Free condition selection is ruled by attention: behavioural and electrocortical evidences

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A new visual search paradigm was imagined to isolate neural correlates of endogenous shifts of attention in free condition selection. Our protocol consisted in trials of three successive phases, free condition selection stimuli (Stim), followed by visuo-spatial (Location) and feature (Feat) abilities reports. Stim consisted in the simultaneous presentation of four comparable arrays in the four corners of a screen, each compounded of two types of geometrical elements. Participants were instructed to select one of the four arrays while maintaining a central fixation point, and press a response key once they had determined the most predominant element in it (reaction times for Stim : RT_{Stim}).Then, the two additional phases took place, in which participants released the visuo-spatial and feature specifications of their choice (RT_{Loc} and RT_{Feat}, respectively).
Continuous electroencephalogram (EEG; 32 channels) of sixteen students was acquired while they performed the task. EEG signal was offline filtered, referenced to common average and epoched in 1000ms segments starting 500ms prior to each stimulus onset. Event-related potentials (ERP) were computed by averaging epochs independently for the three phases of each trial, triggered in function of the lateralized choice in Stim, for the right (RVH) or left visual hemifield (LVH).
The left visual field represents a significant preference (57% of choice), with correspondences in RT_{stim} duration ($RT_{LVH} < RT_{RVH}$). Interestingly, this advantage significantly transferred in both reports, particularly in RT_{feat}. Marked contralateral fronto-central negativity dissociates both electrophysiological patterns of cortical activation relative to left and right choices. These topographical differences take place from 450 to 150 ms prior to the Stim onset, and repeat 150 to 250 ms post-stimulation. Similar distinctions are measured for the two successive phases, associated with posterior lateralized negativities.
Our results reveal that in a free condition selection task, choice is made to optimize behaviour, in this case through the mediation of a left visual hemifield advantage. Electrophysiological correlates of these free hemifield selections match with the description of the anterior directing attention negativity (ADAN). In addition, functional properties of ADAN should be understood in light of the fact that ADAN appears in a recurrent way, as observed in the time-range of 200 ms post-stimulation. Finally, our results provide fruitful predictions concerning new relevant features to optimize brain-computer interface classification of electrophysiological directing-attention markers.