Functional facilitation of visual inputs during visual guidance of movements: A visual evoked potential study

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Résumé

Vision is a power source of information for controlling goal-directed arm movements, but the neural processes that enable vision to enhance movement accuracy remains largely unknown. Here we tested whether the visual control of movement is associated with a facilitation of visual inputs compared to a situation where vision has no particular utility. To do so, we compared the cortical visual-evoked potentials (VEPs) in response to flashes (right hemifield) recorded while participants were following the contour of a shape with a pen with those obtained when they were resting. These two conditions (i.e. drawing, resting) were repeated with mirror-reversed vision. This task is known to be achieved more accurately when somatosensory inputs are reduced to indirectly facilitate visual guidance of the movement (Lajoie et al. 1992; Bernier et al. 2009). We employed current source density (CSD) as well as cortical sources (minimum norm) analyses to sharpen the spatial resolution of the EEG recordings (64 electrodes) and to obtain a good estimate of their cortical topography. As the flashes appeared in the right hemifield, we focused our analyses on the VEPs (i.e. amplitude of the N1(80ms)-P1(100ms) and P1(100ms)-N2(130ms)) recorded in the occipital, parietal and temporal regions of the left hemisphere. We predicted that the VEPs would be greater during drawing movements and that a supplementary facilitation of visual inputs would be observed in the condition with mirror-reversed vision. Participants (n=12) were assigned to high performer (HP) or low performer (LP) groups (6 participants per group) according to their performance when drawing with mirror-reversed vision. We found that for both groups, VEPs were generally higher in the drawing than in the resting conditions in occipital, parietal end temporal regions. Moreover, HP showed greater VEPs than LPs in theses areas. However, mirror-reversed vision had no specific effect on VEPs amplitude. In conclusion, our results show that the control of externally-visually driven movements is associated with a facilitation of visual inputs in the cortical areas that are involved i) in "primary" visual perception (occipital areas), ii) in perception, recognition and identification of complex visual stimuli (temporal areas) and iii) in processing relevant visual inputs for action (parietal areas). All together, theses results suggest that the way the brain processes visual information in the different areas is largely context-dependant.

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