

This response was submitted to the consultation held by the Nuffield Council on Bioethics on *Novel neurotechnologies: intervening in the brain* between 1 March 2012 and 23 April 2012. The views expressed are solely those of the respondent(s) and not those of the Council.

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## **General questions**

**1. Have you ever used a technology that intervenes in the brain, and with what consequences? Please describe your experience.**

No

**2. If you have not used a technology that intervenes in the brain before, would you do so if you were ill? Why / why not?**

Yes – but only if the benefits outweighed both the risks and negative side effects.

More generally I have to admit that technologies which intervene to reprogram aspects of the brain, nomatter how minor give me the creeps. I have no objection to others using repetitive TMS, but I would have to be quite ill before I would allow someone to bring one near my head.

**3. Would you use a technology that intervenes in the brain for non-medical purposes, such as gaming or improving your cognitive skills? Why / why not?**

My belief is that it will be a very long time before neuroprosthetic technologies have sufficient bandwidth to truly give additional benefit over non prosthetic interfaces. Cochlear implants can return only a rudimentary level of sound and all music sounds like death metal. Visual prosthesis is still at the level of a few flashing dots. And Deep Brain Stimulation technologically has yet to come out of the dark ages. Additionally, there are fundamental limitations to the brains architecture which could probably not be improved upon.

Sensory enhancement devices such as night vision sensors, and mobile phones are in daily use – allowing us to do things that were not previously possible without any need for neuroprosthetic intervention.

As such, I would not recommend any invasive procedure for a long time for non medical purposes. Where it to be possible and prove advantageous, then there may be a case. However we have many hurdles in terms of security – the potential for hackers to eavesdrop or command destructive illusions, cause epilepsy or other negative consequences. This will not be an easy solution as data encryption and processing requires additional energy consumption – not very desirable in an implantable device.

**4. What are the most important ethical challenges raised by novel neurotechnologies that intervene in the brain?**

In the case of medical intervention, there is very little ethical issues. Failure of a visual prosthesis could cause a patient to get knocked down or killed. But then even guide dogs get it wrong occasionally.

In the case of military intervention, blame for atrocities could be put down to super-users influencing soldiers brains. But by the time neuroprosthetic systems will get to this point robotic warfare will be considerably more advanced and more significant. Already automated shoot on sight sentry guns man the Korean DMZ, and US drones regular bomb women children civilians attending weddings and other non-combatants.

Perhaps the key issue will be akin to the situation with drugs in sports. We do not allow them because they are fundamentally damaging and dangerous to the user and it is not fair to those sports people who do not want to use them. The spread of web based applications is increasingly isolating those who are afraid of using computers. Similiarly in a few decades or a half a century when neuroprosthetic interfaces may get to the point of providing true enhancement to normal people, some may resent this unfair advantage while being wary of committing to it themselves (e.g. for religious reasons or fear of criminal/big brother control)

**5. In what ways, if at all, should the development and use of these technologies be promoted, restricted and/or regulated? Please explain your reasons.**

At the present time neuroprostheses should be developed for medical purposes.

Non invasive systems like EEGs may not have negative consequences, but are toys and will never be significantly useful. These neither require promotion nor restriction.

**6. Have you used a BCI, and if so, with what consequences? Please describe your experience.**

I have not used a BCI

**7. If you have not used a BCI before, under what circumstances would you do so?**

I would use non invasive BCI's like EEG's out of interest – but I do not see any circumstances where they will become effective or useful for daily tasks.

I would use an invasive BCI if I received a terrible injury that prevented my normal neurological function.

**8. What are your expectations and concerns for BCIs?**

I have no concerns at the present time. In terms of expectations, I forsee them slowly getting better over the next couple of decades.

**9. Are there any particular ethical or social issues associated with BCIs?**

As per above, the major issue surrounds security with regards hacking.

**10. What would robust and effective regulation of research in this area look like? Is more or less regulation needed? Please justify your response.**

Any research in BCI will eventually need to involve primates and humans. As such, it will need to be strictly regulated.

The key thing is that the regulation is effective rather than turning into a situation where researchers entering the area are expected to write long tomes of justification which will never be read again.

**11. Have you used neurostimulation and if so, with what consequences? Please describe your experience.**

I have only used surface muscle stimulators on myself– not very pleasant.

Within my laboratory I am investigating optoelectronic/optogenetic stimualtors

**12. If you have not used neurostimulation before, under what circumstances would you do so?**

I would use it should there be medical need to do so.

**13. Under what circumstances do you think it might be acceptable to use neurostimulation in non-medical context (that is to say, not for the treatment of a disease or disability)?**

Neural stimulation is just one component of a neural machine interface. In the end to the user it is the cost benefit that matters. Will the neuroprosthesis return effective function compared to negative consequences.

**14. Are there any particular ethical or social issues associated with neurostimulation?**

In the case of optogenetics – which could form the basis for neural stimulation in the future, a virus is required to make the target nerve cells light sensitive. There is a tiny chance that this could effect the germ line, so probably patients undergoing such treatment may need to be required not to subsequently have children.

**15. What would robust and effective regulation of research in this area look like? Is more or less regulation needed? Please justify your response.**

The problem with regulation at present is not its existence but its method of implementation. It should not be a pointless paper filling exercise. Statistical data should be recorded when procedures take place and follow ups recorded

so that any long term risks due to implantable device degradation assessed (think the present debacle with breast augmentation and non-regulated clinics). As such all providers in public or private sectors need to be properly regulated and ordered to keep statistics and perform follow ups.

**16. Under what circumstances would you use neural stem cell therapy?**

If there was clinical need and it was proved to be safe.

**17. What do you think of the risks and benefits of neural stem cell therapy?**

The risks are simple – cancer

The benefits could potentially be great, but this remains a could. There has been very little demonstration of effective implementation to date. Additionally in the long term cells will need to be genetically reprogrammed to match the hosts immune system rather than requiring extensive use of anti-rejection drugs.

**18. Are there any particular ethical or social issues associated with neural stem cell therapy?**

Middle Eastern religions – Christianity, Islam and Judaism seem to have a problem as they view life as a one chance only event. Those coming from Hindu and Buddhist traditions have a lot less of an issue with the technique. As such the ethical issues are often overstated in the press.

I have no ethical or social issues with the use of stem cells.

**19. How do you feel about neural stem cell therapy being used for non-medical purposes one day, for example for human enhancement?**

I do not see it as feasible in the next few decades if ever.

We have a highly engineered architecture with trade-offs. We have a more advanced visual system than dogs but a poorer olfactory system. We see fewer colours than fish but have better acuity. Blind people develop significantly better hearing. This is no accident. I therefore suggest that any attempt at bolt-on function to the human architecture would either fail or cause reduced function elsewhere. Basically, to do it properly, we would have to be re-engineered at the genetic level.

**20. What would robust and effective regulation of research in this area look like? Is more or less regulation needed? Please justify your response.**

The area should be properly regulated to ensure the highest standards of procedures are performed and that people are not being mis-sold quack stem

cell therapies which do not work – e.g. what seems to regularly happen in other countries.