Electrophysiological neural correlates of navigational affordances processing during spatial reorientation

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Résumé

Scene perception and path identification are two closely related cognitive processes that are essential for human spatial navigation. Supported by a common cerebral network, they allow us to rapidly process visual information and plan our movements in complex environments. Recently, a scene-selective region (SSR) in the dorsal visual stream, the occipital place area (OPA), has been proposed to be involved in the automatic detection of navigational affordances (*i.e.,* the potential paths in the immediately visible environment), with the corresponding EEG P2 component scaling linearly with the number of visible exits. However, these results were obtained using a passive scene perception paradigm, and possible interactions between scene identification and reorientation processes remain unexplored. To investigate this, thirty young adults performed a desktop-based virtual reality task in which artificial visual scenes were presented with either 1, 2, or 3 visible affordances (*i.e.,* doorways). The first condition was a *scene identification task* in which participants indicated whether the presented image was the same as the previous one, using wall color to discriminate scenes (n-back task). The second condition was a *reorientation task* in which participants had to retrieve the position of a goal (*e.g.,* center, right or left) relative to a previously learned location. EEG signals were recorded, and we computed event-related potentials from occipito-parietal electrodes associated with SSR activity. Reaction time, accuracy, and peak amplitudes of the P1, N1, and P2 components were then analyzed, considering differences between scene identification and reorientation conditions and the influence of the number of available affordances. At the behavioral level, our results showed that the reorientation task was more error-prone and took participants longer to answer. Increasing the number of affordances specifically decreased accuracy in the reorientation task without affecting scene identification. Regarding the EEG results, both tasks elicited a similar general pattern of occipito-parietal activity with P1, N1 and P2 components. However, the amplitude of the P2 component was higher during the reorientation task than during scene identification. Critically, this P2 component was not modulated by the number of affordances in either task. We only reported a scaling of N1 amplitude with the number of affordances, but this effect disappeared after controlling for the position of the doorways. Taken together, these results highlight the intertwined nature of scene perception and spatial navigation systems and the complex role of the SSR in the integration of visuospatial information for reorientation.

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Mots-Clés: Spatial navigation, Scene perception, EEG, ERP, Scene selective regions