

- ❖ Fast Periodic Visual Stimulation (FPVS) coupled with EEG provides objective and sensitive (high signal-to-noise ratio) measures of visual recognition processes without explicit tasks required (Rossion et al., 2020)
- ❖ A robust index of lexical representation in the left occipito-temporal cortex has been shown with FPVS-EEG approach in a visual word oddball paradigm (Lochy et al., 2015; Lochy et al., 2018)
- ❖ Inter-individual variability in word-selective responses and relationship to reading efficiency are still unclear

Is there an optimal stimulation rate for word-selective responses that relate to reading efficiency?

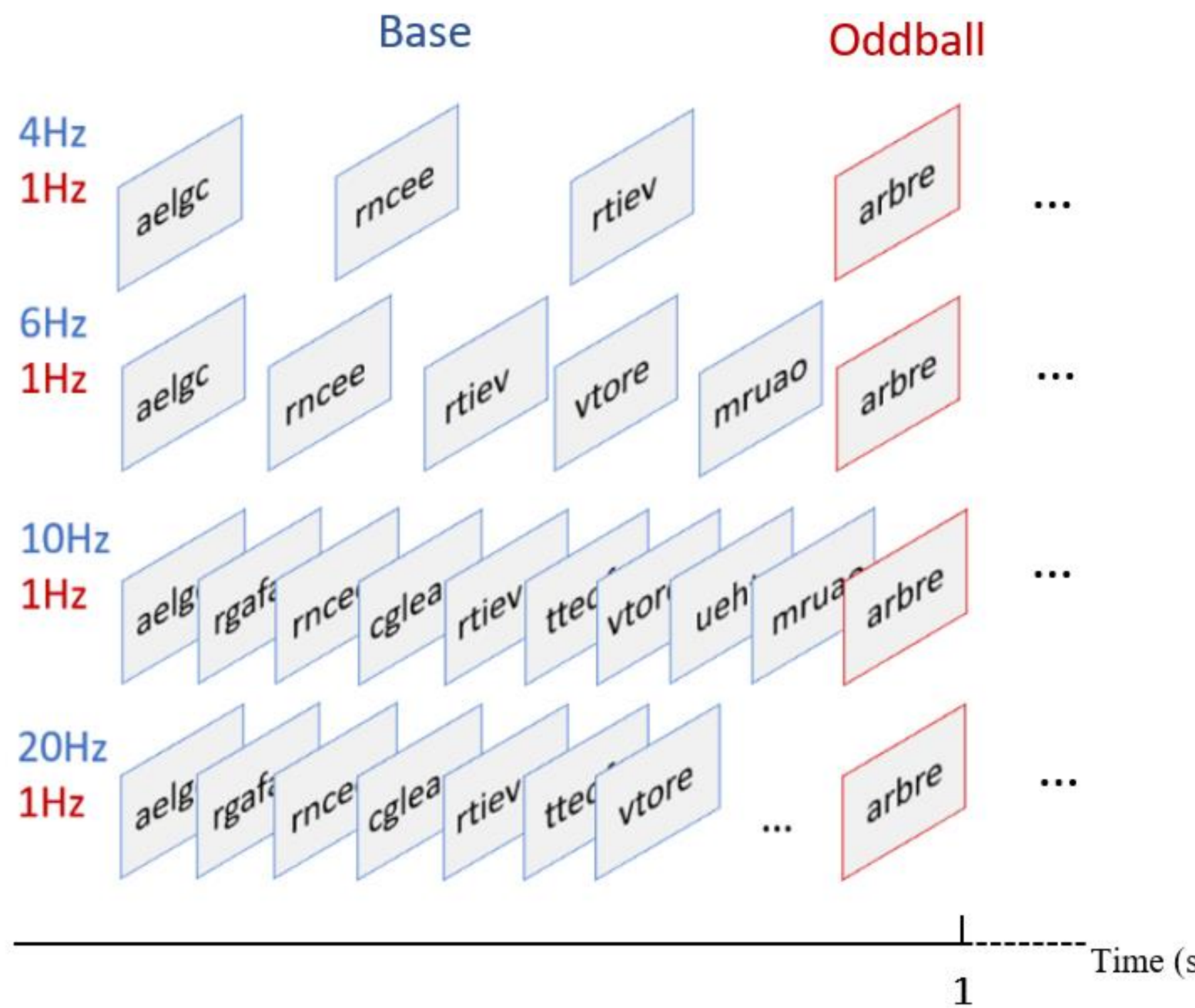
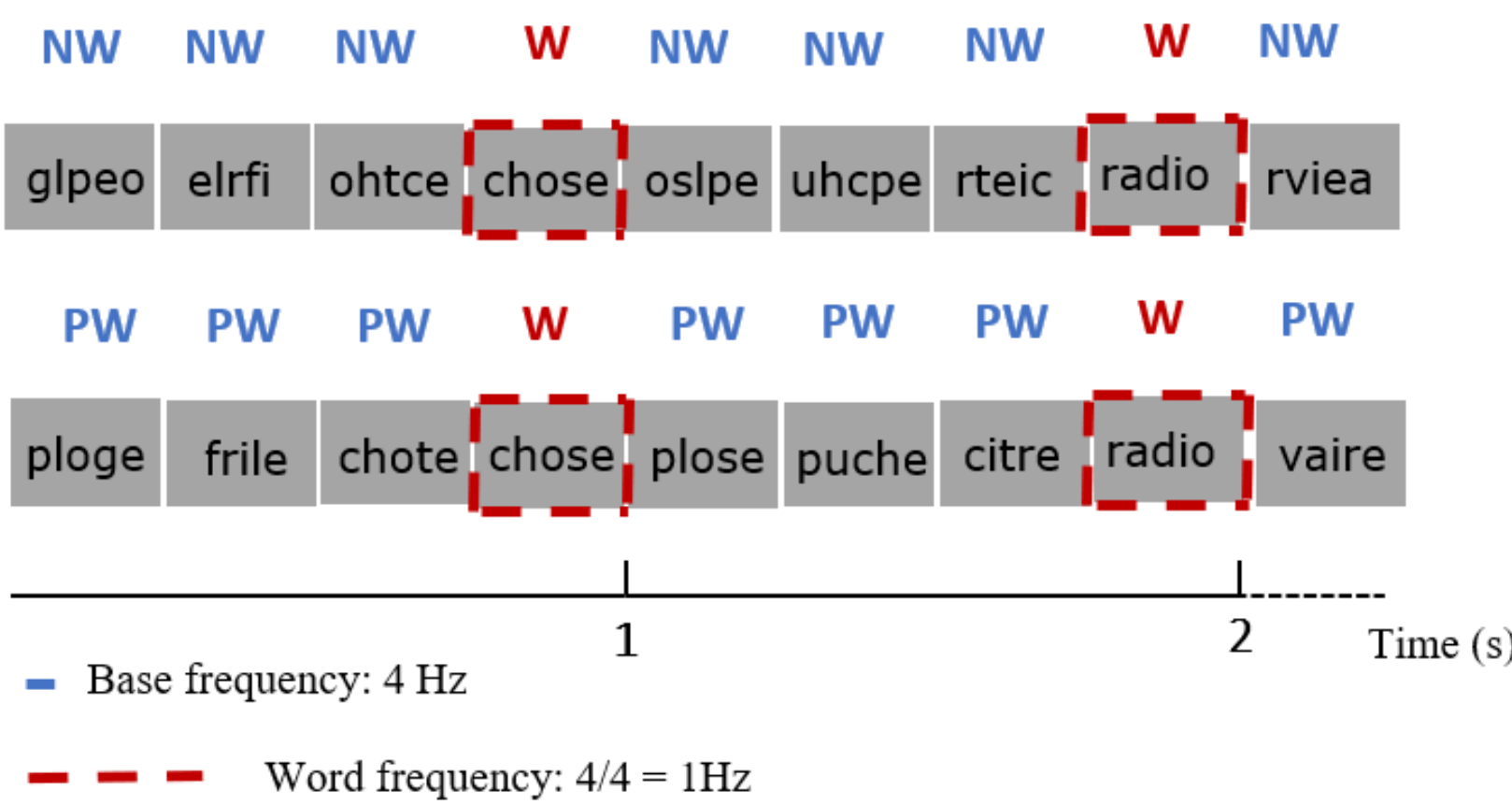


Participants : 41 right-handed French speakers

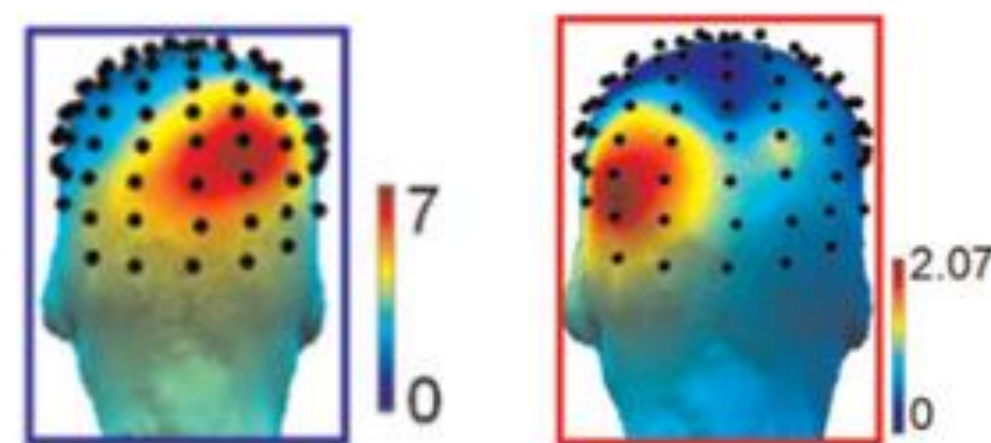
Reading tests : ECLA 16+, LUM (reading words in one minute), Lexical decision task (LDT) & Progressive demasking task (PDM)

Oddball paradigm (FPVS) :

- FPVS during EEG recording (68 channels)
- 2 types of neural response :
Base stimulation : synchronization of the visual system to the periodic stimulation
Oddball frequency : word-selective response, *i.e.*, discrimination of words among base stimuli
- 2 conditions of base stimuli:
Words embedded in streams of non-words (NW) : Pre-lexical
Words embedded in streams of pseudo-words (PW) : Lexical
- 4 base frequencies : 4Hz, 6Hz, 10Hz, 20Hz (oddball 1Hz)

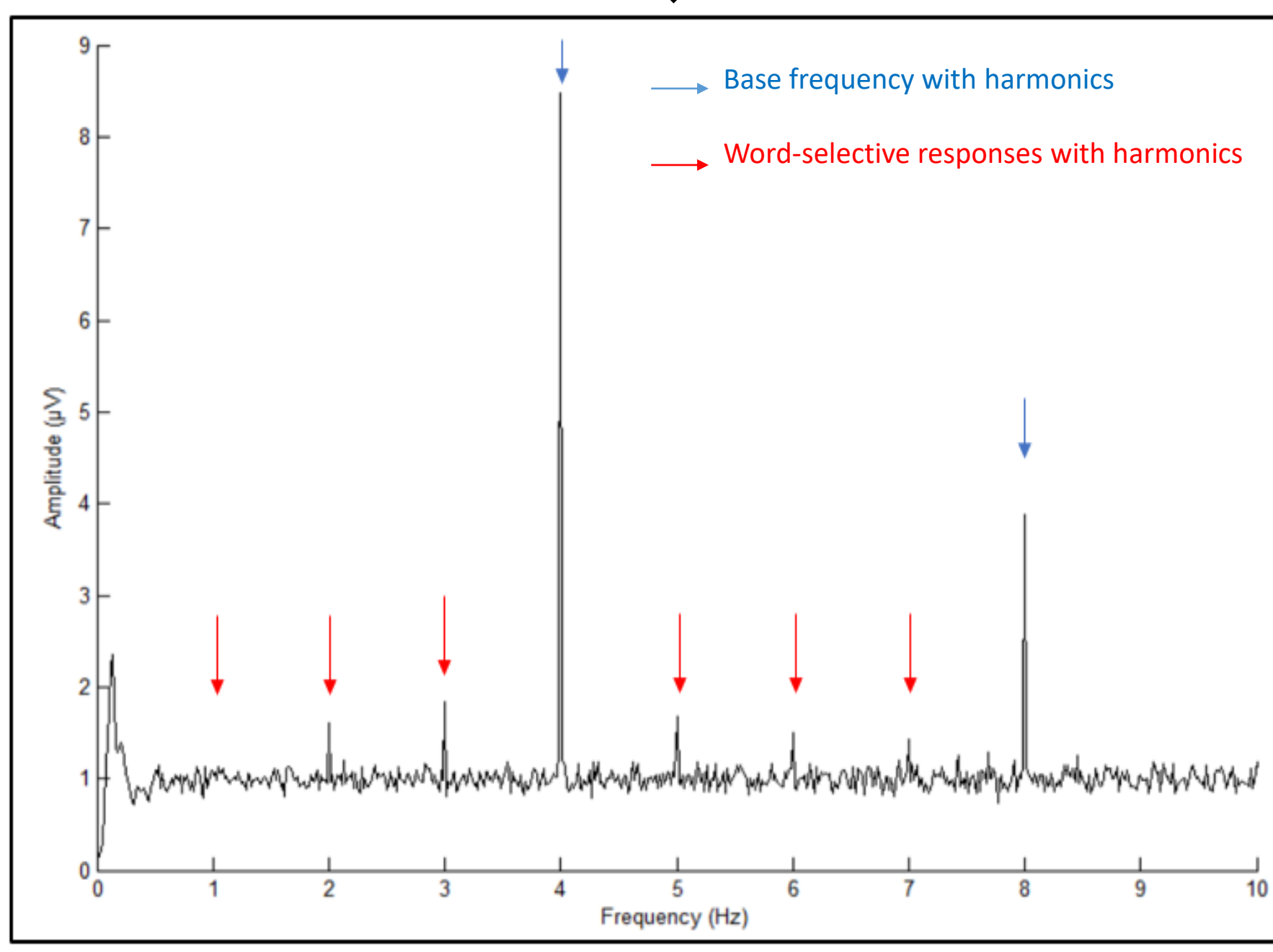


Base response Word-selective response

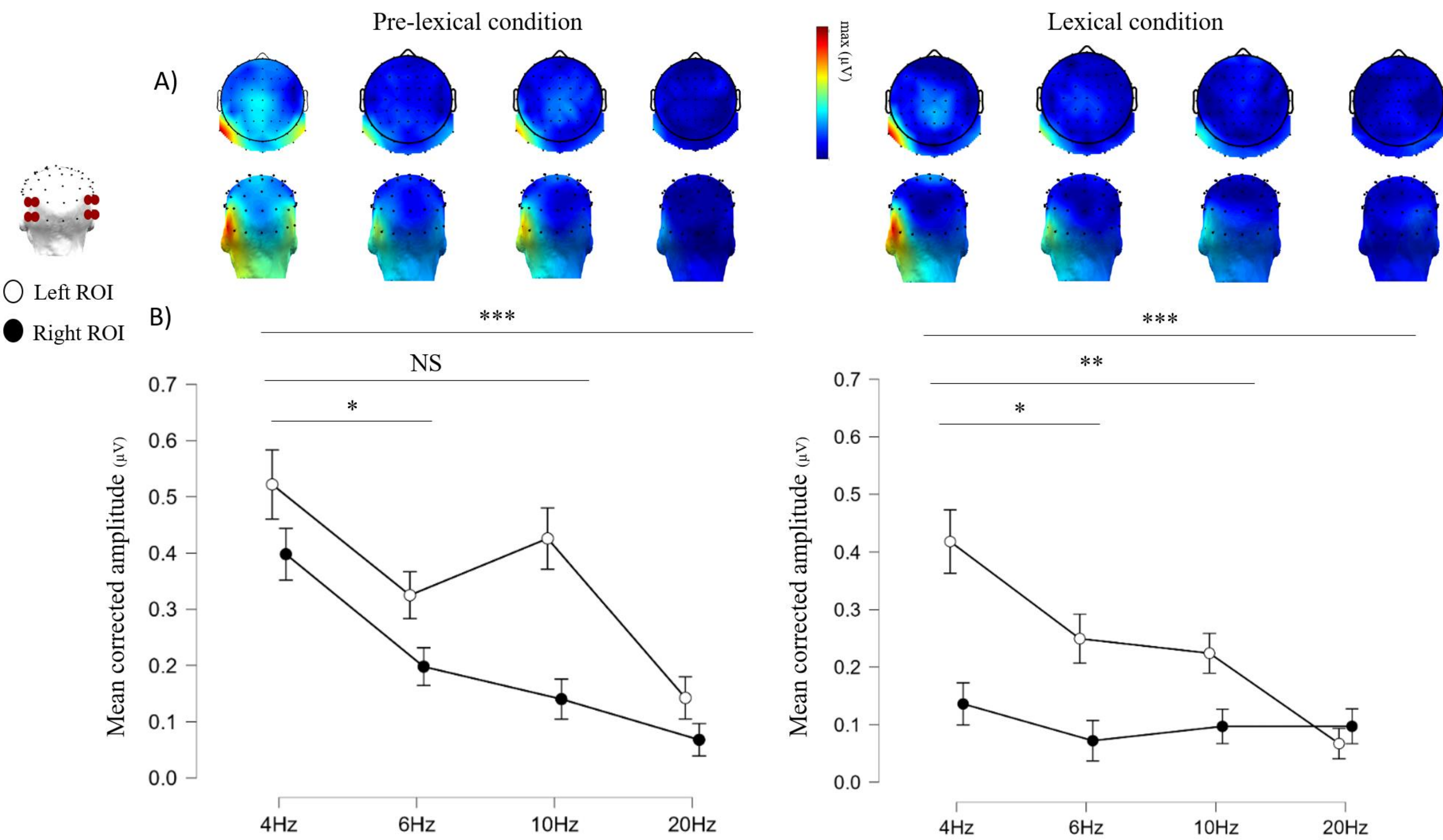


Lochy et al. (2015)

FFT (Fast Fourier Transform)
Frequency-domain



Analysis at the word-selective frequency (N=41)



Individual discrimination responses (N=41)

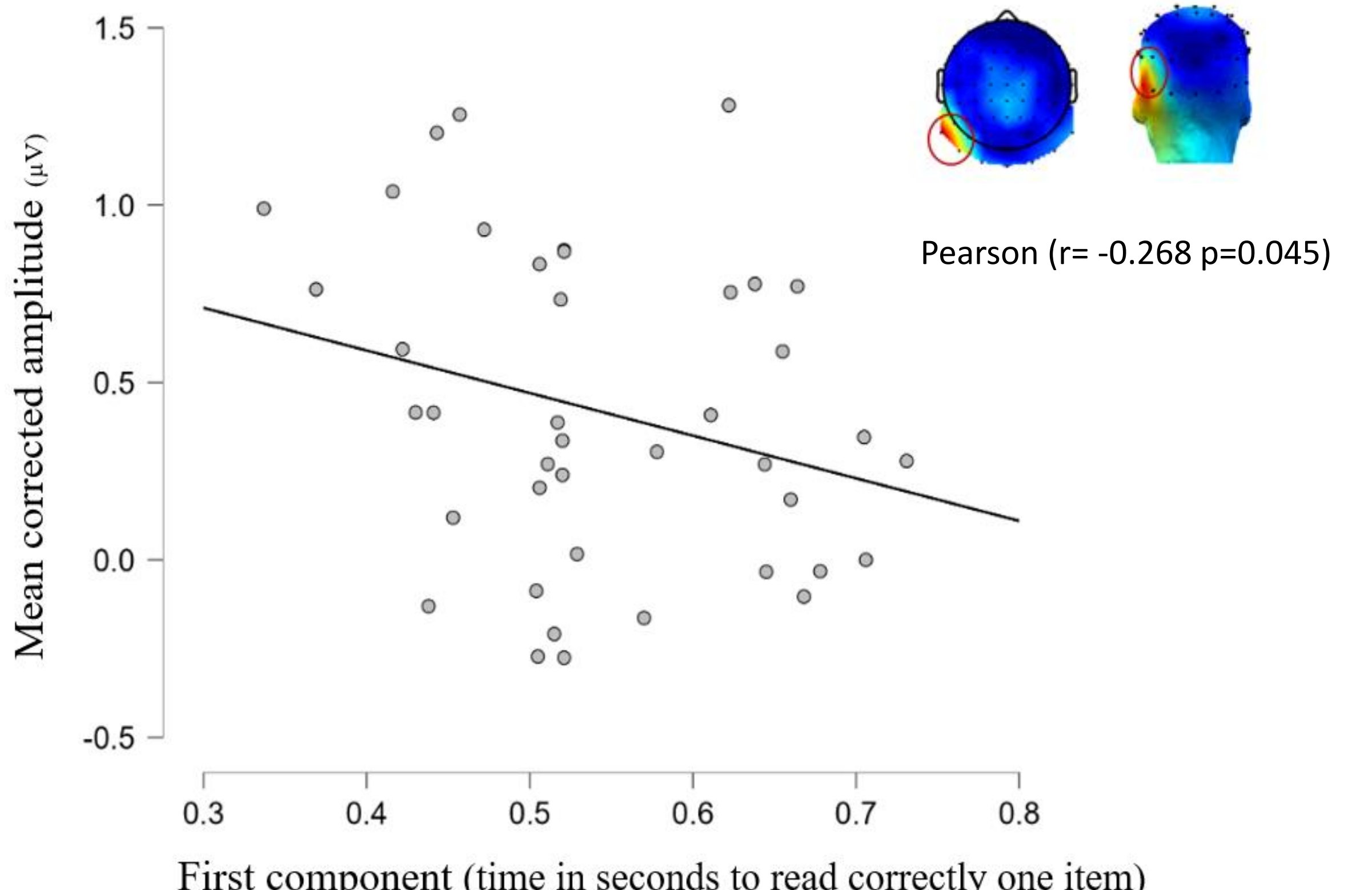
Percentage of subjects with one significant electrode (left ROI or right ROI) N=41

	4Hz	6Hz	10Hz	20Hz
NW-W (pre-lexical)	90.2% (N=37)	75.6% (N=31)	80.4 % (N=33)	58.5% (N=24)
PW-W (Lexical)	80.4% (N=33)	56% (N=23)	68.2 % (N=28)	58.5% (N=24)
Percentage of subjects with one significant electrode only over the left ROI N=41				
NW-W (pre-lexical)	85.3 % (N=35)	63.4 % (N=26)	75.6 % (N=31)	41.4 % (N=17)
PW-W (Lexical)	70.7 % (N=29)	48.7% (N=20)	58.5 % (N=24)	31.7% (N=13)

Correlations with reading tasks and amplitude at the word-selective response (N=41)

Component Loadings	PC1	PC2	PC3	PC4	Uniqueness
Irregular_words_index	0.891				0.189
Regular_words_index	0.853				0.214
Pollueur_index *	0.846				0.194
Pseudo-words_index	0.771				0.301
LUM_index	0.770				0.347
Letter_reading_index	0.550				0.445
Alouette_index *	(0.500)	0.502			0.300
Image_naming_index		0.944			0.091
LDT_index			0.829		0.277
PDM_index			-0.512		0.330
Categorical_fluency_index				0.937	0.104

Eigenvalues 4.798 1.314 1.084 1.011
Variance explained (%) 43.6% 11.9% 9.9% 9.2%
Index : time (sec) /accuracy
*Pollueur : reading text with meaning in one minute
*Alouette : reading text without meaning



Significant correlations found with PC1 and the corrected amplitude over the left ROI at 4Hz in the lexical condition

- Word-selective responses vary according to the stimulation frequency and contrast :
 - Amplitude for words embedded in non-words > pseudo-words
 - 20Hz is too fast in the lexical condition to lead to a clear visual word-selective response
- Optimal frequency at **4Hz (250ms SOA)** :
 - Amplitude over the left occipito-temporal cortex largest at 4Hz than other frequencies but more focal in the lexical condition
 - Individual discrimination of responses (*i.e.*, 90.2% for the pre-lexical & 80.4% for the lexical discrimination)
 - Relationship with reading performance : Correlation at 4Hz over the left ROI in the lexical contrast and the “purest” reading component (*i.e.*, the higher the amplitude at this frequency is, the faster the person reads words)

- Lochy A, Van Belle G, Rossion B (2015). A robust index of lexical representation in the left occipito-temporal cortex as evidenced by EEG responses to fast periodic visual stimulation. *Neuropsychologia* 66:18–31.
- Lochy, A., Jacques, C., Maillard, L., Colnat-Coulbois, S., Rossion, B., & Jonas, J. (2018). Selective visual representation of letters and words in the left ventral occipito-temporal cortex with intracerebral recordings. *Proceedings of the National Academy of Sciences*, 115(32).
- Rossion, B., Retter, T.L., Liu-Shuang, J. (2020). Understanding human individuation of unfamiliar faces with oddball fast periodic visual stimulation and electroencephalography. *European Journal of Neuroscience*, 52, 4283–4344.