Brain-machine interfaces: Villainous gadgets or tools for next-gen superheroes?

September 23 2019, by Erica K. Brockmeier

Science fiction and superhero films portray brain-machine interfaces as malevolent robots that plug into human brains for fuel in The Matrix (top left) or as power-enhancing devices in X-Men (top right). In reality, they can help patients use artificial limbs or directly connect to computers. Credit: from top left to bottom right: Warner Brothers, 20th Century Fox, Intelligent Films, AFP Photo/Jean-Pierre Clatot

For the many superheroes that use high-powered gadgets to save the day, there's an equal number of villains who use technology nefariously. From robots that plug into human brains for fuel in *The Matrix* to the memory-warping devices seen in *Men in Black*, *Captain Marvel*, and *Total Recall*, technology that can control people's minds is one of the most terrifying examples of technology gone wrong in science fiction and superhero films.

Now, progress made on brain-machine interfaces, technology that provides a direct communication link between a brain and an external device, is bringing us closer to a world that feels like science fiction. Elon Musk's company NeuraLink is working on a device to let people control computers with their minds, while Facebook's "mind-reading initiative" can decode speech from brain activity. Is this progress a glimpse into a dark future, or are there more empowering ways in which brain-machine interfaces could become a force for good?

Penn Today talked with Konrad Kording, a Penn Integrates Knowledge Professor whose group works at the interface of data science and neuroscience to better understand the human brain, to learn more about brain-machine interfaces and where real-world technologies and science fiction intersect.

What are the main challenges in connecting brains to devices?

The key problem is that you need to get a lot of information out of brains. Today's prosthetic devices are very slow, and if we want to go faster it's a tradeoff: I can go slower and then I am more precise, or I can go faster and be more noisy. We need to get more data out of brains, and we want to do it electrically, meaning we need to get more electrodes into brains.

So what do you need? You need a way of getting electrodes into the brain without making your brain into a pulp, you want the electrodes to be flexible so they can stay in longer, and then you want the system to be wireless. You don't want to have a big connector on the top of your head.

It's primarily a hardware problem. We can get electrodes into brains, but they deteriorate quickly because they are too thick. We can have plugs on people's heads, but it's ruling out any real-world usage. All these factors hold us back at the moment.

That's why the Neuralink announcement was very interesting. They get a rather large number of electrodes into brains using well-engineered approaches that make that possible. What makes the difference is that Neuralink takes the best ideas in all the different domains and puts them together.

Most examples in pop culture of connecting brains to machines have villainous or nefarious ends. Does that match up with how brain-machine interfaces are currently being developed?

Let's say you've had a stroke, you can't talk, but there's a prosthetic device that allows you to talk again. Or if you lost your arm, and you get a new one that's as good as the original—that's absolutely a force for good.

It's not a dark, ugly future thing, it's a beautiful step forward for medicine. I want to make massive progress in these diseases. I want patients who had a stroke to talk again; I want vets to have prosthetic devices that are as good as the real thing. I think short-term this is what's going to happen, but we are starting to worry about the dark sides.

What about brain-machine interfaces like Professor X's Cerebro from the X-Men comics, which amplifies his psychic abilities so he can find

other mutants?

It's the most stupid example for such a technology you can possibly think of. If I want to search the world, I would explain to my computer what I'm looking for and then it can look.

There's this illusion that lots of data go into the brain and lots of data go out of the brain. But we can see and read much faster than we can understand text, and we have more muscles in our body that can type faster than we can produce meaningful decisions.

This division of labor, where we tell commands to a computer that reports back to us, is a much better way of interfacing with the world. In that sense, I think Professor X is solving a non-issue.

What are some examples of pop culture depicting a more accurate or effective way of connecting humans with machines?

Things that human bodies can't support would be good uses for brain-machine interfaces. Say I need to control a strong robot; that is something that my own body doesn't support. So if I want to be Iron Man, that's very good because you want to do things that the body doesn't support. And certainly in *Transformers*, they do things that your body or mine wouldn't support.

Also Luke Skywalker: He's got a prosthetic device that connects the stump of his arm onto his new prosthetic device, and it's purely curative.

Are there any real-world examples of how computers are enhancing human abilities?

Computer systems are already enhancing our activities. If I want to win against a chess player, I will use a computer who tells me what it thinks are good moves. I don't necessarily need to build it into my head.

The closest would be remote surgery. In a way, we have something that's like a brain-machine interface: You have the eyes of the robot and your hand movements translate to the surgery. There, you could say that brain-machine interface technologies might allow you to be a surgeon beyond what anyone can really do.

But maybe being a super-surgeon isn't actually a problem, and in that case you'd want to build intelligence into the device. We have an AI system that is really good at anesthesia, a system that moves the scalpel, and all you do is say, "There's the tumor, take it out."

It depends how you want to work with computers. In one way, what happens is that computers give us information relevant for our high-level decisions, and we give commands for midlevel decision making. Alternatively, we want everything to run through us, but I don't think that's going to work because humans aren't very good at high bandwidth input/output.

You mentioned that researchers are already starting to think about the dark sides of using brain-machine interfaces. What sorts of risks come with using this technology?

The risk at the moment is surgery and its complications, not that it reprograms you. But you need to think of the risks before you start implementing because we would get more enmeshed with electronic systems and they can have more influence on us.

It's happening already on some level. Anything around you that is electronic is changing who you are. If we move into brain-machine

interfaces, there are more opportunities, including making you happy or sad. That comes with a risk of neurally enslaving people. You can make them do whatever you want in a way that robs people of their personality.

We will need to develop systems that protect us, like an ad filter. In the future, no one would dream of allowing a system to have broad access to their brain without having rather aggressive software that goes through and filters things out. We should start thinking about it, and I've been talking with [PIK Professor] Jonathan Moreno in the neuroethical space about this.

If you had unlimited technology at your disposal, how would you decide to incorporate a brain-machine interface into your superhero persona?

If I could be a Transformer, I could walk around and then I could fly into the sky Iron Man-style, that would be pretty awesome.

Provided by University of Pennsylvania

Citation: Brain-machine interfaces: Villainous gadgets or tools for next-gen superheroes? (2019, September 23) retrieved 2 May 2024 from https://techxplore.com/news/2019-09-brain-machine-interfaces-villainous-gadgets-tools.html