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Sir,

Recently, Pareés et al. (2014) compared patients with functional (psychogenic) movement disorders and healthy subjects when asked to match a force delivered to their left finger by pressing directly or by operating a joystick to press down on it with the other hand. They observed that healthy subjects generated more force than required when directly pressing on their finger (compared with using the joystick), while patients did not. They interpreted and discussed this result as a loss of sensory attenuation that typically occurs for healthy subjects during self-generated movements and suggested by return, that it illustrates an altered sense of agency for the patients. More specifically, sensory attenuation is generally observed when the intensity of sensation induced by self-generated movements is reduced, like for instance when tickling ourselves (Blackemore et al. 1998). Experimentally, sensory attenuation is classically assessed with force matching paradigms (Shergill et al. 2003).

I am wondering here whether it is possible to assess adequately sensory attenuation (and discuss its role on the sense of agency) using both hands simultaneously in a force matching paradigm. Despite the authors acknowledged that sensory attenuation may be an attentional process by essence, bilateral coordination may indeed introduce some confounding factors in the sense that attentional processes may be distributed differently between the two effectors (e.g. hands/indexes). In consequence, an interpretation in terms of sensory attenuation of the behaviours observed in this kind of tasks could be a byproduct of attention problems.

Bilateral coordination can actually appear quite complex when considering, the involvement of attentional constraints or movement intention (Ohtsuki 1994; Swinnen 2002, Gueugnon et al. 2014). Motor attention, dedicated to the left parietal cortex, can be focused differently on one or the other part of the body (Rushworth et al. 1997). In a bilateral task, Ohtsuki (1983) demonstrated that attention can be symmetrically shared between both effectors or focused asymmetrically. More recently, by using lateralized fatigue to bias the sensory-motor system mainly, we demonstrated in a bilateral isometric matching protocol, that bimanual coordination can be asymmetrically influenced depending on very subtle variations of motor intention (Gueugnon et al. 2014). These variations were comparable or even lower to those observed in the task used by the authors. More precisely, in our study, the isometric and thus static behaviour of the two arms were apparently strictly “equivalent”, however one was the “arm to match” or “leading” one and the other the “matching” arm. It suggested that motor attention or some others cognitive aspects (maybe linked to motor intention) were not

distributed identically and that movements or behaviours were not fully "equivalent" despite similar kinematics features. In other words, motor attention can be shared asymmetrically even when the coordination require static or isometric behaviours. In this vein, considering the joystick condition as a control one may also not be an optimal choice as the level of interference for controlling each hand separately may vary substantially in the two conditions. Manipulating a joystick or using the other index to press on the target index clearly involves different motor attentional foci. Not only can attention be different between the two hands but it can also be different between the two tasks.

Intriguingly, the alien hand syndrome (Goldstein 1908, Uddin 2011) can be observed after lesions of the corpus callosum. Thus, it could be tempting to consider attention sharing, that requires some level of inter-hemispheric transfert, as a factor or an intermediate process involved in the sense of agency. However, there is a need for more straightforward demonstrations and to identify more precisely the causal links between these aspects.

In conclusion, it seems that despite movements or behaviours are "thought" to be equivalent during bilateral tasks they may be not. Some (higher and cognitive) processes may be involved to continuously monitor and compare movements or behaviours performed bilaterally. Bilateral coordination and behavioural measurements may not be optimal to assess sensory attenuation. By contrast, it would be more convincing to directly measure sensory evoked potentials (SEP) to determine the potential re-weighting of somatosensory inputs that should be associated with sensory attenuation during self-generated movement.

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