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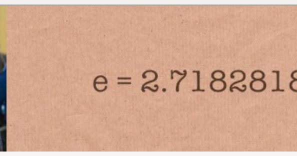

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Implants Can Overcome Spinal Injury in Monkeys. Are Humans Next?

Why neurological chips in humans are a long way off — if ever.

By Eric Tegler Nov 18, 2016

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Grégoire Courtine holds a silicon model of a primate's brain and a brain implant. The brain-spine interface uses a microelectrode array like this one to detect spiking activity of the brain's motor cortex.

Alain Herzog / EPFL

Last week Swiss researchers announced something amazing—they'd successfully made partially paralyzed monkeys walk again. With a wireless brain implant and a dizzying amount of technical coordination, these monkeys were able to overcome a lower spine injury only a week or two after the surgery.

These kinds of stunning results have become almost commonplace in the past several years, as scientists have used brain-machine interfaces to send commands from the brain. Yet perhaps using this technology to make humans walk again remains many years off. But why?

BRAIN AND MACHINE

The field of brain-computer interfaces—where your thoughts are detected and understood by a sensor attached to a computer—has been around since the early 2000s. Four years ago, using a similar technique, scientists at Northwestern University in Chicago successfully bypassed a damaged region of the spinal cord, restoring motor arm control to a rhesus monkey.

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Daofen Chen, program director of systems neuroscience at NIH, told Popular Mechanics that there are two areas where this experiment breaks new ground: the monkeys' amazing coordination and precise muscle mapping.

"The paralyzed hind leg has to be stimulated and participate with the other three legs in a coordinated way, says Chen. "You need to stimulate [the muscle] at the right time." That sophisticated coordination is at the center of this project, Chen says.

But that improved coordination only works once you've accurately located the right muscles to stimulate. "They systematically mapped the muscle they want to function," Chen says. "It's no longer the old way of blasting signals into the spinal cord. It's a discreet activation pattern of relevant motor-neuron pools."

While the Swiss team proved the concept by restoring some mobility to the monkeys, Chen cautions that this research is just the beginning. "In order to know where to precisely place electrodes in humans, we need fundamental research on appropriate location of specific muscle activation," Chen says.

A brain implant and a silicon model of a primate brain.

Alain Herzog / EFPL

ENABLERS, OR SOLUTIONS?

These human-meets-machine innovations come with inherent limitations. While computer interfaces can read and decode human thought, they cannot inject that thought into a brain. That's important because movement isn't a one-way street with the brain telling the limbs and extremities what to do—it requires feedback from the body to the brain. At best, such interfaces can only artificially stimulate a specific part of the brain's motor cortex in order to *simulate* control.

So making this concept work in humans is far more difficult. Human bipedal locomotion requires more than coordinating impulses to extend and bend the leg at the right time. Two-legged humans also balance effortlessly, change direction, and navigate obstacles by a combination of brain and spine commands that we have yet to decode. And as another piece of brain-spine [research published in Nature] points out, we'll need better processing as the success rate in humans remains unclear.

But we shouldn't confine ourselves to think as these advancements as "device-based magic," says Chen. "We should think of wireless brain-spine interface devices as enablers," he says, rather than the solution itself. Electrical stimulation of limbs via external computer interfaces for the purpose of rebuilding brain-spine motor neuron "circuits" has been studied in partially paralyzed stroke patients, a technique informally called [robotic therapy]. The basic idea is to use repetitive stimulation to induce brain plasticity or relearning of lost motor function.

Jocelyne Bloch, the EPFL neurosurgeon behind this project, is already leading a clinical study that evaluates using spinal cord stimulation for therapy—no invasive brain implant required. If successful, stimulation could soon improve the mobility of thousands and thousands of people suffering from lower spinal cord injuries.

So the age of the android isn't quite upon us just yet. In fact, it may never be. But thanks to the sacrifices of our primate cousins, we get to remain more human than humanoid.

"We still have a lot to do," Chen says, "but this step is significant and raises a lot of hope."

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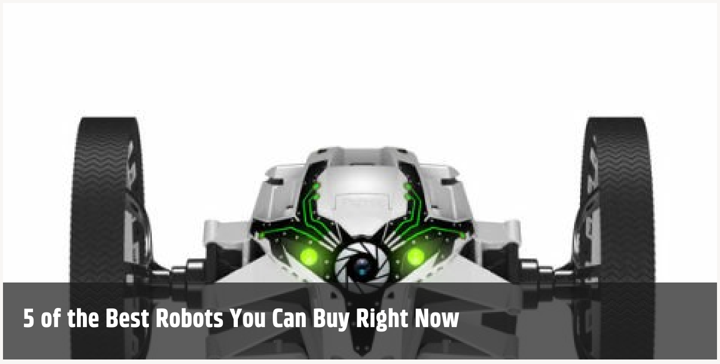
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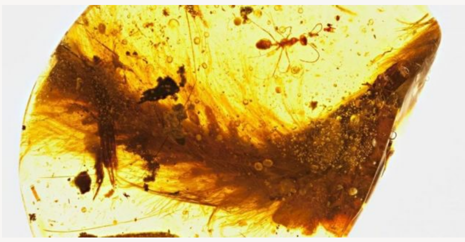
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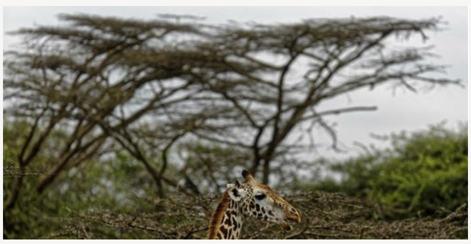
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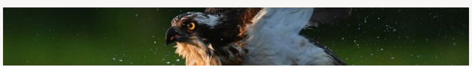

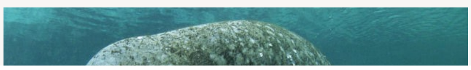

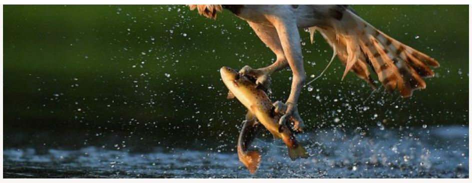

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