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Facial and Bodily Emotion Recognition in Multiple Sclerosis: The Role of Alexithymia and Other Characteristics of the Disease

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Abstract

Multiple sclerosis (MS) may be associated with impaired perception of facial emotions. However, emotion recognition mediated by bodily postures has never been examined in these patients. Moreover, several studies have suggested a relation between emotion recognition impairments and alexithymia. This is in line with the idea that the ability to recognize emotions requires the individuals to be able to understand their own emotions. Despite a deficit in emotion recognition has been observed in MS patients, the association between impaired emotion recognition and alexithymia has received little attention. The aim of this study was, first, to investigate MS patient's abilities to recognize emotions mediated by both facial and bodily expressions and, second, to examine whether any observed deficits in emotions recognition could be explained by the presence of alexithymia. Thirty patients with MS and 30 healthy matched controls performed experimental tasks assessing emotion discrimination and recognition of facial expressions and bodily postures. Moreover, they completed questionnaires evaluating alexithymia, depression, and fatigue. First, facial emotion recognition and, to a lesser extent, bodily emotion recognition can be impaired in MS patients. In particular, patients with higher disability showed an impairment in emotion recognition compared with patients with lower disability and controls. Second, their deficit in emotion recognition was not predicted by alexithymia. Instead, the disease's characteristics and the performance on some cognitive tasks significantly correlated with emotion recognition. Impaired facial emotion recognition is a cognitive signature of MS that is not dependent on alexithymia. (*JINS*, 2014, *20*, 1004–1014)

Keywords: Multiple sclerosis, Alexithymia, Emotion, Depression, Facial expression, bodily postures

INTRODUCTION

Multiple sclerosis (MS) is a chronic inflammatory disease of the central nervous system associated with accumulating multifocal tissue damage, early onset, and variable and unpredictable course (Compston & Coles, 2002). Cognitive and emotional impairments are frequently observed in MS patients, together with neuropsychiatric symptoms such as anxiety and depression (Feinstein, DeLuca, Baune, Filippi, & Lassman, 2013). In particular, as for patients with Parkinson's disease (Aiello et al., 2014; Assogna, Pontieri, Caltagirone, & Spalletta, 2008; Baggio et al., 2012; Narme et al., 2013; Sprengelmeyer et al., 2003), schizophrenia (Hall et al., 2004; Namiki et al., 2007; Tsui et al., 2013), progressive supranuclear palsy (Ghosh, Rowe, Calder, Hodges, & Bak, 2009; Pontieri et al., 2012), mild cognitive impairment and Alzheimer's disease (McCade, Savage, & Naismith, 2012; Spoletini et al., 2008) or Huntington's disease (Robotham, Sauter, Bachoud-Lévi, & Trinkler, 2011; Sprengelmeyer, Schroeder, Young, & Epplen, 2006), MS patients experience deficient emotion recognition (Henry et al., 2009, 2011; Jehna et al., 2010; Krause et al., 2009; Phillips et al., 2011; Prochnow et al., 2011; but see Di Bitonto et al., 2011; Jehna et al., 2011; Pinto et al., 2012). Given its role in non-verbal communication it is, therefore, not surprising that a deficit in emotion recognition is found to interfere with interpersonal relationships and adversely affect family and social life (Schwartz & Frohner, 2005).

Previous studies showed that emotion recognition mediated by facial expressions could be impaired in patients with MS (Di Bitonto et al., 2011; Henry et al., 2009, 2011; Jehna et al., 2010, 2011; Krause et al., 2009; Pinto et al., 2012; Phillips et al., 2011; Prochnow et al., 2011). However, bodily expressions are also important in conveying information that

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is essential for social interaction (de Gelder, 2006; de Gelder, Snyder, Greve et al., 2004; de Gelder et al., 2010; Kret, Stekelenburg, Roelofs, et al., 2013). In healthy individuals, emotions mediated by bodily expressions are recognized as well as those mediated by facial expressions. While the co-occurrence of deficits in recognizing facial expressions and bodily postures has been documented in some pathological populations (de Gelder, Van den Stock, Balaguer et al., 2008; Hadjikhani, Joseph, Manoach et al., 2009; Tamietto, Geminiani, Genero, et al., 2007; Van den Stock, van de Riet, Righart, et al., 2008), to our knowledge, recognition of the bodily emotional expressions in MS patients has never been studied before.

Recently, it has also been suggested that emotion recognition deficit is somewhat related to alexithymia—a cognitive-affective disturbance marked by a reduced ability to identify and describe one's feelings, together with a difficulty in distinguishing feelings from bodily sensations and a tendency to focus on external events (Nemiah, Freyberger, & Sifneos, 1976). The prevalence of alexithymia in MS has been suggested to vary between 13.8% and 50% (Bodini et al., 2008; Chahraoui et al., 2008), and seems to contribute to the severity of depression and fatigue (Bodini et al., 2008; Gay, Vrignaud, Garitte, & Meunier, 2010). Despite the extensive co-occurrence of emotion recognition deficit and alexithymia, to our knowledge only one study directly assessed this association in MS patients (Prochnow et al., 2011). In this study, the authors investigated patients' and healthy participants' ability to recognize six different emotional facial expressions (i.e., happiness, anger, fear, sadness, surprise, and disgust), as well as the presence of alexithymia. Patients obtained higher alexithymia scores and were also less accurate in labeling emotions than controls; however, no significant correlation between alexithymia and emotion recognition was found, even if the impairment in recognizing emotions was associated with alexithymia in the majority of patients. As the patients enrolled suffered from both secondary progressive and relapsing-remitting multiple sclerosis and the course of the disease is known to augment cognitive dysfunctions (Chiaravalloti & DeLuca, 2008), it is difficult to clearly interpret the results presented in this study.

The association of emotion recognition and alexithymia deficits is consistent with the simulationist models of emotion recognition according to which, to understand other people's emotions, one needs to simulate, replicate, or reproduce in his own mind the same state as the other's (Barsalou, 2008; Goldman & Sripada, 2005). In line with these models, if the ability to understand one's own emotions is somewhat impaired, the understanding of other's people emotions is also expected to be affected. For instance, patients with amygdala lesions are impaired both at experiencing fear as well as recognizing facial expressions of fear (Adolphs, Tranel, Damasio, & Damasio, 1994; Adolphs et al., 1999).

The aim of the present study was twofold. First, we tested whether impaired emotion recognition in MS patients can selectively affect faces or whether it can also affect bodily postures. In particular, if recognition of bodily expressions is controlled by the same mechanism that controls perception of facial expressions, we should observe impairment in emotion recognition of both types of stimuli when this mechanism is damaged. On the contrary, if dissociation in recognizing these two types of stimuli is observed, we hypothesized that the two processes are at least partially independent. Second, we aimed at testing whether alleged deficits in emotion recognition observed in patients with MS could be associated with concurrent alexithymia. If the ability to understand our own emotions is necessary to understand other people's emotions, then an association of deficits should be observed. Alternatively, if no association were to be found, we could conclude that the ability to understand our own emotions is not necessary to understand other people's emotions. To achieve this aim, we had 30 patients with relapsing-remitting multiple sclerosis (RRMS) and 30 healthy participants complete the 20-item revised Toronto Alexithymia Scale (TAS-20; Bressi et al., 1996) and to perform a series of experimental tasks assessing emotion discrimination and recognition mediated both by facial and bodily expressions.

METHODS

Participants

Thirty patients (21 female) with clinically diagnosed MS took part in the study. They were recruited from the neurological unit of the Azienda Ospedaliero-Universitaria "Santa Maria della Misericordia," in Udine. Inclusion criteria were a definitive diagnosis of Relapsing-Remitting MS (RRMS) according to the criteria defined by McDonald et al. (2001); an Expanded Disability Status Scale (EDSS; Kurtzke, 1983) score ≤ 4.5; age between 20 and 40 years; no corticosteroid pulse within the past 6 weeks; a minimum estimated IQ of 80; no history of other neurological disorder or major depression or other psychiatric disorders (i.e., anxiety, bipolar disorders, schizophrenia); no severe motor or visual impairment; a score greater than 20 on the Benton Facial Recognition Task (Benton, Hamsher, Varney, & Spreen, 1983). Thirty age-matched healthy adults (21 females), with no history of neurological disorder or psychiatric disorders, and who present a score greater than 20 on the Benton Facial Recognition Task (Benton et al., 1983), took part in the study as controls. The SISSA Ethics Committee approved the study that was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and with its later amendments. Participants signed informed consents before taking part in the study.

Neuropsychological Assessment

Patients performed the Rao's Brief Repeatable Battery (BRB; Amato et al., 2006) which assesses short- and long-term spatial and non-spatial memory (Selective Reminding, Spatial Recall), attention and processing speed (Symbol Digit Modalities, Paced Auditory Serial Addition test) and

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semantic verbal fluency (Word List Generation). Patients also completed the Benton Facial Recognition task (Benton et al., 1983), Trail Making test (Giovagnoli et al., 1996), Phonemic verbal fluency (Novelli, Papagno, Capitani, & Laiadcona, 1986), and Verbal and Spatial span (Orsini et al., 1987).

Tests of Emotion Recognition

Facial Expressions (stimuli and experimental tasks)

One hundred twelve stimuli were used for each experiment. Seventy faces belonged to the Nim Set collection of facial expressions [http://www.macbrain.org/resources.htm; see Tottenham et al. (2009) and consisted of naturally posed photographs of professional actors (8 female and 8 males) of different nationalities expressing anger, disgust, fear, happiness, sadness, and surprise]. The remaining 42 were selected from a dataset composed by similar photographs of six old actors (three female) of different nationalities and collected in our laboratory according to the Nim set criteria. All stimuli were included within a 9 cm × 12 cm frame.

Participants performed three tasks involving facial stimuli. The first was an emotion recognition task in which they were requested to choose which of the six labels (i.e., the word "happiness") correctly matched the facial expression (of an happy face), and then rate their intensity using a continuous scale from 1 (not at all) to 7 (very much). Participants' responses were recorded by the experimenter who wrote on a score sheet whether a response was correct or incorrect. The task consisted of 30 trials (five for each emotion) and lasted 5 min. The second was an emotion discrimination task in which participants were asked to judge whether two emotional facial stimuli expressed the same or different emotions. The third was an identity discrimination task, in which participants had to judge whether two faces expressed the same or a different identity (i.e., person). In both tasks, participants were asked to respond "as quickly but as accurately as possible" and they answered by pressing yes/no buttons on the computer keyboard. The dependent variables were accuracy and reaction times. During each trial, two faces were presented serially, separated by 1000 ms inter-stimulus lapse; the second task consisted of 72 trials and lasted 10 min while the third task consisted of 36 trials and lasted 5 min.

Bodily expressions (stimuli and experimental tasks)

Photographs of bodily emotional expressions were selected from the BEAST set (http://www.beatricedegelder.com/beast.html; see also de Gelder and Van den Stock, 2011). This set consist of 254 black-and-white posed photographs of face-blurred whole body expressions, taken from 46 non-professional actors (31 female and 15 males), instructed in a standardized procedure to display four expressions (i.e., anger, fear, happiness, and sadness) with the whole body. A total of 128 stimuli (6 female and 6 male actors) were used and framed within an 8 cm × 12 cm area.

The tasks involving bodily stimuli were the same as those used with facial stimuli. The emotion recognition task consisted of 32 trials and lasted 7 min, the emotion discrimination task of 60 trials and lasted 9 min, and the identity discrimination task of 60 trials and lasted 10 min.

Self-report Questionnaires

Alexithymia

All participants were assessed for alexithymia with the 20-items Toronto Alexithymia Scale (TAS-20; Bressi et al., 1996). The TAS total score corresponds to the general level of alexithymia. The TAS-20 includes three subscales: Difficulty in Identifying Feelings (F1), Difficulty in Communicating Feelings (F2) and Externally Oriented Thinking (F3). The international cutoff values are the following: 20–50 = non-alexithymic subjects; 51–60 = borderline alexithymic subjects; 61–100 = alexithymic subjects (Bressi et al., 1996).

Depression

All participants were assessed for depression with the 13-item Beck Depression Inventory (BDI: Beck & Beck, 1972). Each item is scored on a four point Likert scale ranging from 0 to 3; the sum of each item gives the BDI total score (range, 0–39). The 13-item BDI has been used since it has been suggested that the inclusion of somatic and vegetative symptoms (items 14–21 of the BDI-II) in the evaluation of depression in MS could produce an overestimation of its severity (Brown et al., 2006; Nyenhuis et al., 1995; Quaranta et al., 2012). This version has been already used with MS patients (Besharat, Pourhosein, Rostami, & Bazzazian, 2011; Pittion-Vouyovitch et al., 2006; Solari et al., 1999).

Fatigue

MS patients (but 4) were assessed for fatigue using the Fatigue Severity Scale (FSS: Krupp, LaRocca, Muir-Nash, & Steinberg, 1989). The FSS is a self-rated questionnaire composed by nine items selected for their ability to describe fatigue in MS (Krupp et al., 1989). Patients were asked to express their agreement on a seven-point Likert scale ranging from 1 (strongly agree) to 7 (strongly disagree). The final score is calculated by averaging each item scores. Patients were considered to be fatigued if they obtained a total FSS score of ≥4 (according to Bakshi et al., 2000; Bodini et al., 2008).

Procedure

Participants performed emotion recognition task, emotion discrimination task and identity discrimination task with facial expressions and bodily postures as stimuli. They completed the questionnaires for alexithymia (TAS-20: Bressi et al., 1996), depression (BDI: Beck & Beck, 1972), and fatigue (FSS: Krupp et al., 1989). The order of the tests

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Table 1. Demographic characteristics of patients and controls

Group	*n*	M:F	Age (years)	Education (years)	TIB	EDSS	Disease duration (years)
Patients	30	9:21	34.2 (6.2)	14.7 (2.0)	108.9 (2.5)	2.0 (1.0)	9.1 (6.7)
Controls	30	9:21	32.5 (6.4)	15.2 (3.1)	109.0 (3.8)	n/a	n/a
p value		—	n.s.	n.s.	n.s.	—	—

Note. Mean values and standard deviations (in brackets) are given for age, education, disease duration, EDSS, TIB, and BDI. F = female; M = male; EDSS = Expanded Disability Status Scale (Kurtzke, 1983); TIB = The Short Intelligence Test (Sartori, Lombardi, & Mattiuzzi, 2005); BDI = Beck Depression Inventory (Beck & Beck, 1972).

was kept constant whereas the order of the stimulus type was counterbalanced across participants. The stimuli were presented using PowerPoint software (emotion recognition tasks) or the E-prime experimental software package (emotion and identity discrimination tasks) on a LCD screen of a 17.3-inch HP laptop. Participants sat approximately 58 cm from the computer screen.

Statistical Analysis

Between-group comparisons for socio-demographic and clinical scores were performed using *t* tests for continuous variables. Two analyses of variance (ANOVAs) were performed separately for faces and for bodily postures. An ANOVA on accuracy with group (MS, HC) as between factor, and task (emotion recognition, emotion discrimination and identity discrimination) as within factor; an ANOVA with group (MS, HC) as between factor, and emotion as within factor were conducted to explore possible group differences in the recognition of single emotions. Accuracy percentages were arcsine-transformed to normalize the distribution of the accuracy data in the emotion tasks. To better characterize their emotion processing, patients were divided into two groups according to the median of the EDSS score, 1.5. Six one-way ANOVAs were performed separately for faces and for bodily postures, with group as categorical predictor and accuracy as dependent variable (for emotion recognition, emotion discrimination and identity discrimination). To investigate the relationship between emotion recognition and alexithymia, Pearson's correlations were performed for patients, while a multiple linear regression was calculated for the entire group. For MS patients, Pearson's correlation and a multiple linear regression analysis were carried out to examine the relationship of disease characteristics (disease duration, EDSS) and neuropsychological performance with emotion recognition. Finally, the relationship among alexithymia, fatigue, and depression was tested using Pearson's correlation. Two additional ANOVAs with two groups (MS, HC) as between factor were performed separately for faces and for bodily postures: an ANOVA on intensity ratings with emotion as within factor, and an ANOVA on reaction times with tasks as within factor. In the RT analysis, trials associated with incorrect responses and those with RTs 2 *SD* above or below the individual condition mean were discarded. The results of these two analyses can be found in the supplemental materials.

RESULTS

Demographic Information, Screening, and Questionnaires

Groups were matched for gender, age ($t(58) = 1.14$; $p = .26$), education ($t(58) = -0.69$; $p = .49$), intelligent quotient (TIB; $t(58) = -1.00$; $p = .32$), and depression (BDI; $t(58) = .25$; $p = .80$). Means and standard deviation of demographic variables are detailed in Table 1. Neuropsychological and screening test scores obtained by all MS patients, and the proportion of those who resulted impaired in the different cognitive tests are summarized in Table 2. Table 3 displays questionnaire scores in the patients and

Table 2. Scores of MS patients on neuropsychological tests

RAO's Brief Repeatable Battery:	Mean (*SD*)	No. (%) of patients impaired
SRT-LTS	47.5 (14.4)	3 (10)
SRT-CLTR	40.2 (19.3)	5 (16.6)
SRT-D	8.7 (2.7)	2 (6.7)
SPART	18.9 (4.8)	3 (10)
SPART-D	6.5 (2.3)	1 (3.3)
SDMT	50.9 (14.5)	6 (20)
PASAT 3	45.7 (11.9)	3 (10)
PASAT 2 (28 patients)	34.6 (11.2)	2 (7.14)
WLG	27.2 (6.8)	4 (13.3)
Cognitive test	Mean (*SD*)	No. (%) of patients impaired
TMT	30.2 (18.6)	0 (0)
Corsi SPAN (29 patients)	5.2 (0.8)	6 (20.7)
Digit SPAN (forward; 29 patients)	6.3 (1.1)	1 (3.4)
Digit SPAN (backward; 29 patients)	5.2 (1.2)	1 (3.4)
Phonemic Fluency (29 patients)	41.1 (9.2)	0 (0)
Benton	24.7 (1.6)	0 (0)

Note. SRT-LTS = Selective Reminding Test-Long Term Storage; SRT-CLTR = Selective Reminding Test-Consistent Long Term Retrieval; SRT-D = Selective Reminding Test-Delayed; SPART = Spatial Recall Test; SPART-D = Spatial Recall Test-Delayed; SDMT = Symbol Digit Modalities Test; PASAT 3 = Paced Auditory Serial Addition Test 3 seconds; PASAT 2 = Paced Auditory Serial Addition Test 2 seconds; WLG = Word List Generation; TMT = Trial Making Test; normative data for Digit SPAN (forward and backward) from Monaco, Costa, Caltagirone, and Carlesimo (2013).

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Table 3. Alexithymia in patients and control group

	MS group	Control group	*t* tests	
	Mean (*SD*)	Mean (*SD*)	*t*()	*p*
Alexithymia (TAS-20)	43.6 (10.9)	41.6 (10.8)	0.71	.48
Alexithymia (F1)	13.9 (5.5)	13.7 (4.7)	0.13	.91
Alexithymia (F2)	12.5 (4.6)	12.2 (5.0)	0.21	.83
Alexithymia (F3)	17.2 (4.1)	13.7 (4.5)	1.34	.18
Depression (BDI)	4.5 (4.7)	4.2 (3.4)	0.25	.80
Fatigue (FSS; 26 patients)	3.9 (1.9)	—	—	—
No alexithymia, %	76.7	76.7		
Borderline alexithymia, %	13.3	13.3		
Alexithymia, %	10.0	10.0		
BDI, % lightly depressed	6.7	6.7		
BDI, % moderately depressed	10	0		
BDI, % severely depressed	0	0		
FSS, % above cut-off	53.8	—		

Note: MS = multiple sclerosis; *p* = *p* value; BDI = Beck Depression Inventory (Beck & Beck, 1972); FSS = Fatigue Severity Scale (Krupp et al., 1989). For each self-report questionnaire, the percentage of participants below the cutoff are reported.

control group. No significant differences were found in the TAS-20 score or in its subscale scores between patients and controls.

Recognition of Facial Emotions and Emotional Bodily Expressions

Facial expressions

The mixed ANOVA revealed a significant effect of Task, $F(2,116) = 118.8$, $p < .001$, with higher accuracy for identity discrimination task than for the other tasks, as well as a significant interaction Group × Task, $F(2,116) = 3.23$, $p = .04$, with patients being less accurate than controls in emotion recognition task ($p = .003$). The main effect of Group was not significant, $F(1,58) = 3.55$, $p = .064$ (Figure 1). The mixed ANOVA on accuracy of single emotions revealed a significant effect of Group, $F(1,58) = 4.16$, $p = .045$, with patients being less accurate than controls, and a significant effect of Emotions, $F(5,290) = 26.2$, $p < .001$, with some emotions (i.e., happiness, anger, surprise, disgust) being better recognized than others (i.e., fear, sadness); however, the two factors did not interact, $F(5,290) = 1.05$, $p = .39$. For further information refer to the supplemental materials and Table 4.

Bodily expressions

The mixed ANOVA revealed a significant main effect of Task, $F(2,116) = 84.4$, $p < .001$, with an overall better performance in identity discrimination task than in the other tasks, and a significant effect of Group, $F(1,58) = 7.46$, $p = .008$, with patients being less accurate than controls.

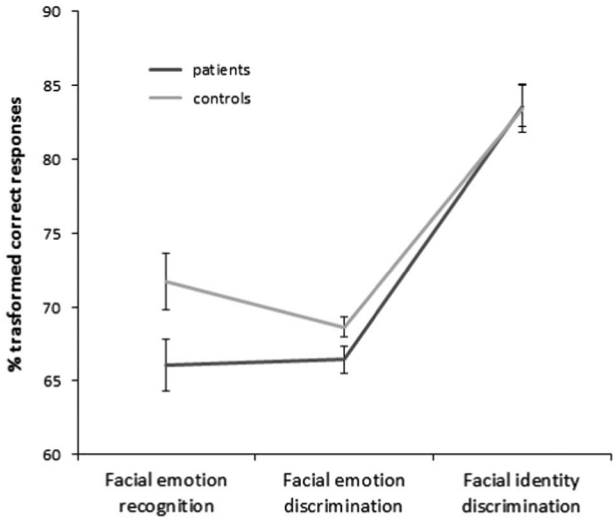

Fig. 1. Patients and controls' accuracy on tasks with facial stimuli.

The two factors however did not interact, $F(2,116) = .12$, $p = .88$. The mixed ANOVA of single emotions yield a significant main effect of Emotion, $F(3,174) = 47.8$, $p < .001$, with some emotions (i.e., fear, sadness, and anger) being better recognized than others (happiness), but not a significant main effect of Group, $F(1,58) = 3.20$, $p = .08$, or interaction, $F(3,174) = .83$, $p = .47$. For further information, refer to the supplemental materials and Table 4.

Comparison of patients with lower and higher disability scores

Two groups of patients were identified according to EDSS score: group (a) with a lower disability score (EDSS ≤ 1.5; $n = 17$) and group (b) with a higher disability score (EDSS >1.5; $n = 13$). As represented in Figure 2, an univariate ANOVA showed a significant group effect for both facial emotion recognition, $F(2,57) = 8.43$, $p < .005$), and facial emotion discrimination, $F(2,57) = 6.28$, $p < .005$, with patients of group (b) being impaired in both tasks as compared to patients of group (a) ($p < .005$ and $p = .006$, respectively) and controls ($p < .005$ and $p = .001$, respectively). No differences were detected between patient group (a) and controls (emotion recognition $p = .63$; emotion discrimination $p = .76$). As for bodily expressions, the ANOVAs showed a main effect of Group approaching significance for emotion recognition, $F(2.57) = 2.87$, $p < .06$, and significant for emotion discrimination, $F(2,57) = 4.36$, $p < .017$. In particular, patients of group (b) were impaired in bodily emotion recognition and discrimination compared to controls ($p = .02$ and $p = .006$, respectively), while a difference toward significance is observed compared to patients of group (a) in emotion recognition ($p = .07$) but not discrimination ($p = .24$). No difference was observed between patients of group (a) and controls in emotion recognition ($p = .70$), and emotion discrimination ($p = .09$). Moreover, differently from facial identity discrimination, in which no differences were observed between the three groups, one way ANOVA $F(2,57) = 0.59$, $p = .55$, a group effect was

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Table 4. Summary statistics of the tasks involving recognition of facial emotions and emotional bodily expressions

	Patients		Control group	
Faces stimuli	Accuracy	RT	Accuracy	RT
Emotion recognition	81.86 (12.16)	—	88.14 (7.56)	—
Emotion discrimination	83.49 (6.66)	1260.26 (252.17)	86.49 (3.89)	1166.52 (256.17)
Identity discrimination	97.13 (4.16)	851.99 (164.93)	97.07 (6.14)	796.54 (165.44)
	Patients		Control group	
Bodily stimuli	Accuracy	RT	Accuracy	RT
Emotion recognition	77.62 (14.71)	—	83.83 (11.86)	—
Emotion discrimination	81.83 (7.36)	1454.49 (292.42)	86.71 (6.38)	1282.60 (311.42)
Identity discrimination	96.14 (3.45)	953.71 (210.28)	97.85 (2.47)	809.52 (176.26)

Note. Mean values and standard deviations (in brackets) of experimental tasks.

observed in bodily identity discrimination, one way ANOVA $F(2,57) = 3.07$, $p = .05$, with patients of group (b) being more inaccurate than controls ($p = .017$). None of the remaining differences was significant.

Relationship between Alexithymia and Emotion Recognition

For patients, Pearson's correlations indicated that alexithymia did not correlate with facial emotion recognition ($r = -0.09$; $p = .60$) or with bodily emotion recognition ($r = -0.05$; $p = .77$). A multiple linear regression was calculated to determine whether alexithymia explained the facial and bodily emotion recognition. In the entire group, the proportion of variation in facial emotion recognition accounted for by alexithymia was negligible (2%) and the resulting equation was not significant ($F(1,58) = 2.24$ R^2 adjusted $= 0.02$; $p = 0.14$). Similar results were found for facial emotion discrimination ($F(1,58) = 1.78$; R^2 adjusted $= 0.01$; $p = 0.18$); bodily emotion recognition ($F(1,58) = 0.49$; R^2 adjusted $= -0.008$; $p = .48$) and bodily emotion discrimination ($F(1,58) = 0.68$; R^2 adjusted $= -0.005$; $p = .41$).

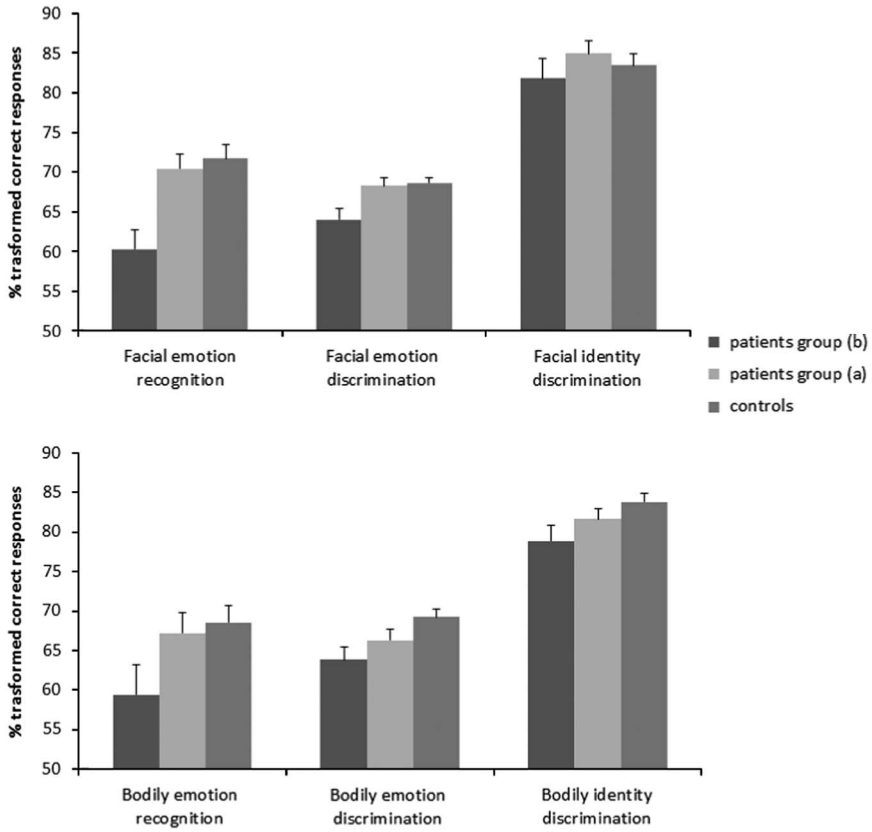

Fig. 2. Accuracy of patients (a – low disability), group (b – high disability) and controls on tasks with facial stimuli (above graph) and with bodily stimuli (below graph).

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Relationship between Emotion Recognition, Disease, and Neuropsychological Performance

Patients' performance in facial emotion recognition task correlated significantly with age, education, disease duration, EDSS score, and with the following tests of the RAO's BRB: SRT-LTS, SRT-CLTR, SRT-D, and SDMT, and with TIB test. Facial emotion discrimination task correlated significantly with age, disease duration, EDSS score, and with the following tests of the RAO's BRB: SRT-D, SPART, and SPART-D. Regarding bodily stimuli, patients' performance in bodily emotion recognition task correlated significantly with EDSS score and with the following tests of the RAO's BRB: SDMT, PASAT 3, and PASAT 2. Bodily emotion discrimination task correlated significantly with disease duration and with the following tests of the RAO's BRB: SRT-D, SPART, SPART-D, and SDMT. Results of Pearson's correlations extensively reported in Table 5. A multiple linear regression was carried out to determine if deficit in facial emotion recognition was explained by different characteristics of the disease such as disease duration, EDSS score and SDMT, one of the most sensitive tasks to cognitive impairment in MS (see Parmenter, Weinstock-Guttman, Garg, Munschauer, & Benedict, 2007). The variables were entered simultaneously into the analysis. Overall the three variables significantly accounted for the 36.9% of the adjusted facial emotion recognition variance ($F = 6.66$; $p = .001$) but the effect was due only to SDMT (slope = 0.36; $B = .23$; $p = .04$). The same analysis conducted on bodily emotion recognition showed that the same three variables accounted for the 24.09% of the adjusted bodily

Table 5. Correlational analysis between the performance on facial emotion recognition task, facial emotion discrimination task, neuropsychological tests and disease characteristics (EDSS, disease duration, BDI, and FSS)

	Facial emotion recognition task		Facial emotion discrimination task		Bodily emotion recognition task		Bodily emotion discrimination task	
Demographic characteristic	r	*p* value	r	*p* value	r	*p* value	r	*p* value
Age	**−0.49**	**.005**	**−0.41**	**.023**	0.05	.788	−0.18	.332
Education	**0.61**	**<.001**	0.19	.302	0.19	.317	0.09	.619
Disease characteristic	r	*p* value	r	*p* value	r	*p* value	r	*p* value
Disease duration	**−0.50**	**.005**	**−0.60**	**<.001**	−0.25	.174	**−0.57**	**.001**
EDSS	**−0.56**	**.001**	**−0.50**	**.005**	**−0.48**	**.007**	−0.32	.081
BDI	−0.06	.740	−0.13	.492	−0.15	.424	−0.05	.804
FSS	−0.38	.051	−0.13	.518	−0.28	.164	−0.09	.644
RAO's Brief Repeatable Battery:	r	*p* value	r	*p* value	r	*p* value	r	*p* value
SRT-LTS	**0.44**	**.014**	0.24	.203	0.11	.573	0.34	.064
SRT-CLTR	**0.39**	**.040**	0.30	.112	0.13	.485	0.32	.090
SRT-D	**0.38**	**.040**	**0.40**	**.032**	0.15	.419	**0.42**	**.021**
SPART	0.22	.240	**−0.38**	**.039**	0.23	.213	**−0.39**	**.032**
SPART-D	0.25	.190	**−0.38**	**.039**	0.36	.054	**−0.43**	**.018**
SDMT	**0.56**	**.001**	0.32	.083	**0.42**	**.019**	**−0.37**	**.047**
PASAT 3	0.19	.320	0.31	.092	**0.39**	**.035**	0.32	.089
PASAT 2	0.07	.690	0.21	.277	**0.48**	**.010**	0.37	.051
WLG	0.36	.052	0.32	.705	0.20	.289	0.30	.111
Cognitive test	r	*p* value	r	*p* value	r	*p* value	r	*p* value
Benton	0.08	.659	0.23	.215	0.11	.566	0.31	.097
TIB	**−0.48**	**.008**	−0.25	.174	−0.24	.203	−0.05	.796
TMT	−0.25	.190	−0.35	.055	−0.20	.283	−0.14	.470
Corsi SPAN	−0.09	.630	−0.03	.881	0.27	.151	0.36	.054
Digit SPAN (forward)	−0.09	.650	0.23	.225	−0.05	.804	0.27	.163
Digit SPAN (backward)	−0.07	.730	0.15	.425	0.18	.344	0.25	.193
Phonemic Fluency	0.26	.160	0.35	.064	0.30	.111	0.22	.246

Note. EDSS = Expanded Disability Status Scale (Kurtzke, 1983); BDI = Beck Depression Inventory (Beck & Beck, 1972); FSS = Fatigue Severity Scale (Krupp et al., 1989); SRT-LTS = Selective Reminding Test-Long Term Storage; SRT-CLTR = Selective Reminding Test-Consistent Long Term Retrieval; SRT-D = Selective Reminding Test-Delayed; SPART = Spatial Recall Test; SPART-D = Spatial Recall Test-Delayed; SDMT = Symbol Digit Modalities Test; Pasat 3 = Paced Auditory Serial Addition Test 3 seconds; PASAT 2 = Paced Auditory Serial Addition Test 2 seconds; WLG = Word List Generation (Amato et al., 2006); Benton = Benton Facial Recognition Task (Benton et al., 1983); TIB = The Short Intelligent Test (Sartori et al. 2005); TMT = Trial Making Test (Monaco et al., 2013).

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emotion recognition variance ($F = 4.06$; $p = .017$), but that the effect was due only to EDSS (slope = −0.52; B = −6.16; $p = .03$).

Relationship between Depression, Fatigue, and Alexithymic Features

Alexithymia TAS-20 score correlated significantly with depression measured using the BDI ($r = 0.51$; $p = .004$). No significant correlations were found between alexithymia and fatigue ($r = 0.21$; $p = .305$).

DISCUSSION

In the present study, we investigated the ability of patients with MS to recognize emotional facial and bodily expressions controlling for the presence of concurrent alexithymia.

Consistently with previous reports (Henry et al., 2009, 2011; Jehna et al., 2010; Krause et al., 2009; Phillips et al., 2011; Prochnow et al., 2011), patients with MS recognized significantly fewer facial emotional expressions than controls. However, in contrast with studies that reported a selective impairment for unpleasant emotions such as anger, fear, and sadness in MS (Henry et al., 2009, 2011; Prochnow et al., 2011), the patients in our study were worse at recognizing *all* facial emotions. These inconsistent results could be accounted by methodological differences across studies. For instance, while in Prochnow et al. (2011) the selective impairment for fear, surprise, anger and sadness was found with morph sequences of emotional faces, here we used static emotional facial images in a recognition task.

Moreover, no significant differences between patients with MS and controls were found in tasks involving bodily postures when patients were considered as a group. This result is at variance with the impaired recognition of emotional bodily postures observed in patients with schizophrenia (Van den Stock et al., 2011), and Huntington disease (de Gelder et al., 2008) who were often found to be impaired also at recognizing facial emotional expressions. In these studies, the authors proposed that emotion perception mediated by bodies and faces shares common areas, possibly in the amygdala, fusiform gyrus, specific parts of STS, and the parietal lobe (de Gelder et al., 2010; Hadjikhani et al., 2009). Differently from the abovementioned studies our study assessed both facial and bodily emotion recognition in the same sample of patients thus allowing us to directly test whether facial and bodily emotion recognition share a common mechanism that could be damaged due to the neurological disorder. Of interest, after dividing the patients according to their disability scores, the analysis showed that not only the emotions conveyed by facial expressions but also those conveyed by bodily expressions were more difficult to be recognized by patients with a higher disability score. Moreover, as for faces, correlation analysis revealed that bodily emotion recognition and discrimination significantly correlated with disease duration, disability scores and with some neuropsychological scores. This result suggests that a common mechanism to both facial and bodily expressions may actually be damaged in patients with MS. However, patients with higher disability exhibited difficulties even in the discrimination of bodily identities, and it is not clear whether these difficulties are responsible for the emotion recognition impairment. We speculate that recognizing bodies may be, in general, more difficult than recognizing faces, especially with black/white stimuli. However, future studies should examine this issue more in detail.

Furthermore, the design we used allowed us to clarify whether the integrity of our ability to understand our own emotions is necessary to understand other people's emotions. Indeed, Pearson's correlation and multiple regression analysis showed that alexithymia did not explain a lower ability to recognize emotions. Our findings do not support the hypothesis that alexithymia might be a better predictor of the ability to recognize emotional facial expressions (Grynberg et al., 2012). More importantly, they suggest that the ability to understand our mental state is not necessary to understand mental states of others in contrast with what the simulationist models of emotion recognition predict (Barsalou, 2008; Goldman & Sripada, 2005). Our study is not the first to have failed to find an association between alexithymia and emotion recognition in clinical disorders. For instance, Kessler, Schwarze, Filipic, Traue, and von Wietersheim (2006) reported patients with eating disorders who were significantly more alexithymic than controls but showed no emotion recognition deficits. Mann, Wise, Trinidad, and Kohansky (1995) reported the same finding in substance abusers. Both studies support our hypothesis that alexithymia is not a good predictor of the ability to recognize emotional facial expressions.

There are two possible alternative explanations as to why we failed to observe a clear relation between emotion recognition performance and alexithymia. First, our negative findings might be due to the fact that the emotion recognition tasks we administered were too easy. However, as Prochnow et al. (2011) failed to find a significant correlation between alexithymia scored and emotion recognition even though they used ambiguous items such as morphed faces. The second alternative explanation suggests that our negative findings might be due to the characteristics of the patients' sample, in which a low proportion of patients exhibited alexithymia.

Of interest, we observed that the characteristics specifically associated to the disease such as duration and disability score were significantly associated with bodily and facial emotion recognition and discrimination tasks and that the performance in SDMT, a measure of information processing speed, significantly accounted for facial emotion cognition performance. Moreover, we also showed that emotion recognition and discrimination tasks (both with facial and bodily expressions) significantly correlated with a subset of neuropsychological tests. These results are in line with previous studies on patients with neurodegenerative disorders like Parkinson's disease. For example, Assogna et al. (2010) observed that emotion recognition correlates with long-term memory, verbal memory, attention, and complex cognitive functions suggesting that recognizing emotions is a complex

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cognitive process that requires the integrity of several neural circuits. Our results support this view and suggest that impaired facial emotion recognition and, to lesser extent, bodily facial recognition might be a cognitive marker of MS. Accordingly, functional imaging studies have provided clear evidence that patients with MS showed altered brain activation of the ventrolateral prefrontal cortex (VLPC) in response to emotional stimuli (Jehna et al., 2011; Krause et al., 2009; Passamonti et al., 2009). Recently, impaired emotion recognition and theory of mind abilities have been attributed to white matter disconnection and regional cortical atrophy in temporal lobe (Mike et al., 2013).

Consistently with the association between mood and alexithymia observed in studies with MS patients (Bodini et al., 2008; Gay et al., 2010), our study shows that alexithymia was associated with depression. In contrast with previous studies (Bodini et al., 2008), we failed to observe a significant association between alexithymia and fatigue. However, the small sample size of our study could be responsible for negative result.

Our study has some limitations. First, as in most studies, we have used the TAS-20 as the measure of alexithymia. Several concerns have been raised regarding the use of self-report measures to the assessment of alexithymia since alexithymic people could not be aware of their emotional difficulties. Second, our sample size is mainly composed by females (70%) consistently with the disease being twice more common in females than males (Milo & Kahana, 2010). As several studies suggested that men score higher than woman on alexithymia questionnaires (Levant et al., 2006; Levant, Hall, Williams, & Hasan, 2009), our results can reflect the composition of the patients' sample. Third, our results cannot possibly be extended to all patients with MS. In fact, the population of the present study was characterized by a mild level of disability and a mild level of depression.

In conclusion, the results of this study provide evidence that emotion recognition mediated by facial stimuli and, to lesser extent, by bodily expressions can be impaired in patients with MS. In particular, patients with higher disability showed impairment in emotion recognition as compared to patients with lower disability and matched controls. This deficit seems to be related to the disease's characteristics and also to some deficit in processing speed and attention, suggesting that impaired emotion recognition might be a general feature of multiple sclerosis. Moreover, our study does not support the hypothesis that alexithymia might be a good predictor of the ability to recognize emotional facial expressions (Grynberg et al., 2012) and suggests that the ability to understand our mental state is not necessary to understand mental states of others in contrast with simulationist models.

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Supplementary material

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