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Impaired recognition of emotional facial expressions in patients with multiple sclerosis

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Abstract
Background: Disturbances that occur in patients with multiple sclerosis (MS) are not restricted to motor, sensory, or urinary functions; they also include cognitive dysfunction, fatigue, and depression. Moreover, people with MS are known to have fewer social activities and a reduced quality of life. One aspect of social interaction is accurate recognition of facial expressions. Several studies have suggested impairment in the processing of facial expressions in patients with multiple sclerosis, but it is not clear if these deficits are based on cognitive, depressive, or other attendant symptoms.
Objective: To investigate emotion recognition and facial identity recognition abilities and their relation with cognitive functions, depression, and fatigue in a cohort of MS patients.
Methods: Emotion recognition and facial identity recognition abilities were investigated in a cohort of 61 MS patients with unimpaired visual acuity and 53 healthy controls using the Florida Affect Battery. Additionally, we investigated possible relationships between impaired facial expression recognition and other clinical features.
Results: MS patients were not impaired in facial identity discrimination, but showed a poor performance in all subtests that required emotion recognition.
Conclusion: Impaired recognition of facial emotions by patients with MS seems to be associated with both cognitive and affective (depression) aspects of the disease.

1. Introduction

Deficits in psychosocial functioning have long been described in patients with multiple sclerosis (MS): they have fewer social activities, a higher risk of divorce, and are more often unemployed (Rao et al., 1991; Julian et al., 2008). These

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types of "social maladjustments" are more likely to occur in cognitively impaired patients in general (Rao et al., 1991). However, recent research also indicates that MS patients have more specific deficits in social cognition (Jehna et al., 2011; Phillips et al., 2011). Social cognition refers to the ability to process social signals in a way that enables the person to take advantage of being part of a social group (e.g., getting the desired job) (Frith, 2008). Thus, we were interested in the ability of MS patients to process a certain kind of social signal; i.e., emotional facial expressions. Moreover, we wanted to determine if there was a relationship between potential deficits in the ability to process emotional facial expressions and other disease symptoms.

Successful social interactions require observing, learning, and processing of, as well as reflecting on, social cues (Frith and Frith, 2012). Emotional facial expressions are considered to trigger inferential processes and affective reactions in the observer, which then leads to adaptive changes in the observer's behavior (e.g., withdrawal when faced with an angry expression); (Van Kleef, 2009) thus, the correct recognition of facial expressions is a prerequisite for successful social interactions. In 1989, Beatty and coworkers reported deficits in MS patients' ability to recognize emotional facial expressions, which coincided with a reduced ability to differentiate among different faces. The authors concluded that deficits in emotional facial expression are secondary to impaired facial recognition (Beatty et al., 1989). Meanwhile, several studies have suggested that both emotion recognition (Jehna et al., 2011; Phillips et al., 2011; Krause et al., 2009; Henry et al., 2009) and theory of mind (e.g., inferring other people's thoughts from their facial expressions) (Ouellet et al., 2010; Banati et al., 2010; Pottgen et al., 2013; Kraemer et al., 2013) are impaired in people with MS. However, these results differ with respect to the presumed influence of depression and cognition on emotion recognition abilities in MS patients. Furthermore, some studies were not controlled for facial identity recognition, fatigue, and disability.

The prevalence of depression in patients with MS is approximately 50% (Sadovnick et al., 1996) Depression has long been considered as a symptom associated with the psychosocial stress inflicted by the progressive, albeit unpredictable, course of MS (Feinstein, 2011) This close link between depression and disability in MS may be caused by both, psychosocial factors (e.g., coping behavior) (Lynch et al., 2001) and structural brain changes (e.g., frontal lobe atrophy) (Bakshi et al., 2000). On the other hand, depression is associated with deficits in emotional expression recognition, (Feinberg et al., 1986; Persad and Polivy, 1993; Asthana et al., 1998) which may lead to inappropriate reaction to others' emotions, (Persad and Polivy, 1993) thereby interfering with successful social interaction.

Emotion recognition abilities may also be influenced by cognitive dysfunctions in patients with MS, since attentional control may be necessary to distinguish specific features of different facial expressions (Palermo and Rhodes, 2007). Fatigue encompasses elements of both cognitive and motor impairment (Mills and Young, 2008) and is known to be more prevalent in both depressive (Induruwa et al., 2012) and cognitive impaired (Andreasen et al., 2010) MS patients. Therefore, we investigated whether fatigue might explain an independent proportion of variance in the emotion recognition abilities of MS patients. Finally, we hypothesized that emotion recognition deficits in MS patients are associated with deficits in facial identity recognition, since both functions share common neural pathways during early processing stages (Haxby et al., 2000). In summary, our objectives were to compare the emotion recognition abilities of MS patients with those of healthy controls and to investigate possible predictors of the presumed emotion recognition deficits, such as poor facial identity recognition, depression, cognitive dysfunction, fatigue, and other disease-related factors.

2. Patients and methods

2.1. Participants

Sixty-one adults with multiple sclerosis according to the 2010 McDonald criteria were recruited from the MS clinics of the Department of Neurology, University of Greifswald, Germany (Polman et al., 2011) Patients with an acute relapse, steroid therapy within 30 days prior to enrollment, or a history of psychiatric disorders other than MS-related depression or other known CNS diseases were not eligible. Individuals with reduced visual acuity (less than 80% on the better eye with correction) were also excluded. Clinical evaluation of patients included a complete neurological examination and determination of Kurtzke extended disability status scale (EDSS) score (Kurtzke, 1983) Throughout the study, patients continued to take medications at doses intended to produce optimal clinical benefits as prescribed by their attending physicians.

The results of the MS patients were compared to those of 53 healthy individuals with no history of neurological or psychiatric illness. They were recruited from hospital staff or by means of an announcement. Written, fully informed consent was obtained from all participants in the study. The study was approved by the local ethics committee. The participants' details are given in Table 1.

2.2. Materials and procedure

All participants underwent testing of emotion recognition using the Florida Affect Battery (FAB); in total, testing lasted approximately 1 h (Bowers et al., 2001). Testing took place in one session at the MS clinic of the Department of Neurology, Greifswald. The FAB consists of photographs of female faces depicting one of five expressions: happiness, sadness, anger, fear, or neutral (no emotion). The formats of FAB subtests are as follows: Subtest 1 comprises a non-emotional facial identity discrimination task. Two photographs of faces with neutral expressions that belong to either the same or two different individuals are presented. Subjects are required to indicate whether the two faces belong to the same individual or to different people. Subtests 2–5 involve recognition of facial expressions of emotion. Subtest 2 requires facial emotion discrimination; subjects are required to indicate whether the faces presented on two cards depict the same or different emotions. Subtest 3 requires facial emotion naming; subjects are required to name the emotion expressed on a single face. Subtest 4 comprises a facial emotion selection task; the

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