

Intercontinental mind-meld unites two rats

But critics are sceptical about predicted organic computer.

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The brains of two rats on different continents have been made to act in tandem. When the first, in Brazil, uses its whiskers to choose between two stimuli, an implant records its brain activity and signals to a similar device in the brain of a rat in the United States. The US rat then usually makes the same choice on the same task.

Miguel Nicolelis, a neuroscientist at Duke University in Durham, North Carolina, says that this system allows one rat to use the senses of another, incorporating information from its far-away partner into its own representation of the world. "It's not telepathy. It's not the Borg," he says. "But we created a new central nervous system made of two brains."

Nicolelis says that the work, published today in *Scientific Reports*¹, is the first step towards constructing an organic computer that uses networks of linked animal brains to solve tasks. But other scientists who work on neural implants are sceptical. Lee Miller, a physiologist at Northwestern University in Evanston, Illinois, says that Nicolelis's team has made many important contributions to neural interfaces, but the current paper could be mistaken for a "poor Hollywood science-fiction script". He adds, "It is not clear to what end the effort is really being made."

Animal engineering

In earlier work², Nicolelis's team developed implants that can send and receive signals from the brain, allowing monkeys to control robotic or virtual arms and get a sense of touch in return. This time, Nicolelis wanted to see whether he could use these implants to couple the brains of two separate animals.

His colleague Miguel Pais-Vieira started by training one rat — the encoder — to press one of two levers, as indicated by a light. An implant recorded neural activity in the rat's motor cortex (the area that controls its movements), compared it to earlier recordings, and converted it into a simpler signal: a single pulse representing one lever, or a train of them representing the other.

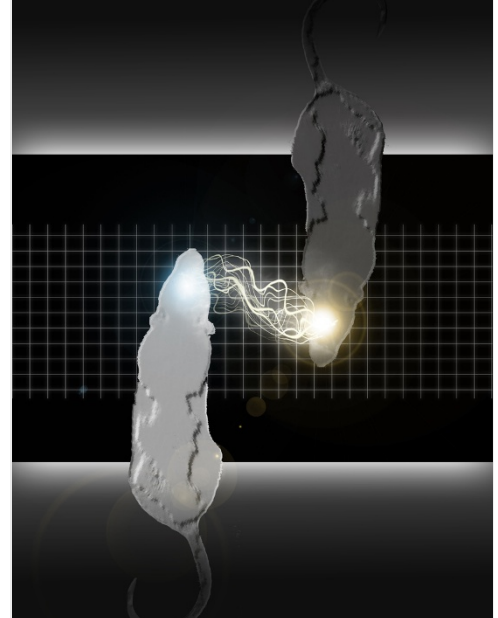
These pulses were delivered to the motor cortex of a second rat in the same lab — the decoder — which reacted by pressing its own levers. If it chose the right one, both rats got a reward. This happened 64% of the time — a low rate of success, but significantly greater than chance (see [video](#)).

The rats achieved a similar accuracy at another task in which they had to judge different stimuli with their whiskers, and implants linked their somatosensory cortices, the regions involved in touch. This link worked even when one rat was in Natal, Brazil, and the other in the Duke lab.

But Andrew Schwartz, a neurobiologist at the University of Pittsburgh in Pennsylvania, notes that the decoders performed poorly, even though they had to solve only a basic task with just two choices. "Although this may sound like 'mental telemetry', it was a very simple demonstration of binary detection and binary decision-making," he says. "To be of real interest, some sort of continuous spectrum of values should be decoded, transmitted and received."

Better, stronger, faster

Nicolelis argues that even in this simple task, the rats showed some interesting emergent behaviours. Because the encoder always got an extra reward if the decoder chose correctly, it started making movements that were cleaner, smoother and faster than at the beginning. That increased the signal-to-noise ratio in its brain activity and inadvertently provided the decoder with signals that were



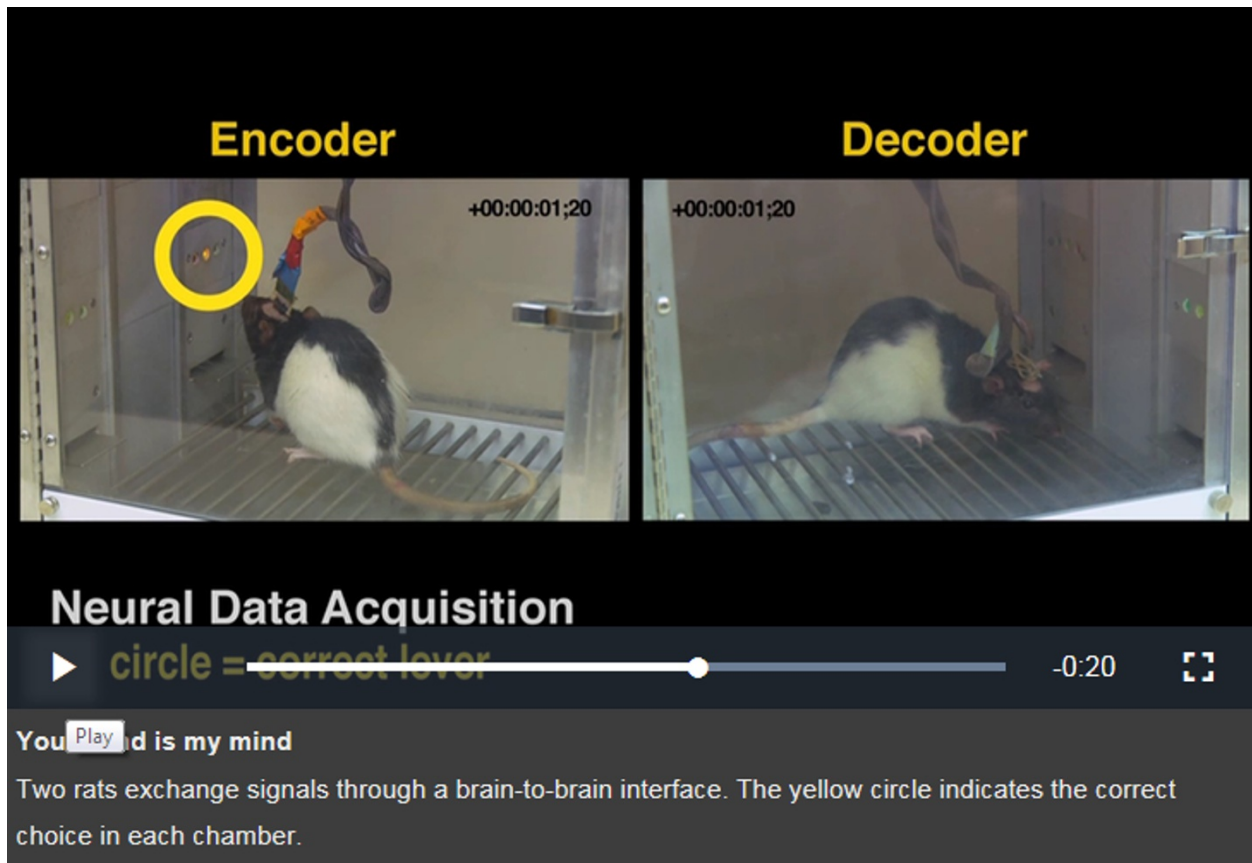
Katie Zhuang, Laboratory of Dr. Miguel Nicolelis/Duke University

Two rats were wired up together (here in an artist's impression) so that one would make decisions using sensory cues from the other.

easier to decipher.

Such interfaces have many applications, says Nicolelis, from creating organic computers to uniting different parts of the same brain that have been cut off by damage or disease. But Sliman Bensmaia, a neuroscientist from the University of Chicago in Illinois, says that if the goal is to make better neural prosthetics, “the design seems convoluted and irrelevant”. And if it is to build a computer, “the proposition is speculative and the evidence underwhelming”.

Nicolelis is undeterred: his team is already working to link the brains of four mice. The researchers are also set to start similar experiments with monkeys, in which paired individuals control virtual avatars and combine their brain activity to play a game together. “Rats don’t have a sense of self so it’s hard to say what the effect on the animals are,” he says, “but monkeys can collaborate in a much more complex way.”



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References

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2. O'Doherty, J. E. *et al. Nature* **479**, 228–231 (2011).