Precision of neural representations supporting auditory-verbal working memory

M. Bouffier[1], B. Kowialiewski[2,1], L. Attout[1], C. Grégoire[1], C. Phillips[1], & S. Majerus[1]
[1]Université de Liège, Liège, Belgium
[2]Université Grenoble Alpes, France

1.Introduction

- Working memory (WM) precision can be defined as the **resolution** with which items are stored in WM. For WM precision, **resources** in WM are flexibly and variably allocated to all memoranda, while for WM **capacity**, a certain **quantity** of items or slots can be held in WM in an all-or-none fashion (Ma et al., 2014).
- WM precision has been extensively studied in the visual domain (e.g., Gorgoraptis et al., 2011; Zokaei et al., 2012), but considerably less in the verbal domain (Joseph et al., 2015; Hepner & Nozari, 2019).

2.Aims

- The aim of **this functional magnetic resonance (fRMI) study** is to explore the **precision of neural representations** associated with verbal WM memory.
- We used a **multivariate decoding approach (MVPA)** in order to investigate the extent to which neural patterns can distinguish nonwords held in WM, the nonwords furthermore being either very distinct or highly overlapping at the phonological level.

3.Methods

- 27 right-handed French-speaking young adults (15 women) aged 18-30 years (μ = 22,63 years, σ = 2,67).
- They were presented auditorily with a single nonword in each trial, the nonwords showing high or low phonological overlap between trials; each stimulus was presented 24 times (**Table 1**).
- After encoding, each nonword had to be maintained during a 7000 ms interval.
- Neural patterns associated with each nonword were identified using MVPA and searchlight analyses.

Overlapping	Non-overlapping
Cordoriment	Dédunbageau
Corpomirent	Panfinouran
Cormopirent	Loncechetait

Table 1: Nonword stimuli used in the fMRI experiment

4.Results

- One-sample t-tests compared classification accuracies (**Table 2**) and normalized classification accuracy maps (**Figure 1**) to a chance level distribution.

→ Above-chance level classification accuracies in the dorsal language pathway only for non-overlapping nonwords.

	BF_{10}	error %
Non-overlapping	351.660	1.382e -5
Overlapping	0.674	2.268e -5

Table 2. Bayes factor values for the comparison of classification accuracies against a chance level distribution.

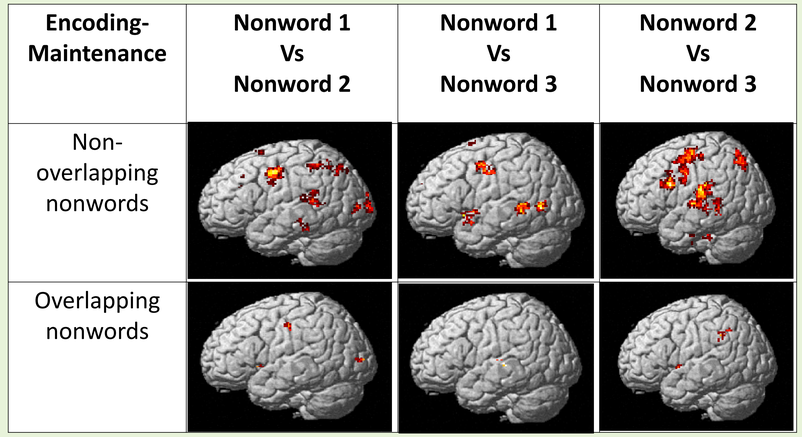

Figure 1. Clusters showing above-chance level classification accuracies (searchlight analysis; k = 30, p<.001)

5.Discussion

- While classification accuracy for decoding phonologically overlapping nonwords based on associated neural patterns was at chance level, **reliable decoding was observed for non-overlapping nonwords in regions mainly involving the temporal and frontal parts of the dorsal language pathway**.
- **Neural precision for representing phonological information in WM appears to be rather limited**, with nonwords only differing by a single consonant (at the item or serial position level) not being represented in a reliable manner when using an fMRI approach with standard spatial resolution.

Contact: Bouffier Marion, PhD Student F.R.S-FNRS
PsyNCog Research Unit, University of Liège
E-mail: marion.bouffier@uliege.be

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