Behavioral and neurophysiological evidence for a tactile-based control of voluntary movements

Marieva Vlachou*[1], Juilette Legros[2], Cécile Sellin[1], Martin Simoneau[3], Laurence Mouchnino[4], and Jean Blouin*[1]

[1]Laboratoire de Neurosciences Cognitives – Aix-Marseille Université - AMU – France
[2]Laboratoire de Neurosciences Cognitives – Aix-Marseille Université - AMU – France
[3]Centre interdisciplinaire de recherche en réadaptation et intégration sociale du CIUSSS de la Capitale-Nationale – Canada
[4]Laboratoire de Neurosciences Cognitives – Aix-Marseille Université - AMU – France

Abstract

The sense of touch does not only provide information about the external environment but also acts as a crucial auxiliary proprioceptive cue. Activation of cutaneous mechanoreceptors enables us to perceive the relative motion between our hand and a surface. Yet, it remains unknown whether tactile feedback contributes to control spatially oriented movements. To assess this, we used an established paradigm during which the performance of a visually-guided motor task is perturbed by conflicting visual and somatosensory inputs. In this context, the greater the weight given to somatosensory input, the worse the tracing performance. We expected an increased sensory conflict due to tactile feedback, resulting in a deteriorated tracing performance. Participants traced the outline of a polygon on a surface with their index finger (Cutaneous group, N=16) while looking both at the polygon and their hand directly (NoConflict) or through an inclined mirror (Conflict). The same tasks were performed by a control group (NoCutaneous group, N=15) wearing a finger splint to reduce tactile stimulation. In line with our hypothesis, tracing accuracy was smaller in the Cutaneous group, implying a greater weight given to somatosensory information. Furthermore, previous EEG studies have revealed an increased gating of somatosensory inputs during the incongruent visuo-proprioceptive condition. This sensory gating was observed only in the Cutaneous group, supporting the argument of tactile interference to the sensory conflict. Collectively, our results provide evidence for a pivotal contribution of cutaneous feedback to motion control and shed new light on the interplay between proprioception and touch in active tasks.

Keywords: Electroencephalography, Tactile, Somatosensory, Sensory conflict, Vision, Sensory gating, Finger movement, Somatosensory cortex

*Speaker