EMBO reports

viewpoint

The implications of the new brain sciences

The 'Decade of the Brain' is over but its effects are now becoming visible as neuropolitics and neuroethics, and in the emergence of neuroeconomies

Joelle M. Abi-Rached

In November 2007, seven neuroscientists and political consultants published an opinion-editorial (op-ed) article in the *New York Times* in which they made predictions about how swing voters would react to the candidates in the Democratic and Republican Primaries for the US Presidency (Iacoboni *et al*, 2007). The intriguing aspect of their predictions was that the authors had used functional magnetic resonance imaging (fMRI) to measure the response of their test subjects' brains to videos and photographs of Hillary Clinton, Mitt Romney, Rudy Giuliani and the other candidates. On the basis of which areas of the brain showed increased or decreased activity, the scientists determined how each person had reacted and deduced the acceptability of the Primary candidates to undecided voters in general. But, perhaps most intriguingly, none of this research had been—or has been—published in a peer-reviewed journal.

…neuroscience has become 'big science', in so far as it is now of interest to the public

Three days later, the *New York Times* published a letter from 17 neuroscientists from the USA and Europe who were critical of both the conclusions of Marco Iacoboni, a neuroscientist at the University of California Los Angeles, USA, and his co-authors, and the way in which the experiment was published (Aron *et al*, 2007). "As cognitive neuroscientists, we are very excited about the potential use of brain imaging technology to better understand the psychology of political decisions. But we are distressed by the publication of research in the press that has not undergone peer review, and that uses flawed reasoning to draw unfounded conclusions about topics as important as the presidential election," the authors wrote. It also turned out that the predictions in the op-ed piece were not that good: "Barack Obama and John McCain have work to do," Iacoboni and the other authors had written. "The scans taken while subjects viewed the first set of photos and videos of Mr McCain and Mr Obama indicated a notable lack of any powerful reactions, positive or negative." Needless to say, Barack Obama is now President-elect of the USA.

Presidential elections aside, the episode shows that neuroscience has become 'big science', in so far as it is now of interest to the public. Indeed, the enormous progress made in neuroscience research during the 'Decade of the Brain', as US President George W. Bush dubbed the 1990s, has created the expectation that we will finally understand topics ranging from how humans perceive themselves as conscious beings, to the molecular basis of many psychiatric disorders, to why people favour one brand of lemonade over another. Moreover, advances in our understanding of the molecular basis of brain functions, as well as improvements in psychopharmacology, neuroimaging and various therapeutic applications—deep brain stimulation for the treatment of dystonia and Parkinson disease, for example—are also changing the way in which we perceive ourselves. This knowledge is increasingly informing public policies, whether in education, security or health.

The ethical, social, economic and political impacts of the modern brain sciences have become the cornerstones of new interdisciplinary platforms that bring together social scientists, brain researchers and other practitioners. One of the newest, launched in November last year in London, is the European Neuroscience and Society Network (ENSN; London, UK; http://www.neurosocieties.eu/). The discussions and presentations given during the launch conference, which attracted almost 100 participants from Europe, the USA and Australia, highlighted the dire need for a European public forum in which various stakeholders in the brain sciences can investigate concerns and problems from different schools of thought and practice.

In fact, little is known about the public perception of the brain sciences or their wider implications for society, despite the increasing public interest in the mental and psychological disorders the research seeks to understand. The burgeoning patient and advocacy groups for diverse neurological and mental disorders—in addition to the abundant self-help literature on memory, intelligence and emotion, for example, as well as the increasing media coverage of neuroscience research applications—are all raising the status of neurological research in the public eye. But how is it possible to identify the agents that drive the agenda of the brain sciences? Is the direction of neuroscience research a democratic process, or one that is driven by select groups with political, economic or other interests? Moreover, are the brain sciences challenging our understanding and definition of collective interests, and are these in conflict with an individual's right to privacy? Lastly, is there a need for a genuine 'European voice' in this debate?

As the episode mentioned at the start of this article shows, the media have an important role in communicating and shaping claims from neuroscience. However,

the realities of neuroscience research are naturally much more complex than the simplified media reports about new insights into our minds and brains. The intense controversy sparked by the article in the *New York Times*—including a scathing editorial in *Nature* (Anon, 2007)—is certainly an exemplar in that respect. Indeed, the deluge of criticism that the op-ed piece garnered was partly due to the real lack of debate about neuroscience findings, their limitations, and the potential implications and applications of the research.

Regardless of the op-ed article's scientific validity, Marco Iacoboni has certainly articulated interesting questions and thoughts about neuroscience research, and its applications, on a popular blog about neuroethics and law. The use of fMRI seems uncontroversial when used by scientists in a laboratory to study the mental functions that underlie religious beliefs, artistic inclinations, love, decision-making or political behaviour. "One way of disseminating the scientific method in our public discourse is to use the tools and approaches of science to investigate issues that are salient to the general public. In neuroscience, we have now powerful tools that let us do this. We can study how people make decisions and form affiliations not from a timeless perspective, but from the perspective of what is salient 'here and now,' for instance the current electoral campaign. These are the kinds of studies that naturally engage the general public," Iacoboni wrote (http://kolber.typepad.com/ethics_law_blog/2008/06/iacoboni-respon.html). Therefore, what is so wrong in extending the use of fMRI and other technologies to the study of real-life cases and scenarios? As Iacoboni has pointed out, there is no such debate yet among scientists.

Some scientists at the ENSN meeting argued that it might be more useful to correctly formulate the questions that neuroscience seeks to address in the first place, rather than just discussing the progress of methods, new technologies and experiments designed to answer those questions. Consider, for example, the claim that brain imaging can 'detect' lying or 'hidden intentions' (Haynes *et al*, 2007). Instead of pursuing and refining this application of imaging technology, we should rather start with the question: what do we mean by 'lying'? Similarly, the use of brain imaging to determine whether the accused party can be held responsible for his or her crimes begs

the question of what do we actually mean by responsibility?

This illustrates the need to contextualize scientific claims and to understand what neuroimaging really measures. Do we measure the different functions of the brain that drive specific human emotions and behaviour—such as greed, love and fear—or do we only see general activation patterns? In the latter case, how should we interpret these patterns; are we able to establish correlations with specific mental processes?

Kenneth Hugdahl, a member of the ENSN steering committee and Professor of Biological and Medical Psychology at the University of Bergen in Norway, argued that this search for the specificity of mental states is "fundamentally wrong, philosophically speaking". Contrary to what is claimed, brain imaging does not tell us whether a person is lying or not: rather, it shows a certain state of mind—such as anxiety and/or fear—that we associate with lying. Moreover, these interpretations are based on statistics derived from data gathered using variably sized groups of people, who were tested mostly in a laboratory environment. Given the artificial environment, the statistical distribution of data, and other inherent limitations and margins of error, it seems that detecting specific mental states is not as easy as is often claimed. Consequently, we should be much more careful in applying these technologies for highly sensitive uses such as security or in the legal system.

…confirming and analysing the interplay between science and politics is not an attempt to question science's legitimacy, but rather to examine its relevance

And yet, there is a persistent and uncritical belief in the power of neuroscience and its technologies that is feeding a growing neuro-inspired marketing industry focused on analysing consumers' perceptions and tastes, and predicting their behaviour. 'Neuromarketing' companies such as Lucid Systems (San Francisco, CA, USA), for example, promise to produce "unimpeachable scientific data—telling you not what people say about your products, but what they truly think about them" (www.lucidsystems.com). Such claims of being able to reach the 'hidden truth' or the authentic consumer brain through a supposedly indubitable scientific method are only possible because of the lack of informed debate about neuroscientific technologies, their limitations and their potential ethical, societal and economic implications. So far, these types of company seem to be a uniquely American phenomenon, but it might only be a matter of time until marketing research companies worldwide begin to use advanced brain imaging to study the minds of consumers everywhere.

Neuromarketing, in turn, is only one small aspect of the larger neuroeconomy that includes the psychopharmaceutical industry, the neurological products themselves—from devices that claim to stimulate brain function, to psychiatric drugs or therapies, and diagnostics for a range of neurological and mental disorders—the financial services, the marketing companies, the consumers and, lastly, its own financial index: the NASDAQ NeuroInsights Neurotech Index or 'NERV', in reference to 'nerves' or the 'nervous system'. NERV was created by the NASDAQ stock exchange in New York (NY, USA) in conjunction with NeuroInsights (San Francisco, CA, USA)—a research firm that analyses trends in neurotechnology. Its founder, Zack Lynch, referred to these growing neuromarkets as "emerging global neurosocieties" that represent those who invest in the neurotechnologies. But none of these developments specifically address the ethical, medical and legal dilemmas—particularly those related to psychiatric drugs—that are created by the rapidly growing neuroeconomies (Anon, 2002; Farah, 2002; Illes, 2003; Rose, 2002). Moreover, we also need a thorough analysis of how the growing neuroeconomies are having an impact on social justice, and whether they are influencing the direction and dynamics of scientific research.

Indeed, the interface between the brain sciences and the social sciences is highly fertile ground for the creation of new objectives of scientific study, as well as for new concerns and topics for debate about how to use these technologies and the knowledge that they create. One more telling and popular example is that of 'neuropolitics'. During the ENSN launch conference, the term was used to refer to the interaction between scientific knowledge, political discourse and policy-making to reflect the discussion on the 'global burden of mental and neurological disorders' (WHO, 2001) and the different agendas to tackle it. Yet, it also includes studies intended to understand the neural basis of political behaviour such as Iacoboni's work and others (Kaplan *et al*, 2007; Oxley *et al*, 2008) or to explain our behaviour in a pluralistic society (Connolly, 2002). Another related field is 'neuropolicy', which has its first dedicated research centre at Emory University in Atlanta (GA, USA) and which aims to explain the neural basis of decision-making in politics, policy and business.

This new vision of a neuroscience of stress has clear 'biopolitical' consequences as it provides an opportunity for governments to shape public health policies by focusing on social inequality

We are also witnessing the emergence of 'neuroculture', whereby artists engage with the new brain sciences and neuroscientific findings and use these as a new medium for expression (Frazzetto, 2008). This is notably different from so-called 'neuroart' or 'neuroaesthetics' research that studies the neural basis of artistic behaviour, aesthetic perception and experiences (Zeki, 1999). Varied though they are, all of these emerging fields, trends, markets or research topics use neuroscience as an innovative, and perhaps more 'convincing', language with which to explain our complex interactions in an intricate network of heterogeneous media, politics, economies, bodies, minds and selves. But, are these forms of knowledge and expression truly new ways to explain the tripartite composition of 'body, mind and the world', or are they symptoms of a 'neuro-age and neuro-industry', which Philippe Pignarre, a lecturer on 'psychotropes' at the University of Paris VIII, France, denounced as part of a "messianic market strategy"?

Pignarre spoke mainly about the increasing medicalization of behaviours; a trend that is driven by advances in neuroscience. He argued that the development of the antipsychotic drug chlorpromazine in 1952, which is used primarily to treat schizophrenia, could be considered as the beginning of a trend of alienation and chronicity in psychiatry. Indeed, the current controversies around psychiatry, including its systems of classification and categorization, are another important debate at the interface between brain research, medical practices and society. It might seem surprising that such debates, particularly in pharmacogenomics

and psychiatric genetics, are not settled in an age of 'evidence-based' medical practice, including evidence-based approaches to psychiatry (Goldner & Bilsker, 1995).

Specifications and categorizations of diseases and disorder have been changing and expanding throughout the history of neurology and psychiatry—as have social and ethical dilemmas. The first version of the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 1952) did not recognize alcoholism as a 'mental disease'; homosexuality was not removed until the second version; post-traumatic stress disorder was introduced in the third version in 1980 to address the large numbers of Vietnam War veterans who were suffering from a cluster of war-related psychosomatic disturbances (Blank, 1985), and the list goes on. The controversies surrounding these many changes, as well as the role of the pharmaceutical industry and its efforts to define new psychiatric disorders for which to provide drugs, need to be investigated.

Although the official 'Decade of the Brain' ended in 2000, the scientific exploration of the brain and the mind is far from over and will continue to influence society in numerous ways

For example, how are new psychiatric categories created and what is the evidence behind such claims? The debates and the arguments for or against introducing new or modifying existing 'psychiatric categories' highlight the need to focus on the broader social, ethical, cultural and political implications of classifying and categorizing mental disorders, as well as on the controversial links between psychiatry and genetics, as in the case of pharmacogenomics (Rose, 2006), or indeed between politics and science.

The latter topic is of particular relevance to our discussion. In contrast to a recent editorial in *Nature* (Anon, 2007), which emphasized the mutual exclusiveness of politics and science, others have claimed that it is self-defeating, if not misleading, to separate these seemingly distinct realms. As the American philosopher Hilary Putnam (2002) has argued, the 'fact–value' dichotomy originates from an impoverished empiricist conception of 'fact' and an equally impoverished positivist understanding of 'value'. Both ideas are entangled and "a proper understanding of social and scientific change requires the abandonment of this dichotomy" (Callon *et al*, 1986). After all, the declaration of the 'Decade of the Brain' was a political statement; hence, confirming and analysing the interplay between science and politics is not an attempt to question science's legitimacy, but rather to examine its relevance.

It is also at the border between science and politics where neuroethics gains new relevance and importance. Although some consider this emerging discipline as a 'neologism' (Rees & Rose, 2004), in the sense that it is just a new term for old problems, some argue that the nature of these debates, and the concerns and arguments around the ethical and legal aspects of brain research, have changed considerably—a position that led to the first international conference on this "new field of neuroethics" in San Francisco in 2002 (Marcus, 2002). It is possible that these changes reflect societal development, including new markets; but they might equally be caused by the institutionalization of neuroethics as a distinct field of inquiry.

The discussions that took place during the launch of ENSN showed how limited the current scope of neuroethical debate is and the immensity of its actual potential. An informed debate should not only discuss the usual suspects—namely, issues of enhancement, addiction, brain–machine interfaces and psychiatric drugs—but must also include the controversies surrounding the potential application of various technologies in 'neuro-security' and 'counter-terrorism' (Moreno, 2006). The debate should also examine the potential implication of new markets and neuroeconomies on a range of issues, and address how new psychiatric classification schemes, interventions and the emerging neurotechnologies are changing our concepts of identities and subjectivities—of what essentially defines us as human beings—and what the consequences are, if any.

This leads to the topic of the brain–mind, rather than mind–body, dichotomy, and the knowledge and technologies intended to explore the dimensions of 'self'. Although various neuroscientists view 'the mind'—by which we mean a combination of emotion, intellect, perception and consciousness—to be a mere brain product, many social scientists and philosophers express concerns about such an absolutist neurobiologization of what characterizes us as a thinking and spiritual species. Their resistance to a cultural hegemony of neuroscience—which is visible in the growing literature on the neural basis of various aspects of 'mental life' ranging from spirituality to creativity—is another indication that the mind–body–brain relationship is still at the heart of philosophical explorations of selfhood, personhood or indeed what some have termed 'brainhood' (Vidal, 2005).

Some have already started to examine the wider implications of this trend. Nikolas Rose (2007), for example, has suggested that we have become "somatic individuals"—or rather, "neurochemical selves"—who understand thinking, living and feeling as being shaped by the brain; an organ that is scrutinized, dissected and treated by psychiatrists, neurologists and psychotherapists among others.

In a broad ethnographic work on bipolar disorder, Emily Martin (2007) has explored some answers to the sort of selves we have become by tracing the way in which the psychiatric category 'bipolar disorder' is circulated and 'performed' from the psychiatric ward and support groups to the market, media and popular culture. Here again, assumptions about manic behaviour are examined from a broader, critical view of American culture and neuropsychiatric practices. These perspectives definitely differ from the canonical medical narratives or the normative bioethical discourse.

In fact, the impact of neuroscience and neurotechnology on our understanding of individual and group identity is another challenging topic; how does technology define population groups? Conversely, do population groups use technology to define themselves? This concern echoes the idea of the looping effect, which was proposed by the Canadian philosopher Ian Hacking (1999) and according to which, people who are being classified begin to adapt or accommodate to their new role or class. But how does technology have a role in mediating or perhaps inducing such new definitions of selfhood? The dynamics and interactions between all the agents involved—including the 'inanimate objects' (Latour, 2005), that is the drugs, the pharmaceutical industry and governments—need to be explored.

Although neuroethics has raised a broad range of possible philosophical frameworks (Marcus, 2002), one of the most striking questions at the ENSN conference was whether there is, or could be, a single unified neuroethical framework. Such an attempt could come from the new model of stress advanced

by Alexandre Mauron, a molecular biologist and bioethicist from the University of Geneva in Switzerland. Drawing on physiopathology, neuro-endocrinology, primate studies, evolutionary studies and cognitive psychology, he has argued that stress should constitute the basis of any debate on neuroethics. The evidence in animal models shows how environmental stress leads to clear differences at the neuronal level, whereas, in humans, stress arises from poor social conditions and social inequality, which, as Mauron argued, similarly translates to the neuronal level. This new vision of a neuroscience of stress has clear 'biopolitical' consequences as it provides an opportunity for governments to shape public health policies by focusing on social inequality. This new paradigm of stress rests on three new ideas that need to be explored independently: the ethics of neuroscience; a neuroscience of ethics; and a neuroscience of equity—that is, of how social structures impinge on our health.

Neuroethically framed ethics would explain morality on scientific grounds, and would be both a new addition to the classical ethical frameworks of Kantianism and utilitarianism, among others, as well as an expansion of the current ways in which we define ethics and morality. In fact, it is becoming increasingly evident that neuroscience is infiltrating the traditional discourse about ethics and morals. Numerous publications have studied the genetic basis of antisocial, aggressive and violent behaviour, or have correlated physical brain pathologies with 'immoral' behaviour, or have localized some ethical types of thinking and acting with the prefrontal cortex, and so on. But, as pointed out in the previous discussion of lie detection, these findings and studies have to be interpreted and used with caution. Nonetheless, they provide new and fascinating insights into how humans function as social animals, and how they create and preserve societies. This knowledge therefore has the potential to inform social policies, as well as open new discourses on ethics and morals.

Although the official 'Decade of the Brain' ended in 2000, the scientific exploration of the brain and the mind is far from over and will continue to influence society in numerous ways. We can already see the rise of new markets and economies based on the new findings and technologies coming from brain research. We can foresee applications in politics and in the courtroom; we have seen the continuous expansion of psychiatric disorders and diseases, and we are witnessing an intensifying debate about the ethical, moral and philosophical aspects of neuroscience and its applications. What is lacking, however, is a broad and inclusive debate about how society values and should deal with the knowledge and technology and their applications.

The launch of ENSN in 2007 therefore provided a much-needed platform to bring together theoreticians and practitioners, scientists and social scientists, and sceptics and enthusiasts from across many disciplines and schools of thought. The creation of such a challenging forum was necessary, inevitable and timely. The next challenge will be to formulate innovative theoretical and methodological tools to investigate the empirical disciplines and findings of this 'neuro-age', whereby human behaviour and the other aspects that define us as a species are predominantly formulated in neurochemical terms.

ACKNOWLEDGEMENTS

I am grateful to Nikolas Rose and Linsey McGoey for their comments on an earlier draft, and to Ofer Engel for his remarks on the final version. This report is part of the 'Brain Self and Society' project (http://lse.ac.uk/collections/brainSelfSociety/) funded by the Economic and Social Research Council (ESRC; London, UK) ESRC grant number RES-051-27-0194.

REFERENCES

American Psychiatric Association (1952) *Diagnostic and Statistical Manual of Mental Disorders*. Arlington, VA, USA: American Psychiatric Association

Anon (2002) Open your mind. *The Economist*, May 23

Anon (2007) Mind games. *Nature* **450:** 457

Aron A *et al* (2007) Politics and the brain. *New York Times*, November 14

Blank A (1985) The Veterans Administration's Viet Nam veterans outreach and counseling centers. In *The Trauma of War: Stress and Recovery in Viet Nam Veterans*, SM Sonnenberg, AS Blank, T Ja (eds), pp 227–238. Washington, DC, USA: American Psychiatric Press

Callon M, Law J, Rip A (1986) *Mapping the Dynamics of Science and Technology: Sociology of Science in the Real World*. Basingstoke, UK: Macmillan

Connolly WE (2002) *Neuropolitics: Thinking, Culture, Speed*. Minneapolis, MN, USA: University of Minnesota Press

Farah MJ (2002) Emerging ethical issues in neuroscience. *Nat Neurosci* **5:** 1123–1129

Frazzetto G (2008) Festival: neural networking in Manhattan. *Nature* **451:** 772

Goldner EM, Bilsker D (1995) Evidence-based psychiatry. *Can J Psychiatry* **40:** 97–101

Hacking I (1999) Making up people. In *The Science Studies Reader*, M Biagioli (ed), pp 161–170. New York, NY, USA: Routledge

Haynes JD, Sakai K, Rees G, Gilbert S, Frith C, Passingham RE (2007) Reading hidden intentions in the human brain. *Curr Biol* **17:** 323–328

Iacoboni M, Freedman J, Kaplan J, Jamieson KH, Knapp B, Fitzgerald K (2007) This is your brain on politics. *New York Times*, November 11

Illes J (2003) Neuroethics in a new era of neuroimaging. *AJNR Am J Neuroradiol* **24:** 1739–1741

Kaplan JT, Freedman J, Iacoboni M (2007) Us versus them: political attitudes and party affiliation influence neural response to faces of presidential candidates. *Neuropsychologia* **45:** 55–64

Latour B (2005) *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford, UK: Oxford University Press

Marcus SJ (ed) (2002) *Neuroethics: Mapping the Field*. Conference Proceedings (May 13–14). San Francisco, CA, USA: The Dana Press

Martin E (2007) *Bipolar Expeditions: Mania and Depression in American Culture*. Princeton, NJ, USA: Princeton University Press

Moreno JD (2006) *Mind Wars: Brain Research and National Defense*. New York, NY, USA: The Dana Press

Oxley DR, Smith KB, Alford JR, Hibbing MV, Miller JL, Scalora M, Hatemi PK, Hibbing JR (2008) Political attitudes cary with physiological traits. *Science* **321:** 1667–1670

Putnam H (2002) *The Collapse of the Fact/Value Dichotomy and Other Essays*. Cambridge, MA, USA: Harvard University Press

Rees D, Rose S (eds) (2004) *The New Brain Sciences: Perils and Prospects*. Cambridge, UK: Cambridge University Press

Rose N (2006) Social and ethical aspects of pharmacogenomics in psychiatry. *Psychiatry* **6:** 80–82

Rose NS (2007) *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century*. Princeton, NJ, USA: Princeton University Press

Rose SP (2002) 'Smart drugs: do they work? Are they ethical? Will they be legal? *Nat Rev Neurosci* **3:** 975–979

Vidal F (2005) Le sujet cérébral: une esquisse historique et conceptuelle. *Psychiatrie, Sciences Humaines, Neurosciences* **3:** 37–48

WHO (2001) *Mental Health: New Understanding, New Hope*. Geneva, Switzerland: World Health Organization

Zeki S (1999) *Inner Vision: An Exploration of Art and the Brain*. Oxford, UK: Oxford University Press

Joelle M. Abi-Rached is at the BIOS centre at the London School of Economics and Political Science, UK. She is the Research Officer on the 'Brain Self and Society' project.
E-mail: j.m.abi-rached@lse.ac.uk

doi:10.1038/embor.2008.211

Published online 14 November 2008