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## **Assessing slow-learning in MS with time-to-event data approach**

Clémentine Luneau, Béatrice Degraeve, Patrick Hautecoeur, Bruno Lenne

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## INTRODUCTION

- In MS, episodic memory (EM) disorder is one of the most observed and complained cognitive deficits (Chiaravalloti et DeLuca, 2008 ; Goverover et al., 2007).
- The mechanism at the origin of this learning deficit is controversial in the literature (Saenz, 2014).
- The impact of reduced speed processing Information (SPI) on EM remains unclear in MS, despite the importance of this possible relationship on rehabilitation strategies.
- Many large-scale standardized tests are intended to assess learning ability. Time limits or fixed number of trials make it difficult to distinguish between the effect of low ability and lack of time.
- If the SRT is widely used to assess EM deficits, a possible beneficial effect of extra-time on performance has been debated (Goverover et al., 2009).

### OBJECTIVE

To assess the impact of time on episodic memory in MS

## METHODS

### Participants

	CONTROL, N=40	MS, N=61
Sex ratio (W/M)	21/19	46/16
Age (mean / SD)	41.9 (12.2)	40 (9.1)
Niveau d'études	13.2 (2.9)	13.3 (2.6)
Disease	-	7.4 (6.5)
EDSS	-	2 (1.5)

### Material

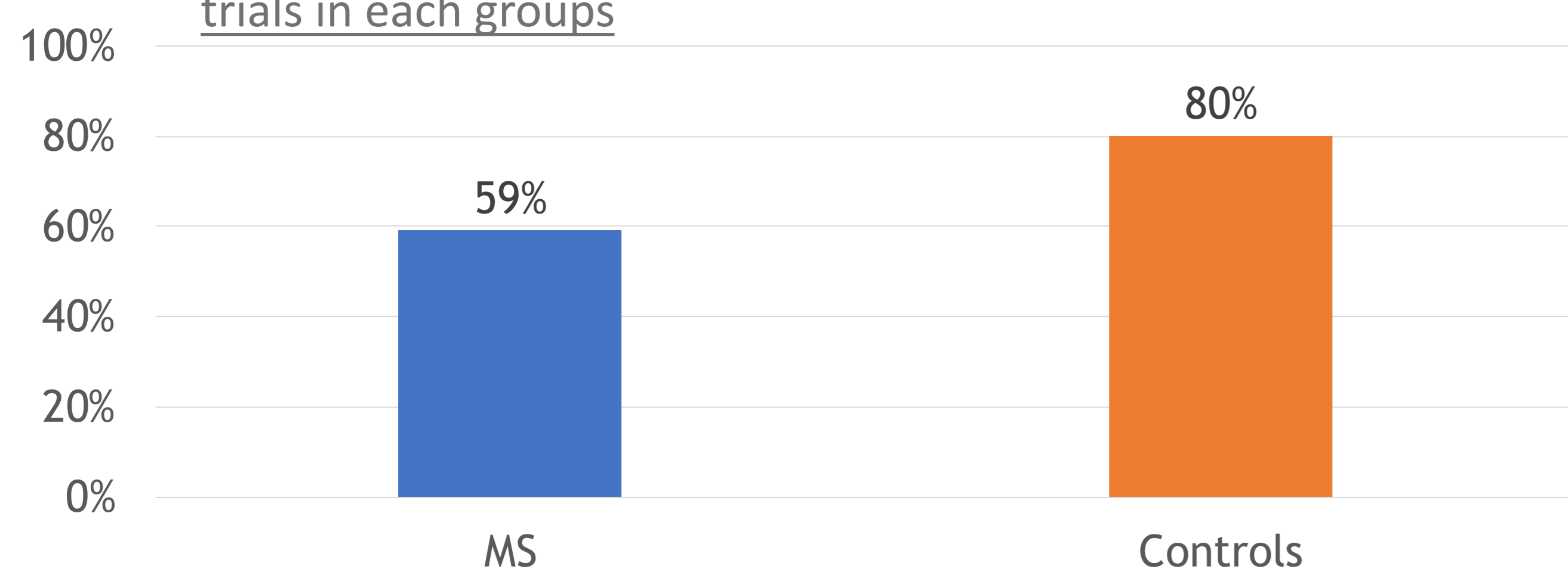
**Selective Reminding Test (SRT)** (Buschke et al., 1987) uses a selective reminding procedure during 11 learning trials. In the first trial, the participant listens a list of 15 unrelated words and then repeat as many words as she/he can recall. On each subsequent trial, the participant is reminded only of the words that were not recalled on the previous one. **The test is stopped after the 11 trials or after the participant recalls the 15 words on 2 consecutive trials.**

### Statistic Analysis

To characterize the slow vs. rapid progression of learning in patients compared to controls, we use the **time-to-event data approach** (i.e., survival analysis, Kleinbaum & Klein, 2005), which focuses on the time until a particular event (i.e. recalls the 15 words on two consecutive trials) occurs.

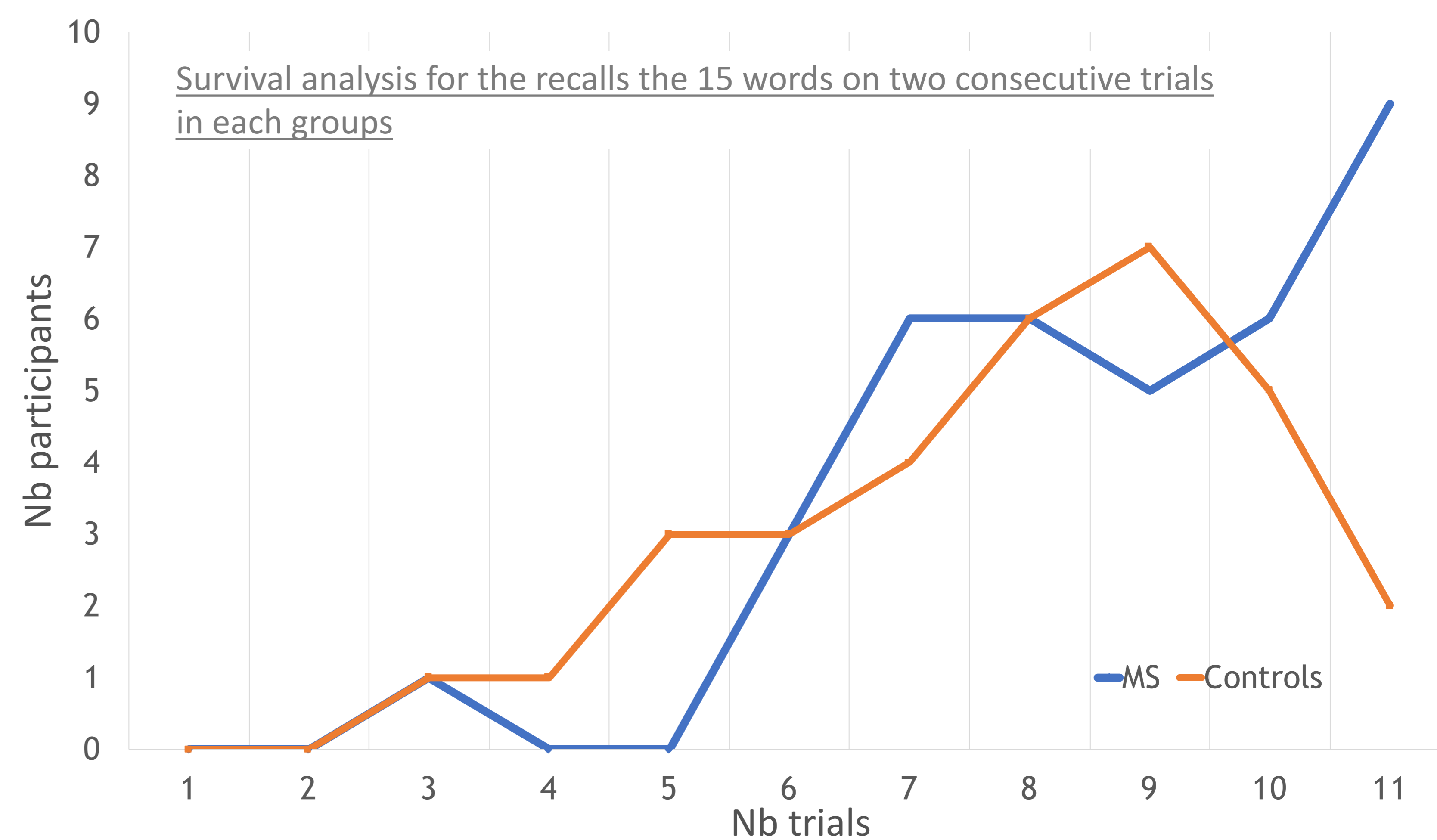
## RESULTS

Proportion of recall of the complete list on 2 consecutive trials in each groups



- A significant difference among patients and control ( $\chi^2 = 7,0402$  ;  $p = 0,008$ ).
- An analysis of the learning curves showed an increasing linear trend for patients, suggesting that more and more patients completed the task as trials progress.
- Comparisons of performance curves were performed after 3, 6 and 9 trials :
  - At 3 ( $\chi^2 = 2.9$  ;  $p = 0,084$ ) and 6 trials ( $\chi^2 = 0,182$  ;  $p = 0,67$ ) the evolution curves of patient and control learning do not differ;
  - At 9 trials, the proportion of healthy subjects completing the task is significantly higher than that MS patients ( $\chi^2 = 7.67$  ;  $p < .05$ ).

- 59% of patients were able to recall the complete list on 2 consecutive trials against 80% of the control subjects ( $\varepsilon = 2,201$  ;  $p < .02$ ).
- Controls achieved the task faster than patients: The number of median tests to achieve this goal is 9 trials in patients versus 8 trials in the controls.



## DISCUSSION

- Survival analysis provides a complementary assessment of EM to the traditional paradigm, and an innovative way to address slow-learning in MS.
- The evolution of the learning would be broadly similar in MS and controls for the first six trials, favoured by the beneficial effect of rehearsals during an apprenticeship (Rossi, 2014).
- In the 9<sup>th</sup> trials, the proportion of healthy subjects completing the task is significantly higher than that of patients. MS patients are less quickly able to learn a list of words than healthy, who requires a lower time, underline a slow learning over time in MS patients (DeLuca et al., 1994).
- An "open-trial" procedure for the SRT (DeLuca, 1994), increasing the number of trials can be use to test this hypothesis. Such procedure have been used in previous study and allowed MS patients to recall the total of the 15 words to two consecutive trials, which allowed for the standardization of delayed recall and recognition scores (Chiaravalloti et al., 2003, 2009, 2013; DeLuca et al., 1998; Demaree et al., 2000).

## REFERENCES

- Chiaravalloti, N. D., Demaree, H., Gaudino, E. A., & DeLuca, J. (2003). Can the repetition effect maximize learning in multiple sclerosis? *Clinical Rehabilitation*, 17(1), 58–68 ; DeLuca, J., Barbieri-berger, S., & Johnson, S. K. (1994). The nature of memory impairments in multiple sclerosis : Acquisition versus retrieval. *Journal of Clinical and Experimental Neuropsychology*, 16(2), 183–189 ; DeLuca, J., Gaudino, E.A., Diamond, B.J., Christodoulou, C., & Engel, R.A. (1998). Acquisition and storage deficits in multiple sclerosis. *Journal of Clinical and Experimental Neuropsychology*, 20(3), 376-390.

