The Experimental Induction of Out-of-Body Experiences

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An out-of-body experience (OBE) has been defined as the experience in which a person who is awake sees his or her body from a location outside the physical body (*1*, *2*). OBEs have been reported in clinical conditions that disturb normal brain functioning, such as strokes, partial epileptic seizures, and drug abuse (*1*–*4*). Here, I report that this illusory experience can be induced in healthy participants. I report a perceptual illusion in which individuals experience that their center of awareness, or "self," is located outside their physical bodies and that they look at their bodies from the perspective of another person. This illusion demonstrates that the sense of being localized within the physical body can be fully determined by perceptual processes, that is, by the visual perspective in conjunction with multisensory stimulation on the body.

In the first experiment, participants sat on a chair, wearing a pair of head-mounted displays that were connected to two video cameras placed side by side 2 m behind the participant's back (Fig. 1A). The images from the left video camera were presented on the left eye display and the images from the right camera on the right display. Thus, the person would see his or her back with the perspective of a person sitting behind him or her with stereoscopic vision. The experimenter stood just beside the participant (in their view) and used two plastic rods to touch simultaneously the person's actual chest, which was out of view, and the chest of the "illusory body," by moving one rod toward a location just below the cameras in view (*5*).

After 2 min of stimulation, the participants were asked to complete a questionnaire on which they had to affirm or deny 10 possible perceptual effects with a seven-point visual analog scale. Three statements were designed to capture the experience of the illusion, and the other seven served as controls for suggestibility and task compliance (SOM text). The participants affirmed illusion statements and denied the controls, and the difference in ratings was significant [$P < 0.0001$, $F(1, 170) = 189.92$, $P < 0.00001$ (fig. S1 and SOM text)]. Thus, the participants reported the experience of sitting behind their physical bodies and looking at them from this location.

I hypothesized that the illusion is caused by the first-person visual perspective in combination with the correlated visual and tactile information from the body. To test this and to provide objective evidence for the illusion, I registered the skin-conductance response (SCR) as a measure of the emotional response when the illusory body was "hurt" by hitting it with hammer after a period of stimulation (SOM text). I compared the illusion condition (with synchronous touches) to an asynchronous condition in which the person's real and illusory chests were touched alternatingly. I observed significantly greater threat-evoked SCRs after the illusion condition ($P < 0.013$; paired t test) (Fig. 1B and SOM text) and stronger ratings of the illusion ($P < 0.05$; paired t test) (SOM text). A control experiment was conducted to rule out that the SCR difference was due to a conditioned response after a period of synchronously presented stimuli (SOM text, experiment 3). The observed SCR difference provides objective evidence that the participants were emotionally responding as if they were located behind their physical bodies.

The present illusion is fundamentally important because it informs us about the perceptual processes that underlie the sense of being located inside the body. There are two key components to this process. First, visual information from the first-person perspective provides indirect information about the location of one's own body in the environment (*6*). The first-person visual information also updates the proprioceptive representations and defines the origo of the body-centered reference frames that are used to represent near-personal space (*7*, *8*). The second key factor is the detection of correlated tactile and visual events on the (illusory) body. Multisensory correlations are known to be important for self-attribution of single body parts in near-personal space (*9*, *10*). Thus, these correlations, in conjunction with the first-person visual perspective, are sufficient to determine the perceived location of one's own whole body. This finding represents a fundamental advance because the natural "in-body experience" forms the foundation for self-consciousness.

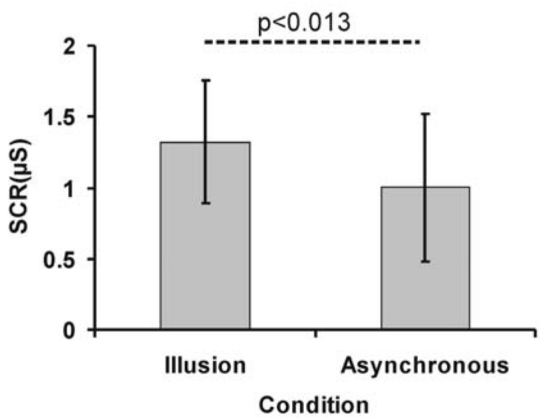

Fig. 1. (**A**) The setup used to induce the out-of-body illusion. (**B**) The SCRs from the 12 participants when the illusory body was "hurt." Mean values and standard deviations (error bars) are presented.

References and Notes

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Materials and Methods
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References

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