Saccades to either visual or tactile targets can be adapted but with an asymmetrical cross-modality transfer

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Résumé

Saccadic adaptation is a plasticity-based mechanism that allows to overcome the effect of fatigue, aging, neuronal and/or neuromuscular lesions on the precision of our saccades. The adaptation of reactive saccades made toward the sudden appearance of stimuli in our environment, is hypothesized to act on the motor command of saccades. As oculomotor command derives from the integration of multisensory information (visual, tactile, auditory) at the level of superior colliculus, we hypothesized that the adaptation of saccades toward targets in one modality (visual or tactile) should transfer to saccades in the other modality. To test this hypothesis we used the double-step target paradigm (Mclaughlin 1967) to adapt, in two separate experiments, rightward 'visual' or 'tactile' saccades made toward targets at different eccentricities on the participants' fingers (LEDs and electrodes generating skin stimulation, respectively). In each experiment the rate of adaptation induced for the trained saccades modality and the percent of adaptation transfer toward saccades of the un-trained modality were compared to those measured in a control session where no adaptation was induced (no double-step). Experiment 1 showed that the adaptation of visual reactive saccades transfers to tactile saccades toward the visually trained fingers (middle and index), furthermore, this adaptation transfer was also observed to untrained saccades made toward the other fingers in both tactile and visual modalities. Experiment 2 demonstrated for the first time that tactile saccades can be adaptable through our modified target double-step paradigm. However, despite the partial generalization of this adaptation to un-trained tactile saccades, there was no transfer of tactile saccades adaptation to visual saccades, contrasting with the visual-to-tactile transfer disclosed in Experiment 1. This asymmetrical transfer of adaptation across the two sensory modalities could be related to tactile saccades in our study being more voluntary than visual saccades or to partially segregated pathways for adaptation of tactile versus visual saccades. In conclusion, this study brings additional evidence for motor functional loci(us) of reactive saccades adaptation. In addition, the finding that tactile saccades can be adapted in the absence of post-saccadic visual feedback supports the hypothesis that a sensory prediction error drives saccadic adaptation.

Mots-Clés: Saccadic adaptation, Crossmodal transfer, Tactile saccades, Visual saccades

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