

Are parity and magnitude status of Arabic digits processed automatically? An EEG study using the fast periodic visual stimulation.

Alexandre Poncin^{1*}, Amandine Van Rinsveld¹, Mathieu Guillaume¹, Bruno Rossion², Christine Schiltz¹.

¹Cognitive Science and Assessment Institute, ECCS unit, University of Luxembourg, Luxembourg

²Institute Of Neuroscience, Université catholique de Louvain, Belgium

*Corresponding author: alexandre.poncin@uni.lu

Introduction

- Magnitude represented by number symbols is automatically processed in the right parietal cortex of healthy human adults (Cohen Kadosh & al. 2012; Tzelgov & al., 1992)
- Magnitude is processed faster than parity (Dehaene, Bossini, & Giraux, 1993).
- Magnitude is processed automatically during parity judgement task (Dehaene & al 1993).

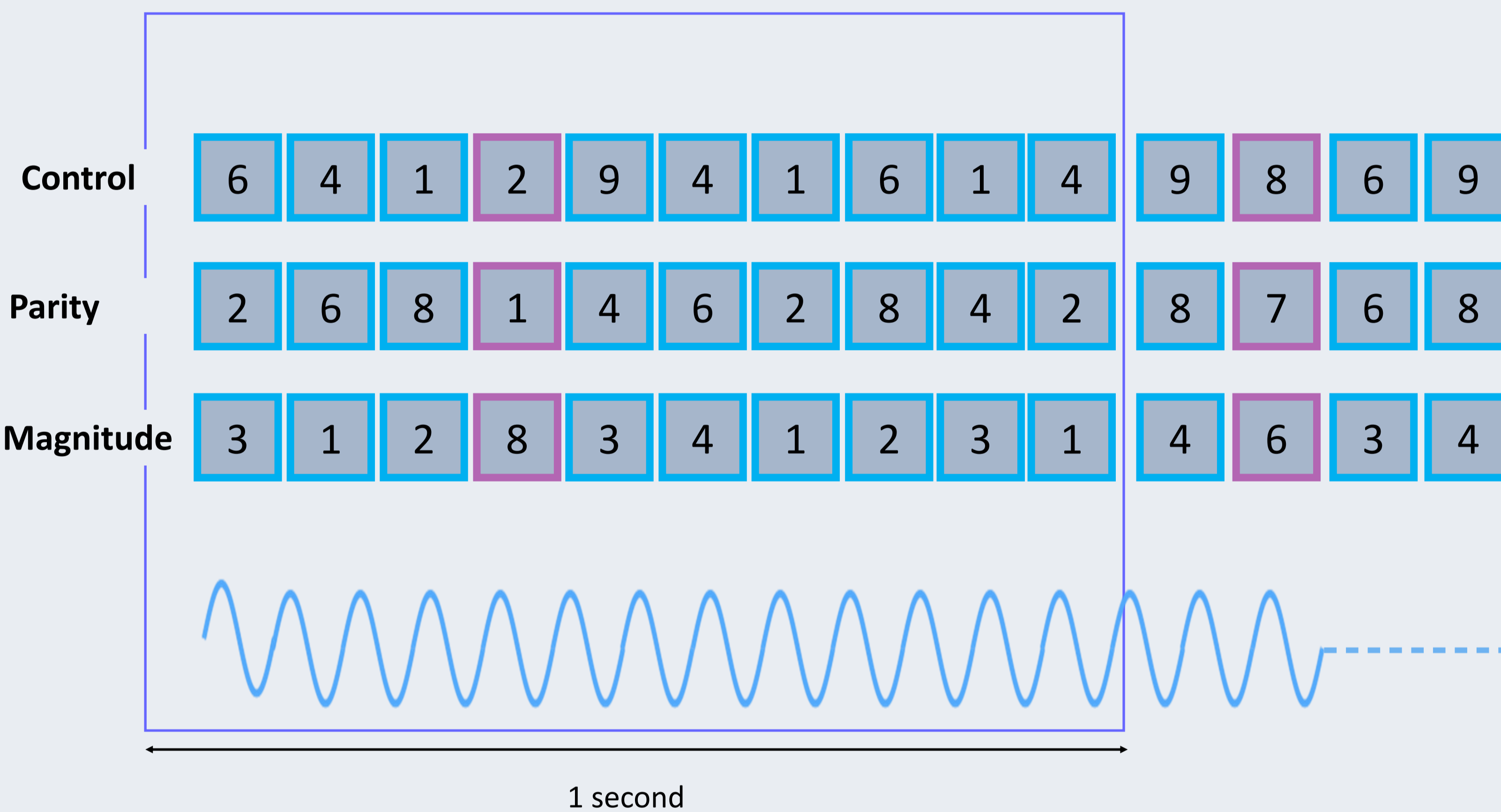
Hypotheses

We expected:

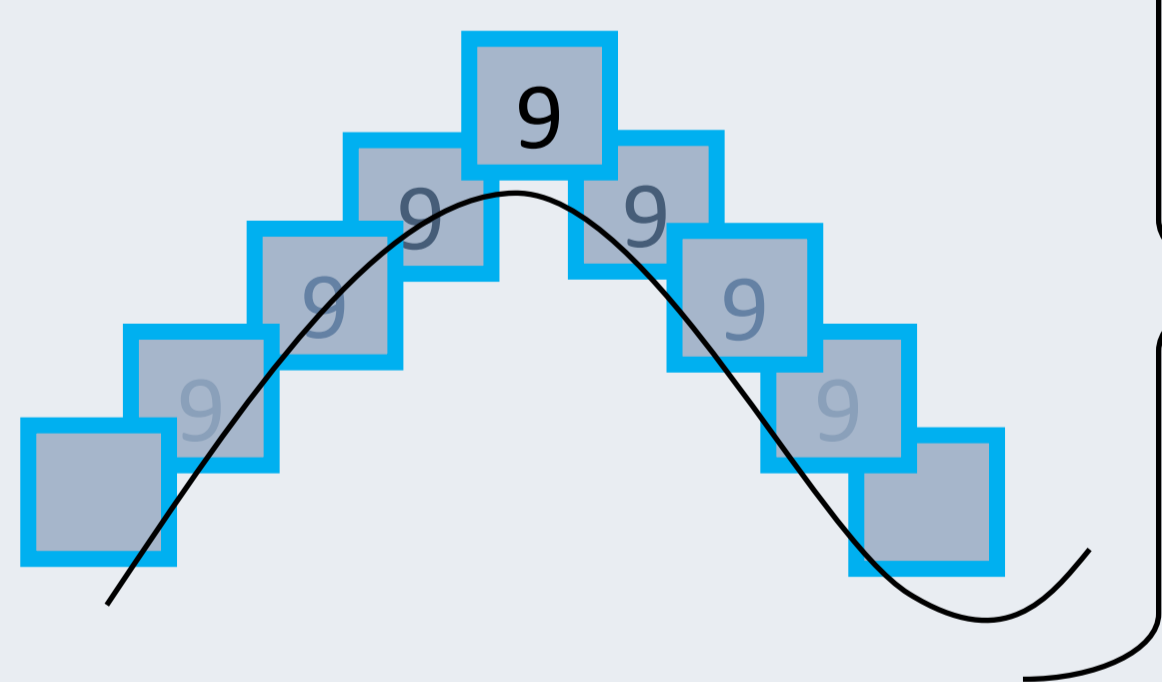
- 1) A significant oddball both for the magnitude and the parity conditions but not for the control condition, reflecting automatic magnitude and parity processing.
- 2) A right lateralization of the responses in both the magnitude and the parity conditions.

Fast Periodic Visual Stimulation

Conditions	Frequent stimuli	Oddball stimuli	Oddball frequency	Base frequency	Number of repetitions
Parity	Odd (1-3-7-9)	Even (2-4-6-8)	1.25Hz (1/8 stimuli)	10Hz (10 stimuli/second)	4
Parity	Even (2-4-6-8)	Odd (1-3-7-9)	1.25Hz (1/8 stimuli)	10Hz (10 stimuli/second)	4
Magnitude	Small (1-2-3-4)	Large (6-7-8-9)	1.25Hz (1/8 stimuli)	10Hz (10 stimuli/second)	4
Magnitude	Large (6-7-8-9)	Small (1-2-3-4)	1.25Hz (1/8 stimuli)	10Hz (10 stimuli/second)	4
Control	No rules (1-4-6-9)	No rules (2-3-7-8)	1.25Hz (1/8 stimuli)	10Hz (10 stimuli/second)	4



Stimuli presentation

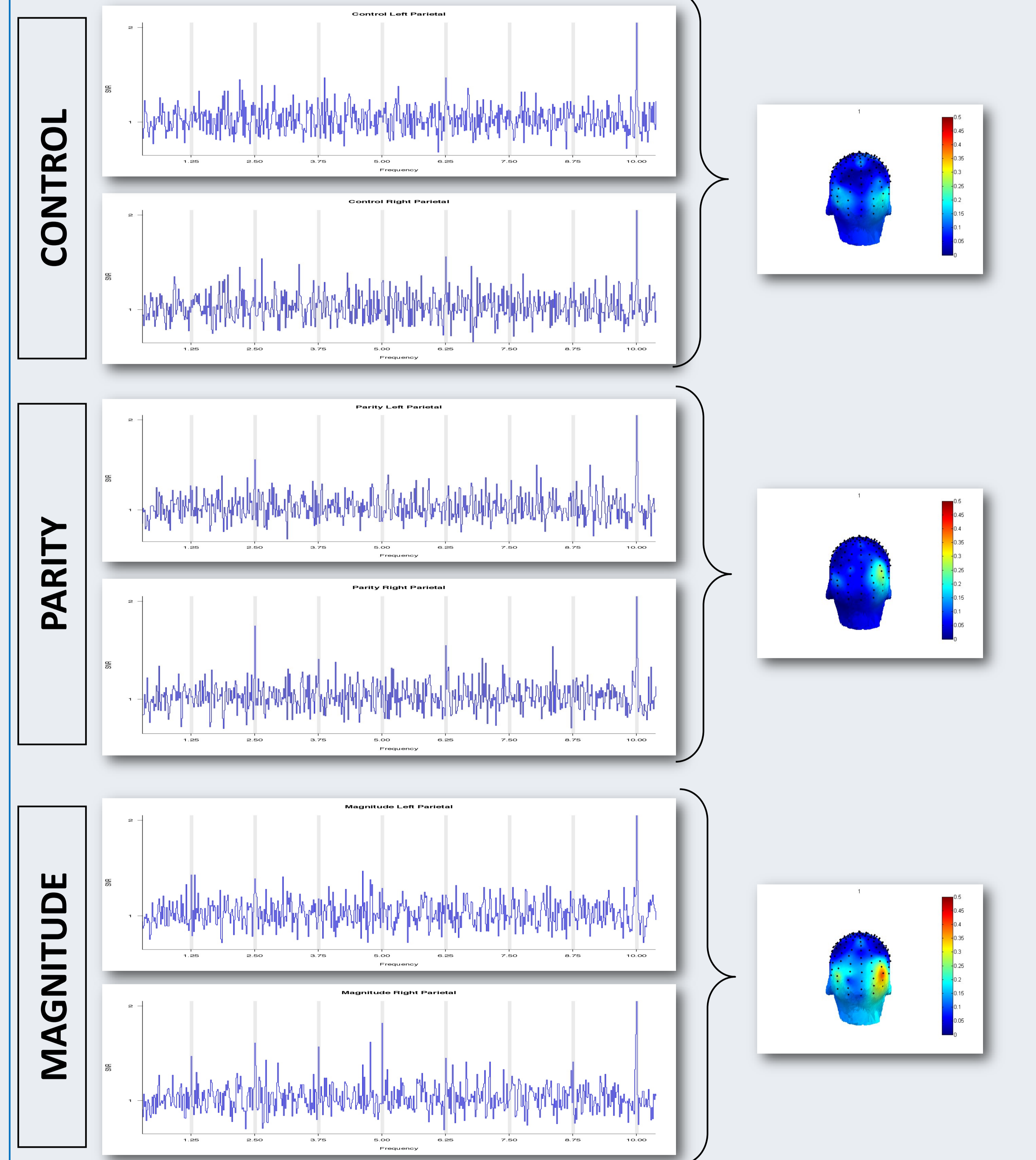


- Stimuli were continuously displayed through sinusoidal contrast modulation, during four sessions of 60 seconds.
- We varied stimulus font, size and position around the fixation cross in order to avoid visual bias

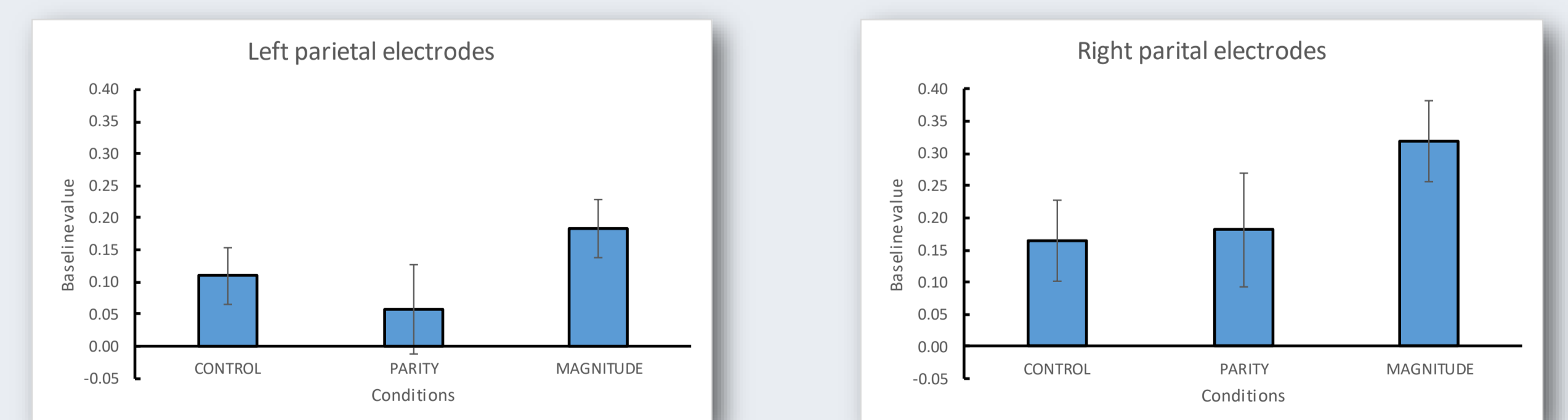
Methods

- Sixteen young adults (9 males; Mean age = 24 years old).
- First, we averaged the signal of the 4 repetitions for each condition. Then we averaged both of the parity and the magnitude conditions respectively (Average: odd-even + even-odd ; small-large + large-small).
- Acquisition system: BioSemi ActiveTwo system with 128 channels at 1024Hz .

Signal-to-noise ratio and topography



Comparison of the left and right parietal activations



Conclusion

The three tasks activated the same area of the right and left parietal cortex. Nevertheless, oddball responses were stronger in the magnitude condition than in the other two conditions. Those results are consistent with the existing literature:

- 1) Magnitude processing involves the right and left parietal area (Cohen Kadosh, Bien, & Sack, 2012; Tzelgov, Meyer, & Henik, 1992).
- 2) The weaker response over the right parietal cortex during the parity task could be caused by slower processing due to the need of magnitude retrieval before accessing the parity status of the number (Dehaene, Bossini, & Giraux, 1993).
- 3) The response over the left and right parietal cortex during the control task could be caused by the fact that subjects can quickly learn to categorize numbers even if their categorization is done arbitrarily.