Research Report

Wavelet analysis of the EEG during the neurocognitive evaluation of invalidly cued targets

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\begin{abstract}
In a spatial central cueing paradigm, positions in the horizontal meridian were cued to evaluate the neurocognitive processing of validly (V) and invalidly cued (I) targets. ERPs were obtained from 20 EEG channel recordings. Complex Morlet wavelets were applied for computing event-related spectral power (ERSP) modulations and inter-trial phase coherence (ITC). P3a and P3b responses were increased in a statistically significant manner in I targets with regard to V targets. This increase seems to be generated only by phase resetting without enhancement of spectral power. Comparing ERSP modulations between I and V target trials we found a major effect centred in the alpha range. The following results were obtained for invalid condition in relation to valid condition: 6–12Hz ERSP decrease topographically widespread over the scalp, starting around 450ms and peaking around 650ms; 10–14Hz ERSP increase peaking around 200ms at fronto-central electrodes; and 10–14Hz ERSP decrease occurring from 400 to 600ms at posterior electrodes. Therefore, the invalidity effect indeed produces salient changes in the stimulus related and ongoing neuronal activity leading to a brain state of comparative higher activity both excitatory and inhibitory with respect to the validly cued target processing.
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1. Introduction

In daily life humans continuously monitor actions in order to act according to the environment. In a broad perspective, this “perception–action cycle” has been introduced by Fuster (2003) to highlight the continuous interplay and outcome evaluation between perceptual and executive networks. However, a continuous expectancy bias occurs for certain stimuli and action driving the former perception–action cycle to a preparation–perception–action cycle. The existence of a neural signature indicating the adequacy among preparation, perception and action might help validating the hypothesis of a complete preparation–perception–action cycle.

In the central cue Posner paradigm a central cue can validly (V trials) or invalidly (I trials) indicate the spatial position of the upcoming target. As a consequence of preparation there is a speeded response (benefit) when the spatial position of targets is validly predicted and a delayed response (cost) if the spatial position of the target is invalidly predicted (Posner, 1980). This spatial cueing effect on the attentional sensory processing has also been evaluated by analyzing the modulation of the ERPs to targets which have been validly or invalidly


