Neuroscience and Ethics

Note: This paper is the National Council of Churches of Singapore's response to the Bioethics Advisory Committee's Consultation Paper entitled 'Ethical. Legal and Social Issues in Neuroscience Research released on 9 January 2013. The paper was submitted in March 2013.

The National Council of Churches would like to thank the Bioethics Advisory Committee for preparing this consultation paper on neuroscience and its applications and for the invitation to respond to it. There can be no doubt that some of the most innovative and exciting work in contemporary medicine is in the area of neuroscience and its impact on psychiatry, neurology and neurosurgery. But the significant advances in the study of the human brain and the various technologies they have spawned do not only have their application in medicine. Neuroimaging in the form of computed tomography (CT), positron emission tomography (PET), single photon emission computed tomography (SPECT), magnetic resonance imaging (MRI), and functional magnetic resonance imaging (fMRI) that can reveal several pathologies have also been used to ascertain the ability of an offender to control behaviour. These technologies and techniques, therefore, have profound implications to how society should respond to offenders with a diminished sense of responsibility due to compromised brain functions (for example, lesions in the orbitofrontal cortex of the brain that may result in antisocial behaviour).

In addition, accompanying the advances in neuroscience are the changing ways in which scientists and philosophers understand the relationship between the brain and the mind. This has in turn led to radical changes to the way in which we understand personhood as well as concepts like free will and responsibility. As the BAC has rightly observed, brain research must be distinguished in some significant sense from research on other tissues. This is because 'the brain is the seat of one's mind, intelligence, consciousness, thoughts and emotions'. Brain research and some of the resulting therapeutic applications are ethically controversial because, as the BAC again has perceptively pointed out, 'the brain holds the key to unique characteristics, and any intervention in the brain has the potential of causing physical disability or altering cognition, emotion and even personality' (para 4). This in itself should give us pause to reflect on the breathtaking speed in which brain research is presently being conducted and the claims that neuroscience is making.

The BAC paper provides an excellent sketch of the history of neuroscience and the way in which brain research is being conducted internationally, with special reference to the US and the UK, the undisputed trailblazers for such research. The paper provides a helpful account of some of the work that is being done in the field in Singapore. It discusses the various key neurotechnologies including neuroimaging, brain stimulation and neuropharmaceuticals and presents a set of ethical questions, many of which are not exclusively associated with neurotechnologies. Totally absent from the paper, however, is a philosophical analysis and appraisal of neuroscience itself and the way in which it has urged some scientists and philosophers to conceptualise the relationship between the physical brain and the mind. Furthermore, the BAC's discussion on the various neurotechnologies is too brief to do justice to the many complex philosophical and ethical issues they raise. Because of these omissions, the BAC consultation paper in some ways fails to help readers to have an adequate grasp of the numerous issues associated with neuroscience and its applications that have direct or indirect bearing on their ethical, social and legal implications.

In view of this, the Council's response will begin with a robust critique of neuroscience (its presuppositions and metaphysical claims) and discuss briefly the profound weaknesses of a physicalist or materialist view of the relationship between the brain and the mind. The Council will then discuss the different neurotechnologies, examining the particular ethical and metaphysical issues associated with each of them in some detail. The Council will also turn its attention to the specific ethical issues highlighted by the BAC paper, many of which are not unique to neuro- science and technology. The Council hopes that the reflections it offers in this paper would make some contribution to the wider discussion on this important topic. It also hopes that the points it raises would in some ways help the BAC to formulate its final report and recommendations.

NEUROSCIENCE: PHILOSOPHICAL ISSUES

Progress in neuroscience research has no doubt enabled us to better understand neural correlates of the mind. Researchers are beginning to identify the relationship between certain brain processes that may be said to have an influence on or are related to certain experiences which we have conceptualised as free will, moral agency and self. There are numerous studies that attempt to investigate how brain activity influences or shapes experiences like bodily self-awareness,[1] self-reflection,[2] empathy[3] and self-consciousness or extraversion.[4] While these studies have provided us with important insights on the importance of the brain in relation to the human person, it has also led to some radical changes in the way in which we understand personhood and the self. For example, there are scientists and philosophers who suggest that the self is only an epiphenomenon of brain states and the relevant structures in the brain. Thus, concepts like the 'synaptic self' or the 'self-model' theory of subjectivity see the self as merely the product of the electrochemical and computational processes in the brain and nothing more. Any ethical evaluation of the advances in neuroscience must therefore take into consideration their profound

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[1] G. Berlucchi and S. Aglioti, 'The Body in the Brain: Neural Bases of Corporeal Awareness', *Trends Neuroscience* 1997, 20:560-564.
[2] S.C. Johnson, L.C. Baxter, L.C. Wilder, *et el*, 'Neural Correlates of Self-Reflection', *Brain* 2002, 125:1808-1814.
[3] J. Decety, P.L. Jackson, 'The Functional Architecture of Human Empathy', *Berhavioural Cognitive Neuroscience Review* 2004, 3:71-100.
[4] N.I. Eisenberger, M.D. Lieberman, A.B. Satpute, 'Personality from a Controlled Processing Perspective: an fMRI Study of Neuroticism, Extraversion, and Self-Consciousness', *Cognitive Affective Behaivoural Neuroscience* 2005, 5:169-181.

metaphysical or philosophical implications, some of which are already presented as dogma by some neuroscientists and philosophers. As we shall see, a philosophical critique of neuroscience and the materialist anthropology that is often associated with it has profound bearing on the ethical evaluation of the specific neurotechnologies. However we may wish to ignore or avoid these abstruse philosophical issues, the fact remains that our sciences and technologies are profoundly undergirded by metaphysical assumptions. This means that clarity in ethical evaluation of neurotechnology would be seriously compromised if these philosophical issues were simply brushed aside as unimportant or irrelevant.

Ontological and Methodological Reductionism

As already alluded to in the preceding paragraphs, a number of neuroscientists implicitly (if not explicitly) hold a reductionist view of the relationship between the brain and the mind. Some maintain that the mind is only the epiphenomenon of the brain. Perhaps the most articulate and energetic presentation of this view comes from the pen of Francis Crick, the British molecular biologist and co-discoverer of the structure of the DNA molecule. In his now famous book, *The Astonishing Hypothesis* Crick famously argues that '"You", your joys and your sorrows, your memories and your ambitions, your sense of personal identity and free will, are in fact no more than the behaviour of a vast assembly of nerve cells and their associated molecules'.[5] What Crick and many others are proposing in their particular view of the brain-mind relationship may be termed as ontological reductionism. Explaining this form of reductionism, Greg Peterson writes: 'To study the brain is to study ourselves, but in a way that makes us both subject and object. It is as if we were trying to look in and out of the window at the same time'.[6] It is also interesting to note that the European Brain Council has pledged to make 2014 the Year of the Brain. What is interesting in the context of this discussion, however, is not the fact that 2014 is chosen but the fact that it is called the Year of the Brain and not the Mind. The same is true of the designation for 1990-1999 as the Decade of the Brain by the then U.S. President George W. Bush. This perhaps betrays the pervasiveness of the ontological reductionism both in the scientific community as well as in the general public. As Jeffrey M. Schwartz and Sharon Begley have observed:

> It is telling that the Decade of the Brain … had that name rather than the Decade of the Mind. For it was in the brain rather than the mind that scientists and laypeople alike sought answers, probing the folds and crevasses of our gray matter for the roots of personality and temperament, mental illness and mood, sexual identity and even a predilection for fine food.[7]

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[5] F. Crick, *The Astonishing Hypothesis* (London: Touchstone, 1995), 3.
[6] Greg Peterson, 'God and the Brain: The Neurobiology of Faith', *Christian Century*, January 27, 1999.
[7] Jeffrey M. Schwartz and Sharon Begley, *The Mind and the Brain: The Neoplasticity and the Power of Mental Force* (New York: Harper Collins, Regan Books, 2003), 365.

Alongside the ontological reductionism that reduces human ambitions and aspirations to neurological activities is explanatory reductionism. Again Crick has provided us with the most succinct description: 'The scientific belief is that our minds – the behaviour of our brains – can be explained by the interactions of nerve cells (and other cells) and the molecules associated with them'.[8]

The ontological and explanatory reductionisms that we find in Crick and others have profound implications not only in the way in which we understand human beings and human behaviour. They also profoundly change the way in which we understand disease, especially mental illness. According to Thomas Fuchs, the mind-brain relation that neuroscience suggests may result in the medicalisation of some (anti)social behaviour.[9] Because abnormal behaviour has been reduced to brain processes, Fuchs argues, it will be regarded as a medical problem and nothing more: 'Low cognitive performance becomes ADHD, shyness becomes social anxiety disorder, dissocial or criminal behaviour turns into mental illness and so on'. And with the proliferation of more efficacious psychotropic drugs with fewer side effects, the domain of illness will inevitably be enlarged. But reductionist approaches, as Fuchs has correctly pointed out, may lead to serious practical problems such as inaccurate diagnosis, because their myopic vision of what is human has prevented them from achieving a more sophisticated and holistic appreciation of the condition in question. This 'localising fallacy' as Fuchs calls it (where, for example, mental disorder is attributed only to the increased metabolic activity in certain regions of the cortex) prevents us from appreciating the fact that increased metabolic activity can be the result of disorders with different aetiologies. He also points to the fact that the relationship between the patients and their environment is seldom addressed when diagnosis is localised in the way he describes. The final difficulty is reification, where 'imaging and other methods of neuroscience tend to turn lived experience and dynamic processes into thing-like objects'.[10] As a result simplistic explanations are offered (like depression is caused by chemical imbalance) that fail either to recognise or acknowledge the causal complexity of mental disorders.

Concept of Moral Responsibility

One of the most important consequences of the reductionism in neuroscience's account of personhood or self has to do with the concept of free will. A man kills another man in a fit of rage and was arrested and charged with second-degree murder. In his defence, his lawyer points out that his client acted in this way because of a violent impulse that he simply could not control. The accused undergoes a PET scan that showed that the metabolic activity and blood flow in the frontal cortex is abnormally low. The scan also detected an abnormally high metabolic activity in and blood flow to the amygdala. Neuroscientists believe that the combination of these two factors has been closely related to uncontrollable impulses. The lawyer therefore argues that because of these abnormalities in his client's brain he should not be held responsible for his

[8] Crick, *The Astonishing Hypothesis*, 11.
[9] Thomas Fuchs, 'Ethical Issues in Neuroscience', *Current Opinion in Psychiatry* 2006, 19:604.
[10] Fuchs, 'Ethical Issues in Neuroscience', 605.

actions. He lacked free will to control his behaviour and therefore should be exonerated of his offense. The ontological and explanatory reductionisms associated with neuroscience can therefore inspire a deterministic view of human actions, emptying the concept of free will of its traditionally received meaning. Analogies of this type of argument and conclusion can be found in the narrative inspired by a certain interpretation of genetic science. Stephen Gay Gould, who is not a genetic determinist, offers a succinct account of the logic of determinism based on an ontological reductionism: 'if we are programmed to be what we are [by our genes] our traits are ineluctable. We may, at best, channel them, but we cannot change them either by will, education or culture'.[11]

The liberterian concept of free will was challenged in a spectacular fashion by the famous but heavily criticised experiments counted in the 1980s by Benjamin Libet.[12] Using a technique called event-related potentials (ERPs), Libet measured the brain activity of his subjects during voluntary hand movements. He found that between 500 and 1,000 milliseconds before his subjects moved their hands, a wave of brain activity (termed, the readiness potential) could already be detected. This means that brain activity can be detected even before his subjects consciously move their hands. This experiment therefore seems to suggest that free will, a concept that we have cherished for so long, is in fact an illusion. From his experiments Libet theorises that the time from the onset of the readiness potential to the actual hand movement is 500 ms. He argues further that it takes about 50 ms for the neural signals to travel from the brain and cause the actual hand movement. He maintains that there are only about 100 ms for the conscious self to either follow the unconscious decision or to veto it. If there is free will at all, Libet concludes, then it must be understood only as the power to veto. This has led behavioural neurologist Vilayanur Ramachandran to propose a slightly modified version of John Locke's theory of free will, namely, that 'our conscious minds may not have free will but rather "free won't"'.[13]

If Libet is right, the implications of his conclusions concerning mental causality to our understanding of free will are staggering. But Libet's approach and conclusions have been rightly criticised by neuroscientists and philosophers. This is not the place to offer a detail analysis and critique of Libet's work and conclusions. In what follows, we will merely highlight (in broad brush strokes) the methodological flaws of his experiments and the erroneous conclusions that they inevitably urge. From the methodological standpoint, Libet's experiments seem to be premised on a certain understanding of the timing of mental and brain events. He assumes that each type of event takes place in a discretely identifiable moment. Libet also seem to assume that human actions always begin with unconscious brain events that bring about conscious mental events. This abstract theory of causality is however challenged by the studies of the aetiology

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[11] Stephen Gay Gould, *Ever Since Darwin* (New York: W.W. Norton, 1997), 35.
[12] B. Libet, 'Conscious vs Neural Time', *Nature* 352 1991, 6330: 27-28; ''Do We Have Free Will?' *Journal of Consciousness Studies* 8 (1999): 8-9, 45.
[13] V. Ramachandran, Quoted in 'The Zombie Within', *New Scientist*, September 1998.

of depression, anxiety and mental illness that seem to suggest that the pathway can go in two directions.[14]

Libet's approach from the very start presupposes a dualistic framework that postulates that physical motor action must be preceded by a mental state that somehow acts on the body. Whether Libet is aware of it or not, the metaphysics that undergirds his paradigm of 'mental causation' is reminiscent of Cartesian dualism.[15] But the dualistic paradigm implicit in Libet's experiments surely misses the point. That which acts is not a certain abstract mental state but the embodied subject. In other words a physical act is the act of the entire person. This means that free will can never be associated with neurons, muscles and limbs. Rather it must be associated with rational and self-transcending beings whose actions are meaningful and purposeful. Free will, therefore, can never be attributed to mental states but to the whole person. The reductionism in Libet's approach is seen in the way in which the results of a simple experiment conducted within its narrow scope become the bases for addressing profound concepts like free will and moral responsibility. The decision to pick up a glass of water to quench a thirst is not distinguished from the decisions that we make concerning our education, our career, our politics and our health. More provocatively, can Libet's theory of 'mental causation' be used to explain the great enterprises and achievements of human civilisation and culture – art, music, architecture, philosophy, politics, and science (neuroscience)? Is it not simply too incredulous to suggest that Libetian causation is responsible for Beethoven's Fifth Symphony, the Mona Lisa and La Sagrada Familia?

The denial of free will that some materialist philosophies seem to urge not only contradicts our experience but also the very assumptions upon which we organise ourselves as a society. Take our judicial systems. The basic and indispensable assumption of the judicial system is that human beings possess free will and are therefore responsible for their actions. Although the concept of free will has been subjected to complex analyses in the history of philosophy, it is not unreasonable to surmise that philosophers of almost every stripe would broadly agree that free actions must have the following characteristics: (1) they can be explained by their motivations, (2) the authors of these actions must have the experience of performing them, and (3) the possibility of taking a different course of action under the same external circumstances. To say that our actions are causally determined purely by brain functions is to reject the reality of free will and turn it into an illusion. It is impossible to see how the judicial system is

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[14] Glannon, *Bioethics*, 56.

[15] The philosopher Charles Siewart perceptively draws a parallel between Cartesian dualism and eliminative materialism when he argues that 'Descartes granted a certain privileged epistemic status to our judgements about what is "in our minds" relative to judgements about what is "outside of them", in the realm of matter. And the eliminativist recognizes a similar asymmetrical epistemic relation between the "mental" and "physical" – only the assignments of privilege and subordinate status are reversed. Our right to claims made in a mind-including ideiom is made to depend entirely on their providing the best theory of what is conceived of in a mind-excluding one, while our right to apply this latter conception does not in turn depend on what our warrant for claims about attitudes and experience'. Charles P. Siewert, *The Significance of Consciousness* (Princeton: Princeton University Press, 1998), 53.

necessary or meaningful if this is indeed true. In many mental disorders, first-person experience is restricted in various degrees. The aim of psychiatry and other forms of therapy in such cases is to restore autonomy and agency in the patients. One of the aims of psychotherapy is the restoration of the patient's self-determination, of at least to enable the patient to achieve greater autonomy. If free will does not exist and is only an illusion, the goal of such therapy would merely be the restitution of a 'healthy illusion', and nothing more. Ontological reductionism (and the accompanying explanatory reductionism) has led to determinism, which in turn results in fatalism.

The Mystery of Personhood

While neuroscience has undoubtedly made possible a better understanding of the relationship between the brain and the mind, concepts of personhood and the self, constructed solely on neuroscience will surely suffer from serious reductionistic distortions. According to the Christian faith, the human being cannot simply be reduced to his physical body (including his brain) without remainder. The narrative in Genesis 2 brings out the complex nature of the human being who is a psychosomatic unity: 'the Lord God formed the man from the dust of the ground and breathed into his nostrils the breath of life, and the man became a living being' (Gen 2:7). That the human being is formed from the dust of the ground shows that he is a physical and material being, whose bodily reality should never be ignored or marginalised. But the fact that God breathed into the lump of clay turning it into 'a living being' emphasise that the human being must never be understood purely in physicalist or materialistic terms. Although Christian theologians have proposed many ways of understanding the human soul, many (if not all) of them would reject a purely physicalist definition of the human being. This is not only the view of Christian theologians. It is also that of many philosophers of mind who are dissatisfied with the materialist account. Although the materialist philosophy of mind is gaining ascendency and greater acceptance in the modern discussion, the theories that reject this view – substance dualism, nonreductive physicalism, and hylomorphism (to name just a few) – are still attracting interest and rigorously debated.

What does it mean to reject the materialist understanding of the human being? It is to assert that just because everything is made up of matter does not mean that the human being can be ontologically reduced to his nervous system. It is to hold that although human beings are made up of different parts that are composed of certain chemical elements, these parts are not identical to the human being. In relation to neuroscience, it is to insist that even the most complex and privileged of our organs – the brain – cannot be said to be constitutive of or identical with the human being. It is to maintain that the characteristics and attributes we possess are not the characteristics and attributes of our brains. It is to maintain that to say that the human being is nothing more than just an assembly of nerve cells is as ludicrous as saying that a painting is just a collection of pigments or brush strokes.[16] To reject the materialist view is to reject the theory that the self

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[16] M.R. Bennett and P.M.S. Hacker, *Philosophical Foundations of Neuroscience* (London: Blackwell, 2003), 359.

is simply an epiphenomenon of brain states. It is to say that the human self is complex and dynamic, transcending itself and interacting freely and creatively with other selves and with the environment, shaped in many ways by its past and open to the future. To reduce human agency and behaviour to no more than the activities of the bundle of cells and molecules or a mass of neurons is to commit what Bennett and Hacker call the 'mereological fallacy'.

As we have seen above, the physicalist understanding of the brain-mind problem is unable to provide a satisfactory account of human free will and moral responsibility. Neither is it able to convincingly explain concepts like consciousness and self. Michael Lemonick provides a succinct summary of the way in which materialists like Francis Crick and Christoph Koch attempt to explain consciousness: 'Consciousness is somehow a by-product of the simultaneous, high-frequency firing of neurons in different parts of the brain. It's the meshing of these frequencies that generates consciousness … just as the tones from individual instruments produce the rich, complex and seamless sound of a symphony orchestra'.[17] This eloquent account of how consciousness may possibly arise is, by Crick's own admission, highly speculative and neuroscience, at least in its current state of development, cannot demonstrate this to be the case. The fact remains that human self-consciousness cannot be directly observed.[18] It is impossible to locate consciousness in any part of the brain (Crick and Koch recognise this), and *ipso facto* it is impossible to locate it in the activity of certain neurons or in the chemistry in the neurons. In other words, there is no specific brain activity that is active when we are conscious and idle when we are not. As philosopher of mind, B. Alan Wallace, has observed:

> Despite centuries of modern philosophical and scientific research into the nature of the mind, at present there is no technology that can detect the presence or absence of any kind of consciousness, for scientists do not even know what exactly is to be measured. Strictly speaking, at present there is no scientific evidence even for the existence of consciousness! All the direct evidence we have consists of non-scientific, first-person accounts of being conscious.[19]

The puzzle of consciousness is so insurmountable for materialists like Crick that the only way out is to assert that we are insufficiently evolved (or that evolution does not require us) to explain it:

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[17] Michael D. Lemonick, 'Glimpses of the Mind', *Time*, July 17. 1995.

[18] Related to the problem of consciousness is that of qualia, that is, how things (the colour 'red' for instance) appear to us individually. Crick admits that science is unable to explain this phenomenon: 'It is certainly possible that there may be aspects of consciousness, such as qualia, that science will not be able to explain. We have learned to live with such limitations in the past (e.g., limitations of quantum mechanics) and we may have to live with them again', Crick, *Astonishing Hypothesis*, 258.

[19] B. Alan Wallace, *The Taboo of Subjectivity: Religion as a Natural Phenomenon* (New York: Viking 2006), 3.

> Our highly developed brains, after all, were not evolved under pressure of discovering scientific truths but only to enable us to be clever enough to survive and leave descendents.[20]

This is not the place to develop an alternative account (inspired by a Christian theological anthropology) of important concepts like personhood, consciousness, moral responsibility and self. The purpose of this discussion, which we must now draw to a close, is to show that neuroscience can sometimes lead to reductionist accounts of the human being (and consequently, of human mental pathology) that would have serious implications not only to the practice of medicine and the law, but also to the ways in which we understand ourselves and society. It is not unusual for protocols on neuroscience and its applications to focus on the more 'practical' concerns related to ethics, the law and best practices, while totally bracketing away philosophical discussions on the presuppositions of the science and its portrait of the human being. It is the view of the Council that this philosophically uncritical approach would willy-nilly be drawn into the naïve reductionisms (ontological and explanatory) that sometimes dictate both the science and its conclusions. A truism for all human disciplines is surely especially poignant in this case: neuroscience (and neuroethics) is too important to be left only to the neuroscientists!

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[20] Crick, *Astonishing Hypothesis*, 262.

NEUROTECHNOLOGIES: ETHICAL ISSUES

Neuroimaging

In its discussion on diagnostic neuroimaging through the use of CT, PET, SPECT, MRI and fMRI the BAC rightly notes that these methods used to 'detect structural abnormalities in the brain' and 'neuropsychiatric disorders' are still 'preliminary' (para 20). The paper also points out that neuroimaging has also been used in recent years as the preliminary method of 'mind reading' and the 'detection of particular perceptions, thoughts, or intentions to perform an action'. It however notes that 'neuroimaging data are currently not considered as sufficiently reliable or specific to be used in the courts as evidence in criminal cases in many countries' (para 21). The BAC paper does not discuss in any great detail the ethical issues related to neuroimaging that is used either for diagnosing psychiatric disorders or violent offenders. The Council maintains that such discussions are important for a consultation paper on neuroethics because it would help participants, especially those who are unfamiliar with the field, to understand the plethora of issues surrounding the use of this technology. To address this lack, the Council would like to point briefly to four main areas related to neuroimaging that require more robust analysis and reflection.

Reliability and Validity

The first issue has to do with the reliability and even the validity of brain imaging. Brain imaging techniques, such as fMRI has been used not only to map salient cortical areas before surgery, the technology is also employed to aid the diagnosis of Alzheimer's disease (AD), mental illness in adults, and pediatric pathology such as attention deficit hyperactivity disorder (ADHD). The use of fMRI has expanded to include studies of lying and deception, competition and cooperation, and brain differences in violent people. Some scientists have even used a combination of fMRI, EEG and PET to investigate the neural bases of religious experience. Others anticipate the effective use of such technologies in the legal arena. Henk Greely has summarised what many seen to be the promise of neuroscience when he wrote: 'Neuroscience may provide answers to some of the oldest philosophical questions, shedding light, for example, on existence limits, and meaning of freewill. It may also provide new ways to distinguishing truth from lies or real memories from false ones. This ability to predict behaviour with the help of neuroscience could have important consequences for the judicial system as well as for society as a whole'.[21]

Scanning the brain to understand or even predict a particular social behaviour in the subject, however, has been criticised to be a severely problematic at various levels. At one level, the assumptions of such approaches may be shown to be just too simplistic. It may be fallacious to think that complex subjective experiences can be understood by simply observing electromagnetic signals derived from brain activity. For example, how far can the complex phenomenon of social attitude or behaviour be really understood by employing simple scenarios of

[21] H. T. Greely, 'Neuroethics?' *Health Law News*, July 2002, 5.

neuroscience experiments like using video games or faces on a screen instead of real social interactions? Furthermore, as some philosophers and scientists have pointed out, the design of the study and the interpretation of its results are influenced by cultural and anthropological frameworks of those conducting the studies. As Judy Illes has put it, 'We must ask, for example, whether all studies of normative neurobehavioural phenomena are ethically acceptable. How might social or racial biases affect applications of the technology, the conditions under which imaging is performed, or the interpretations are made?'[22]

According to Walter Glannon, although brain imaging has increased our understanding of the neural bases of many psychological traits, it is still limited in five aspects. Firstly, we do not have a reference data of brain imaging from the general population that is large enough to confirm a diagnosis. To achieve this database, large numbers of the population must be scanned over a period of time. Secondly, a mental state may be due to activation in some brain area and inhibition in others. 'While a substantial degree of metabolic under- or overactivation of an area of the brain may correlate with a psychopathology, it is unclear whether metabolic activity slightly less or greater than normal for the general population would have any clinical significance'. Thirdly, since cognitive and affective capacities relate to numerous circuits distributed throughout the brain, an image in one region may be inconclusive. Fourthly, although brain imaging can show the relationship between normal and abnormal brain states and mental states, it cannot provide the 'causal explanation of the etiology and pathogenesis of neurological and psychiatric diseases'. And finally, brain imaging cannot capture the interaction between the subject and the environment.[23]

Interpretation and Prediction

In a recent study, brain scans of adolescents judged to have a high risk for developing schizophrenia revealed structural and functional abnormalities in their brains.[24] These subjects have diminished gray matter, especially in the frontal and temporal lopes, and in the cingulated gyrus of their brains. Diminished gray matter is these regions of the brain are often associated with a sign of schizophrenia. But what is of note is that the brain abnormalities in these subjects indicate the mental disease before they exhibit full-blown symptoms. Some neuroscientists have regarded diagnostic or predictive neuroimaging as an important development especially in treating mental disorders because it enables early detection of disease. But the problem with using brain images to either diagnose a mental disorder or predict its onset has to do with the often-unexamined assumptions of the procedure as well as the interpretation of the results.

[22] Judy Illes, 'Neuroethics in a New Era of Neuroimaging', *American Journal of Neuroradiology* 2003, 24:1739-1740.
[23] Walter Glannon, *Bioethics and the Brain* (Oxford: OUP, 2007), 47.
[24] C. Pantelis *et el*., 'Neuroanatomical Abnormalities Before and After Onset of Psychoses: A Cross-Sectional and Longitudinal MRI Comparison', *Lancet* 2003, 361:281-88.

One of the problems with the whole approach is that brain imaging tends to oversimplify complex genetic and brain data. This has often led to the ontological and explanatory reductionisms discussed in the previous section. Long-standing studies of developmental brain plasticity, however, have shown that reductionist accounts cannot do justice to the complex phenotype in consideration. These studies have also shown that organisms – in this case the human being – cannot be understood without taking into consideration environmental, social and other factors. In addition, it must be pointed out that the interpretation of brain imaging studies is not only bound by the scientific framework, but is also influenced by cultural sensibilities and philosophical commitments. This is the case especially when brain scans are used to interpret psychological states and emotions, which are always (and mostly unconsciously) value-laden concepts. Another important concern, which should not be brushed aside lightly, is the tendency for scientists and others (like the court of law) to have an exaggerated estimate of what brain imaging can do. In this regard, it may be prudent to heed the caution of analysts like Winslade and Rockwell, who maintain that 'Humans are forever prone to make premature and presumptuous claims of new knowledge … One may think that brain imagery will reveal mysteries of the human mind. But it may only help us gradually comprehend organic life, chemical and physiological features of the brain rather than provide the keys to unlock the secrets of human behaviour and motivation'.[25]

It must be stressed that brain imaging is always bound to momentary states. This means that inferences on personality and propensities for violence made on the basis of the results of brain scans highly problematic. For example, brain imaging may indicate that people with the propensity to commit violent crimes have significant abnormalities in the prefrontal cortex of their brains. But not every person with the same brain abnormalities is violent, making generalisations and predictions of behaviour highly problematic. Some neuroscientists have rightly pointed out that the complexity and plasticity of the brain would significantly limit the reliability of such prognoses. Focusing only on the prefrontal cortex, for example, may prove to be an oversimplified approach to ascertaining the link between brain and behaviour. Abnormality in this region, as some studies have shown, does not necessarily result in the disruption of the disruption cognition and emotion or the loss of the ability to reason. It is therefore important that the limits of the current technology is clearly presented and understood. If left unchecked, the wide-spread myth that brain scans can enable us to understand psychological states and even character traits would lead courts, immigration services and insurance companies to use these technologies prematurely.[26]

Perhaps one of the most important problems in relating brain scans to social behaviour is the move from empirical claims about the brain and normative claims about proper and acceptable behaviour. When free will and responsibility

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[25] W.J. Winslade and J. W. Rockwell, 'Bioethics', *Health Law News* (Health Law and Policy Institute, University of Houston Law Centre, 2002), 1.
[26] See M.J. Farah and P.R. Wolpe, 'Monitoring and Manipulating Brain Function: New Neuroscience Technologies and their Ethical Implications', *Hastings Centre Report* 2004, 34:35-45.

are not understood primarily as normative notions informed by social conventions and expectations and seen only as empirical realities, another form of reductionism is at work. While the study of brain activity can in some sense enable us to understand free will and responsibility, these normative claims cannot be reduced to empirical notions without skewing our perception of them. To make matters even more complicated, brain imaging alone cannot be used to ascertain psychological traits. As has already been pointed out, the design of brain imaging experiments and the interpretation of its results is not free from bias. Furthermore, these experiments are conducted under conditions that are far removed from the chaos of real-world situations. For all these reasons, caution must be exercised in claiming that these are diagnostic in that they help us to understand the link between the brain and social behaviour. And as Walter Glannon has pointed out: 'Even if functional neuroimaging is perfected, it will not necessarily translate into simple answers to normative questions such as when and to what degree people are responsible. These will always be influenced by social norms'.[27] In light of this, brain imaging should supplement and not supplant existing criteria for responsibility in the criminal justice system.

<u>Disclosure and Treatment</u>

The question concerning what to do with findings also raises some important ethical concerns. The question of whether brain abnormalities would invariably result in cognitive and behavioural abnormalities, and whether the correlation between the two is the same as the causal relation between them is an important one in deciding on treatment. It is not necessarily the case that the individual with less gray matter in his brain will become psychotic later in life. Treating a person with brain abnormalities early to prevent the onset of schizophrenia, for example, raises some ethical concerns because of the possible adverse side effects. Antipsychotic drugs can result in a movement disorder called tardive dyskinesia. And even though newer psychotropic medications boast of fewer side effects, their long-term use would still result in adverse side effects. Glannon clearly states the ethical concern thus: 'Administering these drugs on predictive rather than definitive diagnostic grounds might mean that an iatrogenic disorder would result from treatment for a possible disorder that never would have developed. The risk of using these drugs must be weighed against the risk of not using them for those who are at high risk of developing schizophrenia'.[28]

Even if neuroimaging techniques are perfected and the interpretation of the results are less problematic, ethical concerns still remain. One of the most controversial has to do with whether we should intervene in the neuro-circuitry of biochemistry of people who have brain abnormalities related to violent behaviour in the first place. Such interventions tantamount to forced behaviour control, a procedure that can be seen as a form of eugenics, and is therefore ethically problematic. There are basically two forms of intervention, each with their own peculiar ethical concerns. The first, more controversial, approach is the surgical manipulation of the brain, which permanently alters brain and

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[27] Walter Glannon, 'Neuroethics', *Bioethics* 2006, 20(1): 41-2.
[28] Glannon, 'Neuroethics, 44.

possibly the identity of the person (although 'identity' is a philosophically complex concept). Because of the modifications to the brain is permanent, many find this approach ethically more controversial. The second is behaviour control through pharmacological intervention. This approach would be less controversial because it is not invasive and the modification to the brain is not permanent. The problem with treatment is especially acute when it has to do with children with severe prefrontal cortex abnormalities and (in some cases) with no moral sensibility. These children are destined to a life of crime and violence. Would intervention be the ethically responsible action even if consent cannot be obtained? The philosopher Patricia Smith Churchland presents the moral conundrum in this way:

> Certainly, some kinds of direct intervention are morally objectionable. So much is easy. But *all* kinds? Even pharmacological? Is it possible that some forms of nervous-system intervention might be more humane than life-long incarceration or death? I do not wish to propose specific guidelines to allow or disallow any form of direct intervention. Nevertheless, given what we now understand about the role of emotion in reason, perhaps the time has come to give such guidelines a calm and thorough reconsideration.[29]

Privacy and Discrimination

One of the concerns of brain imaging is the protection of the privacy of individual subjects. Because brain imaging claims to be able to reveal the neural correlates of our thoughts and attitudes – conscious or unconscious – the invasion of the privacy of subjects has become an important consideration. This is the case even if the claims of what brain imaging can do are often exaggerated. In fact, this poses a dual problem: not only is there a possibility that the privacy of individuals may be violated, conclusions regarding their mental states and behavioural traits may be skewed and inaccurate because of the method used, the interpretation of the results, and the inadequacies of current technology. There must therefore be sufficient measures in place to safeguard the privacy and confidentiality of data subjects such as replacing names and other identifiers with codes, and storing paper and electronic research material and records in a secure manner. In situations where researchers wish to use identifiable data without the consent of the data subjects, an IRB must review not only the project in question but also the legitimate use of data. Furthermore, the potential identifiability of anonymous files and data continues to pose a serious problem. The problem of privacy is in some ways related to that of stigmatisation and discrimination. There is a growing recognition of the fact that health information is not entirely private. This has naturally fanned the fear that such information may be used in justifying denial of assess to health insurance, education, employment and even bank loans. Neuroimaging will eventually lead to widespread neuroprofiling, and this in turn may result in an ever-widening

[29] Patricia Smith Churchland, *Brain-Wise: Studies in Neurophilosophy* (Cambridge, MA: MIT Press, 2002), 235-6.

scope for abuses, especially in relation to stigmatisation and discrimination against certain individuals as well as certain groups.

Brain Enhancement

Another important if controversial aspect of the application of neuroscience and technology is cognitive enhancement. Although the common method of brain enhancement is achieved by neuropharmaceuticals designed to improve alertness, memory, or mood, non-pharmacological approaches such as Transcranial Magnetic Stimulation can also be employed for this purpose. As the BAC has rightly noted, 'enhancement is a complex concept'. It can be broadly defined as improving a person's abilities and wellbeing either through natural and artificial means. Human beings have always been involved in the quest for self-improvement. For example, athletes strive to run faster or jump further through rigorous exercise, strict diet and with the help of better equipment, like running shoes. But as the BAC has again rightly noted, to achieve enhanced abilities through the use of 'performance-enhancing drugs or genetic engineering' is ethically controversial (para 58). Neurotechnologies and neuropharmaceuticals have the potential to improve human performance in ways that cannot be matched by rigorous training or even psychotherapy. What are some ethical problems associated with cognitive enhancement?

<u>Safety</u>

The most obvious concern is of course safety. The BAC raises this issue and is rightly concerned with the use of prescription neuropharmaceuticals for psychiatric patients by healthy individuals (para 59). But the discussion on the dangers of these drugs when used for the purpose of enhancement in the consultation paper is very sketchy and rather vague. Because the use of neuropharmaceuticals for neurocognitive enhancement involves intervention in a highly complex system, the consequences and long-term side effects are often difficult to anticipate. Even when the drugs are used only to manipulate a certain part of the brain, it is difficult to predict how this may affect other parts and indeed the whole brain. Enhancing one function of the brain could produce both desired and undesired outcomes at the same time.

- For example, fortifying one's memory could lead to 'over-enhancement – and being plagued by unwanted and traumatic memories that cause us distress and possibly psychological harm'.[30]
- Another example is the enhancement of reasoning ability may result in the impairment of freewheeling thinking, imagination or aesthetic sensibilities. In addition, enhancements may make the individual overly dependent on the technology or drug. If supply is for some reason interrupted or cut off, users may suffer serious withdrawal symptoms or impairment.

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[30] BMA, 'Boosting Your Brainpower: Ethical Aspects of Cognitive Enhancements. A Discussion paper from the British Medical Association', http://www.bma.org.uk/images/Boosting_brainpower_tcm41-147266. Pdf.

- Drugs like modafinil are used to promote alertness in people with regular sleep-wake cycles. Although researches believe that modafinil does not produce the hyperactive or addictive effects of other stimulants, sleep plays an important role in the plasticity of the brain. Lack of sleep would therefore reduce the brain's ability to adjust to the environment. 'Chronic uses of these drugs', writes Glannon, 'could remodel synapses, alter neural circuits, and result in permanent changes in the brain'.[31]

Even proponents of cognitive enhancement have indicated the need for more research on smart drugs.[32] Some have argued that all drugs have side effects and pose a risk to the health of the patient, and that the presence of risks in itself may not be sufficient reason to prohibit their use. Although it is true that all drugs have side effects and risks, our tolerance for risk must be smallest when treatment is elective. With cognitive enhancement, the issue is complexified by the fact that the individuals who wish to derive some benefit from the drugs or the technology are healthy. In other words, the issue becomes more salient because the drugs are used for non-therapeutic purposes, and they neither reduce nor prevent morbidity in the user.

Altering the Human Condition

The BAC is also rightly concerned that the use of neuropharmaceuticals may have an adverse impact on 'personal identity' (para 60). The use of such drugs may result in mood swings and behavioural changes, and the long-term consequences of such side effects are hard to predict with any accuracy. Some of course would argue, rather naively, that enhancement with cognitive drugs and new technologies pose no new ethical problems at all because this is what we have been doing throughout human history. Transhumanists would argue that the science and technology that evolution has made possible should in turn be used to hasten human evolution. Accompanying this development is the constructionist views of reality that are often associated with neuroscience and which the current postmodern ethos supports. Once again, we are reminded of the importance of a rigorous appraisal of the philosophical assumptions that undergird the science. Thomas Fuchs has summarised the constructionist argument well: 'if every brain creates its own world, then why should not we intervene in this construction to select a better version?'[33] But at the very fundamental level, we must ask the question whether we want to allow the use of drugs for non-therapeutic purposes that have the possibility of changing what some neuroscientists are even calling 'the human condition' when we are not able to even chart the possible ramifications of this to the health of individuals and the welfare of society.

Competition and Inequality

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31 Glannon, 'Neuroethics', 49.
32 See I. Singh and K. Kelleher, 'Neuroenhancement in Young People: Proposal for Research, Policy, and Clinical Management', *AJOB Neuroscience*, 2010, 1:13-16.
33 Fuchs, 'Ethical Issues in Neuroscience', 603.

Some writers have argued that enhancements would create a more equitable society. However, even the most cursory survey of the distribution of existing technologies and their benefits would show that this view is obviously mistaken. It is more likely that cognitive enhancement drugs and technology, like most biotechnology, will not be fairly or evenly distributed. For example, in the US Ritalin is used by healthy college students who mostly belong to the middle-class, a privileged segment of the population. The cost barrier to legal cognitive enhancement drugs will compound the education and employment problems of the already disadvantaged people who belong to the low socioeconomic strata of society. Of course the question of inequality in bioethics is always a complex one and is therefore irreducible to the availability of a particular pharmaceutical or technology. But, as Nick Bostrom and Anders Sandberg have perceptively noted: 'There might … be a degree of complexity that is often overlooked in the ethical literature on inequality'.

> One should also have to consider under what conditions society might have an obligation to ensure universal access to interventions that improve cognitive performance. An analogy might be drawn to public libraries and basic education. Other relevant factors include the speed of technology diffusion, the need for training to achieve full utilization of an enhancement, whether and to what extent/what type of regulation is appropriate, and accompanying public policies. Public policy and regulations can either contribute to inequality by driving up prices, limiting access, and creating black markets; or reduce inequality by supporting broad development, competition, public understanding, and perhaps subsidized access for disadvantaged groups.[34]

Another possible problem associated with enhancement is that it will raise our standards of normalcy once the practice becomes widespread. This would mean that individuals who either choose not to enhance or who are unable to (because of cost) will be put at a disadvantage. This situation would result in coercion. Thus, even individuals who do not wish to be enhanced are 'forced' to do so since remaining in a job or in a school is dependent on it. But coercion works both ways with the dawn of accessible enhancement drugs and technology. Martha Farah, Judy Illes et el explain:

> The straightforward legislative approach of outlawing or restricting the use of neurocognitive enhancement in the workplace or in school is itself also coercive. It denies people the freedom to practice a safe means of self-improvement, just to eliminate any negative consequences of the (freely taken) choice not to enhance.[35]

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[34] Nick Bostrom and Anders Sandberg, 'Cognitive Enhancement: Methods, Ethics, Regulatory Challenges', *Sci Eng Ethics*, 2009, 15:329.
[35] Martha j. Farah, Judy Illes, Robert Cook-Deegan et el, 'Neurocognitive Enhancement: What Can We Do and What Should We Do?' *Nature Reviews Neuroscience* 2004, 6:243.

The widespread use of enhancement will increase social competition as students try to secure places in the best schools, get the best grades, and, after graduation, secure the best jobs. Competition would in turn increase the frequency of 'brain doping', exposing large segments of the population – especially children and young adults – to the adverse side effects and unknown long-term consequences of the overuse of neurocognitive enhancements drugs.

Other Issues

Although there is only anecdotal evidence for this, some have argued that enhancement may impede the maturity of the individual because it would enable him to achieve success without putting in too much effort. Those who raise this issue often use of the analogy of wealthy parents who make their children work during summer holidays to earn their spending money because they wish their children to learn the value of the experience. People generally are of the view that there is value in earning one's success, happiness, etc., and that this experience is important for individual growth and maturity. By creating shortcuts to success, enhancement drugs and technology, some have argued, have interfered with this important and necessary process. Some have also argued that the use of enhancement drugs to deal with social ills and bad behaviour has become a convenient way of refusing to acknowledge the failings of our institutions. The use of Ritalin is a case in point. Addressing the situation in some schools in America, Bostrom and Sandberg write:

> These medications can function as cognitive enhancers in healthy subjects, but their widespread use in the school-aged population in the U.S. has sparked fierce debates, with some arguing that these medications are often used to paper over the failings of the education system by making rowdy boys calmer instead of developing teaching methods that can accommodate a wider range of individual learning styles and needs.[36]

Another problem with enhancement is that it may result in the commodification of human abilities. Many ethicists maintain that human beings are an end in themselves and should never be treated as commodities that can be bought and sold. Put differently, persons have a special value that distinguishes them from other material things. One of the most fundamental qualities of the human being is his ability to live a meaningful life. An aspect of what constitute a meaningful life is the achievements and accomplishments of one's life that came about as the result of work and effort one has invested. Cognitive enhancements would infringe on some of these important aspects of our personhood in a way that raises a number of important concerns. As Martha Farah and Paul Wolfe has put it, 'Maximising the performance capabilities of already healthy, functional person can be viewed as commodifying human abilities'. This would in turn result in the devaluation of human achievements, and in the final analysis, the devaluation of the human person.

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[36] Bostrom and Sandberg, 'Cognitive Enhancement Methods', 324.

Neurostimulation

Another neurotechnology discussed in the BAC paper is brain stimulation, which it defines as 'the application of an electric or magnetic stimulus to the brain to modify or improve its function' (para 23). Some doctors see brain stimulation as a promising alternative to standard neurosurgery for the treatment of neuropsychiatric disorders. There are basically two types of neurostimulation. The first type is sometimes described as deep-brain stimulation (DBS) where electrodes connected to batteries in a pacemaker are implanted in a region in the brain. Patients can control stimulation to the brain by switching on and off the device. This technique can help patients whose physical functions were either impaired or lost due to neurodegenerative disorders to regain them to some extent. The technique is especially used on patients with advanced Parkinson's disease to restore coordinated movement and regain some motor control. Many patients with Parkinson's have opted for neurostimulation after Angen, the maker of glial-cell-line deprived neurotrophic factor, took the drug off the market in 2004.

The second type of neurostimulation technique is Transcranial Magnetic Stimulation (TMS). This non-invasive technique is reported 'to be effective in patients with major depression who have failed to respond satisfactorily to or cannot tolerate antidepressant medication' (para 29). TMS is also found to be effective in the treatment of a whole range of disorders (para 29). Other alternatives to DBS, not discussed in the BAC paper include electroconulsive therapy (ECT), vagus nerve stimulation (VNS) and echo-planar magnetic resonance spectroscopic imaging (EP-MRSI). Although neurostimulation has arguably enjoyed modest success in treating certain neuropsychiatric disorders, there are a number of serious concerns associated with the technique that may have important ethical and social implications.

Problems with the Technique

In the case of DBS, great precision is needed in the implantation and stimulation of electrodes in the brain. Scientists have noted that implanting and stimulating the region even as narrow as one millimetre off the intended target could induce unforeseen adverse neuorological sequelae. Patients could as a result either suffer seizures, become emotionally passive or flat or even become suicidal. Even when the targeted area is stimulated as planned, the fact that one circuit of the brain is activated to the isolation of other circuits may lead to problematic outcomes, some of which are severe, such as the impairment of the patient's motor control. Such an outcome would of course defeat the very purpose of the treatment. Here, safety issues, which will be discussed below, are linked to the fact that the technique itself is imperfect or inadequate. Thus, careful selection of patients[37] and the strict guidelines for the application of these techniques on patients with psychiatric illness[38] are of paramount importance.

The fundamental problem with neurostimulation techniques, according to some neuroethicists, is that medical researchers working in this field do not know exactly how brain stimulation work.[39] Some of these techniques are effective only up to a point because they can only penetrate only so far into the brain. For example, TMS could only activate the cortex because the strength of the magnetic field falls sharply as the distance increases, even by only a few centimetres. Additionally, the effect of TMS on the targeted areas is only short term and therefore the improvement it brings is transient. This means that many patients would require repeated treatment, even though the risk of seizure increases in repeated TMS (rTMS). The problem of the isolated activation of one circuit in the brain has already been noted above. A somewhat related issue has to do with the fact that our brains are wired differently. This means that 'the location of the neural source or sources of a mental disorder may not be the same for two different people with the same disorder'.[40] Furthermore, two people with the same disorder and exhibiting the same symptoms may not respond to brain stimulation in the same way. These considerations have ethical implications that should not be overlooked. They must determine how and to what extent the technology is used, and they must shape the guidelines and protocols governing the therapeutic application of these techniques.

Question of Safety

The main safety issue pertaining to neurostimulation is that the procedure may produce a seizure. The likelihood of this happening especially for TSM and rTSM is small, although the risks are higher with DBS. There are also relative and absolute contraindications to TMS. These include the presence of metal in the head, cardiac pacemakers, intracranial or intracardiac electrodes, a history of

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[37] Sabine Müller and Markus Christen, 'Deep-Brain Stimulation in Parkinsonian Patients – Ethicsl Evaluation of Cognitive, Affective, and Behavioural Sequelae', *AJOB Neuroscience* 2011, 2 (1): 8.
[38] B. Nuttin et al, 'Ethical Guidelines for Deep-Brain Stimulation', *Neurosurgery* 2002, 51:519.
[39] Glannon, *Bioethics and the Brain*, 140.
[40] Glannon, *Bioethics and the Brain*, 141.

seizures and epilepsy and patients taking medicine that might increase the risk of seizures.[41] Doctors and neurologists working with patients with Parkinson's have noticed that some have developed mania and other abnormal behaviour after receiving DBS treatment. Cases of patients developing edema and infection at the sites of the stimulation also been reported. Furthermore, there is to date insufficient studies to ascertain the long-term effects of such treatments. As we have seen, neural stimulation can either excite of inhabit neurons. In some cases, the techniques are used to achieve both, but it is difficult to balance and control the effects of the stimulation. The effects are dependent to some extent also on the frequency that is used and the areas of the brain that are targeted. And, as we have pointed out earlier, because our brains are wired differently, it is difficult to anticipate the risks without the benefit of long-term studies using placebo-controlled trials. As Steven and Pascual-Leone have pointed out, '… TSM has only been studied for approximately 20 years and the data on potential long-term effects in humans remain insufficient. Although animal studies using TSM have not indicated any risks of brain damage or long-term injury, caution remains imperative'.[42] Furthermore, it is not always clear whether neuorstimulation would be more effective in some cases of psychiatric disorders and some patients than drug therapy. These uncertainties and potential risks, however, do not mean that such techniques should be prohibited.

> Rather, more long-term studies are needed to adequately assess their benefits and risks. Given the uncertainty about the effects of these techniques, the same strict experimental conditions should be applied to all forms of neurostimulation, regardless of degree of invasiveness. In addition, informed consent from patients or subjects, or from surrogates, must be obtained. This requires that the researcher explain the potential benefits and risks of these techniques and risks. Finally, the medical uncertainty of these experiments indicates that they are ethically justifiable only when the neuropsychiatric conditions they are designed to treat are refractory to pharmacological or other proven treatments.[43]

Brain-Computer Interfaces

One of the most fascinating of the new neurotechnologies is brain-computer interfaces (BCIs) or neural prosthetics. This technology enables people suffering from paralysis to control patterns of neural activity through their thoughts to indirectly perform movements and tasks. The BAC defines BCI as 'a system that allows its users to interact with their surroundings by controlling devices such as computers, automated wheelchairs and artificial limbs solely with brain activity, without the normal intermediaries of peripheral nerves and muscles' (para 31). As the BAC points out, there are non-invasive, partially-invasive and invasive

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[41] Megan S. Steven and Alvaro Pascual-Leone, 'Transcranial Magnetic Stimulation and the Human Brain: An Ethical Evaluation', in Judyl Illes (Ed.), *Neuroethics: Defining the Issues in Theory, Practice and Policy* (Oxford: University of Oxford Press, 2006), 206.
[42] Steven and Pascual-Leone, 'Transcranial Magnetic Stimulation', 206.
[43] Glannon, 'Neurethics', 49.

BCIs, and therefore users of this technology face different degrees of risk. The BAC provides a list of possible risks such as injury to the brain and infections. These risks are especially associated with invasive forms of BCI. There are, however, several important philosophical and ethical issues associated with BCIs that the BAC paper does not address.

Intentions and Decisions

An important philosophical question surrounding the use of BCIs has to do with the distinction, if there indeed is one, between intentions and decisions. Intention is notoriously difficult to define, but it may be described as involving a complex combination of desires, beliefs and reasons. Philosophically (and logically), we must make the distinction between having an intention, making a plan and executing that plan in the form of concrete actions. Furthermore, it is possible for a person to have an intention and to draw up a plan of action, but failed in the end to execute it because he suddenly changed his mind. It is also possible for a person to have an intention and not act on it at all. This raises the question of whether the BCI system is sophisticated enough to make the distinction between intending to perform a particular act and deciding to execute the act. It raises the question of whether we are sufficiently confident that we know exactly which regions of the brain are involved in these different mental acts. Additionally, there is also the question of how much control a person can have of his brain signals and how these signals activate the neural prosthetics to perform a certain act. If neuro- scientists and technicians are unable to answer these questions with sufficient certainty, BCI systems could make people perform certain actions involuntarily, and this might have serious safety and ethical implications.

Agency and Responsibility

One of the most pressing ethical problems associated with this problem has to do with agency and responsibility. It is of course the responsibility of scientists and technicians to develop BCI systems with its devices and computational algorithms in such a way that they have maximum reliability. But regardless of how sophisticated our systems may be, they can never be 100% error-free. Should there be an involuntary act on the part of the user of BCIs due to an erroneous interpretation of intention and decision on the part of the system, should the user be held responsible for the resulting act? Should he bear the consequences? One possible way of achieving slightly more clarity in thinking about this is to determine the relationship between the neural prosthetics and the patient, that is, how integrated is the former to the latter. For example, when the prosthetics is external to the patient, that is, if it is not in some sense integrated to him, responsibility for the error of interpretation and execution can be attributed to the scientists, technicians and industrial agencies associated with the development and production of the device. But if the prosthetics in question is integrated to the self-concept of the patient, for example, an implanted chip, then the patient himself must bear some responsibility, even though the action is the result of an erroneous interpretation. The patient may be said to be *responsible* for a *disaster* caused by a *mistake* analogous to accidentally knocking over and smashing a vase. In any case, as Jens Claussen has wisely pointed out:

> Since possible malfunctions are not specific to neural motor prostheses but in principle inevitable whenever technical devices are used, established procedures may be adapted to the medical applications of BMIs. Possible risks due to technical failures are typically addressed by insurances. Insurances are obligatory for technical devices which put third persons at severe risks if one is to protect innocent people from damages and to be able to award compensations where necessary. Whether an obligatory insurance is appropriate for BMI-based prostheses depends on prostheses-related risks and their estimate severity. Additionally, as a precaution the execution of some actions (such a flying a passenger plane) with the help of BMIs may be prohibited.[44]

Other Issues

There are a number of other social and ethical issues that must be briefly mentioned at this point. BCIs and similar technologies can be used not only for the restoration of functions lost because of accident or injury but also to enhance the abilities of normal and healthy people. The use of neurotechnologies for such ends pose additional social and ethical problems, some of which are already discussed in a previous section of this paper. Although not associated only with neurotechnologies, implanted microchips can also be used to track humans, raising the problems of privacy.[45] Expanding on an issue already raised above, because the brain is the biological basis of human personhood or personality, the technological manipulation of the brain could result in radical changes whose long-term effects are still not properly studied and understood. Therefore, as Clausen has observed, 'questions of mental changes, shifting personality and personal identity come up when interventions into the human brain in general and technological implants specifically are discussed'.[46] Finally, even if these technologies were perfected so that the risks are significantly reduced, they would still be expensive. This means that certain segments of the population (perhaps the people who need these technologies the most) are not able to take advantage of them.

Stem Cell Therapy

The introduction of human stem cells to the brain to repair or restore certain functions is a promising strategy especially for patients with Alzheimer's or Parkinson's disease. Although the transplantation of cells and tissues into the brain is still at an experimental stage, exciting research is being conducted to

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[44]Jens Clausen, 'Moving Minds: Ethical Aspects of Neural Motot Prosthese', *Biotechnol. J.* 2008, 3: 1498.
[45] Kenneth Foster, 'Engineering the Brain', Judy Illes (Ed.), *Neuroethics* (Oxford: Oxford University Press, 2006), 196.
[46] Clausen, 'Moving Minds', 1496.

ascertain its therapeutic applications. The Council broadly encourages such research because of its possible contribution to regenerative medicine that seeks to regenerate cells, tissues and organs that have either failed or are failing due to disease. However, the Council maintains that the use of human embryonic stem cells for such research should be prohibited. This is because the Council maintains that human life begins at conception and that the human embryo is a human being worthy of respect and protection. The Council supports the use of progenitor cells procured from bone marrow, adult humans, and human umbilical cord blood. The Council also encourages more research in the area of induced pluripotent stem cells (iPS cells) because of their malleability and because their use does not raise serious ethical issues.

Due to the fact that stem cell therapy to the brain is still at the experimental stage, it is imperative that we remain very cautious and alert to the risks associated with the therapy. The BAC has very briefly listed some of these risks (para 41). Perhaps a more detailed discussion is required to enable readers to better appreciate their seriousness.

<u>Risk of Tumours</u>

According to reports of experimental Parkinson models, the risk of patients developing tumours as the result of stem cell therapy is a real one. One report cited a 20% risk of new onset tumours in experiments where undifferentiated stem cells are used. The use of viral vectors and the attempts to guide the differentiation and effectiveness of dopaminergic neurons (in the case of Parkinson's) has the risk not only of losing control of the viral transmission and missing the target but also that of mutagenesis (developing a mutation).

<u>Inadequate Migration</u>

As a more accurate and refined method of target migration is still a challenge for scientists, the risk of migration defects resulting in heterotopias (displacement of clumps of grey matter in the brain) is still great. This in turn could result in complications such as a form of epilepsy that is difficult to control (refractory) and other serious neuropathological conditions.

<u>Transplant Rejection and Infections</u>

There will always be immune rejection conditions in neural adult stem cell transplants. 'Theoretically, since cells are more differentiated in adult tissues and more antigenic they might require greater use of immunosuppressive drugs with the inherent additional risks such as liver and renal toxicity, hypertension and immunodeficiency'. In addition, the risk of infections resulting from the introduction of stem cells should also be taken seriously. 'This is a constant risk in every cell transplant process in which pathogens may be transmitted from the donor to the recipient, such as hepatitis B or C, lymphotropic virus, HIV/AIDS, cytomegalovirus, and herpes simplex virus. In addition, there is also the risk of infection in the culture media and in handling the samples, either from bacteria (Staphylococcus, Streptococci, *E. coli*), yeasts, spores, and prion diseases'.[47]

In light of the above risks, we not only have the responsibility to expand research in this area, we also have the responsibility not to harm any individual. As Glannon has put it,

> We … have a responsibility to ensure that neural stem-cell transplantation is safe and effective so that people could benefit from it and not be harmed. This is especially important for the protection of vulnerable individuals such as children, who may not understand the risks of procedures designed to treat chronic neurological disabilities.[48]

NEUROSCIENCE RESEARCH

In the final section of its consultation paper (paras 45-69), the BAC raises a number of important questions on research involving human subjects. Many of these questions and issues are pertinent to different types of research involving human subjects and are therefore not exclusive or unique to neuroscience. In fact, the BAC has already addressed a number of the issues raised in this section in previous consultation papers and reports. The recommendations and guidelines found in these earlier documents are therefore applicable to the cases and questions raised in this consultation paper that is focussed on research in neuroscience. For example, in its paper 'Ethics Guidelines for Human Biomedical Research' which was issued on 20 June 2012, the BAC has presented comprehensive guidelines on the issue of informed consent involving vulnerable persons (3.15). These guidelines should apply to neuro-scientific research on persons with diminished mental capacity (A. para 47-51). That research involving such persons is important because it may yield results that would be of significant benefit to them and others is not in doubt. What is important is that such persons must be protected from abuse and exploitation. The same applies to research involving children. In paras 3.22 to 3.26 of the 2012 paper, the BAC has also presented some guidelines on research involving children. Although terms like 'minimal risk' should be further clarified, the guidelines are generally sound and relevant to neuro-scientific research on children. The question of neuro-enhancement has been addressed in a previous section of this paper. The question of clinically significant incidental findings has also been addressed in the 2012 paper (para 3.29-3.33). The guidelines are sufficiently comprehensive to include research in neuroscience. However, there is one particular issue that deserves further discussion and closer attention.

Sham Surgery

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[47] Rodrigo Ramos-Zúñiga, Oscar González-Pérez et el, 'Ethical Implications in the Use of Embryonic and Adult Neural Stem Cells', *Stem Cells International* 2012, Article ID 470949, 4.
[48] Glannon, *Bioethics and the Brain*, 129.

As the BAC has rightly noted, the use of sham surgery in clinical trials especially for patients with Parkinson's disease is highly controversial (paras 54-55). Sham surgery is used to address the placebo effect in clinical trials and chiefly to ensure that the experimental design is adequate. Part of the difficulties associated with surgical studies has to do with determining to what extent is the effect due to the surgery itself and to what extent is it due to the placebo effect. Sham surgery is used in surgical trials to equalise the placebo effect of surgery. This procedure would enable researchers to more accurately assess the direct effect of the surgical procedure.
Thus, the problem sham surgery poses has to do with the tension between the highest standard of research design and the highest standard of ethics. The question is when these two standards are on conflict, which should be allowed to prevail, and how can a balance be struck if researchers are unable to meet both simultaneously.

As with any surgical procedure, sham surgery presents risks to the research subject. For example, in a recent trial of the treatment of pain in cancer patients, researchers inserted capsules into a space at the base of the spine by lumbar puncture. In some subjects the capsules contain an analgesic that could relief pain, while in other subjects the capsules contain an inert substance. According to one report 10 percent of the patients experienced headaches that lasted a couple of days after the procedure. Furthermore, there is also a risk of permanent nerve injury or even paralysis. The risks of such surgeries cannot be described as minimal. The assessment of risks associated with sham surgery is of course subjective. For example, a group of researchers in Yale University decided against conducting sham surgery because of unjustifiable risks to research,[49] while another researcher likened the risk involved to that of going to the dentist.[50] Part of the problem in assessing the benefits and risks of a certain procedure is that the objectivity required for more precisely judgement is often elusive. The National Commission for the Protection of Human Subjects of Biomedical and Behavioural Research (in the US) recognises this in its report:

> It is commonly said that benefits and risks must be 'balanced' and shown to be 'in a favourable ratio'. The metaphorical character of these terms draws attention to the difficulty of making precise judgements. Only on rare occasions will qualitative techniques be available for the scrutiny of research protocols. However, the idea of systematic, nonarbitrary analysis of risks and benefits should be emulated insofar as possible.[51]

Be that as it may, the Council believes that performing a surgery for non-therapeutic purposes is ethically problematic even if it is meant to ensure the

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[49] L. Johannes, 'Sham Surgery is Used to Test Effectiveness of Novel Operations', *Wall Street Journal*, December 11, 1998: A1, A8.
[50] S.G. Stolberg, 'Decisive Moment on Parkinson's Fetal-Cell Transplants', *New York Times*, April 20, 1999:F2.
[51] National Commission for the Protection of Human Subjects of Biomedical and Behavioural Research, *The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research* (Washington, D.C.: Government Printing Office, 1978), 85.

integrity of the research in question. Thus, the Council would privilege ethical standards over research design. The Council believes that this basic approach is supported not just by the Christian moral tradition but also by the collective wisdom of society, especially in the wake of the atrocities of the Second World War. Thus, the Nuremberg Code of 1947 explicitly states that all research should avoid inflicting unnecessary physical or mental suffering. The Code also insists that the risks involved in any research involving human beings should not exceed the humanitarian significance of the problem it aims to solve. In similar vein, the Declaration of Helsinki of 1964 echoes the principles enshrined in the Nuremberg Code when it emphatically maintains that 'concern for the interests of the subject must always prevail over the interests of society and science'. In its 2012 consultation paper entitled, 'Ethics Guidelines for Human Biomedical Research', the BAC delineates the ethical principles that inspire and shape its recommendations. Two of these principles, namely respect for persons and beneficence, relate directly to the issue of sham surgery. The flipside of beneficence is nonmaleficence, which urges researchers and physicians to 'do no harm', that is, to refrain from providing ineffective treatments. This principle should serve as the basis for prohibiting the use of sham surgery.

The Council maintains that performing a surgical procedure that has no other benefit except to produce the placebo effect violates the principle that risks of harm should be minimised in the conduct of research. Sham surgery must be distinguished from inert substance used as placebo in a drug trial for obvious reasons: the inert substance has no adverse effects on the research subjects. In a recent study to evaluate the intracranial implantation of fetal neural cells for Parkinson's disease, some study patients underwent randomised sham surgeries that simulated all aspects of the surgery, including the drilling of burr holes on the skull under anaesthesia. The Council maintains that such surgery should not conducted on study patients in order to achieve a certain standard of research design because it puts the research subjects at considerable risks. The Council therefore fully concur with Ruth Macklin of the Albert Einstein College of Medicine that:

> Sham surgery is ethically unacceptable as a placebo control in trials of fetal-cell transplantation in patients with Parkinson's disease. Sham surgery, with accompanying anaesthesia, poses risks of any surgical intervention that would not be used alone for therapeutic purposes. In trials that use antibiotics to protect subjects against inflection, there are the added risks associated with antibiotic treatment. In trials that forgo the use of antibiotics in the sham-surgery group, there are the added risks of infection … The placebo-controlled trial may well be the gold standard of research, but unlike pure gold, it can be tarnished by unethical applications.[52]

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[52] Ruth Macklin, 'The Ethical Problems with Sham Surgery in Clinical Research', *The New England Journal of Medicine*, September 1999, 341: 996.