Tactile double-step at the fingers induces saccadic adaptation without transferring to visual saccades

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Résumé

Saccades are fast eye movements allowing to explore the world around us. While most of our saccades are triggered voluntarily based on our motivations and goals, they also can be driven by the sudden appearance of visual and/or auditory stimuli in our environment as well as of physical touches on our body ('tactile saccades'). Saccadic adaptation is a mechanism relying on cerebral plasticity that maintains the precision of our saccades throughout life. The functional loci(us) of saccadic adaptation as well as the nature of error signal driving this adaptation have been strongly debated, mostly based on studies of the adaptation of visual saccades. In contrast, whether tactile saccades can be adapted and whether this would potentially transfer to visual saccades remains unknown. In this study, we modified the double-step target paradigm (McLaughlin 1967) to try to induce adaptation of rightward saccades toward tactile targets consisting of electro-cutaneous stimulations delivered to the participants' fingers (Middle and Index). We also measured the rate of adaptation transfer to un-trained tactile saccades toward the other fingers (Pinky, Ring, and Thumb) as well as to un-trained visual saccades toward LEDs on the same fingers' locations. To control for unspecific changes in saccade amplitude, all 16 participants also performed a second session where no adaptation was induced (no double-step). The results showed that tactile saccades are adaptable, as reflected by the significant reduction of saccadic gain in double-step target trials as well as by the significant difference of saccadic gain between pre-adaptation and post-adaptation phases (as compared to no change in the control session). In addition, tactile saccades adaptation generalizes to un-trained saccades of different amplitudes in the same modality. Yet, despite this, tactile saccades adaptation did not transfer to visual saccades. These findings demonstrate for the first time that tactile saccades can be adapted and suggest that the adaptation loci(us) involve oculomotor circuits segregated from those underlying visual saccades. Also, concerning the nature of error signals used for adaptation, the existence of tactile saccades adaptation occurring without any post-saccadic visual feedback supports the sensory prediction error hypothesis.

Mots-Clés: Saccadic adaptation, Tactile saccades, Transfer

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