Mind-blowing Advance? Direct Brain-to-Brain Communication Between Humans Demonstrated

By Emily Waltz
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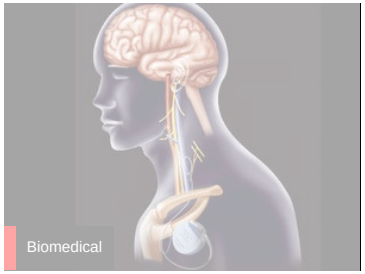
Starlab Barcelona

In an experiment that one rival scientist dubbed a "stunt," Spanish researchers claim to be the first to have demonstrated direct brain-to-brain communication between humans. The researchers, led by Giulio Ruffini, CEO of Starlab in Barcelona, successfully transmitted the words "hola" and "ciao" in binary code from the brain of a person in India to the brains of three people in France. Electroencephalography (EEG), which monitors electric currents in the brain, was used to record the information from the sender's brain, and robotized transcranial magnetic stimulation (TMS), which causes neurons to fire from an electric current that is generated by a rapidly changing magnetic field, was used to deliver the message to the brains of the receivers in France.



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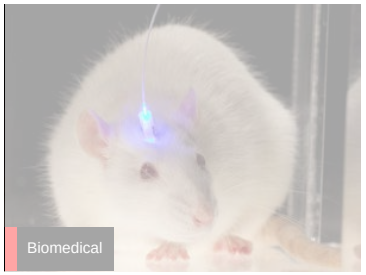

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Researchers have for years been developing noninvasive systems for translating information directly from the human brain to the computer. These systems, called brain-computer interface, often involve brain activity-sensing tools such as EEG, functional near-infrared spectroscopy (fNIRS), and functional magnetic resonance imagine (fMRI). Researchers have also, to a lesser extent, experimented with translating information from the computer to the brain, using brain stimulating tools such as TMS — variations of which have also been used to treat depression — and transcranial focused ultrasound (FUS), which has been used to link the brains of rats.

The Starlab experiment integrates two of these existing technologies to move a message from human brain to computer to human brain. The experiment was set up like this: While hooked up to an EEG device the sender was asked to imagine moving his hands or feet when shown an image that represented a 1 or 0, respectively. The EEG data was transmitted to the computer, translated into binary code, and emailed to the system at the recipients' end. The recipients, blindfolded, received electric pulses from the robotized TMS system in the visual cortex of their brains. That triggered the experience of phosphenes: the perception of seeing flashes of light that are not actually there. The recipients reported verbally when they experienced a flash, and this was translated into binary code and then to the message. It's super slow — the equivalent of telepathic Morse code. Still, the message was delivered.

The authors published the experiment in *PLoS On*e, describing it as "the first human brain-to-brain interface." Ruffini at Starlab said the work stemmed from his company's involvement in a four-year collaborative project funded by the European Commission to develop noninvasive brain stimulation technologies. The paper was "a way to show that our technologies work," said Ruffini in a phone interview.

It's a fun experiment, and it's exciting to think about potential (but far-fetched) applications, like soldiers with high-tech helmets communicating silently behind enemy lines. But some researchers not involved with the experiment say the paper doesn't really present a "first" and smacks of publicity grubbing. It's "pretty much a stunt I think as it's all been shown before," said Christopher James, a professor of biomedical engineering at the University of Warwick in the UK, in an email to *IEEE Spectrum*.

A group at the University of Washington in Seattle led by Rajesh Rao last year demonstrated in an unpublished pilot study a very similar experiment involving EEG on the brain-to-computer end of the experiment and TMS on the computer-to-brain end. In that study, the researchers stimulated the motor cortex of the brain, causing the message receiver's hand to move subconsciously to strike a keyboard. The university declared it "the first noninvasive human-to-human brain interface." That was in August 2013. Rao told *IEEE Spectrum* he was "surprised and disappointed" that his experiment wasn't acknowledged in some way in Ruffini's paper.

Ruffini says he had seen Rao's experiment before publication of his, but that

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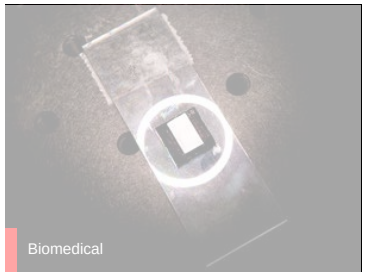

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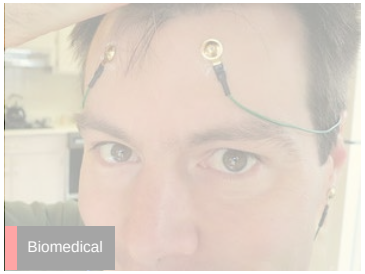

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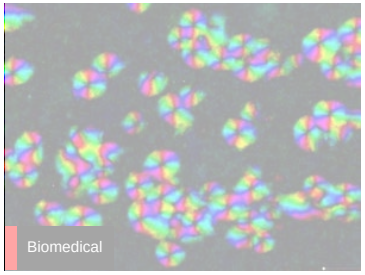

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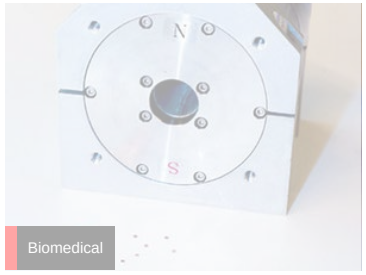

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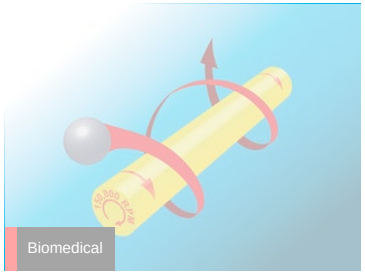

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since it was unpublished "there was no paper to refer to." And he maintains that his paper was no stunt. "I believe such comments stem from not having read carefully the paper and missing the point," he says. Ruffini's experiment adds to scientific literature because unlike previous work, including Rao's, he stimulated the visual cortex, bypassing all peripheral nervous system involvement, and resulting in a conscious, rather than subconscious, brain-to-brain communication, Ruffini says. Rao's experiment "is interesting work. But I don't think's it's really brain-to-brain," he says.

Future experiments will no doubt help us define what "brain-to-brain interface" really means. In the meantime, we'll have to squabble over the few experiments under our belts.

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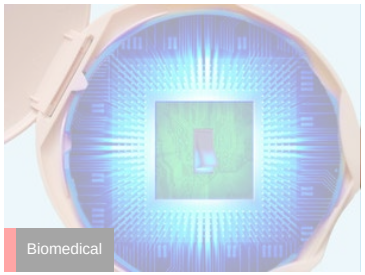

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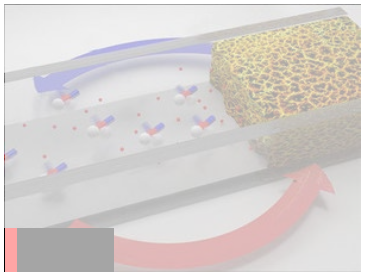

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