

The Art of Medicine

Empowering brain science with neuroethics

More than two decades ago I was a young researcher in a laboratory in San Francisco, California, using multichannel electroencephalography (EEG) to study the functions of the brain. One of our experiments was on the effects of fatigue on memory, and we were interested to learn how the brains of elite professionals whose work required extraordinarily long periods of wakefulness and attentiveness differed from people with more ordinary wake-sleep schedules. Fighter pilots were our target group, and each received an MRI that provided the structural map on which we would overlay the functional signals once we had analysed them. In one case of a fit young man, the MRI suggested a brain anomaly of potential medical significance. As non-physician researchers, we were ill-equipped to deal with such an incidental finding. We were not trained to read MRI, did not formally have a physician partner who could, and had not put in place a protocol for seeking the advice of one. What we did know was that if we disclosed our suspicion, whether the finding turned out to be a real health threat or a false alarm, the career of this pilot would probably end there and then. We remained silent. That was the 1980s.

Fast forward to the present. Neuroethics has established itself as a discipline dedicated to tackling tough practical questions like those of unexpected brain anomalies in research and has been moving age-old debates about

mind and brain towards modern theoretical discussions about the understanding of human behaviour enabled by advances in neurosciences. In unusually interdisciplinary collaboration between neuroscientists and scholars from ethics, philosophy, law, and others who focus on the implications and applications of science, consideration of the ethical, legal, social, and policy challenges of neuroscience have been explicitly brought forward. These initiatives are allowing neuroethicists to think about topics well known to other pursuits within the domain of research and bioethics, such as consent, confidentiality, and disclosure, and others unique to the brain, such as personhood, authenticity, agency, and mental states. Through this wide lens, the societal implications both of laboratory studies and clinical neuroscience studies have come into view.

Issues of personhood and authenticity, for example, have become hotly debated among neuroethicists as pharmaceuticals developed for improving mental health disorders, sleeping disorders, or attention disorders in children are now being consumed at high rates as off-label “cognitive enhancers” to boost mood, memory, and alertness. If these drugs, or substances like oxytocin, become the Viagra of daily functioning and create new benchmarks for productivity, wakefulness, and emotional love, what will happen to the fabric of society and the character of our interactions with one another? Are these altered states a genuine reflection of a new and improved “me” or “we”, or some transient drug-induced condition that thoroughly confounds what we inherently value? Will we be coerced into conforming to a wave of drug intervention in the ever expanding, do-it-yourself, self-help world? The race for cognitive enhancers poses questions of social justice as well. Will the opportunity gaps between those who can afford them and those who cannot be widened or narrowed? Will the safety of some be compromised as low-cost, poor-quality alternatives are acquired on the black market or on the unregulated internet? Moreover, what happens if enhancement by drugs becomes obsolete, only to be replaced by possibly more enduring, lower-maintenance forms of neurotechnological interventions, such as direct brain stimulation through implanted devices or with stem cells?

Interlinked with these concerns is the ever-improving understanding of the neurobiology of behaviour for which questions about social policy and law come into play. For example, neuroscience has done much to explain how the adolescent brain is not fully developed and myelinated before the age of roughly 21 years, complementing readily made observations and fundamental intuitions about risk-taking behaviour and notions of right and wrong in this age group. But given the diversity of people and their experiences

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within a complex world—whether they are young people or adults—how can a biological explanation of the brain alone inform notions of moral agency, intention, and motivation? It is hard to imagine, as some neuroethicists have asserted, that a purely reductionist, neuroessentialist explanation of the brain working in isolation of society can fully account for these intangible human phenomena.

On equally bumpy terrain, how shall scientists, physicians, legal scholars, policy makers, and society at large manage new tests that may soon be able to forecast with acceptable reliability unacceptable levels of risk for aggression, sociopathy, psychopathy, and suicide? Neurogenetics may get us there. Neuroimaging may get us there. The recent coupling of neurogenetics and neuroimaging known as imaging genetics will surely get us there. The power of this combined technology, in fact, places it at the forefront of available tools for the in-vivo study of brain responses and functional genetic variation.

First introduced for Alzheimer's disease, successful imaging genetics studies unleashed others on apolipoprotein E and memory systems, catechol-o-methyltransferase and prefrontal cortical executive function, and 5-HTT and emotional systems in the amygdala. Prominent studies focused on common gene variants known to affect cognitive and behavioural processes within the normal range, as well as on various disorders, such as anxiety, stress, and schizophrenia. With advanced capabilities, will an integrated understanding of the genetics and brain biology of these conditions or others, such as addiction, promote the development of more effective interventions than before, good compliance with therapeutic protocols, and reduce stigma? Or will they plunge those affected into fatalistic states of hopelessness out of which they feel they cannot ever emerge?

Today, imaging genetics resides in the laboratory with translation to clinical application still a vision for the future. But the horizon for translation is not a distant one. Like other capabilities that emerge to yield powerful information about people and their brain wellbeing, the impact on health care, especially for neurological and psychiatric disorders for which cures remain elusive and for resource allocation across varying health-care systems, will be profound. Whether the system is health-driven or profit-driven and who will cover the costs of predictive testing and the societal and medical follow-up that will inevitably be needed is unknown. Entrepreneurs will surely lose no time in selling the technology directly to consumers who may be curious for what they interpret to be a neurogenetic signature or fearful about their neurogenetic status. What, and how much, would you want to know? At what personal and financial cost? It will fall to the new breed of neuroethics scholars, among others from traditional disciplines, to guide responsible responses and effective interventions to such extraordinary progress in neuroscience and the medical and societal challenges they will pose.

While many aspects of neuroethics enjoy growing international participation, the direction of the field is still charted primarily by scientists and scholars from English-speaking countries and the discourse is based primarily in western ethics and moral philosophy. Yet I believe that a global health neuroethics is also vital to pave the way for a mutually informing path focused on the broader world community. Research with brain imaging is surely not likely to be a first priority for developing countries. However, global health neuroethics can provide new ways to address compelling challenges at the intersection of brain health and disease that respect and value the differences and commonalities between health issues and systems for individuals, societies, and multicultural communities. For example, despite positive system-wide changes in the former Soviet Union, public distrust in regional health care is still pervasive, especially with regard to mental health care. Mental health services are underused, satisfaction with the quality of care and outcomes is low, and treatment options are limited. Stigma and discrimination are major health and public policy challenges. Another issue that tests clinical, research, and cultural boundaries is medical tourism. Tensions surround still unregulated, scientifically unvalidated stem cell interventions, for example, offered in many regions of Europe and Asia for people with multiple sclerosis and other neurodegenerative diseases. Better solutions for care and consent are needed for those travelling to locations distant from their homes in pursuit of help and hope.

The eye of neuroethics is on the wellbeing of people and society. It is on empowering brain science to promote health by incorporating values into the experimental process earlier than ever before, using knowledge about those values to shape strategies for translation of results into effective and culturally attuned treatments and cures, and ensuring the trust of all beneficiaries of science and medicine. Guidelines for handling incidental findings have been proposed, refined, published, and adopted by many laboratories and institutional review boards. That early and ongoing work is a model for flexibly and pragmatically tackling other challenges that neuroscience faces in neurology and psychiatry, and in the public and commercial spheres as human curiosity and innovation continuously test personal and cultural limits, risk and benefit, and right and wrong. To this end, I think of the pilot often. He did not have the benefit of this visionary thinking in 1980. He would today.

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Judy Illes

National Core for Neuroethics, Division of Neurology, Department of Medicine, The University of British Columbia, Vancouver, BC V6T 2B5, Canada
judy.illes@ubc.ca

Further reading

- Illes J, Bird SJ. Neuroethics: a modern context for ethics neuroscience. *Trends Neurosci* 2006; **29**: 511–17.
- Illes J, Kirschen MP, Edwards E, et al. Ethics. Incidental findings in brain imaging research. *Science* 2006; **311**: 783–84.
- Lombera S, Illes J. International dimensions of neuroethics. *Developing World Bioethics* 2008; **9**: 57–64.
- Tairyan K, Illes J. Imaging genetics and the power of combined technologies: a perspective from neuroethics. *Neuroscience* 2009; **164**: 7–15.
- Illes J, Borgelt E. Incidental findings: in practice and in person. *Nat Rev Neurosci* 2009; **5**: 643.
- Illes J, Moser MA, McCormick JB, et al. Neurotalk: improving the communication of neuroscience. *Nat Rev Neurosci* 2010; **11**: 1–69.
- National Core for Neuroscience. <http://neuroethicscanada.ca> (accessed Oct 1, 2010).