Brainiacs

As video games go, it was pretty lame. The player, Rajesh Rao, had to shoot down slow-moving missiles launched by pirate ships. He hit 83 percent of them—not bad, but hardly anything to brag about.

Still, his performance may go down in history.

It wasn't his score that was so impressive; it was his technique. Rajesh shot down the missiles simply by thinking. A colleague, Andrea Stocco, pulled the actual trigger. And, no, the two players weren't talking to or texting each other. Rajesh didn't say a word or make any visible gestures. Even if he had, Andea wouldn't have known. He was a mile away in an insulated chamber where he couldn't see or hear anything.

The two gamers pulled off their feat because their brains were linked. When Rajesh thought, "Fire!" Andrea's hand—a mile away—clicked the trigger.

The score's looking more impressive now, isn't it?

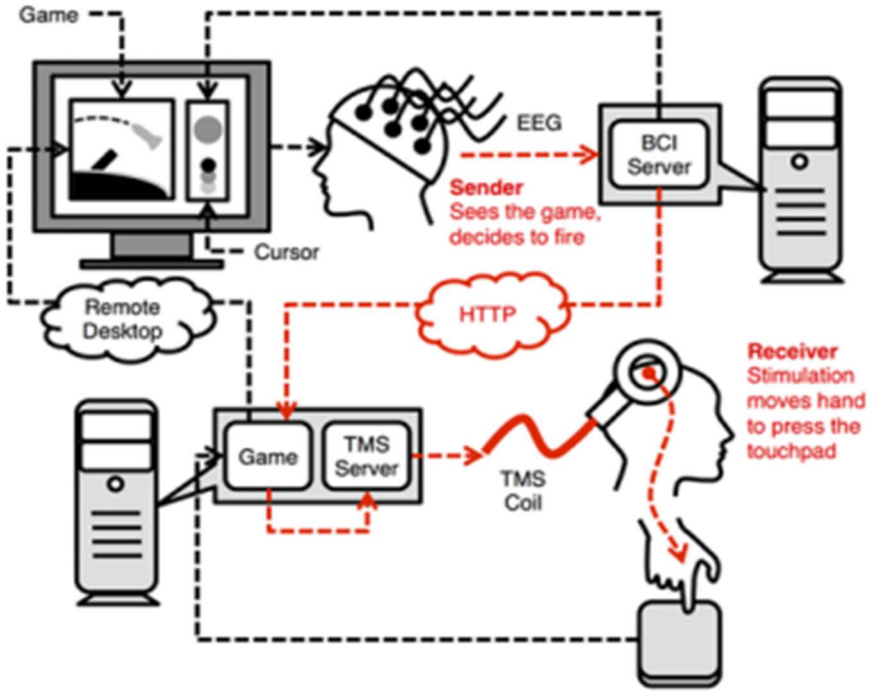
The video game was part of a cutting-edge research project at the University of Washington. It established the first brain-to-brain interface in humans. In other words, the players' brains communicated directly with each other. No need to put the instructions into words or bother speaking to each other.

Instead, the researchers sent Rajesh's brain signals—his "fire" command—directly to Andrea's brain, which signaled his hand to hit the trigger. Andrea, isolated in another building, couldn't even see the video game screen.

It took some sophisticated tech to establish the direct brain-to-brain interface. The researchers picked up Rajesh's "fire" command using electroencephalography (EEG), a method that records a brain's electrical activity using external sensors placed along the scalp. A computer understood the command (no small feat) and transmitted it over the internet to another computer.

The second computer then triggered short electromagnetic pulses—a technique known as transcranial magnetic stimulation (TMS)—to deliver an equivalent "fire" command to Andrea's

Not a very challenging video game? It is if you must use your thoughts to command a partner's hand to fire. Photo: © 2014 Rao et al. Used under a Creative Commons license.



In the University of Washington experiment, two gamers cooperatively played a video game through a direct brain-to-brain interface. Eelectroencephalography (EEG) and transcranial magnetic stimulation (TMS) helped their brains communicate directly without word or gestures. Photo: © 2014 Rao et al. Used under a Creative Commons license.

brain, making him perform the hand movement Rajesh intended. (And, no, the TMS didn't hurt.)

Though the video game experiment was a pretty basic cooperative task, direct brain-to-brain interface ultimately could revolutionize human communication, the researchers say. It could free us from having to find words and symbols to communicate with each other. It could unlock knowledge buried deeply in our brains, below the level of our conscious minds.

Take the example of a master violinist. Her technique—wired into her unconscious brain from years of study and practice—becomes “second nature,” something she can't put into words. But brain-to-brain interface could allow it to be transferred directly to her student in the form of neural code.

That level of communication may still be a ways off, but the researchers caution that people need to start talking now about the ethics of brain-to-brain interface. Should we allow this? Under what circumstances? It may not be long before neuroscience catches up with science fiction. Could we use this technology to perform computer-assisted Vulcan mind melds?

Another cutting-edge neuroscientist, Miguel Nicolelis, whose research explores brain-machine interfaces, puts it this way: “Impossible is just the possible that someone has not put in enough effort to make … come true.”

Nicolelis, a researcher at Duke University, has led an effort to allow paralyzed people to walk again by using a brain-machine interface. His research team has created a wearable robotic “exoskeleton” that a person controls by brain activity.

In a dramatic demonstration of the technology, a 29-year-old man, Juliano Pinto, who is paralyzed in his lower trunk, made the ceremonial first kick at the 2014 World Cup in Brazil.

Nicolelis's other research has demonstrated that monkeys can control the arms of virtual avatars using just their brain activity. The monkeys “scored” a yummy sip of juice.

So, yes, it’s fair to say that the leading edge of brain science includes playing video games and monkeying around.

University of Washington researcher Rajesh Rao, left, imagines firing a virtual cannon in a video game. His brain's "fire" command is picked up by EEG and sent directly to partner Andrea Stocco’s brain using TMS. Both EEG and TMS are painless, non-invasive techniques—but they do require the gamers to wear some pretty funky headgear. Photo: © 2014 Rao et al. Used under a Creative Commons license.

Sources:

Rao RPN, Stocco A, Bryan M, Sarma D, Youngquist TM, et al. (2014) A Direct Brain-to-Brain Interface in Humans. PLoS ONE 9(11): e111332. doi:10.1371/journal.pone.0111332

Nicolelis, Miguel. (2013) A Monkey That Controls a Robot With Its Thoughts? No, Really. TED talk. www.ted.com/speakers/miguel_nicolelis

National Science Foundation. World Cup exoskeleton allows paraplegic to walk again. https://www.youtube.com/watch?v=6WO71e0XLqs

Martins, A, and Rincon, P. (12 June 2014) Paraplegic in robotic suit kicks off World Cup. BBC News. www.bbc.com/news/science-environment-27812218