When balance is likely to be threatened, the brain triggers a "sensory vigilance" by facilitating proprioceptive afferent inputs

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Abstract

It has been recently proposed that the transmission of afferent inputs from the periphery to the somatosensory cortex is attenuated during the preparation phase of voluntary movements. However, it appears counterintuitive and dysfunctional to suppress sensory inputs conveying critical somatosensory information to perform a task such as in gait initiation task. Indeed, gait initiation requires information about the standing condition relative to the equilibrium constraints prior to initiate a step (i.e., during movement preparation). In such conition, we hypothesise that sensory attenuation is selectively alleviated. Here we directly tested this hypothesis with 8 subjects by recording cortical somatosensory potentials (SEPs) evoked by lower limb vibration (i.e., proprioceptive inputs) during the preparation phase of a voluntary step movement. In a control condition the subjects were standing still during the vibration. SEPs were significantly larger in the stepping condition than in the static condition. To determine whether this facilitation of proprioceptive inputs was related to step movement preparation per se or to equilibrium constraints, we performed the same experiment with 6 subjects in microgravity (parabolic flights) in order to remove equilibrium constraints. In microgravity, no difference was observed between the SEPs in stepping condition as compared to the static condition. Most likely, the absence of equilibrium constraints in microgravity did not call for a facilitation of proprioceptive inputs. Our observations suggest that the brain exerts a dynamic control over the transmission of the afferent signal (i.e. facilitation) according to their current relevance during movement preparation.

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