'Linking our brains and computers': Elon Musk's controversial dive into human experimentation

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Credit: Pixabay/CC0 Public Domain

Elon Musk's team has implanted a powerful computer chip inside a living person's brain, a startling step toward a sci-fi future when we can steer computers with our thoughts.

The patient is fine. Results are promising. How do we know? Because Musk says so.

With great fanfare but disturbingly few details, his Fremont, California-based Neuralink Corp. has jumped into the perilous world of human experimentation.

The technology behind the robot-powered device, announced on Musk's X (formerly known as Twitter) with the acclaim of a SpaceX rocket launch, seems dazzling. If it matures, it could ease communication for the millions of desperate people who suffer from paralysis, stroke and other dreadful conditions.

Someday, it may offer much more, asserts Musk. It could bestow mental superpowers on healthy people, dubbed "human augmentation," by seamlessly linking our brains and computers to download knowledge and upload thoughts.

"Ultimately we will achieve symbiosis with artificial intelligence," he promised at a rare Neuralink news conference in San Francisco in 2019. "This is something that I think will be really important on a civilization-level scale."

While it's not unusual for device or drug companies to tenaciously guard their intellectual property and competitive edge, the news this week is secrecy on a whole other scale, according to a consensus of neuroscientists and bioethicists.

Neuralink issued no official statement. The company didn't respond to multiple requests for comment. No peer-reviewed papers have been published in scientific journals. Unlike most other research, the trial is not registered at ClinicalTrials.gov, an online repository curated by the U.S. National Institutes of Health. There's no disclosure about how the company defines or measures success.

We don't know if the patient is a Bay Area resident, their type of disability or where the surgery was performed. Its only source of public information is a study brochure on the company's website.

Until this week, the company's most notable public announcement was a YouTube video of a treated monkey playing the 1970s video game Pong solely with its mind. It ignited the internet with 6.6 million views.

The secrecy worries the research community, which has long advocated for accountability.

"This is not like a product launch, We're talking about human experiments here," said McGill University's Jonathan Kimmelman, who studies the introduction of novel medical technologies.

"Once you've entered the realm of doing human research, you now have a set of expectations and obligations. One of them is transparency," he said. "You have to be able to establish that the benefits of doing research are sufficient to outweigh the risks and burdens."

Musk's other companies, while brilliant, have run into early problems:

The initial SpaceX rockets exploded into flames. Tesla recalled its initial Roadsters due to a troubled rear hub and electrical cables. The Cybertruck's vaunted "armor glass" was easily smashed. Boring Co., which promised to build one mile of tunnel in just a week, has completed only 2.4 miles in seven years. The former Twitter is facing financial trouble, and his overhaul has alienated many users.

In human experiments, failure isn't an option. Medicine is incremental and cautious; unlike tech, it doesn't move fast and break things. If a patient died in this new Phase I safety study, how would we know? While deaths must be reported to the FDA, there's no obligation for a company to announce the news.

Experts also worry that Musk could give false hope to the sick and injured.

"It's ridiculous. Just overhyped nonsense," said bioethicist Arthur Caplan of New York University's Grossman School of Medicine. "Right now this implant merits transparency, not nerd-man speculation."

There are even deeper concerns about brain implants if tech companies use them to exploit rather than enable us, said Duke University law professor Nita Farahany, author of the book "The Battle for Your Brain." The brain, "our last fortress," is profoundly private—and deserves regulatory drawbridges.

Musk co-founded Neuralink in 2016 with $100 million of his own money and has since raised an estimated $450 million more. Its headquarters in Fremont are located in an unmarked building with a fleet of Teslas in the back parking lot. Manufacturing and testing are done in Austin, Texas. An element of the implant is based on UC San Francisco research. Animal trials were performed at UC Davis.

In documents provided to investors, the company said it plans to perform 11 implant surgeries in 2024 and then dramatically ramp up, doing 22,204 procedures by 2030, according to Bloomberg Businessweek.

There's been turbulence. At least six of the eight original scientists have left the company.

But it has a gold-plated team. The late Krishna Shenoy, Stanford's beloved pioneer of brain-computer interface technology, was a co-founder and adviser. The company's current leadership includes a raft of Stanford and UC Berkeley Ph.D.s, as well as a former product design engineer for Apple and a former senior research scientist at Lyft. Its Product and Technology team is led by Stanford wunderkind Jeremy Barenholtz, age 26.

Dr. Matthew MacDougall of Sutter Health, who has an RFID implanted in his hand to open locked doors and store crypto codes, is its neurosurgeon.

"The mission of Neuralink is to reduce human suffering, at least in the near term," MacDougall said in a recent podcast. "We're focused on people with terrible medical problems that have no options."

But eventually, he added, "there's hope that there's a use here that makes sense for a brain interface to bring AI, as a tool embedded in the brain, that a human can use to augment their capabilities. I think that's pretty far down the road for us, but it's definitely on a desired roadmap."

After rejecting an initial application, the FDA has cleared Neuralink to use its brain implant and surgical robot for a Phase 1, or safety, study on patients but has declined to provide more details. The National Institutes of Health does not have any leverage over the research because it's not federally funded.

"The first human received an implant from @Neuralink yesterday and is recovering well," Musk announced on X. "Initial results show promising neuron spike detection," suggesting that brain cells are communicating.

Legally, there's no requirement that Neuralink's work be registered in a public database. While the FDA requires registration of Phase II and III studies, there's an exception for Phase I research, said Kimmelman.

But there's a clear ethical expectation that was established by the Declaration of Helsinki, created in 1964 by the World Medical Association, which states that every clinical trial must be registered in a publicly accessible database, he said.

Other companies and university researchers, including teams at UCSF and Stanford, have also designed implants in this hot new field of "brain-computer interface," or BCI, disclosing their findings during decades of incremental work. The leader in the field is Salt Lake City-based Blackrock Neurotech, which has tested its device in more than 50 patients and published 1,700 studies. It is preparing for a commercial launch.

But Neuralink's tool is touted to be more sophisticated and could turbocharge the field with its technological prowess. The implant is designed to interpret a person's neural activity, so they can operate a computer or smartphone by simply intending to move—no wires or physical movement are required. The device uses 1,024 electrodes, far more than its rivals.

The company also boasts a robot, which surgically places the implant in a part of the brain that controls movement. The robot is more skilled than any human surgeon, MacDougall said, reliably and efficiently "sewing" threadlike electrodes, each thinner than a human hair, throughout a targeted region of the brain.

"It's potentially a big step. To be able to robotically implant the electrodes, and record lots of single neurons … that's the huge benefit here," said Gregory Cogan, a neurologist at Duke University's School of Medicine, whose team has also built a brain-to-speech device. "But it's all speculative because it's hush-hush."

"It's hard to gauge what has been done, and what hasn't been done," he said. "What is salesmanship? What is reality? That's the tricky part."