

Nuffield Council on Bioethics

Note of a Workshop on ethical issues raised by advances in the neurosciences

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28 Bedford Square, London, WC1B 3JS**

Present:

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Note of meeting

Brain scan methods, and the ethical issues they raise

1. In the first presentation an overview was given of current non-invasive brain-scanning methods, in particular positron emission tomography (PET), magnetic resonance imaging (MRI), magnetoencephalography (MEG). Consideration was given to their accuracy and reliability, and ethical issues that they raised.
2. PET was a procedure that involved injecting the participant with radioactive compounds and then using detectors to trace them. This indirect measure of brain activity, giving information about

haemodynamic change, was fairly slow and had low resolution. The reliability of this method was difficult to determine, especially since recent guidance by the National Radiation Protection Board recommended that volunteers should only be allowed to have one scan per lifetime due to the radioactivity involved. It was mostly used in a clinical environment, for example in evaluating tumours, rather than in research. PET was limited in relation to measuring brain activation.

3. MRI was another indirect measure of brain activity, focussing on the structures, chemistry and blood flow of the brain. It used a large static field, rapidly switching magnetic fields and radio waves emitted into the participant that were then broadcast back to the scanner. The characteristics of these waves would be determined by the spin of nuclei, such as hydrogen, in the brain. This technique could be used either to show the structure of the brain or to show some aspect of its function, as in functional MRI (fMRI). fMRI had been used, for example, to analyse changes in oxygen levels in the brain. Although this method was still slow, it produced results with a higher spatial resolution of up to 0.3 mm. There had been few studies of repeatability for fMRI and it was suggested that between-subject variation might be fairly high.
4. One method for measuring brain activity directly was MEG. This involved the assessment of neuronal activity through measurement of magnetic fields around the head that were created by neural currents between cells. This technique was fast and had a similar spatial resolution to MRI. It could also be combined with MRI to examine brain activity in more detail. Other scanning techniques that enabled the assessment of different components of the brain include gigahertz imaging metabolic imaging and metabolic imaging using 'spin-labelled' compounds.
5. A number of scientific and ethical issues raised by these scanning techniques were identified:
 - One of the biggest challenges was suggested to be the issue of inter- and intra-personal repeatability, and reliability of the interpretation of the scans.
 - Other issues included how and whether 'normal' should be defined. It had been suggested that there was some discrepancy between 'theory' and 'description' as there was no standardised atlas of normal brain structure and function. This had clear implications in practice as between 2-10 percent of healthy people who volunteered for research were found to have anomalies. Regarding the defining of 'normal', agreed normal ranges were vital if the techniques were to be applied clinically, but the technology was not yet advanced enough to establish these.

- fMRI studies carried out in Edinburgh had revealed that areas of the brain degenerated before the onset of specific types of psychoses. raising issues of what criteria would justify preventative surgery.

Consciousness

6. The second speaker noted that even if we could be confident that for every mental state, there was a physical process that was necessary and sufficient for that state to occur, we would still have difficulty understanding significant aspects of consciousness. It was suggested that this difficulty arose from an 'explanatory gap'. Some philosophers argued that the explanatory gap testified to substance dualism, that is, the theory that the physical and the mental were two radically distinct substances although the mental could causally affect the physical world. However, from a scientific viewpoint, it seemed that all movements and brain processes might be accounted for by prior physical processes.
7. The alternative to dualism is physicalism, that is, the theory that there is nothing more than the physical world and that consciousness is 'nothing but the firing of the neurons'. As to the fact that this still leaves the feeling of an 'explanatory gap', some philosophers believed this to result from a failure of human understanding, in that people by their nature found it hard to see how consciousness could be a physical phenomenon. Others believed that it was not that people had difficulty *understanding* this theory, but that people had difficulty *believing* it, perhaps because people are intuitively dualists. If this was the case perhaps the explanatory gap would be resolved if we could rid ourselves of this intuition.

The phenomenal self, freedom of the will, and the brain

8. The third speaker presented a number of philosophical observations relating to our understanding of self and will, and set out some issues surrounding these observations. The first observation was that there was no such thing as the 'self', only the 'phenomenal self'. This was termed the 'phenomenal-self model' and by this it was meant that individuals may have the experience of a 'self', but that it would be necessary to realise that it was nothing but that, i.e., an experience. Evidence in support of this observation included the rubber-hand illusion, in which a person could be subjected to conditions that allowed them to be deceived into thinking that they experienced a rubber hand as being their own hand.
9. The speaker's second observation was that the 'will' was also a form of phenomenological content without observable properties. There was a discussion of whether 'free will' was truly free, an

issue on which philosophers disagree. It was observed that without free will, the 'possibility to do otherwise' would not exist. This would mean that we would live in a world of physical determinism, meaning that everything that happened was determined by the state of the physical universe, and human consciousness would not causally impact upon it. If this were the case it was commented that a person's exact twin would not act any differently from that person.

10. It was then suggested that the absence of free will was counterintuitive and that the notion of free will was an important social institution. It was important because it made complex society possible and without the belief in free will there could be the risk that the way people treat each other could change and social cohesion be endangered. Additionally it was suggested that in large societies a top-down social model could result, requiring individuals to have their behaviour controlled, since it would be believed that they were not able to have control over it themselves. Further, social problems could result from the reactions of people who believed that self and free will did exist, and also from a shift in our understanding of rationality and morality.
11. Three further arguments were advanced that related specifically to neuroscientists. First, the underestimation of the potential impact of advances that deal with who we are and how we behave. Secondly, the fallacy of confusing properties of parts of the brain with properties of the person. Thirdly, the inappropriate use of terms, such as 'goals' and 'intention', that were not consistent with the absence of a true self or will. Strictly speaking it could be argued that neuroscientists should abandon using such terms, if their premise that conscious processes were simply functions of electro-chemical brain-states were true. In response to this last concern, it was suggested that speaking of 'goals' would not commit one to a Cartesian view of a 'mind in the machine', but could be used as a shorthand term to describe complex states of systems.
12. It was suggested that a major issue in this field was the potential for conflict between our changing understanding of the self and our 'inbuilt' phenomenal-self model. This conflict might not be easily resolved, and that there were possible consequences for mental health if individuals began to see themselves differently and struggled to understand this new self. In the subsequent discussion it was also suggested that part of the reason why people might be described as intuitively 'animist' (or compatibilist) was that a capacity to attribute consciousness widely and readily, even to inanimate objects such as computers or cars, had a

number of practical advantages and could be considered to be a result of evolutionary optimisation.

Therapeutic interferences

13. The fourth speaker outlined some of the therapeutic uses of advances in the neurosciences. Experiments on primates had identified the area of the brain responsible for Parkinson's Disease. Lesional surgery had been used as a treatment in the past, but often resulted in side effects such as the patient having dulled emotions. In the 1960s, it had been found that deep brain stimulation (DBS) reduced the aggressiveness of bulls. Currently this technique was used very effectively in humans to stop tremors without using drugs or causing side effects. Research in monkeys was developing DBS techniques at different frequencies, which might be used to treat those individuals who could not receive other kinds of treatments.
14. As well as treating Parkinson's Disease, DBS was used to treat neuropathic pain, which resulted from damage to the nervous system and was generally a drug resistant condition. The speaker had treated 70 such patients and 70 percent of these had shown significant signs of improvement. Tremors related to multiple sclerosis, benign essential tremor and dystonia were other conditions for which this technique could be used. DBS only helped to stop tremors; it did not treat any change in cognitive state associated with these illnesses. People who had depression would generally be excluded from receiving DBS as it might worsen mood. There had been attempts to use DBS to activate the visual cortex to treat blindness.
15. It was suggested that the beneficial effects of DBS might gradually decline over time. Similar effects of changing functionality due to the 'plasticity' of specific brain areas was known from other fields of research, for example studying people with amputations. It was also noted that in patients with dystonia, patients often had to wait for 6-12 months after DBS treatment before experiencing any relief from their symptoms. In addition, when stimulators broke or ran out of batteries, symptoms did not immediately return in patients with neuropathic pain. The brain had changed in some way following DBS, and it was suggested that it could also change to become 'immune' to the stimulators.
16. Consideration was given to the use of DBS for enhancement rather than treatment. It had been suggested in the 1960s that violent criminals should receive DBS rather than being sent to prison. The risks of surgery were comparatively high, so using DBS purely to enhance performance, either mental or physical, was not likely.

Neuroethical issues in cognitive enhancement

17. The next speaker commented on the apparent increase in the use of drugs for neurological disorders. For example, prescriptions for Ritalin (methylphenidate) to treat attention deficit hyperactivity disorder (ADHD) had almost doubled in the US since 2000. It was not clear whether this was due to an increase in diagnoses of the disorder, a greater readiness to prescribe Ritalin by doctors, or a true rise in the occurrence of ADHD. Ritalin had not been shown to have any serious side effects and there had been a large number of double-blind studies that provided evidence of its efficacy. ADHD occurred in 3-7.5 percent of school age children, although other estimates indicated that this figure could be as high as 17 percent. The condition could continue into adulthood and led to social and learning problems, difficulties with driving and reduced performance at work. It could be argued, however, that individuals with ADHD were just at the extreme end of what might be described as 'the normal range', and that there might also be positive traits associated with ADHD. The misuse of Ritalin increased as children got older in the US, with 5.1 percent of 17-18 year olds having used Ritalin for non-medical reasons. Fifteen percent of university students had taken illegal stimulants thought to have been obtained by theft.
18. Research had shown that drugs such as Ritalin could be used to enhance performance in 'normal' people. Results that Provigil (modafinil) improved response inhibition in healthy volunteers had received much media coverage ("Pill to boost brain power"). Ritalin had also been shown to improve planning skills in Cambridge undergraduates. There were potential benefits on physical performance and as a consequence sports men and women were now banned from using Provigil. It was, however, difficult to show that these drugs would have beneficial effects outside of the laboratory setting. This was because using the drugs in an everyday context, for example, in the examination room or on the sports field, would be illegal.
19. The speaker then turned to 'neuroethics' and questions about the rights and wrongs of cognitive enhancement in healthy people. The potential benefits were increased performance in certain groups of people, such as the military, shift workers and school pupils. It could also lead to normalisation and the removal of unfair disparities in society. The potential negative effects included:
 - long-term side effects;
 - a homogeneous society;
 - greater inequality, with access dependent on productivity and wealth;

- changed perception of achievements, with individuals not being able to take full credit for their actions;
 - the disappearance of virtues such as motivation and hard work;
 - over-enhancement, where individuals were plagued with unwanted traits (not being able to forget as a result of 'enhanced' memory); and
 - pressure, coercion or even force to take cognitive enhancers in order to keep up with the rest of society.
20. Pharmacological enhancement was just one way of improving society. Other methods, such as smaller class sizes and greater consideration for work-life balance, should not be precluded. Cognitive enhancers did, however, have the potential to provide important clinical benefits and further development in this area was likely to be worthy of pursuit. Advances in pharmacogenomics might help to make it possible to target individuals with safe and effective drug-based treatments. Scientists would need to work together with social scientists, philosophers, ethicists, policy makers and the general public to actively discuss the ethical and moral consequences of cognitive enhancement.

'Brain-reading' in the employment or forensic context

21. Neuroimaging data had shown that 'brain reading' could be carried out to some extent. However, it was not clear whether a fMRI or CT scan could predict complex mental states such as intention, deception and intelligence. fMRI scans measured blood oxygenation in the brain and could be used to predict whether subjects were imagining simple images such as houses or faces, as these were controlled in different areas of the brain. More complex techniques using MRI, such as the creation of 'within-area topographies' using multivariate pattern recognition, could be used to decode a wider range of representations. Unconscious thoughts could also be uncovered. Although there was little scope for practical application at the present time, methods had been developed to track the stream of consciousness in a subject, measuring where the focus of attention lies and any covert intentions.
22. Possible applications included computer-brain interfaces, which would enable individuals to control computers through their thoughts. This might be useful for people with artificial limbs in future. Lying stimulates brain arousal, and bodily functions such as heart beat or sweating and polygraphs, which measure physiological changes in the body, are currently used for lie detection. Traditional polygraphs mainly focused on detecting signs of fear of being caught lying. However, some people were

able to train themselves to suppress signs of such fear, and most psychopaths did not show such responses. This method was not therefore not very accurate and open to manipulation. Using fMRI might provide a direct measure of cognitive and emotional correlates of deception, as lying and telling the truth involved different cognitive processes. It would also be more difficult for subjects to manipulate the results. However, the difficulty of decoding representations in different contexts might limit this application of fMRI. Measuring other changes in the body in addition to neuroimaging might increase the accuracy of lie detection.

23. Employers might be able to use 'brain-reading' to screen potential employees in future, which raised a number of ethical issues. Information about personality, medical predisposition to diseases, attitudes and sexual orientation potentially could be obtained and stored. Legislation already existed in the US to restrict the use of results from polygraphs, and this would need to be expanded if fMRI technology was applied to employment and forensic settings.
24. There were several limitations to the use of fMRI for 'brain reading':
 - the scanner itself was immobile and expensive;
 - it was difficult to recognise representations in different contexts, for example, the same person in different clothes, alone or in a crowd of people;
 - the detection of novel thoughts was particularly challenging;
 - propositional/compositional semantics: it was not currently possible to decode all the different parts of a proposition, for example, dog bites man; and
 - decoding data acquired from different subjects was currently very difficult.

Ethical issues raised by neurosciences

25. In the second part of the workshop, two breakout groups were held to consider ethical issues related to advances in neurosciences either now or potentially in the future. The Chairman noted that the Council was particularly keen to identify issues that were unique to this area of science rather than those that might overlap with other areas such as genetics. The issues raised were then discussed at the final plenary session; in some cases it was found that there was considerable overlap between the current and future issues.

Current issues

26. There were three main themes emerging from the discussion of the current issues: the ethics of the interpretation of scientific findings, issues in the philosophy of science and medicine, and the ethics of political philosophy.
27. Regarding the interpretation of scientific findings, it was noted that scientific terms and everyday language often overlap and this could lead to misunderstanding of the science. A question was also raised about who should carry out the interpretation and evaluation of scientific findings and what weight should be given to involvement by the public. The role of the media had considerable influence on the views of the public. It was important that information about neuroscience portrayed in the media was both accurate and realistic. The current lack of understanding about what was 'normal' was an important omission in the scientific evidence, and could lead to misdiagnosis and stigmatisation, especially where research findings were communicated inaccurately. More research was also required on child development to inform advances in the application of neuroscience.
28. Issues in the philosophy of science and medicine included the distinctions between health and illness, and treatments and enhancements. In neuroscience one concern might be when to intervene to treat illness and, in particular, when to intervene to treat pre-illness states. Another issue was how scientific and medical advances affect perceptions of human dignity and self worth.
29. In terms of political philosophy, some of the issues raised related to understanding of people and society, for example, the relationship between the brain, mind and behaviour, and the issues of personal autonomy and its role in democracy. Questions were raised about the appropriateness of state interventions for political or social purposes, for example to improve economic output, to make training and education more effective, or to achieve other social or political objectives. Some disorders might be treated more effectively and with fewer side effects by non-drug methods, such as psychotherapy and smaller class sizes. However, the actual treatment used might be determined by the investment required: it was often cheaper and easier to prescribe a drug.

Future issues

30. The discussion of the future issues in neuroscience raised a number of areas of concern, each of which would depend on whether particular advances occurred in the knowledge or treatment of the brain and brain disorders.

31. It was suggested that if cognition-enhancing and mood-enhancing drugs were to improve such that there were no side effects, this could have significant implications for their use. For example, this could mean that they were more widely used, particularly for enhancement, rather than treatment, purposes. Perhaps they would also become available as 'over the counter' drugs, which almost certainly would increase their usage. The participants subsequently questioned what the objection to enhancement was and whether this would be a problem if equality of access was ensured. Improving the general standards or abilities across the population might not be a problem if this was driven by the public interest. However, this would be most likely to be driven by the individual interest, which would be more problematic.
32. There was speculation as to what the effects might be if more information about people could be obtained from scans of their brains. If it was possible to detect attitudes or dispositions it might be possible for totalitarian states to punish people for 'thought-crimes' and not just crimes committed. If it were to become possible to detect deception in anyone and at any time, what effect might this have on society? How could a 'right to deceive' be balanced with a 'right to the truth'. There was also a discussion as to how such developments would affect privacy more widely, for example the right to think freely. Participants were particularly concerned about what would happen if businesses insisted on using these technologies and people had no choice in this matter.
33. Finally it was suggested that in time it may be possible to scan a person to determine various characteristics of their personality. This could lead to the profiling of children at an early stage in order to channel them in a direction, for example of a career, to which they may be particularly suited. Alternatively, a person's profile could be used to determine how they should be trained or medicated in order to conform to social norms.

Other issues

34. The participants returned to the subject of definitions of 'normal'. It was agreed that normal ranges were difficult to define, and in some cases would be different for different ethnic, age or other groupings, making definitions even more complicated. It was also suggested that for some factors, 'normal' was determined by social context, for example by what people valued in one another, and that this could vary over time and between cultures.
35. A theme that recurred during the discussion was the need for embedding ethics in neuroscientific research. It was felt that research might often be conducted without a full consideration of

the ethical implications and that neuroscientists were often not aware of what these implications might be.

Closing comments

36. The Chairman thanked the speakers and participants for attending and contributing to the Workshop. In light of the discussions at the Workshop, the Council would consider whether further work on the ethics of neuroscience might be appropriate. He concluded that this was a large subject area and that any future work would most probably focus on a particular aspect of this subject.