Mould Your Body Schema

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Hack #63

Mould Your Body Schema

Your body image is mutable within only a few minutes of judicious—and misleading—visual feedback.

Our brains are constantly updated with information about the position of our bodies. Rather than relying entirely on one form of sensory feedback, our bodies use both visual and tactile feedback in concert to allow us to work out where, our limbs are likely to be at any one moment. *Proprioception* - generated by sensory receptors located in our joints and muscles that feed back information on muscle stretch and joint position - is another sense that is specifically concerned with body position.

The brain combines all this information to provide a unified impression of body position and shape known as the *body schema*. Nevertheless, by supplying conflicting sensory feedback during movement, we can confuse our body schema and break apart the unified impression.

In Action
Find a mirror big enough so you can stand it on its edge, perpendicular to your body, with the mirrored side facing left. Put your arms at your sides (you'll probably need a friend to hold the mirror). This whole setup is shown in Figure 6-2. Look sideways into the mirror so you can see both your

left hand and its reflection in the mirror, so that it appears at first blush to be your hidden right hand. While keeping your wrists still and looking into the mirror, waggle your fingers and move both your hands in synchrony for about 30 seconds. After 30 seconds, keep your left hand moving but stop your right. You should sense a momentary feeling of “strangeness,” as if disconnected from your right hand. It looks as if it is moving yet feels as if it has stopped.

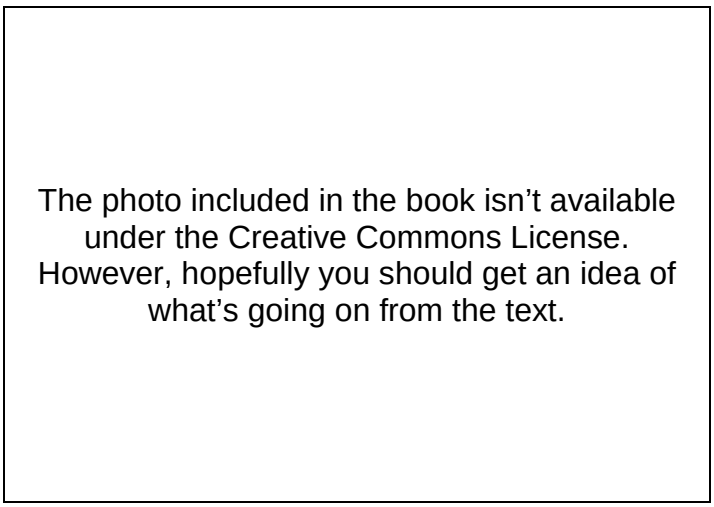

Figure 6-2. Matt confuses his body schema using a mirror and curtain rail (being in dire need of a haircut isn’t essential for the experiment).

One easy way of moving your hands together is to run a curtain rail under the mirror, if you have one handy, and place each hand on a curtain ring (this is what we’re doing in Figure 6-2). Move your hands toward and away from the mirror for 30 seconds, until your brain has confused your right hand and your reflected left hand in the mirror - then release the curtain ring from your right hand. You can feel the ring has gone, but in the mirror it looks as though you’re still holding it. To me, the disconnect felt like pins and needles, all through my right hand.

Alternatively, you can manipulate your body schema into incorporating a table as part of yourself [2]. Sit at a table with a friend at your side. Put one hand on your knee, out of sight under the table. Your friend's job is to tap, touch, and stoke your hidden hand and—with identical movements using her other hand—to tap the top of the table directly above. Do this for a couple of minutes. It helps if you concentrate on the table where your friend is touching, and it's important you don't get hints of how your friend is touching your hidden hand. The more irregular the pattern and the better synchronized the movements on your hand and on the table, the greater the chance this will work for you. About 50% of people begin to feel as if the tapping sensation is arising from the table, where they can see the tapping happening before their very eyes. If you're lucky, the simultaneous touching and visual input have led the table to be incorporated into your body image.

How It Works

These techniques provide conflicting touch and visual feedback, making it difficult to maintain a consistent impression of exactly where body parts are located in space. They're similar to the crossed hands illusion ("Keep Hold of Yourself" [Hack #62]), in which twisting your hands generates visual feedback contradictory to your body schema. In the crossed hands illusion, this leads to movement errors, and in the preceding techniques leads to the sense of being momentarily disconnected from our own movements.

Some of our best information on the body schema has been from patients who have had limbs amputated. More than 90% of amputees report an experience of a "phantom limb": they still experience sensations (sometimes pain) from an amputated body part. This suggests that the brain represents some aspects of body position and sensation as an internal model that does not entirely depend on sensory feedback. Further evidence is provided by a rare disorder called *autotopagnosia*: despite the patients having intact limbs, brain injury (particularly to the left parietal lobe "Tour the Cortex and the Four Lobes" [Hack #8]) causes a loss of spatial knowledge about the body so severe that they are unable to even point to a body part when asked.

These disorders suggest that the brain's system for representing body schema can operate (and be damaged) independently from the sensory feedback provided by the body itself. Sensory feedback must play a role of course, and it seems that it is used to update and correct the model to keep it in check with reality. In some situations, like the ones in the previous exercises, one type of sensory feedback can become out of sync with the others, leading to the experience of mild confusion of the body schema.

Ramachandran and Rogers-Ramachandran applied an understanding of the relationship between sensory feedback and the body schema to create a novel method to help people with phantom limb pain [1]. They used a mirror to allow people who were experiencing a phantom limb to simulate visual experience of their amputated hand. In the same way as the earlier exercise, the image of their amputated hand was simply a reflection of their remaining hand, but this simulated feedback provided enough information to the brain so they felt as if they could control and move their phantom limb. In some cases, they were able to "move" their limb out of positions that had been causing them real pain.

An fMRI ("Functional Magnetic Resonance Imaging: the State of the Art" [Hack #4]) study by Donna Lloyd and colleagues [3] might explain why visual feedback of body position might have such a dramatic effect. They scanned people while they were receiving tactile stimulation to the right hand, either while they had their eyes closed or while they were looking directly at their hand. When participants had the opportunity to view where they were being stimulated, activation shifted dramatically, not only to the parietal area, known to be involved in representing the body schema, but also to the premotor area, a part of the brain involved in planning and executing movements. This may also explain why the earlier exercises confuse our body schema enough to make accurate movement seem difficult or feel unusual. Visual information from viewing our body seems to activate brain areas involved in planning our next move.

See Also

1. Ramachandran, V. S., & Rogers-Ramachandran, D. (1996). Synaesthesia in phantom limbs induced with mirrors. Proceedings of the Royal Society of London. Series B. Biological sciences, 263 (1369), 377–386.

2. Ramachandran, V. S., & Blakeslee, S. (1998). *Phantoms in the Brain: Human Nature and the Architecture of the Mind*. London: Fourth Estate.

3. Lloyd, D. M., Shore, D. I., Spence, C., & Calvert, G. A. (2002). Multisensory representation of limb position in human premotor cortex. *Nature Neuroscience*, 6 (1), 17–18.

4. Tool use extends the body schema with its reach, altering the map the brain keeps of our own body: Maravita, A., & Iriki, A. (2004). Tools for the body (schema). *Trends in Cognitive Sciences*, 8 (2), 79–86.

—Vaughan Bell