# Embodied Cognition and the Reality of Body Ownership Illusions

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One explanation of how we keep a coherent sense of self (at least in so far as we are in and own our bodies) is to say that we use the correlation between our conscious intentions and our bodily movements to arrive at the conclusion of body ownership (Tsakiris et al., 2007). That is, if I intend to make an action, and my muscles perform that action and my sensory system tells me that I experience those muscles perform that action, my *inner self* (I will use the term inner self to refer generally to the self-aware, subjective, experiential consciousness that I take to be characteristic of human experience) draws the conclusion that it is located within the sensorimotor apparatus it has just perceived performing that action.

Interestingly, as with other human cognitive processes that rely on assumptions based in perceptual data, the conclusion that you own and are in your body is liable to error. Lenggenhager et al. (2007) have demonstrated the possibility for error in locating your inner self by filming a participant from behind and feeding that video imagery into a virtual reality helmet worn by the participant. In this experimental situation, participants mislocalized their bodies when asked to move to one side and then return to their starting position. Another similar error in body ownership has been demonstrated with the *rubber hand illusion* (Ehrsson, Spence, & Passingham, 2004), where participants are led to believe that they 'own' a rubber hand. To create this illusion, Ehrsson, Spence, and Passingham hid a participant's hands from view, placed a rubber hand close to her body, and then touched both the rubber hand and the participant's hand simultaneously. Following this synchronized touch, participants reported feelings of bodily ownership of the rubber hand.

If we accept that one's sense of body ownership is a conclusion drawn from sensory information, muscle movements and conscious intentions, and that this sense of body ownership

can be produced by either normal sensory information (that places an inner self within its bodily boundaries), or from illusions (that might place an inner self outside of its bodily boundaries), we are left with an open question that is the focus of my paper; is the "illusory" experience Lenggenhager et al.'s (2007) participants had any less real than the constructed experience we have in the ordinary case?

Intuitively, it seems that the answer to this question is that if your sense of body ownership is something like a story you are telling yourself, then it is not "real" even when you are not subject to an illusion in a cognitive neuroscience laboratory. That is, we lack any firm ground to declare that the perceived placement of my inner self within my body is objectively any more correct than the perceived placement of my inner self somewhere outside my body. I argue, however, that if we hold a strong form of embodied cognition, we are provided grounds on which to argue that "illusory" bodily ownership experiences are actually less real than the ordinary experience of body ownership.

Embodied cognition states (generally) that knowledge is grounded and represented in modality-specific systems (Niedenthal, Winkielman, Mondillon, & Vermeulen, 2009). A strong form of embodied cognition would stipulate that our inner selves are wholly dependent on the biological bodies whose systematic functioning produces those inner selves (through a yet inexplicable emergent process); any non-trivial change to one's body would therefore have corresponding cognitive effects on the inner self that emerges from its functioning. Denial of embodied cognition would imply that our inner selves exist independent of the machinery whose systematic functioning produces those inner selves as an emergent process; my inner self would be the same regardless of whether it was the result of the functioning of my neurons, a sophisticated computer, or a large mechanical system.

Holding a strong theory of embodied cognition allows the argument that "illusory" body ownership experiences are less real than those experienced in the normal case by providing a certain importance to the present mechanism of instantiation of our inner selves (i.e. the specific system whose functioning produces an inner self as an emergent process).

In the view of a strong form of embodied cognition, one's inner self exists as it is only when it is instantiated within its particular embodying system because the cognitive elements constituent of one's inner self are grounded in embodied experiences specific to one's bodily characteristics (see Barsalou 1999; Barsalou, 2003). Correspondingly, if one's inner self were to be transferred to a different system (e.g. an advanced computer system), then by virtue of that difference in mechanism of instantiation, one's inner self would change. In essence, my inner self exists as it is only in my present body; if it were possible to transfer my consciousness/inner self to a computer, a robot, or even another human being the strong form of embodied cognition I have outlined would dictate that my consciousness/inner self would change in a non-trivially. As such, the present pairing of my inner self and my body are privileged, in that my inner self would be objectively, if not subjectively, different were I to exist in a body other than my own. For example, if the emotion of 'falling in love' is scaffolded on the physical sensation of falling through a gravitational field, by transferring my inner self to a 'body' that has no need or capacity to perceive falling (e.g. a stationary computer system), it would follow that I would no longer be able to represent and experience 'falling in love' in exactly the same way as I had prior to the switch.

Having made the claim that one's inner self is dependent on the body whose functioning produces it as an emergent process, and the present pairing of an inner self and its body are therefore privileged, I argue that this dependency allows us to make the further claim that when

the inner self perceives itself to be located within its body, as in the ordinary case of our constructed experience, we have grounds for saying that this circumstance is more real than when the inner self perceives itself to be located outside of its body.

It is possible to illusion the inner self into thinking that it is instantiated within a different body than the one whose function is responsible for its existence (e.g. within a rubber hand, a virtual body, the body of an experimenter, see Ehrsson, Spence, & Passingham, 2004; Petkova, & Ehrsson, 2008; Slater, Spanlang, Sanchez-Vives, & Blanke, 2010). The experience of the inner self during that illusion will not be qualitatively different than in the ordinary case. There remains, however, a verifiable statement about whether the inner self is correctly aware of its instantiating system. If the inner self is correctly aware of the body whose systematic functioning is responsible for its existence, that is, if I am correct in my knowledge that I am located within my own body (the ordinary case), I posit that this is experience is then more real than an illusory experience. When the inner self is incorrect and locates itself somewhere other than within the body whose functioning is responsible for its existence (the illusionary case), we can say that this is less real than the ordinary case because the inner self depends on its method physical instantiation (i.e. its body) and therefore to talk of them being separated, or the inner self being located outside of its body, is in some meaningful way incoherent.

Having made acceptance of the theory of embodied cognition an assumption in making my claim that our experience in the ordinary case is more ‘real’ than our experience when subject to a body ownership illusion, I will address the contingency that this assumption is incorrect. If we deny the theory of embodied cognition, it seems we would then be forced to conclude that that the illusory experience Lenggenhager et al.’s (2007) participants had was no less real than the constructed experience we have in the ordinary case. In denying any causal relationship

between the physical machinery whose functioning produces the inner self, we lose any objective grounds on which to say that the perceived sense of body ownership experienced during an illusion is any less real than that perceived in the ordinary case. If it makes no different what biological/physical/electrical process is actually responsible for my inner self, then ‘where’ my inner self perceives itself to be located is arbitrary.

Based on the idea that the sense of being located within a body is a conclusion based on perceptual data, I have argued that there are grounds to say that our ordinary experience (which places us within our bodies) is more real than so-called illusory experiences (which might place us outside of our bodies). I made this argument from an embodied cognition standpoint, claiming that if our inner selves depend on our bodies, then correctly believing that your inner self is located within your body should be rated as more real than the belief it is located somewhere outside your body.

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