Is there an optimal stimulation rate for frequency-tagged visual word-selective responses?

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Résumé

Fast Periodic Visual Stimulation (FPVS) coupled with electroencephalography (EEG) has revealed a robust index of (pre)lexical representation over the left occipito-temporal cortex (Lochy et al., 2015). In this approach, words are inserted periodically (usually every 5th item) in rapid periodic streams (10Hz base stimulation) of non-words or pseudo-words. Discrimination responses for words in the EEG frequency domain (at 2Hz and harmonics) provide an objective and highly sensitive measure of visual recognition processes without requiring an explicit task (Lochy et al., 2015; 2018).
Here we use this paradigm to determine whether there is an optimal stimulation rate for frequency-tagged visual word-selective responses at the group level and if this rate varies across individuals as a function of their reading performance. Written words were periodically embedded (always at 1Hz) in streams of non-words (i.e., pre-lexical discrimination) or pseudo-words (i.e., lexical discrimination) presented at four different stimulation frequencies (4Hz, 6Hz, 10Hz and 20Hz). We also stimulated at 10Hz/2Hz for comparison with the original data (Lochy et al., 2015). 41 adult participants were tested both in EEG-FPVS and with a battery of reading tests.

Across all stimulation frequencies but 20 Hz, which was too fast for detecting meaningful responses, significantly higher amplitude for visual word-selective response were found in pre-lexical than lexical discrimination, replicating previous observations (Lochy et al., 2015). Amplitude and scalp topography differed according to stimulation rate, with the largest response over the left occipito-temporal cortex found at 4Hz/1Hz and at 10Hz/2Hz, two conditions for which responses did not differ in amplitude. For pre-lexical discrimination, responses were more bilateral at 4Hz/1Hz, but amplitude at this frequency only was significantly related with reading speed, i.e., the faster a person reads a word, the larger the amplitude of the word-selective response in lexical discrimination over the left occipitotemporal cortex.
These results suggest that optimal frequencies of stimulation as well as lateralization vary with the type of word-selective response. However, for lexical discrimination, 4Hz (i.e., SOA of 250 ms between items) seems to be the most adapted frequency to lead to a stronger left word-selective response that relates to reading performance.

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Mots-Clés: Lateralization, Reading, Frequency, tagging, Fast periodic visual stimulation, Electroencephalography