

Is MS patients' emotional recognition impairment related to cerebellar damage?

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Background

Recent studies in MS patients evidenced impairments in emotional processing and social cognition (SC), including tasks testing Theory of mind production and facial affect recognition. The ability to read in others mind and recognize others' mental state plays an important role in social environment adaptation. Specifically, the "Reading the mind in the eyes (RmE)" (Vellante et al., 2013) test performance seems to be related to a fronto-temporal network (Sato et al., 2016), while other studies on SC substrates in different pathologies showed a cerebellar involvement (Van Overalle et al., 2015). Aim of this study was to assess the emotional recognition in patients with MS (pMS) by the RmE test and the possible role of cerebellar lobules atrophy in determining RmE performances.

Figure 1. Slide example from RmE test as shown to participants.



Giocosso
Confortante
Irritato
Annoiato

Note. Extract from Baron-Cohen S. (2004).

Materials and Methods

44 pMS (27 RR; 17 SP) and 25 age- and sex-matched controls (HC) underwent clinical assessments, the RmE test and 3T-MRI (Table 1). For each participant, a high-resolution T1-weighted magnetisation prepared rapid gradient echo (MPRAGE) sequence was acquired. RmE test was composed by 36 stimuli with 4 forced choice answer options each. For each subject the number of correct answers was collected.

Table 1: Clinical and Demographic characteristics of pMS and HC. Mean and standard deviation of RmE tests' correct answers.

	pMS	HC	p value
Number (M/F)	44 (20/24)	25 (10/15)	> .05
Age (M±SD)	43.77 ± 10.49	40.28 ± 12.92	> .05
Education (M±SD)	14.41 ± 3.16	15.40 ± 3.55	> .05
Disease Duration (M±SD)	11.24 ± 9.68	/	/
RmE (M ±SD)	21.86 ± 4.03	24.08 ± 3.13	.015

pMS, patients with multiple sclerosis; HC, healthy controls; M, mean; SD, standard deviation; RR, relapsing-remitting; SP, secondary-progressive; EDSS, Expanded Disability Status Scale; RME, Reading the mind in the eyes test.

Table 2. Cerebellar lobules mean volumes comparisons between MS_P and MS_NP.

	MS_P (15)	MS_NP (29)	p value
Anterior Lobe	11.7932	11.7638	n.s.
Posterior Lobe	72.9610	737.414	n.s.
Vermis			
VI	1.5303	1.5050	n.s.
Crus I	.0175	.0166	n.s.
Crus II	.3317	.3274	n.s.
VII B	.1351	.1474	.013
VIII A	.7900	.8520	.029
VIII B	.4041	.4475	.007
IX	.5673	.6069	.035
X	.2761	.2454	.039

MS_P, patients with Multiple Sclerosis with a pathological score on RmE; MS_NP, patients with Multiple Sclerosis without a pathological score on RmE; n.s., non significant p value.

Results

pMS showed a significantly lower number of correct responses at RmE test compared to HC (p= .015). pMS were then divided into pathologic (MS_P) and non-pathologic (MS_NP) subgroups by using a z-score obtained by HCs' RmE test correct responses (MS_P < 1SD). A t-test between MS_P and MS_NP, was performed for gray matter volumes of each cerebellar lobule corrected for total intra-cranial volume. This analysis showed a significant difference in Vermis VIIb (p=.013); Vermis VIIIa (p=.029); Vermis VIIIb (p=.007); Vermis IX (p=.035) and Vermis X (p=.039) volumes.

Discussion

The "Reading the mind in the eyes (RmE)" test showed that pMS seem to have significantly more difficulties in recognizing emotions expressed in others' eyes without the support of other facial features. These difficulties seem related to a GM loss into some specific cerebellar Vermis lobules.

Conclusion

Till now studies on pMS have evidenced the presence of SC difficulties as well as emotional expression problems due to limbic system dysfunctions. Our data showed that pMS have also problems in recognizing the emotions in others' eyes and we could speculate the presence of an impaired interplay between limbic and cerebellar vermis regions.

References

- W. Sato, T. Kochiyama, S. Uono¹, R. Sawada¹, Y. Kubota, S. Yoshimura¹ and M. Toichi. Structural Neural Substrates of Reading the Mind in the Eyes. *Frontiers in Human Neuroscience*, 2015,10.
- F. Van Overwalle, T. D'aes, and P. Mariën. Social cognition and the cerebellum: A meta-analytic connectivity analysis. *Human brain mapping*, 2015: 5137-5154.
- Vellante, M., Baron-Cohen, S., Melis, M., Marrone, M., Petretto, D. R., Masala, C., & Preti, A. (2013). The "Reading the Mind in the Eyes" test: systematic review of psychometric properties and a validation study in Italy. *Cognitive neuropsychiatry*, 18(4), 326-354.