

BBC Future AMA: I'm Nicholas Opie, a biomedical engineer at the University of Melbourne, Australia. I'm here to answer questions about brain-controlled devices and neural implants. AMA!

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Do you believe that technology will ever reach a stage in which an individual could connect their brain directly to a computer and then control the system with their brain, eliminating the need for physical keyboards and mice?

(I think technology like that would greatly improve ease of use for people with disabilities affecting there limbs but I've no idea if it would ever be possible.)

[TheMechanicusBob](#)

Yes. We are planning on conducting a pilot clinical trial in 2018 to do exactly this. In our initial study, we will implant people with paralysis with our Stentrode, which can record brain activity and interpret these signals into commands that could be used to control a wheelchair, exoskeleton, computer or prosthetic limb. The primary question we have is not whether it will work, but how well it will work.

A number of different technologies have already demonstrated this is possible (to control equipment with your thoughts) and the goal is now to ensure that the implant remains highly functional over a long period of time.

Performance improving implants and body improvements are an essential part of modern science fiction. Examples for this are franchises like Deus Ex, Shadowrun and even Star Wars, where people improve their bodies through technology not because they're suffering from a handicap but want to enhance their natural abilities through technology.

As an expert, how much of those ideas do you deem as fiction and which are actual science? What are you expecting in those regards for the near future?

[Hironymus](#)

Great question. Yes I think that in the near future we will be seeing more and more people using medial technology for augmentation and enhancement rather than out of clinical need.

What is the biggest technological hurdle in interfacing directly with nerves?

Also, are you related to Gregg Opie? He works with autism spectrum disorders.

[tyson766](#)

One of the most difficult things to achieve when interfacing with nerves is selecting an appropriate material. Ideally, electrodes would be made from materials that have similar mechanical properties to the implanted tissue, but this would make them very soft and difficult to implant. As the material also needs to be electrically conductive, this limits the number of available materials, which is why a lot of work is going into the design and development of novel electrodes and smart polymers.

Will the device, either current or future models, be able to send back electrical signals from the attached hardware? For example, if I were in a wheelchair that was outfitted with sensory hardware, would it be possible now or in the future to feel through it? The friction of the wheels, warmth of the hands if someone were assisting me with the handle on the back, the weight and shift of items stored in any pocket or compartment on the chair... what's possible? Are there hard limits, or things you don't think would be buildable without significant progress?

[yttri_inpri4phni](#)

Yes, and I don't think this will be too far away. There is work that is going into making artificial arms and hands that have sensors on them to measure grip strength and heat or the item that is being touched, as well as work to understand the best way to electrically stimulate parts of the brain to induce these different 'feelings'. It is probable that initially, these feelings (induced by electrical stimulation) will be different to start with (i.e., will not be able to generate a specific hot or cold feeling), although the pilot will learn what these mean over time and training.

What are your favorite (not necessarily most impactful or craziest) applications of this technology?

Also, tangentially related: is there much research being done on geriatric exoskeletons? I feel like some simple support and stability frames could be a godsend for patients that are a fall risk or have weakness.

[zero_gravitas_medic](#)

Great question, and I guess what this technology will be used for will depend on what ideas people have for it. We have developed a way to access the brain and record information without risky, open brain surgery. We can extract neural signals and can deliver electrical stimulation. We envisage that our technology will have clinical uses including control of equipment for people with paralysis, detection and suppression of epileptic seizures, stimulation to alleviate Parkinson's tremor and it has been suggested that localised stimulation for the treatment of depression and PTSD would also be possible. Whether the technology could also be used for non-clinical reasons (i.e., to enable people to control equipment with their minds rather than their hands), although to what extent will be interesting.

In answer to your second question, yes, there is some work being done on development of exoskeletons for people who are frail or have fall risks, and I believe that some of these companies are making excellent progress.

Very cool! As the CTO, what do you apply the most from school in your job? (e.g. Digital signal processing, thermodynamics)

[dbombdalion](#)

Most of the things I learn at school (or university) I have needed to apply in some form or other. It is interesting to look back and reflect on the things that I learnt that did not seem relevant at the time that I am now using daily (maths and statistics for example). I studied a lot of physiology, and was always fascinated about how the human body and animals functioned, and how all the different components and organs worked together. I was fortunate enough to be able to combine this with mechanical and electrical engineering, and develop systems that could artificially replicate some of these functions.

I would recommend pursuing whatever it is that you are most excited by, whatever that is. Enjoying what you do is one of the most important things.

Hi there!

Thanks for taking the time to answer our questions.

1. If an object is imbedded into blood vessels, I'm assuming the device will be at least partially within arteries/veins or arterioles/venules, there is a risk for emboli/thrombus formation. How has this risk (potential formation of blood clots) been mitigated?
1. New technology tends to be very expensive and limited to wealthy countries. When developing life changing technologies like this, are mechanisms put in place to address affordability and accessibility to promote beneficence?

[cdnkevin](#)

Yes this is a risk, although stents have been implanted in patients for decades (in cardiology) to keep blood vessels open. We have been able to take advantage of all the work that has gone into developing these stents to ensure that they are safe and are manufactured to prevent thrombus formation, and will be conducting an extensive study to demonstrate that our technology will be safe.

In regards to your second question, you are correct that technology is always expensive when first released (whether this is a car or a brain machine interface). When medical technology is released (as a general rule for all medical and pharma), large amounts of work go into discussing with local governments, health care providers and hospitals that the new technology will be beneficial to the patients (and to them). Each country is different, although I have been pleased with the people I have spoken with so far that they do care about patients and not just profit. This may mean that they are able to subsidise the drug or technology to make it affordable to everyone.

How do endovascular electrodes compare to brain-implanted ones in terms of resolution?

[Ffs_fg](#)

Great question. We have conducted preclinical trials which demonstrated that there was no significant difference between our intravascular electrodes and signal quality and bandwidth obtained from subdural and epidural electrodes (both which require open-brain surgery to implant).

We do not record from single neurons, but are recording local field potentials from a neural population.

First, thanks for your efforts in advancing humanity. How is the software of these neural implants to be handled in your mind?

Do you envision something like the implant remains as is from time of insertion? Would the implant

have programmable software? Is that software accessible by the implantee? Would only the hospitals have software access? What of password control?

[Digitalneo](#)

Thanks for the questions. Yes, the device will remain in permanently. Over time (1-2 weeks), endothelial cells on the inside wall of the vessel grow over the device and anchor it in place. This is a good thing, as it ensures that blood flow is not compromised and increases the quality of the signals. The software would need to be (to some degree) customised for the patient depending on what they wanted to control (i.e., using a computer may have a different switch-set than controlling a wheelchair). The software would be part of the system, so while I do not anticipate the patients writing their own code, they would need to have access to it to control the tech.

How did you get involved in the research that you do, and what cool things have you learned from doing it?

[dhoopicus](#)

I got involved in research as there were things I wanted to make that did not exist yet. I have always wanted to combine my passions of biology (and physiology) with engineering, and work with my hands to make things that would make people's lives easier. I am fortunate that Australia is a great place to do this and have been able to combine these areas. I have learnt a lot over the years, but learn something new everyday which is one of the things I love about this work.

Is there a possibility that the devices (exoskeleton) be hacked or tampered externally ? How will it affect the brain ? Also, will we be seeing reverse of this in near future ? Devices that can influence a subjects brain ?

[rick29de](#)

People always ask this, and I am never sure why or who would want to do this.

At present, the device does not put anything back into the body (i.e., electrical signals are unidirectional coming from the brain to the equipment). It would not be possible in this design for someone to hack the device and harm the patient. Yes, it may be possible for an exoskeleton to be externally controlled (obviously depending on the type of exoskeleton and what is used to control it), although these companies are working hard to ensure that they cannot be remotely controlled by anyone other than the user.

I think it is a shame that mis-use of medical tech is something that we need to focus on. I realise the importance, but would prefer if time could be spent by manufacturers and researchers solving new problems rather than ensuring the technology cannot be used inappropriately to intentionally cause harm.

Hello there, Nicholas Opie! Not sure if I'm off topic, but here it goes:

Has there been any major development towards implants which might enhance the life of chronic pain patients? I read a scientific article which mentioned that the center for pain management in the brain had been found. Could we look forward to a future where pain could potentially be turned on and off by with some kind of implant in the brain?

[Superbugged](#)

Anything is possible. There is still so much about the brain that we do not know, and hopefully our device will enable treatment of a wide range of neurological conditions.

Following the neural implants, will people have trouble controlling their new mechanical body parts? If so, how do you go about assisting in the motor re-learning of these patients and how long does it take?

[nzxtskill](#)

Good question, and one we hope to have a better answer for over the next few years. The time it will take for someone to train to use the device has been suggested (by other implants) to take between a week and a month depending on the person and the task. As I understand it, it is like learning anything new (driving a manual car, or typing on a keyboard) in that once you have 'learnt' the task, it will become second nature.

Direct brain control of exoskeletons by 2018 would be amazing, my question is what about feeling through these? Will the same people be able to feel through these by say 2020 or 2025?

[TheBaris](#)

Yes, I think this is entirely possible that smart prosthetics would be interfaced with devices like the Stentrode to both record information and return feedback.

Are you developing stimulating "stentrodes" for closed loop applications?

[SchmittyVonGritty](#)

Yes, as I have indicated above, there are a number of neurological conditions that would benefit from electrical stimulation and we are working to further develop the Stentrode to be suitable for these.