

Vestibular contribution to self-awareness

Results:

Information from the vestibular peripheral organs in the inner ear is integrated with several other classes of signals about the body, generated by eyes, muscles and joints. The resulting signals provide a coherent sense of body posture and orientation in surrounding space.

In this project, the vestibular organs of healthy volunteers were stimulated non-invasively. Participants made judgements about sensory stimuli, bodily sensations, and the relation between the body and the environment both under vestibular stimulation, and under control conditions.

Our results revealed that the vestibular system influences bodily self-awareness in at least four ways. First, vestibular inputs influence primary processing of both touch and pain. This influence may involve multisensory regulation of gains in somatosensory cortical processing pathways. Second, vestibular inputs influence higher order somatosensory representation, namely the localisation of somatosensory stimuli onto a map of the body. They do not alter the “body image”, or knowledge about the spatial organisation of the body as a physical object. Third, vestibular inputs are crucial in maintaining the differentiation between the self and the world, particularly in coding the distance between one’s own body and external objects. Finally, vestibular stimulation affects the active relation with the external environment, by adjusting the balance between explorative behaviours, i.e. discovering new possibilities and varying choices, and stereotyped behaviours. Taken together our results confirmed that the vestibular system has a pervasive influence on several interactions between the organism and the environment, and also a constitutive influence on the representation of the body and self.

Published Works:

Ferrè, E. R., Fuentes, C. T., & Haggard, P. When things seem far away: vestibular contributions to egocentric distance perception. Submitted to *Cortex*.

Ferrè, E. R., Bottini, G., Iannetti, G. D., & Haggard, P. (2013). The balance of feelings: Vestibular modulation of bodily sensations. *Cortex*, 49(3), 748-758. doi: 10.1016/j.cortex.2012.01.012

Ferrè, E. R., Day, B. L., Bottini, G., & Haggard, P. (2013). How the vestibular system interacts with somatosensory perception: A sham-controlled study with galvanic vestibular stimulation. *Neuroscience Letters*, 550, 35–40. doi: 10.1016/j.neulet.2013.06.046

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Ferrè, E. R., Vagnoni, E., & Haggard, P. (2013). Vestibular contributions to bodily awareness. *Neuropsychologia*, 51(8), 1445-1452. doi: 10.1016/j.neuropsychologia.2013.04.006

Ferrè, E. R., Bottini, G., & Haggard, P. (2012). Vestibular inputs modulate somatosensory cortical processing. *Brain Structure and Function*, 217(4), 859-864. doi: 10.1007/s00429-012-0404-7

Ferrè, E. R., Vagnoni, E., & Haggard, P. (2012). Galvanic vestibular stimulation influences randomness of number generation. *Experimental Brain Research*, 224(2), 233-241. doi: 10.1007/s00221-012-3302-6

Areas of Interest:

Vestibular system; embodiment; multisensory interactions

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