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Homuncular Flexibility

The homunculus is an approximate mapping of the human body in the cortex. It is often visualized as a distorted human body stretched along the top of the human brain. The tongue, thumbs, and other body parts with extra-rich brain connections are enlarged in the homunculus, giving it a vaguely obscene, impish character.

Long ago, in the 1980s, my colleagues and I at VPL Research built virtual worlds in which more than one person at a time could be present. People in a shared virtual world must be able to see each other, as well as use their bodies together, as when two people lift a large virtual object or ride a tandem virtual bicycle. None of this would be possible without virtual bodies.

It was a self-evident and inviting challenge to attempt to create the most accurate possible bodies, given the crude state of the technology at the time. To do this, we developed full body suits covered in sensors. A measurement made on the body of someone wearing one of these suits, such as an aspect of the flex of a wrist, would be applied to control a corresponding change in a virtual body. Before long, people were dancing and otherwise goofing around in virtual reality.

Of course there were bugs. I distinctly remember a wonderful bug that caused my hand to become enormous, like a web of flying skyscrapers. As is often the case, this accident led to an interesting discovery.

It turned out that people could quickly learn to inhabit strange and different bodies and still interact with the virtual world. I became curious how weird the body could get before the mind would become disoriented. I played around with elongated limb segments, and strange limb placement. The most curious experiment involved a virtual lobster (which was lovingly modeled by Ann Lasko.) A lobster has a trio of little midriff arms on each side of its body. If physical human bodies sprouted corresponding limbs, we would have measured them with an appropriate body suit and that would have been that.

I assume it will not come as a surprise to the reader that the human body does not include these little arms, so the question arose of how to control them. The answer was to extract a little influence from each of many parts of the physical body and merge these data streams into a single control signal for a given joint in the extra lobster limbs. A touch of human elbow twist, a dash of human knee flex; a dozen such movements might be mixed to control the middle join of little left limb #3. The result was that the principle elbows and knees could still control their virtual counterparts roughly as before, while still contributing to the control of additional limbs.

Yes, it turns out people can learn to control bodies with extra limbs!

The biologist Jim Bower, when considering this phenomenon, commented that the human nervous system evolved through all the creatures that preceded us in our long evolutionary line, which included some pretty strange creatures, if you go back far enough. Why wouldn't we retain some homuncular flexibility with a pedigree like that?

The original experiments of the 1980s were not carried out formally, but recently it has become possible to explore the phenomenon in a far more rigorous way. Jeremy Bailenson at Stanford has created a marvelous new lab for studying multiple human subjects in high-definition shared virtual worlds, and we are now planning to repeat, improve, and extend these experiments. The most interesting questions still concern the limits to homuncular flexibility. We are only beginning the project of mapping how far it can go.

Why is homuncular flexibility a dangerous idea? Because the more flexible the human brain turns out to be when it comes to adapting to weirdness, the weirder a ride it will be able to keep up with as technology changes in the coming decades and centuries.

Will kids in the future grow up with the experience of living in four spatial dimensions as well as three? That would be a world with a fun elementary school math curriculum! If you're most interested in raw accumulation of technological power, then you might be not find this so interesting, but if you think in terms of how human experience can change, then this is the most fascinating stuff there is.

Homuncular flexibility isn't the only source of hints about how weird human experience might get in the future. There also questions related to language, memory, and other aspects of cognition, as well as hypothetical prospects for engineering changes in the brain. But in this one area, there's an indication of high weirdness to come, and I find that prospect dangerous, but in a beautiful and seductive way. "Thrilling" might be a better word.