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Interoceptive awareness in patients with functional neurological symptoms

Lucia Ricciardi[a,1], Benedetta Demartini[a,b,1], Laura Crucianelli[c], Charlotte Krahé[d], Mark J. Edwards[a], Aikaterini Fotopoulou[e,*]

[a] Sobell Department, UCL Institute of Neurology, Queen Square, London WC1N 3BG, UK
[b] Cattedra di Psichiatria – Dipartimento di Scienze della Salute, Universita'degli Studi di Milano, Italy
[c] Department of Psychology, University of Hertfordshire, London, UK
[d] Department of Neuroimaging, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, UK
[e] Division of Psychology and Language Sciences, CEHP Research Department, University College London, London, UK

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ABSTRACT

Historically, emotional factors, such as trauma or psychological conflict, have been suggested as causal factors of functional motor disorders (FMD). More recent approaches have instead stressed potential neural and cognitive abnormalities in the allocation and maintenance of attention. Yet these studies have mostly focused on how attention is allocated to exteroceptive signals about the state of the body. Given the proposed important role of interoception for emotion, the study of FMD patients' ability to monitor their interoceptive signals may serve as a useful, mechanistic link between studies that aim to identify key emotional factors in FMD, and those that examine specific sensorimotor or cognitive abnormalities.

In the current study, we compared the interoceptive awareness of a group of individuals with FMD ($N = 16$) with a group of healthy controls ($N = 17$). We employed a commonly used heartbeat detection task which tracks the level of concordance between one's heart rate and its subjective perception, as a proxy for interoceptive awareness more generally.

We found that FMD patients have lower interoceptive accuracy than healthy subjects, and such reduced interoceptive accuracy was predictive of their depressive symptoms, as well as their tendency to focus on the external features of their body (self-objectification). Contary to our predictions, interoceptive accuracy was not predictive of alexithymia. These results suggest a potental trade-off between the allocation of attention to internal versus external aspects of the body in FMD. More generally, they warrant further investigation of interoceptive awareness in this population, as a means to understand their emotional abnormalities at a more mechanistic level than studies concentrating on traumatic life events and related risk factors.

1. Introduction

The term functional neurological disorder describes patients that experience neurological symptoms (e.g. motor weakness, epileptic-type attacks, sensory disturbance), but assessment shows that normal function is possible in the relevant body parts. For example, in patients with functional unilateral leg weakness, power of hip extension will be weak when tested directly, but the apparently weak muscles will activate normally when the patient activates the opposite hip flexor (Hoover's sign) (Hoover, 1908). Feigning is not considered to be an adequate explanation for the symptoms in most patients (Hallett et al., 2006). Historically, psychological, emotional factors, such as trauma, conflict or distress, have been suggested as causal factors. These explanations are reflected in the various alternative terms used to describe these disorders, such as psychogenic, psychosomatic, conversion, or hysteria. Distress and psychological trauma are indeed seen at higher rates in these patients than the healthy population (Hallett et al., 2006), but they have not been found to be sensitive markers of functional neurological symptoms (Roelofs & Spinhoven, 2007). Thus, an alternative, perhaps equally problematic terminology focuses on what patients do not have (non-organic, medically unexplained symptoms). Indeed, the related debates regarding the 'psychogenic' or 'non-organic' causes of these disorders portray a

* Corresponding author at: University College London, CEHP Research Department, 1–19 Torrington Place, London WC1E 7HB, UK. Fax: +44 20 7916 8502.
E-mail address: a.fotopoulou@ucl.ac.uk (A. Fotopoulou).
[1] These authors equally contributed to the study.

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compartmentalised, dualistic brain and mind relation that has not been supported by centuries of scientific research. An important missing link that could help transcend such dualistic notions is the understanding of the pathophysiological mechanisms by which cognitive and emotional factors such as attention or distress could cause bodily symptoms of the sort seen in functional disorders. The aims of the present study, as outlined below, fall within this remit.

One subset of functional neurological disorder are functional movement disorders (FMD), in which the critical symptoms relate to movement (e.g., dystonia, tremor). A key feature that distinguishes patients with FMD from those with "organic" movement disorders is that the FMD requires attention to manifest: when attention is distracted there is typically a reduction, even disappearance of the movement disorder (Schwingenschuh et al., 2011). Conversely, patients spend significantly more time directly looking at their affected limb during clinical examination compared to patients with organic tremor, suggesting a role for self-directed visual attention in generation of motor symptoms (van Poppelen et al., 2011).

Despite previous clinical and research interest in potential abnormalities in the allocation and maintenance of attention, most studies on FMD have thus far focused on how attention is allocated to exteroceptive signals about the state of the body, i.e. visual or tactile signals (Edwards, Fotopoulou, & Parees, 2013). To our knowledge, no study has focused on the ability of patients with FMD to pay attention to signals arising from within the body, namely to interoceptive signals. Interoception can be defined as the perception of sensations relating to the physiological condition of the body, including those related to the function of internal organs, such as heart beat, or, respiration (Craig, 2002). Given the proposed important role of interoception for emotion (Damasio, 1994), the study of FMD patients' ability to monitor their interoceptive signals may serve as a useful, mechanistic link between studies that aim to identify key emotional factors in FMD, and those that examine specific sensorimotor or cognitive abnormalities.

We employed a well-validated and widely used method of measuring cardiac awareness (Schandry, 1981; Pollatos & Schandry, 2004). The heartbeat detection task is a procedure in which participants are asked to mentally tack (count silently) their heartbeats during rest, while their heart rate is also objectively measured. The level of concordance between one's heart rate and its subjective perception is considered as a relatively stable trait of 'interoceptive sensitivity', a proxy for interoceptive and emotional awareness more generally. Individuals with higher interoceptive sensitivity are reported to experience more intense emotional experiences (Wiens, Mezzacappa, & Katkin, 2000) and to show higher activation of brain areas thought to play a key role in emotional processing (insular cortex, anterior cingulate cortex (ACC), ventro-medial and dorsolateral prefrontal cortex (PFC) and the somatosensory cortex) (Critchley, Wiens, Rotshtein, Ohman, & Dolan, 2004).

In addition, various psychopathologies relating to emotion, such as depression that has high comorbidity with FMD, have been associated with abnormalities in interoceptive sensitivity (Pollatos, Traut-Mattausch, & Schandry, 2009a; Dunn et al., 2010; Terhaar, Viola, Bär, & Debener, 2012; Furman, Waugh, Bhattacharjee, Thompson, & Gotlib, 2013). Moreover, interoceptive sensitivity has been linked to wider, multisensory representations of the body in both experimental (Tsakiris, Tajadura-Jiménez, & Costantini, 2011; Suzuki, Garfinkel, Critchley, & Seth, 2013) and clinical studies. For example, patients with somatoform and eating disorders have been found to show reduced levels of interoceptive sensitivity (Mussgay, Klinkenberg, & uddel, 1999a; Pollatos et al., 2008; Schaefer, Egloff, & Witthöft, 2012). Conversely, improvements in cardiac awareness have been linked with reduction of distress associated with somatic symptoms in these disorders (Schaefer, Egloff, Gerlach, & Witthöft, 2014). Thus, in this study we were interested to explore whether patients with FMD have altered interoceptive awareness in relation to controls, as measured 'objectively' with the aforementioned mental tracking method. Although the validity of this method has been recently challenged (Ring, Brener, Knapp, & Mailloux, 2015), the brevity of the task and its non-threatening nature renders it an ideal task for a first exploration of this topic in FMD patients, indicating whether future studies are warranted to apply additional control procedures and more thorough and lengthily measures in this population.

Furthermore, interoceptive sensitivity has been found to be negatively correlated with alexithymia (Herbert, Herbert, & Pollatos, 2011), the ability to identify and describe one's emotions (Sifneos, 1973). There are also some indications that patients with alexithymia show altered activation of brain structures involved in the processing of interoceptive signals (mainly cingulate cortex and insula) (Berthoz, Artiges, Van De Moortele, 2002; Kano, Fukudo, & Gyoba, 2003). As we have recently reported that patients with FMD have higher rates of alexithymia than patients with organic movement disorders or healthy controls (Demartini, Petrochilos, & Ricciardi, 2014), in the current study we were also interested to explore whether interoceptive awareness, as measured 'objectively' with the aforementioned mental tracking method was predictive of levels of alexithymia in the same population and in healthy controls.

Depression is one of the most common psychiatric comorbidities of FMD (Gelauff, Stone, & Edwards, 2014; Binzer, Andersen, & Kullgren, 1997). In this study, we excluded individuals with major concomitant psychiatric disorders, including depression, but given that altered interoceptive awareness has been associated with mild to moderate depressive symptoms, particularly in healthy individuals and in subclinical samples (Dunn, Dalgleish, Ogilvie, & Lawrence, 2007; Pollatos, Traut-Mattausch, & Schandry, 2009b), we also examined whether interoceptive sensitivity was predictive of concomitant depressive symptomatology in both groups. Finally, given recent suggestions that interoceptive awareness, the perception of the body from within, is negatively correlated with an appearance-based perception of the body (self-objectification) (Ainley, Maister, & Brokfeld, 2013), we also examined whether interoceptive sensitivity was predictive of self-objectification in FMD patients and healthy controls.

We hypothesised that patients with FMD would have lower interoceptive sensitivity than healthy controls (HC) and such lower sensitivity would predict higher levels of alexithymia, depression and self-objectification, especially in the FMD group. Overall, we envisioned that such investigations could provide some insight into potential emotional abnormalities in patients with FMD at a more mechanistic level than studies concentrating on traumatic life events and related risk factors.

2. Materials and methods

2.1. Participants

We recruited 17 consecutive patients with FMD from the movement disorder outpatient clinics at National Hospital for Neurology and Neurosurgery. Inclusion criteria were age >18 years, a diagnosis of clinically established FMD according to Fahn and Williams criteria (Fahn & Williams, 1988). Patients with any major concurrent neurological, cardiac or psychiatric disorders were excluded. One patient was subsequently excluded as an outlier he scored more than 2 SD above the groups mean on the heart beat detection task (see below) and there were indications that he did not follow instructions during the task. Predominant symptoms in the final sample ($N = 16$) included tremor ($N = 5$), fixed dystonia ($N = 4$), spasms ($N = 4$), tic-like/jerky movements ($N = 2$) and weak-