Decomposition of the Lambda-wave using EEG and eye-tracking data coregistration

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Abstract

EEG and eye-tracking data coregistration is an interesting experimental technique to continuously assess cognitive processes involved during visual tasks of greater ecological validity. However in those paradigms, saccadic potentials (i.e., presaccadic potential, "spike potential", and l-wave) overlap with the potentials elicited by fixations, producing confounding effects on the components of interest depending on the experimental conditions [Nikolaev et al., 2016].
Several studies have shown that the l-wave was mainly composed of three positive sub-components with different latencies. The first two were saccade onset components. The third which is the most prominent one, was a saccade offset component [Yagi, 1981; Thickbroom, et al., 1991]. These two last components (one onset, one offset) appeared separately for large saccade amplitudes. For amplitudes less than 5○, these components could not be distinguished and were merged into a single potential.

Recent methodological studies on evoked potentials estimation have shown how promising are linear models decomposing the effects of different neural activities during a same temporal window [Bardy et al., 2014; Smith, & Kutas, 2015a, 2015b; Congedo et al., 2016; Kristensen et al., 2017].
150 pictures with six numbered circular targets randomly located, were presented to twenty four participants to sequentially fixe all targets. A large dataset of eye movements with different saccade amplitudes and orientations were recorded with synchronized EEG activities. By using such methodology based on the General Linear Model, the potential at the stimulus onset, the Eye Saccade/Fixation Related Potentials (ESRP/EFRP) were estimated according to the saccade amplitude and orientation. To that end, the two last sub-components of the l-wave have been distinguished whatever the saccade features. Moreover, even the ESRP and EFRP were linearly deconvolved, the offset saccade sub-component was always modulated by the saccade features. This modulation must not be ignored for the interpretation of this early component during visual tasks.

Keywords: Eye Movements, EEG, Coregistration, Lambda wave, General Linear Model

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