

Nuffield Council on Bioethics: Novel neurotechnologies: intervening in the brain

Response by the Wellcome Trust

April 2012

Key Points

- There is an overwhelming need for treatments and interventions which can address diseases of the brain such as dementia, Parkinson's Disease and depression. Novel neurotechnologies offer real potential to tackle a growing disease burden.
- A robust regulatory framework must allow innovative research to demonstrate the safety and efficacy of new clinical treatments. The regulation must be proportionate and based on a risk-benefit assessment to ensure effective translation of research into health benefit.
- Ensuring public confidence in novel neurotechnologies will be crucial. This will require collaborative public engagement activities involving both researchers and clinicians, coupled with strong governance procedures and effective regulation.

Introduction

1. One of the five major challenges set out in the Wellcome Trust's Strategic Plan 2010-20 is 'Understanding the Brain'. This lays out our support for the development of novel and pioneering tools to enhance diagnosis and management of brain disorders and our strong interest in applied clinical research. We also support activities which explore historical, ethical and social perspectives on the mind and mental health.
2. Given the Trust's remit, our comments focus primarily on the research perspective, regulatory issues and the need for effective public engagement. We also include details of relevant research that the Trust has funded.

Neurotechnologies to address global health problems

3. The global cost of mental health conditions in 2010 was estimated at US\$2.5 trillion, with the cost projected to rise to US\$6.0 trillion by 2030¹. Mental illness accounts for 13% of the global disease burden¹, with one in four people in the UK experiencing a mental health problem². Dementia affects 800,000 people in the UK³ and every year 111,000

¹ WHO (2008). *Global Burden of Disease: 2004 Update*.

http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf

² NHS Information Centre (2009). *Adult Psychiatric Morbidity in England, 2007: results of a household survey*.

<http://www.ic.nhs.uk/pubs/psychiatricmorbidity07>

³ Alzheimer's UK (2012). <http://alzheimers.org.uk/infographic>

people have a new stroke.⁴ There is therefore a pressing need to invest in research which has the potential to address these growing health problems. Despite the nominal categorisation of these conditions into mental, neurological or cardiovascular disease, all have the potential to be addressed by “intervening in the brain”. Given the paucity of highly effective pharmacological interventions, the Wellcome Trust recognises the huge potential benefits of new approaches to treating brain-based disorders.

4. These potential benefits have been made possible from investment in research from a variety of public, charitable and private funders. It would seem both unethical and significant waste of resources if techniques which are shown to be safe and effective, are prevented or unduly delayed in reaching patients.

The Wellcome Trust supports a range of research into basic neurosciences which we believe is vital in understanding the brain and informing the development of translational technologies, such as the neurointerventions considered here. Examples of this include our funding to the Wellcome Trust Centre for Neuroimaging at UCL and Gero Miesenböck’s pioneering work on ‘optogenetics’, utilising genetic tools to control the function of brain circuits in fruit flies with light.⁵ Specific research and engagement activities the Trust supports in novel neurotechnologies are considered below, along with issues related to these technologies.

Neural stem cell therapy

5. Research into neural stem cell therapy holds promise for the treatment of many conditions, including early spinal cord injury, neurodegenerative disorders and brain cancer. There remain challenges to the safe and successful development of neural stem cell therapy, notably:
 - Detailed characterisation of the cell types;
 - Scalable methods for exact cell production;
 - Immunological compatibility.

Researchers at the Wellcome Trust Sanger Institute working with neural stem cells include David Ryan, a Wellcome Trust-funded Clinical Research Fellow looking at neural stem cells in glioma therapy⁶. Given safety concerns about cell compatibility and tumour-forming propensity, they are currently focusing on autografts of cells generated through induced pluripotent stem cell (iPSC) technology, which allows genetic matching of cells to the diseased or damaged tissue.

Deep Brain Stimulation

6. While deep brain stimulation (DBS) techniques offer potential for the treatment of Parkinson’s Disease, there are concerns about the side-effects. The small size of the Sub-Thalamic Nucleus means that existing techniques often stimulate surrounding brain areas, leading to unwanted and sometimes severe side effects which are preventing

⁴ British Heart Foundation and The Stroke Association. *Stroke Statistics. (2009)*
<http://www.bhf.org.uk/idoc.ashx?docid=d2bf06aa-004f-44b1-bafb-412f99f4b695&version=-1>

⁵ University of Oxford, Gero Miesenböck, Waynflete Professor of Physiology.
http://www.dpag.ox.ac.uk/academic_staff/gero_miesenboeck

⁶ Current Clinical PhD Fellows. http://www.cimr.cam.ac.uk/study/clinicians/current_fellows.html

wide uptake of the treatment. The Wellcome Trust is funding work to improve the spatial resolution of DBS techniques through a Strategic Translation Award to Sapiens BV.⁷ The company is developing a high resolution steerable probe, which could eliminate stimulation based side-effects. This technology could also be utilised in similar treatments for depression and Tourette's syndrome.

Brain computer interfaces

7. Through the Trust's Health Innovation Challenge Fund with the Department of Health, Professor Janet Eyre and her team at Newcastle University are working with specially designed video games to improve rehabilitation following a stroke⁸. The games provide a highly motivating therapy for re-learning arm and hand movements, as well as providing feedback to the patient and remotely to a therapist. Using this system, patients will be able to have more frequent therapy sessions at home, with better outcomes and reduced hospital visits, while therapists will be able to supervise more patients

Effective Regulation of neurotechnologies

8. Any therapy or technology used to intervene in the brain as a clinical treatment must have a robust evidence base demonstrating safety and efficacy. The research to produce this evidence should be supported by clear regulation that is proportionate to the risks and benefits and which allows the efficient and ethically sound translation of research into health benefit. Such a regulatory environment enables innovative research and clinical use of neurotechnologies whilst promoting a safety conscious approach.
9. The research community, in general, consider research with neural stem cells to be well regulated in the UK, allowing pioneering work to proceed in a carefully controlled manner. Accordingly, we believe new neurotechnologies should be assessed using a risk-benefit approach on a case by case basis, based on the available scientific evidence.
10. Given that some neurointerventions may be specifically targeted at treating those with reduced capacity to make decisions about their own care, it is important to note that the application of the Mental Capacity Act (2005) in research already requires a balancing of the risks with the benefits in order for those who lack capacity to be enrolled in research. The potential benefit to the individual must outweigh the risks and be in proportion to the burden of risk undertaken, or there must be a benefit to society and negligible risk for the individual.⁹
11. One of the challenges faced in producing effective regulation for novel technologies is the global nature of research. There is a danger of people travelling from their home country to seek unproven treatments abroad. The Wellcome Trust is a global funder and we would promote international dialogue and, where possible, harmonisation of legislation around the use of novel neurotechnologies worldwide.

⁷The Wellcome Trust: (2012). *Medical Devices*. <http://www.wellcome.ac.uk/Funding/Technology-transfer/Funded-projects/Medical-devices/index.htm>

⁸The Wellcome Trust (2012). *Health Innovation Challenge Fund*. <http://www.wellcome.ac.uk/Funding/Technology-transfer/Funded-projects/Health-Innovation-Challenge-Fund/index.htm>

⁹Section 30-34 of the Mental Capacity Act (2005).

12. The use of neurotechnologies in a non-medical context raises different issues but will also require some form of regulatory oversight, not least to ensure public confidence in the techniques.
13. A possible concern is the use of neurointerventions in 'neuro-marketing'. The use of brain imaging for product research and marketing is becoming commonplace, with companies providing services to a range of large multinational companies and organisations.¹⁰ While neuro-marketing to date has mainly monitored activity using EEG or less frequently fMRI, it is possible more interventionist technologies could be utilised, including trans-cranial magnetic stimulation. We would suggest the use of such technologies for marketing or other non-medical purposes should be regulated and only be utilised where there is strong evidence showing no health risk to the participant.

Public engagement and the exploration of ethical and social aspects of neurotechnologies

14. The Wellcome Trust also supports activities which explore historical, ethical and social perspectives on the mind and mental health. Funded through a Strategic Award in Biomedical Ethics from the Trust, Professor Julian Savulescu and colleagues at the Oxford Centre for Neuroethics (OCN)¹¹ have formed the first international centre in the UK dedicated to neuroethical research. One of the centre's core focus areas is cognitive and affective enhancement. The OCN aims to investigate ethical dimensions of advances in technology and clinical practice in neuroscience and disseminate their findings to influence policy and promote public debate¹².
15. Through a £1 million Strategic Award in Medical Humanities the Wellcome Trust is supporting the Y Touring theatre company to explore and stimulate conversation on biomedical research and its effects on individuals and society through the use of theatre, debate and digital media¹³. As part of the 'Theatre of Debate' project they have developed a play titled "Brainwaves: what new neurotechnology means for us". The play focuses on non-pharmacological technologies that directly intervene in the brain and will be presented in May 2012, before touring schools nationwide.
16. There is a need to develop early-stage public engagement strategies around new technologies, which bring together scientists, the public and policy makers to discuss the science and any associated ethical and social issues. We do not believe that one particular type of public engagement activity is most appropriate for new technologies, but a range of approaches should be used, tailored to the needs of the issues or research in question.

¹⁰There are now many companies providing 'neuromarketing' services, examples include:

Neurofocus. <http://www.neurofocus.com/uk/company.htm>

Whitematter. <http://whitemattermarketing.com/clients.html>

¹¹ The Oxford Centre for Neuroethics. <http://www.neuroethics.ox.ac.uk/home>

¹² The Wellcome Trust (2012). *Research Profile: Professor Julian Savulescu (The Oxford Centre for Neuroethics)*. <http://www.wellcome.ac.uk/Funding/Ethics-and-society/Funded-projects/Research-profiles/WTDV030182.htm>

¹³ £1 million Strategic Award to spark debate on advances in biomedical research. <http://www.wellcome.ac.uk/News/2011/News/WTVM049663.htm>

17. Results of public dialogue or other engagement activity should be taken seriously and considered by researchers and policy makers. However, it should be clear that this only forms part of the broader set of issues considered in decision making. Scientific experts are integral to the progression of research and science policy by providing expert opinion and evidence. They also play a major role in the communication of scientific research to the general public. It is vital that any communication is therefore effective so that the public can reach informed opinions on the risks and benefits of the research and play a collaborative role in how the research impacts on society.

The Wellcome Trust is a global charitable foundation dedicated to achieving extraordinary improvements in human and animal health. We support the brightest minds in biomedical research and the medical humanities. Our breadth of support includes public engagement, education and the application of research to improve health. We are independent of both political and commercial interests.

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