

Rehabilitation of phonological and semantic control in aphasia: an fMRI case study

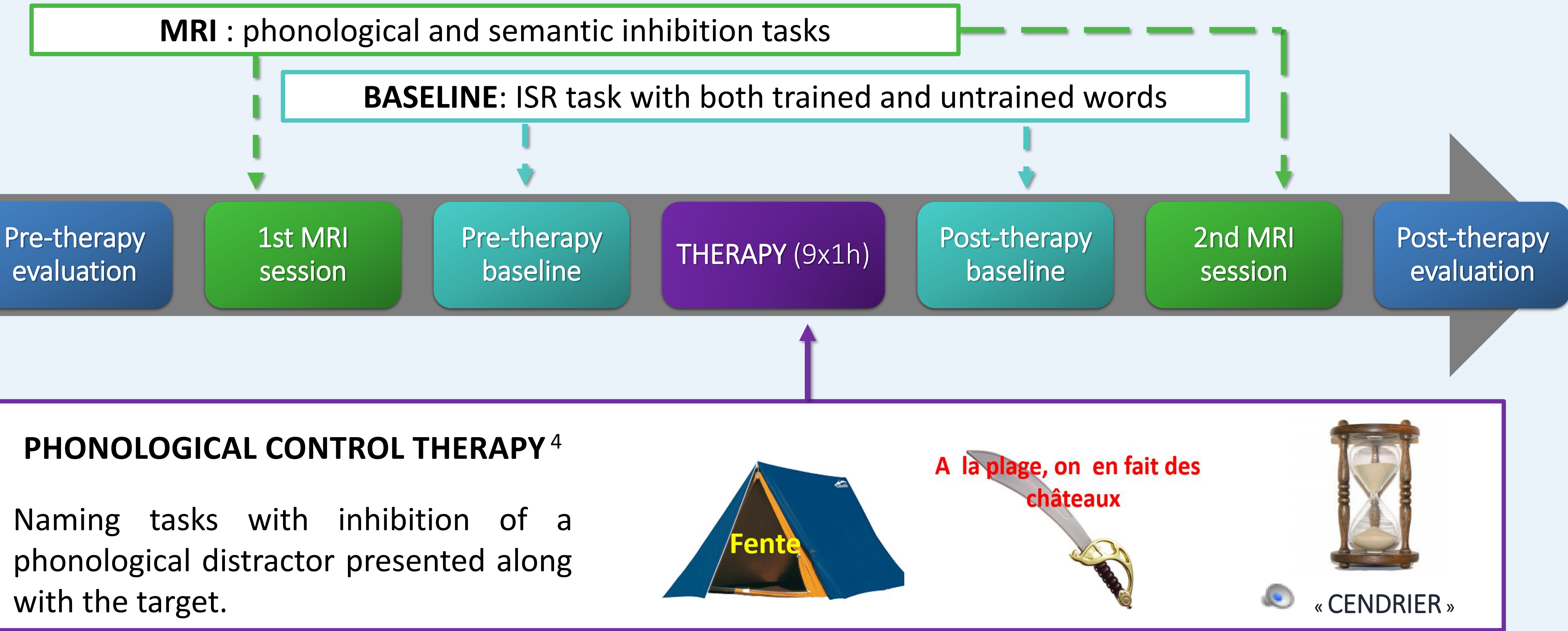
Aphasic patients may suffer from phonological or semantic inhibitory control deficits which are characterized by difficulties at the level of verbal inhibition and working memory (WM) ^{1,2,3}. Very few treatment methods are available for this type of deficit, and few studies have investigated the potential post-therapy brain reorganization that can be observed with fMRI. **AIM** of this case study: to examine the feasibility of a phonological control treatment program in an aphasic patient, at both behavioural and neural levels.

METHODOLOGY

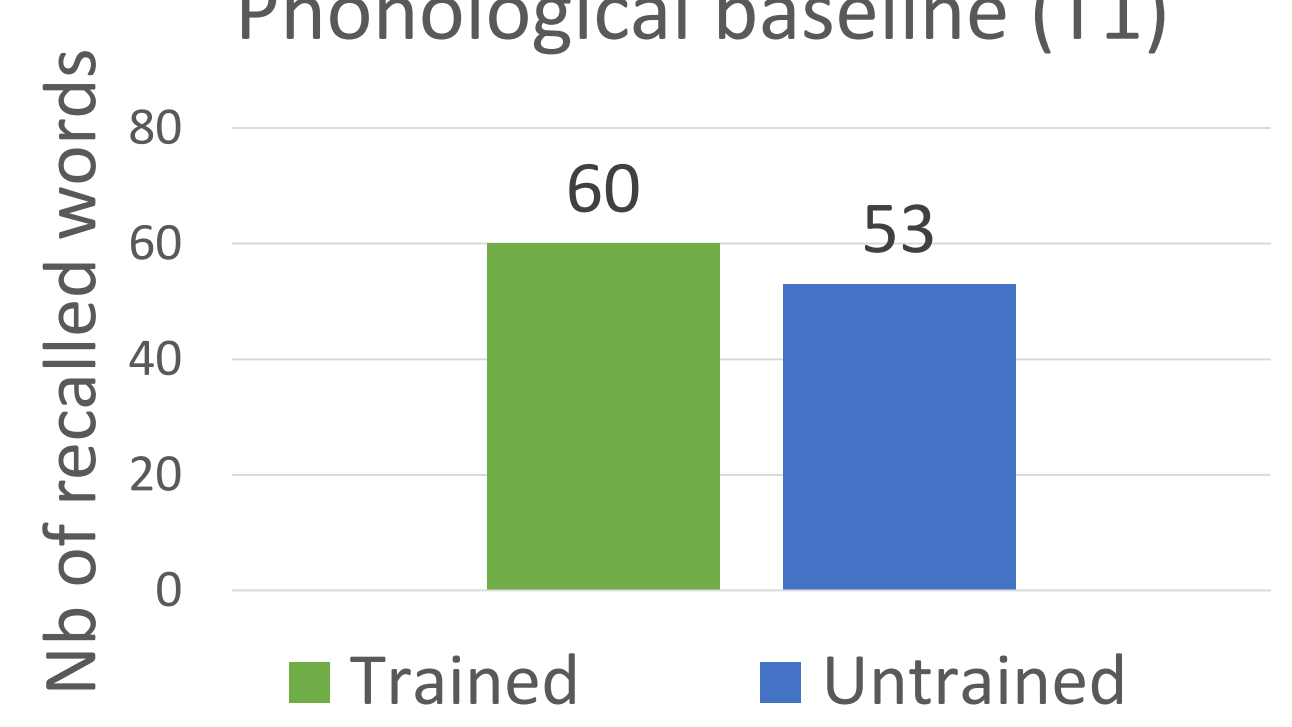
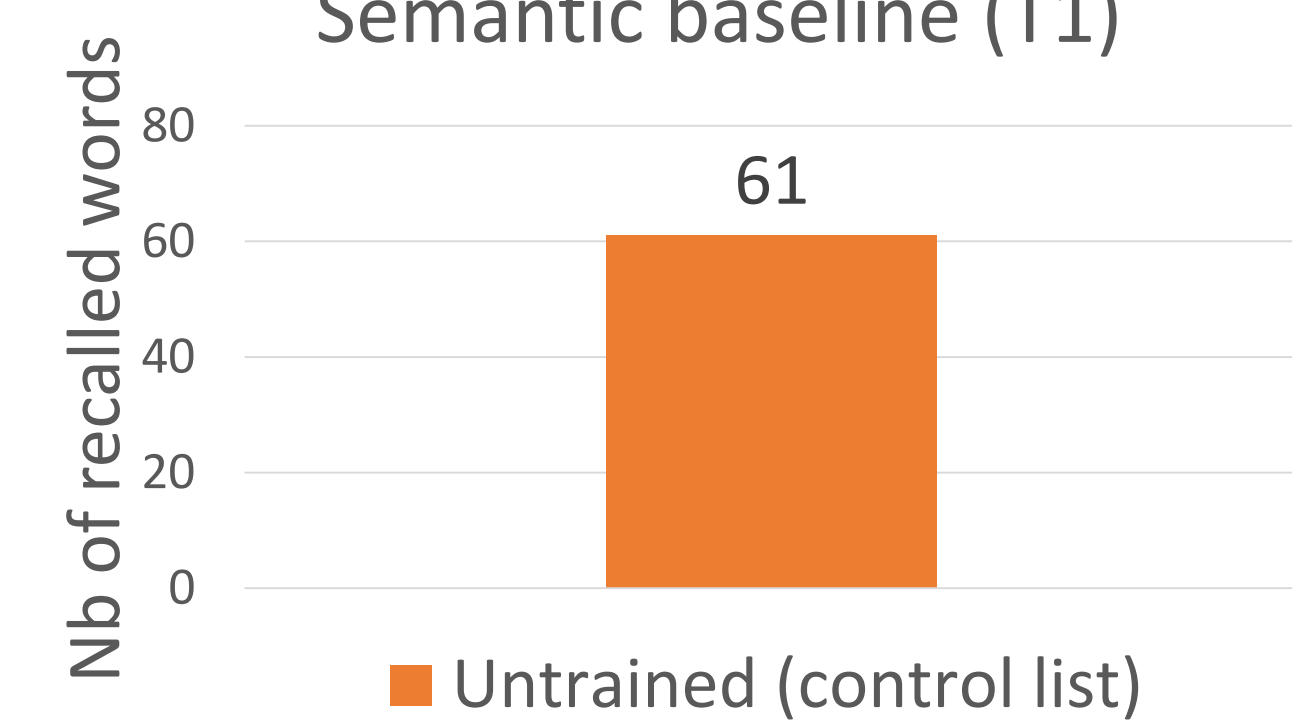
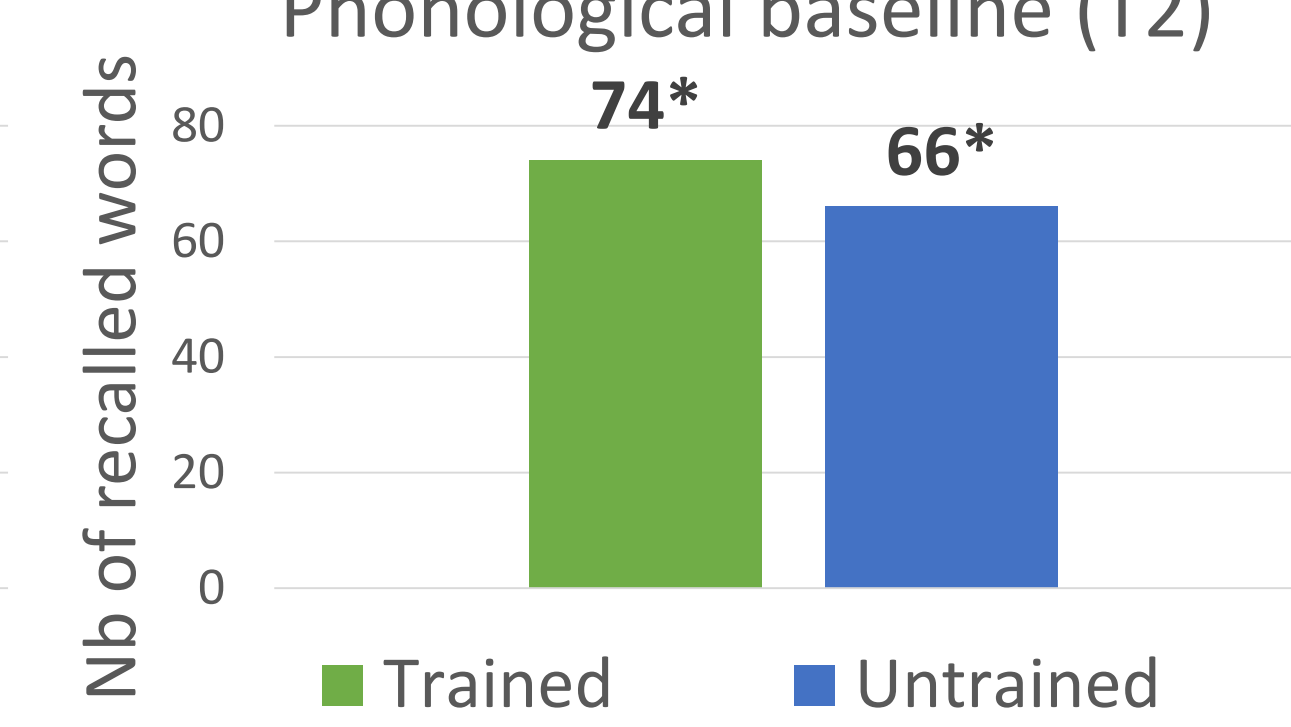
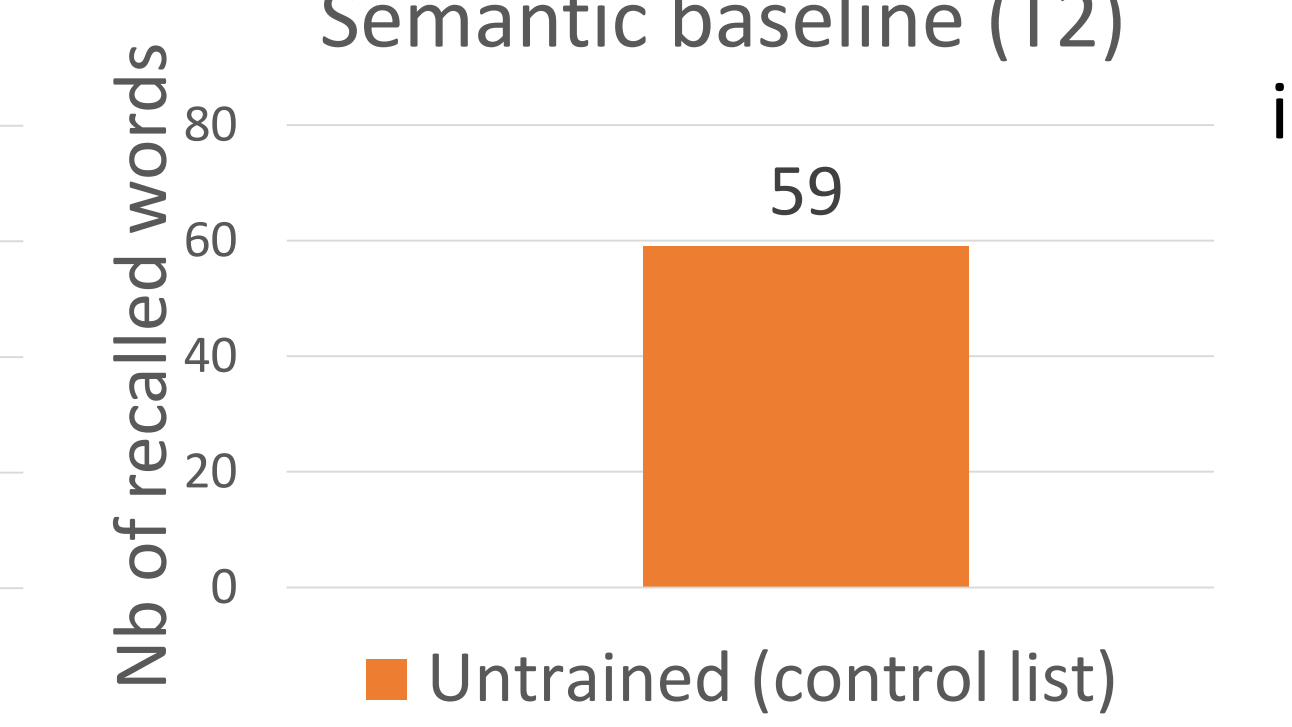
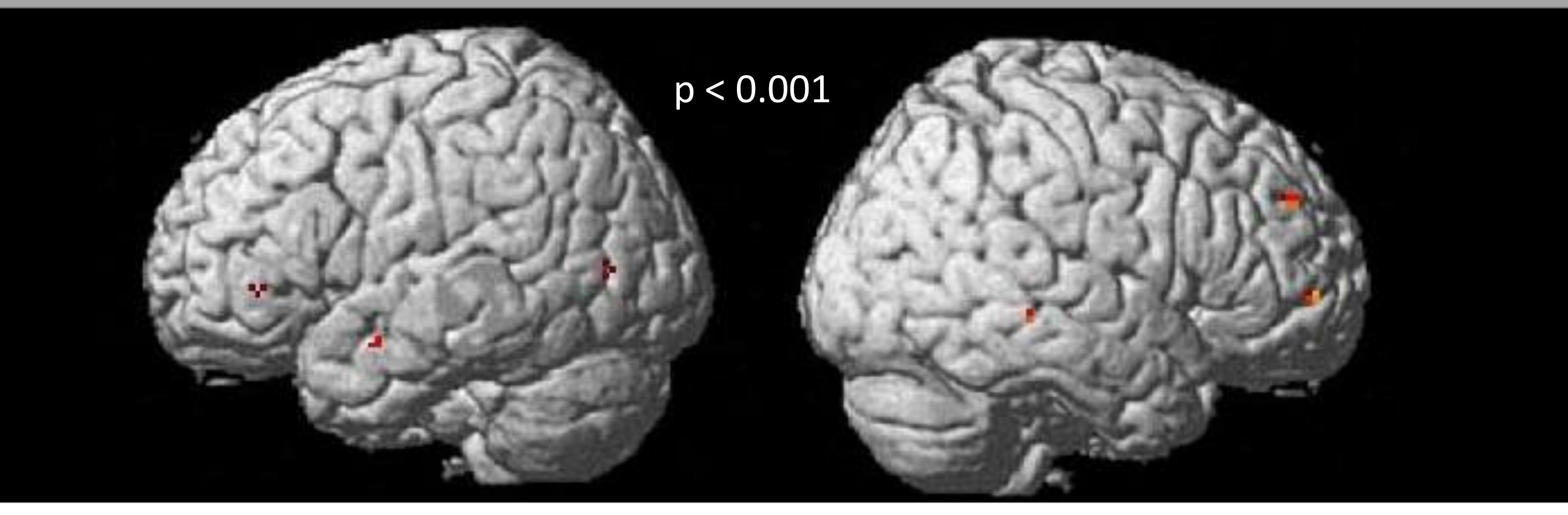
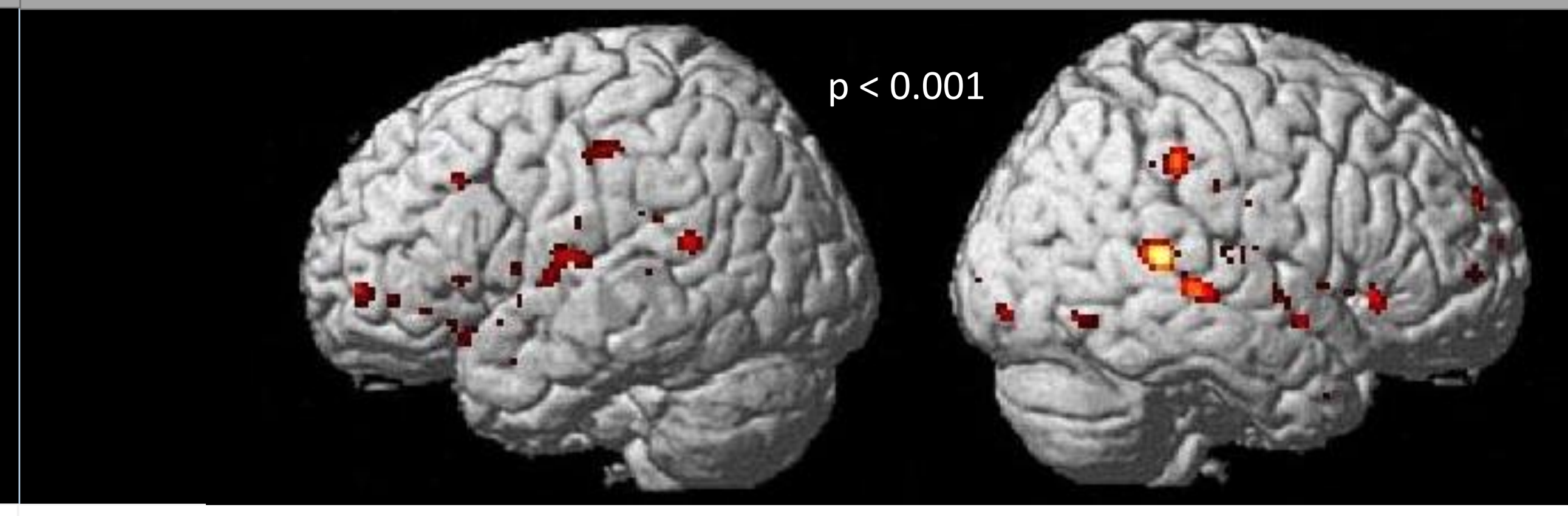
PARTICIPANTS

- **CT, a 77-year-old aphasic patient**, presenting with phonological and semantic paraphasias and verbal intrusions into naming and immediate serial recall (ISR) tasks, indicating a deficit in phonological and semantic verbal control.
- **34 control subjects** (15 men, 19 women) aged 50 to 72 years old (\bar{x} = 59.64).

STUDY DESIGN



RESULTS

	T1 (PRE-THERAPY)		T2 (POST-THERAPY)		
Evaluation <i>Phonological and semantic WM</i> <i>Verbal inhibition</i>	Tasks	Z-score	Tasks	Z-score	Note: decrease of verbal intrusion
	ISR (lexicality effect) – nb of recalled words	- 3,90	ISR (lexicality effect) – nb of recalled words	- 2,37	
	ISR (lexicality effect) – nb of recalled non-words	- 3,04	ISR (lexicality effect) – nb of recalled non-words	- 3,04	
	ISR (imagery effect) – nb of recalled words	- 7,12	ISR (imagery effect) – nb of recalled words	- 2,95	
	Stroop interference (interference condition) – time	- 4,68	Stroop interference (interference condition) – time	- 2,41	
	Stroop interference (interference condition) – nb of errors	- 1,54	Stroop interference (interference condition) – nb of errors	- 0,65	
Baselines	Phonological baseline (T1)		Semantic baseline (T1)		
					
	Phonological baseline (T2)		Semantic baseline (T2)		
					
MRI	Phonological inhibition task – interference effect		Phonological inhibition task – interference effect		
	 T-test : patient – control subjects Left and middle cingulate gyri and left middle temporal gyrus more activated in CT than in controls.		 T-test : patient – control subjects Left and right inferior frontal gyrus, left middle cingulate gyrus, left precentral gyrus, right supramarginal gyrus, right middle temporal gyrus, and left and right insular cortex more activated in CT than in controls.		

DISCUSSION

CT's phonological WM capacities seem to have improved overall but remain deficient following the phonological control therapy. On the other hand, CT significantly improves its performance on the two phonological baseline lists (**efficacy** and **transfer effect** of phonological inhibitory training), without making any progress in the control words list (**specificity effect**). In addition, following therapy, compared to controls, CT activates more regions involved in **inhibitory control processing** (inferior frontal gyrus, middle cingulate gyrus) and **phonological processing** (precentral gyrus, supramarginal gyrus). These results highlight the specificity of treatment programs of verbal inhibition, and by extension, of verbal language control by distinguishing between phonological and semantic inhibitory processes.

¹ Hamilton, A.C., & Martin, R.C. (2005). Dissociations along tasks involving inhibition: A single-case study. *Cognitive, Affective & Behavioral Neuroscience*, 5(1), 1-13.
² Hamilton, A.C., & Martin, R.C. (2007). Proactive interference in a semantic short-term memory deficit: Role of semantic and phonological relatedness. *Cortex*, 43, 112-123.

³ Hoffman, P., Jefferies, E., Ehsan, S., Hopper, S., & Ralph, M.A. (2009). The impact of semantic impairment on verbal short-term memory in stroke aphasia and semantic dementia: A comparative study. *Journal of Memory and Language*, 58(1), 66–87.

⁴ Van der Kaa et al. (en préparation). Centre Hospitalier Universitaire de Liège, Polyclinique Lucien Brull.