Brains of one-handed people suggest new organization theory

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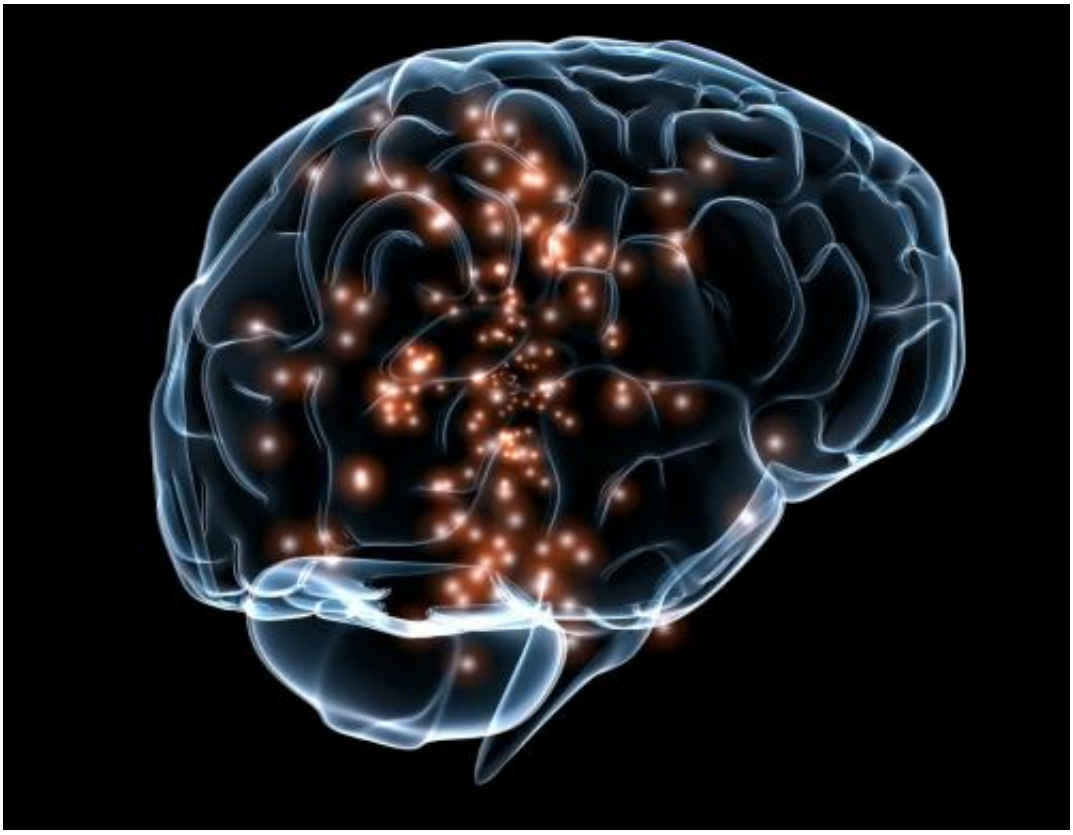

Credit: Wikimedia Commons

In people born with one hand, the brain region that would normally light up with that missing hand's activity lights up instead with the activity of other body parts—including the arm, foot, and mouth—that fill in for the hand's lost function. Now, researchers reporting in *Current Biology*

on April 20 say that the discovery could shake up scientists' fundamental understanding of how the brain is organized.

"Scientifically, I think one way to put our results in context is to say, what if the hand area is not the hand area per se, but just the part of the brain in charge of function 'normally' carried by that hand?" says Tamar Makin of University College London, United Kingdom.

"In intact participants, all this is carried by the non-dominant hand," she continues. "But the fact that we see such a striking different representation in that area in congenital one-handers might suggest that this is not actually the hand area. If true, this means we've been misinterpreting brain organization based on body part, rather than based on function. It's kind of mind blowing for me to think we could have been getting this wrong for so long. The implications, if this interpretation is correct, are massive."

But, she cautions, it's still just a working theory at this point.

Scientists have long known that different parts of the brain control different body parts. In the new study, Makin and her colleagues, including Avital Hahamy at Israel's Weizmann Institute of Science, set out to explore what happens to brain organization in people for whom a body part never existed.

The researchers studied 17 people who lacked a hand from birth along with 24 matched, two-handed controls. Each participant was video recorded while completing five everyday tasks, such as wrapping a present or handling money, to see how he or she went about it. Participants were also asked to move various parts of their bodies while their brains were scanned using functional MRI (fMRI).

"We found that the traditional hand area"—which, Makin notes, takes up

a rather sizable portion of the brain—"gets used up by a multitude of body parts in congenital one-handers. Interestingly, these body parts that get to benefit from increased representation in the freed-up brain territory are those used by the one-handers in daily life to substitute for their missing-hand function—say when having to open a bottle of water."

Whether Makin's theory on brain organization corresponding to function instead of body parts pans out or not, the findings reveal remarkable brain plasticity. Her hope is to find a way to encourage the brain to represent and control artificial body parts, such as a prosthetic arm, using the brain area that would have controlled the missing hand.

"If we, as neuroscientists, could harness this process, we could provide a really powerful tool to better healthcare and society," Makin says. "Unfortunately, this process is currently quite restricted in the brains of adults. But by learning how this occurs spontaneously in one-handers, we can get a handle on what we might be able to achieve."

More information: *Current Biology*, Hahamy et al.: "Representation of multiple body parts in the missing-hand territory of congenital one-handers" www.cell.com/current-biology/f … 0960-9822(17)30352-4 , DOI: 10.1016/j.cub.2017.03.053

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