree of autonomic arousal was associated with short-term increases in fatigue in the CFS participants, this requires further investigation as a contributory factor for this condition.

Keywords: chronic fatigue syndrome; autonomic arousal; galvanic skin response; stress; medically unexplained symptoms.

Introduction

Chronic fatigue syndrome (CFS, sometimes known as "ME" or Chronic Fatigue Immune Dysfunction Syndrome; CFIDS) is characterised by chronic disabling fatigue, typically accompanied by other symptoms such as concentration or memory problems, sleep disturbance and muscle or joint pain (Sharpe *et al*, 1991; Fukuda *et al*., 1994). The aetiology of CFS is likely to be complex and multifactorial. A history of depression or anxiety is associated with increased risk of developing CFS (Goodwin *et al*., 2011) and the level of depression at the time of glandular fever is associated with increased subsequent risk of new onset CFS (Moss-Morris *et al.*, 2011). Additionally, increased rates of anxiety or depression are seen in people who have a diagnosis of CFS compared to healthy individuals or disease control groups (Johnson *et al.*, 1996).

People with CFS report that stress tends to worsen their symptoms (Lutgendorf *et al*., 1995). Dysregulation in the physiological stress-system, including disturbances in sympathetic system arousal and the hypothalamic-pituitary-adrenal (HPA axis), has been proposed as a factor contributing to CFS aetiology (Papadopoulos & Cleare, 2012; van Houdenhove *et al*., 2009; Wyller *et al*., 2009). Physiological disturbances in these stress systems have also been reported in depression and anxiety (Stetler and Miller, 2011, Vreeburg et al., 2010) and may help account for the association between CFS and depression or anxiety (Heim, Newport, Mletzko, Miller & Nemeroff, 2008).

One potentially modifiable factor influencing the impact of stress is the coping strategies utilised. Previous research using self-report questionnaires has shown that compared to healthy individuals, people with CFS are more likely to report beliefs that negative feelings are an unacceptable sign of weakness that will lead to negative evaluation by others (Rimes & Chalder, 2010). Such beliefs may result in the individual attempting to suppress their emotions. There is some preliminary evidence for this. Health professionals observe that they are often struck by reduced expression of distress by patients with CFS (Surawy *et al*., 1995) although this has not been verified using independent observers in a blind study. Hambrook *et al.* (2011) found that individuals with CFS were more likely than healthy controls to report an outwardly socially compliant image while feeling inwardly hostile. In addition, an FMRI study found patterns of brain activation in response to anxiety-provoking stimuli that were consistent with over-regulation of emotions in people with CFS (Caseras *et al.*, 2008). However, direct investigations of whether people with CFS emotionally suppress more than healthy individuals, or whether beliefs about the unacceptability of negative emotions are associated with increased emotional suppression, have not been reported. In contrast, there is evidence for people with anxiety and depression that beliefs about the unacceptability of expressing emotions are associated with greater emotional suppression (Campbell-Sils *et al.*, 2006; Spoka *et al.*, 2009).

Hiding one's emotions may mean that others cannot detect the need to provide support, which could contribute to the development or maintenance of fatigue. Emotional suppression may also have a more direct and immediate impact on fatigue. Attempting to suppress emotionally distressing material can have a paradoxical effect of increasing the occurrence of such thoughts and associated distress (Trinder & Salkovskis, 1994). The process of suppression is likely to be stressful and draining because it is a complex, demanding process requiring sub-tasks such as remembering to

suppress, self-monitoring for signs of emotional expression and ongoing evaluation of success (Pyszczynski & Greenberg, 1987; Richards & Gross, 1999). Similarly, it has been suggested that suppressing feelings is an attempt at self-control which drains finite resources that then become depleted. Muraven and Baumeister (2000) argue that that self-control is similar to a muscle that becomes fatigued after use. Consistent with these suggestions, Goldberg and Grandey (2007) found that in a call centre simulation experiment, participants who were asked to hide their frustration while simulating an interaction with customers reported more post-task exhaustion than those who were encouraged to be authentic. Chronic pain patients instructed to suppress their anger during an experimental provocation task reported greater subsequent pain intensity than participants who were told they were free to express their feelings as they wished (Burns *et al*., 2008). Experimental studies investigating the impact of emotional suppression on acute levels of fatigue in people with CFS are required.

Although one of the physiological mechanisms underlying a fatiguing effect of emotional suppression may be increased sympathetic arousal, this has not been investigated directly. A commonly used indicator of sympathetic nervous system activity is skin conductance, also described as electrodermal activity, which is associated with activity of the sweat glands produced in response to emotion. Studies of suppression in the general population have often found suppression to be associated with increased skin conductance, indicating increased sympathetic arousal (Gross & Levenson, 1993; Kunzmann *et al.*, 2005; Reynauld *et al.*, 2012). Skin conductance responses in relation to emotional suppression have not been previously investigated in CFS. There has been little research into skin conductance responses (SCR) in CFS, one exception being Pazderka-Robinson *et al.'s* (2004) study which reported no significant group differences in SCR between participants with CFS compared to those with depression or healthy controls; however this involved tone or light stimuli rather than an emotional stimulus.

The current study used an experimental paradigm to investigate how people with CFS and healthy control participants respond when asked to view a distressing film under instructions to suppress their emotional responses or to respond as they wish. On the basis of previous literature, it was expected that participants in the suppression condition to show greater sympathetic arousal during the clip and greater increases in anxiety than participants in the expression choice condition. The key hypotheses under investigation in the present study were the following:

1) CFS participants will have greater sympathetic nervous system activity while observing the distressing film clip than HC.
2) CFS participants will have lower observer-rated emotional expression in both suppression and non-suppression conditions than HC.
3) For the CFS group there will be a significant association between autonomic arousal and post-task increases in fatigue.
4) When given the choice about how to respond, CFS participants will self-report more suppression than HC, and self-reported suppression during the task will be associated with a pre-task measure of beliefs about the acceptability of experiencing or expressing negative emotions.

Method

Participants

Participants with CFS were recruited from two specialist CFS services in the UK. Healthy control participants were recruited via web advertising, posters and email circulars. Inclusion criteria were being at least 18 years of age. Participants with CFS had to meet the Center for Disease Control diagnostic criteria for CFS (Fukuda *et al.*, 1994). They were eligible if they were on the waiting list for treatment or at the beginning stages, before emotional processing was addressed. Healthy participants were eligible if they had no history of mental health disorder or CFS. Exclusion criteria were auditory or visual characteristics that would make it difficult to participate.

Procedure

Study procedure was approved by a local National Health Service Research Ethics Committee (ref. 09/H0803/80) and participants provided prior informed consent. Participants were posted standardised questionnaires to bring completed to the experimental session. After the physiological equipment was attached, the participant was engaged in general conversation to ensure that the skin conductance level was settled before proceeding; this took approximately eight minutes. Participants then completed visual analogue scales about their current feelings. The researcher opened an envelope indicating whether the participant had been randomly allocated to the suppression or expression choice condition. According to their condition allocation, participants were given either suppression or expression choice instructions reported by Burns *et al*. (2008). The suppression instructions included directions to suppress and hide thoughts and feelings. The emotional choice instructions included the direction to "deal with your thoughts and feelings any way you want". Once it was clear that the participant understood these instructions, the film clip was started and the researcher left the room. Participants were aware that they were being filmed during the duration of the clip using a video camera. After the nine-minute clip the researcher returned to the room and asked participants to complete another set of visual analogue scales about their current feelings and about suppression and expression during the film. All participants were fully debriefed and given the opportunity to discuss their reactions. Any remaining distress was reduced through relaxation and positive imagery for those who wanted this. It was used for one participant. None had guessed the purpose of the experiment. Participants were reminded that they could contact one of the researchers or their therapist if they wanted to discuss their reactions further. No participants took up this offer.

Materials and measures

<u>Emotion induction</u>

A nine-minute clip from a British Broadcasting Corporation documentary called "Britain's Homecare Scandal", originally shown in 2003 as part of the 'Panorama' series, was used to elicit an emotional response. It shows scenes of reduced quality of care given to older adults by homecare services. The film clip was piloted on 15 individuals (7 CFS participants and 8 healthy control participants). It produced an increase in ratings of emotional distress including anger, sadness and disgust. This complex emotional response was considered to have appropriate ecological validity.

Beliefs about Emotions Scale (BES, Rimes & Chalder, 2010)

This questionnaire assesses beliefs about the unacceptability of experiencing or expressing negative emotions. This is a 12-item scale which includes items such as "It is a sign of weakness if I have miserable thoughts" and "To be acceptable to others, I must keep any difficulties or negative feelings to myself". Response options are "Totally agree", "Agree very much", "Agree slightly", "Neutral", "Disagree slightly", "Disagree very much" and "Totally disagree". Responses are scored 6, 5, 4, 3, 2, 1, and 0 respectively. Higher scores indicate greater endorsement of unhelpful beliefs about emotions. Rimes and Chalder (2010) found that participants with CFS have significantly higher scores on this questionnaire than healthy participants. In the current study the scale had good internal reliability (Cronbach's alpha=0.87).

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983)

This is a 14-item measure of anxiety (7 items) and depression (7 items) over the past week. Participants are asked to rate statements on a four-point (0-3) response category so the possible scores range from 0 to 21 for anxiety and 0 to 21 for depression. Higher scores indicate greater levels of anxiety and depression. This has been shown to be valid and reliable for people with CFS (McCue *et al.,* 2006). In the current study the HADS anxiety and depression subscales was found to be reliable with Cronbach's alphas of 0.73 and 0.78 respectively.

Visual Analogue Scales (VAS)

Visual analogue scales (Jensen & Karoly, 1992) were used to measure fatigue (0 = none; 10 = most severe possible) and the degree to which participants feel different emotions (anger, sadness, happiness, anxiety and disgust (0 = not at all; 10 = extremely) before and after the task.

Manipulation check

Two VAS were used as a manipulation check for the two task conditions. The first VAS measured suppression: "Please place a mark on the line below to indicate how much you were suppressing thoughts and feelings during the video clip (0% = never suppressing your thoughts and feelings during the clip, 100% always suppressing your thoughts and feelings during the clip)". The second VAS measured the extent to which they were dealing with emotions as they wished: "Please place a mark on the line below to indicate how much you were dealing with your thoughts and feelings in any way you wanted during the video clip (0% never dealing with your thoughts and feelings in any way you wanted, 100% always dealing with your thoughts and feelings in any way you wanted)". An independent t-test indicated that in line with the task instructions, self-reported suppression was higher in the suppression (Mean=66, SD=23) than the expression choice condition (Mean=28, SD=25), ($t(1,158)=-9.9$, $p<0.0005$). Participants in the suppression condition reported less freedom to express their emotions as they wished (mean=46, SD=31) than participants in the expression choice condition (Mean=73, SD=23) ($t(1,158)=6.4$, $p<0.0005$).

Observer ratings of emotional expression

Each participant was videoed during the film clip. Independent blind coders who were not involved in this study rated the videos. They were not aware of the experimental condition. Inter-rater reliability was checked as part of the training process that was conducted by the research team. Emotional expressiveness was rated using the Facial Expression Coding System (FACES) by Kring and Sloan (2007). The coding system was used to measure the frequency, intensity (1=low,

2=medium, 3=high, 4=very high) and duration of positive and negative facial expressions. It has been shown to be a reliable and valid measure of facial expressive behaviour (Kring & Sloan, 2007). In the present study, emotional frequency and duration were highly correlated (r(147)=0.91) so duration was not reported, only frequency and intensity.

Skin conductance

Skin conductance was measured using the PowerLab data acquisition system. Bipolar finger electrodes were secured onto the index and ring fingers of the non-dominant hand. These electrodes use a low, constant voltage AC excitation (22mVrms at 75 Hz). A minimum response amplitude of 0.05 µs was used as recommended by Dawson et al. (2007). Mean skin conductance (µs) data were extracted from the raw physiological data recorded in LabChart using the Powerlab 26T. Skin conductance data was not available for seven participants due to equipment-related issues or operator error.

Data preparation and Statistical analysis

Observer ratings were not normally distributed (positive skew) so were natural log transformed prior to analysis. To check the impact of the task on emotions and fatigue, repeated measures ANCOVAs were conducted with ratings taken prior to and during the film as the within-subjects factor and Group (CFS, HC) and Condition (express, suppress) as between-subjects factors. To test hypothesis 1 about skin conductance, a similar repeated measures ANCOVA was undertaken with Time (baseline and during the film) as the within-subjects factor. This was followed by planned comparisons. To test hypotheses about observer-rated emotions and self-reported suppression, ANCOVA with Group and Condition were conducted, followed by planned comparisons. Age and ethnicity were entered as covariates in the GLM. Analyses were also repeated controlling for anxiety and depression to investigate whether this affected the pattern of the results. Correlational analyses were undertaken to investigate the associations specified in hypotheses 3 and 4. All analyses were undertaken using SPSS version 22. Seven participants did not return their pre-experiment questionnaires so there are reduced numbers of participants involved in the subsidiary analyses involving the HADS or the Beliefs about Emotions Scale.

Results

Participant characteristics

Eighty people with CFS and 80 healthy individuals were recruited. For the CFS group, 68% were female compared to 71% of the HC, which was not significantly different ($\chi(1)=0.27$, $p=0.607$). The age of the CFS group (Mean 43.3, SD 11.8) was greater than the HC (Mean 33.0, SD 13.1; $t(157)=5.1$, $p<0.0005$, Cohen's d=0.8); therefore age was controlled for in analyses involving group comparisons. Age information was missing for one of the HC group so the mean age for this group was imputed for these analyses. The ethnicity of the participants was as follows (numbers shown in parentheses): Participants with CFS were White British (62), White Other (7), Black African (3), Indian / British Indian (1), Pakistani / British Pakistani (1), Caribbean (1), Missing data (5). HC participants were White British (31), White Other (18), Black African (7), Caribbean (7), Indian / British Asian (6), Asian and White (3), Black British (3), Chinese and White (1), Black Caribbean and White (3), Black African and White (1). To compare the two groups, these were reclassified into

White versus all other ethnicities. A chi-square analysis indicated that there was a significantly higher proportion of White participants in the CFS group than the HC (χ (1)=19.3, p<0.0005). Therefore analyses involving group comparisons controlled for ethnicity. In order to do this, the five participants with missing data in the CFS group were coded as being White, the modal response (83%) in this group. The mean duration of CFS in the CFS group was 79.3 months (SD 70.3).

An independent t-test indicated that HADS depression was significantly higher in the CFS group (Mean 10.3, SD 1.8) than the HC (Mean 2.8, SD 2.6); t(144) = 20.9, p<0.0005, Cohen's d=3.5. For HADS anxiety the CFS group were significantly higher (Mean 11.3, SD 2.3) than the HC (Mean 5.9, SD 3.5); t(144)=11.0; p<0.0005, Cohen's d=1.8. Scores on the Beliefs about Emotions Scale (BES) were significantly higher in the CFS group (Mean 35.3, SD 12.0) than the HC (Mean 31.0, SD=11.9); t(151)=2.2, p=0.028, Cohen's d=0.4.

Impact of film on emotions and fatigue

To check that the film task was successful in eliciting an emotional response, repeated measures ANCOVAs were conducted to compare self-reported VAS ratings of sadness, anger, anxiety disgust, happiness and fatigue taken before and after the film clip, by group (CFS and HC) and condition (suppression versus expression choice), covarying for age and ethnicity. See Table 1 for results. Significant effects of time indicated increases in sadness, anger and disgust after the film. For anxiety there was a significant time by condition interaction which was investigated further with post-hoc repeated measures ANCOVAs for each condition separately, covarying for age and ethnicity. These indicated that those in the expression choice condition did not show a significant change in anxiety (F(1,77)=0.3, p=0.868), participants in the suppress condition showed a significant increase in anxiety (F(1,77)=6.4, p=0.014; partial η^2= 0.08); this indicates a significant difference with the alpha value adjusted for multiple comparisons (α=0.05/2=0.025). There were significant group effects with CFS participants having higher fatigue, anxiety and sadness ratings and lower ratings of happiness than the HC. No other effects or interactions were statistically significant. When the analyses were repeated with HADS anxiety and depression as covariates there were no longer any significant main effects of group for any variable except for fatigue (partial η^2= 0.05).

------ Table 1 about here -----

Hypothesis 1: Skin conductance response

Repeated measures ANOVAs were conducted to investigate mean skin conductance before and during the task by group (CFS and HC) and condition (suppression and expression), covarying for age and ethnicity. See Table 2 for results. The significant group effect indicated that CFS participants had higher skin conductance than the HC but this was modified by a Time by Group interaction. This was investigated with planned comparisons to test the hypothesis that the CFS group would have higher skin conductance during the film clip than the HC. A univariate ANCOVA covarying for age and ethnicity indicated that during the task the CFS participants had significantly higher skin conductance than the HC (1,146)=8.6, p=0.004). Before the task there was no significant group difference in skin conductance (F(1,146)=2.3, p=0.135). The pattern of results remained the same if HADS depression and HADS anxiety were entered as covariates.

Hypothesis 2: Observer-rated emotional expression

ANOVAs were conducted to investigate observer ratings of total number of emotions and mean emotional intensity by group (CFS or HC) and condition (Suppress or expression choice), covarying for age and ethnicity. See Table 2 for untransformed means and standard deviations for positive, negative and total / mean emotion ratings and results of the ANOVAs. Consistent with Hypothesis 2, there was a main effect of group, with the CFS group receiving lower observer ratings on each of these variables than HC. In line with the task instructions, there were significant main effects of condition: compared to the expression choice condition, the suppress condition had significantly lower observer ratings for number and intensity of emotions. No other effects or interactions were statistically significant. The significant effects of group and condition remained if HADS depression, HADS anxiety, fatigue, sadness, or anxiety reported immediately prior to the task were entered as covariates.

---- Table 2 about here ----

Hypothesis 3: Fatigue changes in relation to sympathetic nervous system activation

Correlational analyses were conducted to investigate the relationship between skin conductance and changes in fatigue (post-fatigue ratings minus baseline ratings) over the course of the experiment. In the CFS group, increases in fatigue were associated with both baseline SCR (Spearman's rho(76)=0.24, p=0.035) and SCR during the clip (Spearman's rho (75)=0.26, p=0.023. In the HC group, these associations were not significant (Spearman's rho<0.08).

Hypothesis 4: Self-reported suppression and association with beliefs about emotions

A 2X2 (Group by Condition) ANOVA was conducted to investigate self-reported suppression during the task, controlling for age and ethnicity (see Table 2). There was a significant Group by Condition interaction; the difference in self-reported suppression between the suppress and expression conditions was significantly smaller in the CFS group than the HC. Planned comparisons were undertaken to test the hypothesis that in the expression choice condition, the CFS participants would report greater suppression than the HC. An ANCOVA indicated that in the expression choice condition, there was a non-significant trend for CFS participants to report suppressing their feelings more than HC ($F(1,76)=3.5$, $p=0.064$, partial $\eta 2= 0.04$). In the suppression condition there was no significant group difference ($F(1,76)=0.4$, $p=0.525$) in self-reported suppression when controlling for age and ethnicity. When the ANCOVA was repeated with HADS anxiety and depression as covariates, the same pattern of results was found.

Correlational analyses were undertaken to test the hypothesis that unhelpful beliefs about the acceptability of negative emotions would be associated with greater self-reported suppression during the film clip. As predicted, higher BES scores were associated with greater self-reported suppression ($r(153)=0.34$, $p<0.0005$). There was smaller association between self-reported suppression and HADS depression ($r(153)=0.19$, $p=0.019$) and none with HADs anxiety ($r=0.07$).

Discussion

Observer ratings of expressed emotions were significantly lower for the CFS participants than the healthy individuals. This is the first empirical study providing evidence for increased emotional suppression in people with CFS compared to healthy individuals. These findings are consistent with clinical observation of emotional restriction in CFS (e.g. Surawy *et al.*, 1995). One factor contributing to the increased suppression in people with CFS may be their more negative beliefs about the acceptability of experiencing or expressing negative emotions. In the present study, such beliefs were correlated with higher self-reported suppression. This is the first time that such an association has been reported in individuals with CFS and is consistent with research in people with depression or anxiety (e.g. Spokas *et al.*, 2009).

Participants with CFS had higher SCR during the task than the HC. As far as the authors are aware, this is the first investigation of autonomic arousal in CFS in response to emotional stimuli. Furthermore, higher levels of autonomic arousal were associated post-task increases in fatigue in the CFS group. These findings are consistent with suggestions that sympathetic nervous system activity may play a role in CFS (van Houdenhove et al., 2009; Wyller et al., 2009). The longer-term effect of heightened autonomic arousal on fatigue now requires investigation.

Greater autonomic arousal in response to distressing stimuli is consistent with previous findings of greater neuroticism, characterised by a tendency to experience negative emotions, in people who develop CFS (Kato et al., 2006; Nater et al., 2010). In the present study, the CFS group reported more symptoms of depression and anxiety over the past week than the healthy controls, which would be expected for this population. Similarly, on the day of the experiment, the CFS group reported greater sadness and anxiety than the healthy participants. The group difference in these self-reported negative emotions was no longer significant if the comparison controlled for anxiety and depression, which is not surprising as neuroticism is a common factor underlying all three of these problems. It is important to note that the lower observer-rated emotional expressivity in the CFS group compared to HCs occurred in the context of this higher self-reported distress in the CFS group, indicating at least some success at hiding emotions from others. This could result in other people failing to identify a need to support the individual, potentially contributing to the development or maintenance of fatigue. The fatigue itself may also contribute to reduced outward displays of emotion, making it even more difficult for others to accurately detect distress. This warrants investigation as previous research about the role of significant others for people with CFS has focused on others' responses to physical symptoms rather than emotional distress (Band, Wearden & Barrowclough, 2015).

Although participants with CFS reported more negative emotions both before and after the film clip, there was no evidence of a larger increase in distress elicited by the film compared to the HC group according to self-report. The findings of a greater SCR in the CFS group in the absence of larger increases in self-reported distress may reflect a reduced awareness of emotional arousal, perhaps as a consequence of chronically suppressing their emotions. If people with CFS have reduced awareness of their emotional arousal, any accompanying increases in fatigue may be difficult to understand. This could account for previous reports of a reduced likelihood of psychological interpretations for

fatigue-related symptoms and greater likelihood of physical interpretations in people with CFS (Dendy *et al.*, 2001).

Participants in the suppression condition showed a significant increase in self-reported anxiety after the distressing film whereas those in the expression choice condition did not. The increased anxiety may reflect the challenging nature of the task. It may also reflect the paradoxical increase in the distressing thoughts and emotions that can occur as a result of suppression (Trinder & Salkovskis, 1994). Contrary to expectations and some previous research findings in healthy individuals (e.g. Gross and Levenson, 1993), skin conductance during the film was not higher in the suppress condition than the express condition. However, this finding is consistent with some studies reporting no effect on SCR of suppression in people with anxiety or depression (e.g. Campbell-Sills, Barlow, Brown and Hofman, 2006).

Limitations of the study include that the groups were not matched for age or ethnicity. Although adjusting for age and ethnicity did not alter the pattern of findings, only a crude method for adjusting for ethnicity was possible (white versus non-white). The study requires replication with groups matched for ethnicity and other potential confounding variables such as years of education. The researcher conducting the experiment was not blind to the group membership (CFS or healthy control) so future research could use researchers blind to participant group. It would have been preferable to check whether independent raters were able to guess group membership, although as the participants were videoed while stationary and silently watching the film clip, so any cues via movement and speech were minimised. Another limitation is that it was not possible to tightly control external factors that could have been influencing the SCR, such as temperature and humidity. A larger sample size might have provided sufficient power for the group difference in self-reported suppression in the expression choice condition to be significant rather than a trend. Greater power would also have allowed hypothesis four to have been tested within one statistical model.

The finding that suppression was significantly associated with beliefs about the unacceptability of experiencing and distressing emotions has implications for interventions. It may be easier and more appropriate to address unhelpful beliefs about emotions, if this is what is causing suppression, rather than the suppression itself, which may have become partly habitual and automatic. A previous study has reported that adults with CFS who had received cognitive behaviour therapy showed a reduction in unhelpful beliefs about emotions (Rimes & Chalder, 2010). Mindfulness based interventions also aim to help individuals develop a more allowing and accepting attitude towards difficult emotions. Mindfulness-based cognitive therapy has shown promise for use with people with CFS, including reducing unhelpful beliefs about emotions (Rimes & Wingrove 2013). Participants' families may also benefit from information about how to best support a patient who tends to suppress their emotions.

Conclusions

This is the first evidence from an experimental study of greater emotional suppression in individuals with CFS compared to healthy controls, from both self-report and observer ratings. Pre-existing beliefs about the unacceptability of experiencing and expressing negative emotions may be one contributory factor to emotional suppression. The CFS group, and participants randomised to the

suppression condition, had higher autonomic arousal in an emotionally distressing task. Higher levels of autonomic arousal were associated with greater increases in post-task fatigue for the CFS participants. Further research is needed into the possibility that increased autonomic arousal, perhaps as a result of greater distress and emotional suppression, contributes to fatigue in people with CFS.

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TABLE 1. Self-reported emotions and fatigue, by group and experimental condition.

	CFS participants		Healthy participants		ANCOVA[a]: significant results	Partial Eta Squared
Condition:	Expression Choice	Suppress	Expression Choice	Suppress		
Emotions						
Sadness	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Time: F(1,154)=8.6, p=0.004	0.05
Before	1.8 (2.0)	2.2 (2.4)	1.0 (1.6)	0.8 (1.5)	Group: F(1, 154)=9.5, p=0.002	0.06
After	4.5 (2.6)	5.2 (2.8)	4.0 (2.3)	3.9 (2.7)		
Anxiety						
Before	2.7 (2.4)	3.2 (2.6)	1.3 (1.6)	1.3 (1.9)	Group: F(1, 154)=18.8, p<0.0005	0.11
After	2.7 (2.6)	3.8 (3.0)	1.4 (1.8)	2.1 (2.4)	Time * Condition: F(1,154)=5.8, p=0.017	0.04
Anger						
Before	0.5 (1.4)	0.8 (1.4)	0.3 (0.6)	0.5 (1.2)	Time: F(1,154)=8.3, p=0.004	0.05
After	3.4 (2.8)	4.6 (3.2)	3.7 (2.6)	4.0 (2.9)		
Disgust						
Before	0.5 (1.7)	0.2 (0.5)	0.2 (0.4)	0.4 (1.1)	Time: F(1,154)=11.3, p=0.001	0.07
After	4.0 (3.2)	4.9 (3.5)	4.6 (2.6)	4.5 (3.2)		
Happiness						
Before	5.6 (1.6)	5.1 (1.8)	6.6 (1.9)	6.8 (1.4)	Group: F(1,154)=12.3, p=0.001	0.07
After	3.8 (2.0)	3.2 (2.0)	4.4 (2.5)	4.5 (2.3)		
Fatigue						
Before	4.9 (2.3)	6.0 (1.5)	2.5 (2.3)	2.6 (2.2)	Group: F(1,154)=74.3, p<0.0005	0.33
After	4.9 (2.4)	6.3 (1.7)	2.9 (2.5)	3.0 (2.7)		

[a] Age and ethnicity were entered as covariates.

Table 2. Skin conductance, self-reported suppression and observer ratings of emotional expression, by group and experimental condition

	CFS		**Healthy participants**		**ANCOVA[a]: significant results**	**Partial Eta Squared**
	Expression Choice	**Suppress**	**Expression Choice**	**Suppress**		
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)		
Skin conductance						
Baseline	2.4 (3.1)	1.5 (3.1)	1.5 (2.0)	1.1 (1.6)	Group (1, 147)=8.1, p=0.005	0.05
During film	4.2 (3.5)	4.8 (3.8)	3.1 (4.2)	2.6 (3.9)	Time by Group F(1,147)=4.2, p=0.041	0.03
Self-reported suppression	34.5 (29.3)	63.9 (23.2)	21.6 (19.2)	68.7 (23.6)	Condition: F(1, 154)=100.0, p<0.0005 Group by Condition: F(1, 153)=5.5, p=0.017	0.39 0.04
Observer ratings of emotions						
Number positive	2.7 (2.2)	0.8 (1.4)	6.5 (5.2)	2.5 (2.8)		
Number negative	5.8 (6.5)	2.2 (2.7)	14.3 (8.0)	10.0 (7.3)		
Total number	8.6 (7.4)	3.0 (3.7)	20.7 (11.8)	12.6 (8.2)	Group: F(1, 141)=71.7, p<0.0005) Condition: F(1, 141)=33.8, p<0.0005)	0.34 0.19
Intensity positive	1.1 (0.3)	0.5 (0.6)	1.4 (0.7)	1.0 (0.8)		
Intensity negative	1.0 (0.6)	0.8 (0.6)	1.9 (1.0)	1.5 (0.6)		
Mean intensity (positive and negative)	1.0 (0.5)	0.6 (0.5)	1.7 (0.7)	1.2 (0.5)	Group: F(1, 141)=43.6, p<0.0005) Condition: F(1, 141)=25.0, p=0.0005)	0.24 0.15

[a] Data for observer ratings were log-transformed before analysis. Analyses controlled for age and ethnicity.