Governing through the Brain

Neuropolitics, Neuroscience and Subjectivity

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This article considers how the brain has become an object and target for governing human beings. How, and to what extent, has governing the conduct of human beings come to require, presuppose and utilize a knowledge of the human brain? How, and with what consequences, are so many aspects of human existence coming to be problematized in terms of the brain? And what role are these new 'cerebral knowledges' and technologies coming to play in our contemporary forms of subjectification, and our ways of governing ourselves? After a brief historical excursus, we delineate four pathways through which neuroscience has left the lab and became entangled with the government of the living: *psychopharmacology*, *brain imaging*, *neuroplasticity* and *genomics*. We conclude by asking whether the 'psychological complex' of the twentieth century is giving way to a 'neurobiological complex' in the twenty-first, and, if so, how the social and human sciences should respond.

Keywords: brain, governing, neuropolitics, neuroscience, subjectivity

Introduction

What kind of creatures do 'we' think we are, we human beings? And how have we come to think of ourselves in this way?[1] This is not just a philosophical question, although it is at the heart of the philosophies we live by. It shapes the way we are 'governed' and the way we govern ourselves. It goes to the heart of how we bring up our children, run our schools, organize our social policies, manage economic affairs, treat those who commit crimes or whom we deem mentally ill, and perhaps even how we value beauty in art and life. It bears on the ways we understand our own feelings and desires, narrate our biographies, think about our futures, and formulate our ethics. Are we spiritual creatures, inhabited by an immaterial soul? Are we driven by instincts and passions that must be trained and civilized by discipline and habits? Are we psychological persons, inhabited by a deep, interior psyche that is moulded by experience, symbols and signs, meaning and culture? Or is our nature as human beings shaped by the structure and functions of our brains? Is it our brains that make us humans human?

Over recent years, many have become convinced that this last answer is the truest – or at least that increasing knowledge of the human brain has fundamental implications

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for our societies and for ourselves. The European Commission's Seventh Framework Programme recently gave an unprecedented one billion euros to the Human Brain Project (HBP), a consortium of several hundred researchers, neuroscientists and computer scientists who proposed simulating the human brain, neuron by neuron, in a supercomputer.[2] Similarly, there have been press reports of President Obama's commitment to funding a ten-year project to build a comprehensive map of brain activity.[3] Eric Cantor, House Majority Leader, signalled his willingness to fund this project, saying: 'Mapping the human brain is exactly the type of research we should be funding, by reprioritizing the $250 million we currently spend on political and social science research into expanded medical research, including the expedited mapping of the human brain. It's great science.'[4] To the distress of social scientists, many now believe, like Cantor, that it is the experts of the brain, rather than of 'psy-' or of society, who will enable us to address the 'grand challenges' facing our societies in the future.

There are many reasons for 'the brain' becoming such a focus of attention and funding since the 1990s – dubbed by US President George Bush as 'the decade of the brain'.[5] Central is the so-called 'burden of brain disorder'. Recent estimates by the World Bank, the WHO and other international bodies now speak of the prevalence of conditions from anxiety and addiction to Alzheimer's disease in terms of 'the global burden of brain disease' and estimate that these brain disorders affect one in three adults in any one year across the globe, accounting for 13 per cent of the total global burden of disease. Demographers urge politicians and policy makers to prepare for the challenge of an ageing society and the predicted dementia 'time bomb' that is ticking across the globe.[6] The future of our brains has come to be framed in economic terms – the insupportable costs of health services, the consequences of days lost through illness, the productivity threatened, the competitiveness weakened, the human resources wasted (Wittchen et al. 2011). Hence Henry Markram, leader of the Human Brain Project (HBP), is typical when he argues that: 'Very soon the cost of brain disease will reach 10% of the world's gross domestic product (GDP), yet the development of new treatments is grinding to a halt. There is still a massive gap between the neuroscience laboratory and the clinic… Without this kind of understanding [produced by the HBP], we will continue to struggle to develop new treatments and brain-inspired computing technologies' (Kandel et al. 2013: 659).

The language of the burden of brain disease prioritizes the negative biopolitical consequences of our lack of understanding of the brain. But from another direction we see an emphasis on the brain as a biopolitical resource, with repeated references to the mental resources that underpin international competitiveness – the demand for 'flexibility' in a rapidly changing economy – and the idea that we are now living in 'knowledge societies' where our destiny depends on our capacity to think rather than to make. This is linked to a more general perception that the international competitiveness of a nation depends on what some have called its 'mental capital' (Jenkins 2008).

In any event, the problems of governing living populations now seem to demand attention to the brains of citizens. These 'big science' projects want to do for the brain what the Human Genome Project (HGP) did for the genome.[7] As with the HGP, the dream of understanding the brain is linked to the pragmatics of finding new explanations and therapies for mental illness – now routinely assumed to lie in or

through the brain. This is an interesting comparison, since the unexpected effect of the HGP was to radically transform almost everything we thought we knew about genetics, while largely failing to deliver the promised benefits in terms of understanding and treating human diseases. But in this article we want to consider how the brain has become an object and target for governing human beings. How has governing the conduct of human beings come to require, presuppose and utilize a knowledge of the human brain? How, and with what consequences, are so many aspects of human existence coming to be problematized in terms of the brain? And what role are these new 'cerebral knowledges' and technologies coming to play in our contemporary forms of subjectification, and our ways of governing ourselves? Is the 'psychological complex' of the twentieth century giving way to a 'neurobiological complex' in the twenty-first?

Governing the Brain – Some Historical Remarks

This is not the first moment in history where the brain has appeared to hold the key to human identity, human difference, human pathologies and human conduct. In nineteenth-century Europe, the question of the cerebral localization of brain functions generated heated sociopolitical debates over the possibility of reading personality and intelligence from the shape of the skull, from the different sizes of the brains of men and women and different races (these endeavours are discussed in detail in Rose and Abi-Rached 2013). Skulls were measured, and the brains of criminals and lunatics – and of the elite – were extracted after death, dissected, weighed and measured (Hecht 2003). Hagner has shown how this 'cultivation of the cortex' developed in Germany: an initial emphasis on cerebral hygiene and eugenics led to the establishment of the Kaiser Wilhelm Institute for Brain Research in Berlin in 1914, which later became the focal point for a Nazi brain science that sought the truth of human difference in the brain, and made ample use of the brains of those who were the victims of that regime's murderous biopolitics (Hagner 1997, 2001; Hagner and Borck 2001).

But it would be wrong to suggest that brain research at this time was intrinsically linked to eugenics. In the first six decades of the twentieth century, more than twenty scientists were awarded Nobel prizes for discoveries concerning the nervous system.[8] These researchers certainly believed that their research had uncovered mechanisms of the brain that would have major social implications. Many worried about the implications of our new knowledge of the brain for the higher human values of morality, autonomy, 'wholeness' and individuality. For some, such as William Grey Walter, the electroencephalograph, with its images of the electrical brain, offered the possibility of objective diagnoses of psychiatric conditions and revelations of the workings of the human mind with implications for everything from child rearing to love and marriage (Hayward 2002: 620ff).

Nonetheless, something seems to have happened around 1960. Neuroscience was actually only born in 1962: the word was first used by Francis Schmitt to describe his interdisciplinary project – the Neuroscience Research Project – which aimed to do for the brain what molecular biology had achieved for the gene (Worden et al. 1975). Schmitt wanted to bring together scientists from all the different disciplines that worked on the brain to close the gap between 'mind' and brain' with the eventual aim

of describing all mental events as brain events to be explained in terms of molecular processes. A 'neuromolecular' vision of the brain was taking shape (Abi-Rached and Rose 2010). In the next three decades, up to the 1990s, much changed in the scale, scope, intensity and infrastructure of research into the brain. The Society for Neuroscience was formed in 1969 and held its first major conference in 1979, which about 1,300 people attended; by 2000 there were over 24,000 attendees.[9] There were now dozens of other conferences and workshops organized by more specialist associations with their own membership, websites and newsletters, along with undergraduate and graduate programs in neuroscience, 'boot camps' for those who sought a rapid immersion in the field and much more.

By the start of the twenty-first century, there was a truly global infrastructure for neuroscience research. And there was a remarkable growth of research: in 2008 alone, over 26,500 refereed articles were published on the neurosciences in over four hundred journals (Rose and Abi-Rached 2013), and it has been estimated that the figure in 2012 was closer to 100,000 (Kandel et al. 2013). But something had also changed in the relation of the laboratory to the world. Dozens of books, newspaper articles, television documentaries and so forth took neuroscience out of the domain of specialized debate among researchers. The language and images of neuroscience entered popular culture, and neuroscientists began to claim that their findings had real and immediate implications for how we should manage ourselves in everyday life – in the family, in work, in love and much else. To put it simply, neuroscience acquired the characteristics of expertise. From now on, neuroscientists would not merely speculate about the wider implications of their laboratory findings: they sought to be directly engaged in the management of human affairs. Of course, there was no one neuroscience – there were multiple schools of thought, many sub-fields with different problems, approaches, methods and techniques, whose researchers attended different conferences and published in different journals, often with intense rivalries within and between research fields. But nonetheless, at the risk of considerable simplification, it is possible to distinguish four pathways along which neuroscience became entangled with the government of the living: *psychopharmacology, brain imaging, neuroplasticity* and *genomics*.[10] Along the first, the neuromolecular vision of the brain was intrinsically linked to the neuropharmacological explosion from the 1960s onwards, and the gradual acceptance of the routine modulation of mental functions by acting pharmacologically on the brain. Along the second, a series of remarkable technological developments made it possible to overcome the barrier to vision presented by the skull, and to seem to see the activity of the living human brain in real time as the person it inhabited thought, felt, desired. These brain imaging technologies were rapidly deployed in attempts to render visible the brain correlates of both pathological and normal mental states and activities – and hence perhaps to explain them and open them for intervention. Along the third, initially as a result of remarkable experiments on the rehabilitation of humans after stroke or brain injury, and some questionable experiments with primates, the brain gradually became envisaged as plastic, mutable, open to transformation not just in childhood but throughout life in response to external inputs. Linked with discoveries concerning neurogenesis and epigenetics, it is now argued that human experience from conception to death shapes and reshapes the brain itself – experience gets under the

skin and under the skull. Along the fourth, a shift in genomic styles of thought away from the 'gene for' paradigm, led to the belief that one might discover biomarkers which would predict susceptibility to psychiatric disorders or other conduct problems which would not only improve accuracy of diagnosis, but would enable early and preventive intervention for those seemingly bound for mental pathology: a powerful new strategy of 'screen and intervene'.

Each of these pathways was imbued with hopes for human betterment, many of which failed to materialize, and others of which proved highly problematic. Nevertheless, by the 1990s, a new vision of the brain had taken shape: a molecular, visible, mutable brain, whose characteristics might be predictable and manageable, open to its milieu, transformable by experience, affected and affecting all that passes through it in ways not available to consciousness, shaping and being shaped by the experiences, feelings, intentions and cognitions of the person within which it resides, creating the illusion of selfhood itself. Along each pathway, developments in neuroscience have become entwined with what one might term 'human technologies' – strategies for the government of conduct drawing upon empirical knowledge of the brain and beliefs about its relation to conduct.

Neurochemical Selves

The most fundamental conceptual shift was the emergence of a 'neuromolecular vision' of the brain: a new scale at which the brain and nervous system were conceptualized, and a new way in which their activities were understood. At this molecular scale, the structure and processes of the brain and central nervous system were made understandable as material processes of interaction among molecules in nerve fibres and the synapses between them. These were conceived in terms of the biophysical, chemical and electrical properties of their constituent parts. At this scale, although there was much that could not yet be explained, there seemed nothing mysterious about the operations of the nervous system. Mystery had become mechanism. Mental processes – cognition, emotion, volition – could be explained in entirely material ways, as the outcome of biological processes in the brain, understood as an organ that was, in principle, like any other, even if, in the case of humans and many other animals, it was far more complex than any other organ. The 'explanatory gap' – the gulf between events at the level of the brain and experiences in the conscious mind – still remained. All serious researchers recognized that the conceptual and experimental move from the molecular level to that of mental processes was highly challenging. But the dualism that had haunted philosophy and the sciences of mental life increasingly seemed anachronistic. As the leading neurobiologist Vernon Mountcastle put it at the turn of the century, 'what makes us humans human is our brain' (Mountcastle 1998: 1).[11]

This 'neuromolecular gaze' was intrinsically intertwined with the development of psychopharmacology and the rise of drugs for treating people diagnosed with mental illness, first within and then outside the walls of the psychiatric hospital. This is a familiar story. First came the discovery of the neuroleptics for treating those with psychoses – Largactil, Thorazine – initially for control within the large asylums and later as a key element in the downsizing of asylums and the management of mental

disorder on the territory of everyday life. Second, the discovery of 'tranquilizers' for anxiety disorders. The first of what became known as mother's little helpers – Miltown or Equanil – came onto the American market in 1955, amid a welter of very favourable publicity about 'happy pills' and 'aspirin for the soul' (the story is told in Smith 1991; Tone 2009). Demand soon became greater than for any other drug marketed in the USA and around thirty-five other 'tranquilizers' were rapidly brought to market, each claiming to be better than the others. Initial professional and public enthusiasm was followed by critical reviews calling for caution, then reports of 'overuse' filled with alarm, resolved by suggestions that the drugs could be used appropriately under strict conditions. Third, the discovery of anti-depressants in the late 1950s came with a correlative rise in diagnoses of mild and moderate depression, principally as a condition afflicting everyday life, to be managed as far as possible outside the hospital (Healy 1997; Rose 2004). A new relation was forged between governing the brain and governing the soul.

It was not merely that mind could be modulated by molecular interventions. It was also that, at the level of mechanism, a fundamental continuity seemed to have been established between 'mice and men' – between the neurobiological determinants of animal behaviour, and the processes that underpinned human action. Almost all the key neuromolecular findings were made in the course of trying to identify the mode of action of those drugs using animal models, and all the drugs that entered the world were first trialled on animals, almost always rodents. Indeed, animal models were epistemologically, ontologically and technologically crucial to the rise of neuroscience: the belief that, in fundamental ways, human higher mental processes are underpinned by the neurobiology they share with mice, rats, perhaps even fruit flies and sea slugs (Kandel 2007; Purves 2010; Rose and Abi-Rached 2013). Given the failures of so many drugs that seem to work in animals to translate into effective treatments for humans, there is much to discuss about the role that model organisms and modellers have played in this story. We cannot pursue that part of the story here.[12]

Since the drugs that were now being used to treat mental disturbances seemed to affect the components of neurotransmission, it seemed that malfunctions in neurotransmission must underpin most, if not all, mental disorders.[13] This 'psychopharmacological imaginary' enabled the growth of the multiple transactions between laboratory, clinic, commerce and everyday life that now are so much criticized (for two examples of many, see Moncrieff 2008; Whitaker 2010). The growing links between the pharmaceutical companies, the neurobiological research community and the profession of psychiatry led to many inflated statements about the effects of the compounds being marketed, and the routinization of the belief that psychoactive drugs could manage the travails of everyday life by acting on the brain. Everyday understandings of distress, and the forms of distress themselves, were being reshaped by the visions of disorder promulgated by psychopharmaceuticals.

Nowhere did this dream of precise targeting gain more traction than in the new generation of anti-depressants, the Selective Serotonin Reuptake Inhibitors: Prozac and its sisters. The claim of these drugs was not that they were more effective, but that they were safe and had few side effects because they precisely targeted the neurobiological anomalies at the basis of depressed mood – too little serotonin in the synapses. Indeed

this 'monoamine hypothesis of depression' – along with the dopamine hypothesis of schizophrenia – was one of the founding myths of contemporary psychopharmacology. But this argument linking levels of serotonin with depression, and more generally linking raised or lowered levels of specific neurotransmitters with specific mental states, has proved to be largely false. The drugs that claim to raise or lower levels of these neurotransmitters do not do nothing, of course, but they do not do what they claim, nor work in the way that was claimed. The relative failure of this dream, on which so much pharmaceutical investment was based, has led to the withdrawal of several large pharmaceutical companies from psychiatric drug development (Miller 2010). Yet this has not reduced the levels of prescribing of the drugs initially developed and marketed on this basis, now generic and made for low cost in the emerging economies. And two other dreams remain potent yet elusive – drugs to combat dementia and drugs for the so-called 'enhancement' of human capacities (a dream so enticing to neuroethicists!).

By the end of the twentieth century, for every problem of everyday existence, in almost every region where the management of mental health was a governmental problem, pharmacological intervention was the first resort. We are familiar with the dilemmas that arise: is this 'medicalization', turning problems of living into conditions deemed suitable for medical treatment, and if so, is that in itself a problem? Have human beings become dupes of the pharmaceutical companies whose only interest is not in cure but in shareholder value? Can we draw a line between legitimate and illegitimate uses of drugs? What should we do about the irrationality of the divisions between the legal and the illegal, the drugs available over the counter and those only by prescription, the herbal cures from nature's own pharmacopoeia, the distinctions between drugs for cure, for normalization and for enhancement etc.? The questions are as important as the answers – for good or for ill, we have become 'neurochemical selves' (Rose 2003).

Visible Minds

It is hard to overestimate the impact of the avalanche of brain images that now populate neuroscientific arguments. The skull initially proved an impenetrable barrier to techniques of medical imaging such as X-rays, although in the first half of the twentieth century some forms of visualization were developed, involving injecting air into the ventricles of the brain, or using various contrast agents infused into the brain's blood supply. The use of the electroencephalograph from the 1920s, for recording human brain activity, is inextricably associated with the name of Hans Berger (Haas 2003). But things really began to change with the development of computerized tomography (CT) scanning in the 1970s and Magnetic Resonance Imaging (MRI) in the 1980s. These produced images of the structure and tissues of the brain that were, to all intents and purposes, equivalent to the images produced of any other bodily tissues. They were simulations, of course, not photographs, but they were open to confirmation by physical interventions into the imaged tissues to locate the anomalies that had been visualized. Two further developments – Positron Emission Tomography (PET) and functional Magnetic Resonance Imaging (fMRI) – seemed to produce identical images, but they were images of something with a very different ontological status: not the *structure* of the brain but its *functioning*, its activity as its human host (with his or

her head in a scanner) engaged in certain tasks or experienced certain emotions. The very activities of the living brain, its patterns in normal perceptions and delusions, in hallucinations and desires, in willing and desiring, now seemed to be rendered visible and correlated with a phenomenology of mental life and subjective experience – we seemed to see the neural correlates of mind itself. Who could doubt that there was a physical basis of 'mind' in the activities of the living brain?

As these technologies became more widely available to researchers, thousands of papers were published claiming to identify the neural correlates of every human mental state – by 2011, such publications were running at around 600 a month. We find papers relating changes in brain activity to responses to art in general and to the work of specific painters, to responses to music and to specific composers or performers, to specific novelists, to television commercials, and to features of language such as metaphor. And there are hundreds of studies purporting to image love, hate, fear and other emotions, as well as studies of brain activation where individuals in scanners are given simple tasks to undertake. What is one to make of this industry of visualization?

Many of those who undertake the brain scanning are all too aware of the technical problems, assumptions and limitations of these technologies.[14] For a start, they are based on surrogate measures of activity – changes in levels of blood oxygenation in different regions of the brain that are thought to correlate with neural activity, although the relation is not fully understood and is certainly far from simple or linear. Scanners measure the changes in 'voxels' in a three-dimensional space, and the data is then mapped or 'warped' onto a standard atlas of brain space, although there are long-standing debates over the most appropriate atlas to use (Toga et al. 2006). Activity levels are then represented by colours that are chosen more or less arbitrarily, thus producing the familiar images. This is undoubtedly an amazing technical process, but also a process that contains many assumptions. There is an assumed localization of functions in almost all interpretations of the brain scans, a style of thought that goes back to the neurology of the nineteenth century and seems to ignore the highly interconnected circuits which underpin neural activity. There is also the question of the scale at which they visualize – it has been estimated that the typical voxel contains 5.5 million neurons, between 2.2×10^{10} and 5.5×10^{10} synapses, 22 km of dendrites and 220 km of axons (Logothetis 2008). But this is more than a technical problem: at what scale *should* we try to visualize these processes? As neuroanatomist Valentino Braitenberg remarked, it makes no sense to read a newspaper with a microscope.[15] There is the decision to factor out all background or 'resting' activity in the brain and to focus only on *changes* during tasks. And there are all the questions arising from the artificiality of the scanning environment which are familiar from the many critiques of experimental psychology (see also the excellent discussions in Cohn 2004, 2008a, 2008b).

Many brain scanner specialists are very uneasy about the widespread use of brain images in so many domains as if they were merely pictures of brain activity. Nonetheless, their apparent ability to track mental processes objectively, often processes outside the awareness of the person themselves, the belief that we can see the living mind in the living brain, can observe the passions and desires that seemingly underlie normal and pathological beliefs, emotions and behaviours, has been a key element underpinning the growing power of neuroscience in the everyday world. Some thought that the

images would gain their most traction in the courtroom – predicting that offenders would deny personal responsibility for their crimes with the claim 'my brain made me do it'. But despite speculations of neuroethicists, the best efforts of lawyers, and the enthusiasm of some neuroscientists, the agonistic environment of the courtroom has proved a hostile niche for brain images. Rigorous questioning often shows experts' interpretations of the images and their implications to be partial and speculative at best.[16] It is in other practices, where expert interpretations are less open to contestation, that brain images are being deployed – in commercial companies promoting neural lie detection, and in attempts to identify abnormalities in brain areas thought to be related to impulse control and risk assessment. It is here that brain scanning joins with neurogenomics in the logics of screen and intervene – the search for the brain signatures of later pathology, whether this be mental disorder or pathological conduct.

Of course, the images are simulations, and imbued with all manner of assumptions – but so are all the images that populate medical practice today. It is not the irreality of the images of the mind that should concern us, but the frequent attribution of a false concreteness to them by researchers, policy makers and popular interpreters. Images are not pictures to be judged by a criterion of realism, but tools, rhetorical devices in arguments, instruments to be judged by criteria of rationality, validity or efficacy. As we see wherever they are deployed, they do not speak for themselves, they have to be spoken for by those who interpret them, and thus the problems of interpretation cannot be avoided. Technology alone cannot bridge the gap between molecules and mental states, even where it appears directly to measure neural activity at the moment a subject reports a thought, feeling or desire. Despite what is often claimed, visualization itself does not, and cannot, resolve the question of the relations between minds and brains.

Let us move to the third path which has allowed neuroscience to leave the lab and enter the world. Here, in the domain of 'plasticity', neurobiology comes into alliance with the hopeful spirit of contemporary biology: where biology is no longer destiny but opportunity.

Mutable Brains

The third pathway for neuroscience to inform interventions in human lives was the growing belief that, at least when it comes to the human brain, neither structure nor function were inscribed in the genes or fixed at birth. One term has come to designate this new way of thinking – *plasticity*. The neural architecture of the brain was now located in the dimension of time – not just the time of 'development' from fertilization to birth and into the early years of life, but also the time of the life course, through adolescence into adulthood and indeed across the decades. It had long been recognized that plasticity existed at the level of the synapse – that 'what fires together, wires together' (Hebb 1949): synaptic connections formed, strengthened or were pruned in response to experience. However the idea of plasticity has taken on a wider meaning. First, work on rehabilitation after stroke in humans, and related work with animals whose brains were lesioned or whose movement was artificially restricted, showed that the primate brain could remap itself after injury and that this process could be accelerated

by neurobiologically informed practices of rehabilitation (Bach-y-Rita 1967; Merzenich et al. 1988).

Second, other researchers – notably Michael Meaney's group – argued that experience in the very early days and months following birth, perhaps even in utero, shaped the brain in fundamental ways through modifying gene methylation – the activation or deactivation of genes and their associated proteins (Szyf et al. 2007). These 'epigenetic' arguments soon became used in a genre of research that explored the ways in which 'experience gets under the skin', altering human biology durably by modulating gene expression.[17] In particular, it seemed, early maternal behaviour towards offspring might shape their neural development, and this would affect their behaviour over their whole lifespan. It would also shape the maternal behaviour of those offspring, and hence modulate the genomes of a third generation of pups. There now seemed to be a mechanism to pass these environmentally acquired characteristics of the brain down the generations.

In a third development which became linked to this idea of plasticity, the long held dogma that no new neurons were produced after the first years of life was itself overturned with the finding by Elizabeth Gould and her group that in humans, neurogenesis, or the growth of new nerve cells in the brain, was possible throughout adult life, and might be stimulated or inhibited by environmental factors from nutrition to cognitive activity (Gould et al. 1999). Many doubts remained about the translation of these findings from animals to humans, and the interpretation of these results. But the brain now appeared as an organ that was *open* to environmental inputs at the level of the molecular processes of the genome, shaping its neural architecture and its functional organization, with consequences that might flow down the generations. The implications were clear: those who were concerned about the future of our children, and the conduct and welfare of the adults they would become, needed to recognize, and to govern, these processes of shaping and reshaping our plastic brains.

What are we to make of this rhetoric of plasticity? Despite many doubts about the functional properties of the neurons produced by neurogenesis, progressive thinkers rapidly latched on to the idea to underpin their belief in the importance of environment. And it was not long before many researchers began to argue that their work led to practical conclusions for policy. Gould argued that her findings that early adverse experience, and factors such as social isolation, reduce plasticity in response to stresses in adult life highlighted the importance of understanding the impact of parenthood on the developing brain of the child, and the potential adverse effects of poor parenting on cognition and mental ability (Mirescu et al. 2004; Stranahan et al. 2006; Leuner et al. 2010). By 2009, Meaney and his colleagues were extrapolating to humans from their work with animals, suggesting that their findings might account for the relations between child abuse and suicide (McGowan, et al. 2009; Meaney and Ferguson-Smith 2010). These and related arguments were taken up by many in arguments for interventions into the family lives of children thought to be at risk. Edward Taub, who had carried out the controversial work on the Silver Spring Monkeys,[18] developed his findings into a programme called Constraint-Induced Movement Therapy that 'empowers people to improve the use of their limbs, no matter how long ago their stroke or traumatic brain injury'.[19] Merzenich, whose research had shown that the mapping of

sensory functions could be redrawn even in adults, founded Scientific Learning, which uses his 'Fast For Word' software, and Posit Science, which sells brain-training software called Cortex™ and Insight™.[20] The metaphor of rewiring led to a slew of self-help manuals advising us how we can 'rewire our brains' for love, success and much more: a set of new technologies of the neurobiological self (Arden 2010; Lucas 2012). Plasticity was to become one of the key dimensions of the matrix that linked the laboratory, the corporation, the self, and the everyday world.

Screen and Intervene

We have become familiar with the rise of multiple practices that seek to 'govern the future' – strategies of prediction, pre-emption, preclusion, prevention, precaution and the like. Neuroscience has found a welcoming niche here. Psychiatric genomics has been perhaps the most prominent in this domain. For many critics, the genetic dimension of the neurobiological is particularly distasteful. They have correctly pointed out that repeated claims to have discovered 'the gene for' schizophrenia, manic depression and so forth were always followed by failures of replication. However as the twentieth century came to a close, a radical transformation in genomic styles of thought made a different approach possible – a move from determinism to probabilities and susceptibilities – which opened a new role for genomics in the government of conduct. In the wake of the Human Genome Project, attention came to focus, not on 'genes for' disorders, but on variations in the nucleotides within coding that might affect the nature of a protein or an enzyme with functional consequences for biological processes linked to health, illness or other capacities (Rose 2007b). As with epigenetics and neuroimaging, when such styles of thought focused on the brain, the gap between the neural and mental was reconfigured. Perhaps a combination of such minor variations would affect neurobiological processes, perhaps shaping fundamental pathways, perhaps influencing the course of neural development, thus increasing an individual's susceptibility to certain mental disorders – their vulnerability or their resilience to external stressors and adverse experiences.

The explanatory focus was now on variations which increase or decrease the activity of an enzyme, the operation of an ion channel or the sensitivity of a receptor site and which, in multiple combinations, underpinned variations in both normal and pathological human mental functioning. The hope was that these could be linked with environmental or other conditions that provoked or inhibited the onset of such conditions. Genome Wide Association Studies (GWAS) compared the genomes of thousands of individuals – cases versus controls – at thousands of sites, with the hope that they could find the variations that distinguished those with the condition from those without. The aim was to identify genetic 'biomarkers' that would enable precise diagnoses of disease types, rather than diagnosing on the basis of observable symptoms and signs (Pearson and Manolio 2008; Goldstein 2009; Manolio et al. 2009). In a new era of objectivity, molecular diagnosis would underpin molecular treatment; the conditions themselves would be regrouped and reclassified on the basis of their molecular underpinnings; research would trace the pathways from the genomic anomalies to their observable consequences; molecular therapeutics would target

these anomalies; patients in the clinic would be diagnosed on the basis of their genetic biomarkers, and targeted 'personalized' treatment would be the order of the day.

The results have disappointed all but their most committed proponents. Despite larger and larger studies, GWAS studies have failed to identify genomic differences that account for a significant proportion of the difference between 'cases' and 'controls'. Those preparing the fifth edition of the APA's Diagnostic and Statistical Manual had to conclude that, at present, there is not a single clinically validated genomic (or other) biomarker for a mental disorder – no 'objective indicator' that can be used to make a differential diagnosis or to decide on treatment options (Hyman 2012; American Psychiatric Association [APA] 2013). The hope that psychiatry could defeat its critics by replacing social normativity with molecular objectivity has had to be postponed. Some turn their attention to non-coding DNA, or to rare variants that run in some families and not in others that may lead to similar appearing disorders. The National Institute of Mental Health has abandoned DSM diagnoses altogether for research. At the end of April 2013, its director Thomas Insel announced that: 'NIMH will be reorienting its research away from DSM categories' on the grounds that 'Mental disorders are biological disorders involving brain circuits that implicate specific domains of cognition, emotion or behavior' – and it is in terms of these that diagnosis should proceed and towards these that treatment should be targeted.[21]

There was another path however. Some suggested that we could use the findings from psychiatric genomics to identify those *at risk* of developing a disorder before the disease became apparent. A well-funded and growing research programme attempted to identify the genomic variants that increased susceptibility to certain diseases or pathological conditions such as impulsive behaviour in the hope that they could be identified and eventually treated in advance of those conditions actually manifesting themselves.[22] This strategy of 'screen and intervene' is today proliferating in almost every field where human health is to be governed (Rose 2010). Part of its attraction is, of course, the aspiration to prevent or minimize distress for the affected individuals and their families. But another part is the belief that the rising costs of governing health could be contained, perhaps even reversed, by a turn to prevention: prevention not in the form of population-wide public health interventions as in the nineteenth century, and not by individualized health education as we saw in the twentieth, but by intervening on the *molecular predispositions* lurking within the individual body and soul. Earlier is almost always better, goes the mantra – seek to identify the signs and markers of disease at the asymptomatic, presymptomatic, prodromal stage, and intervene preventively at that point. We have seen these strategies in the newborn and in cancer screening, we see them consumerized for responsibilized individuals in personal genomics and in the growing commercial market promoting health checks for the seemingly healthy. And we are seeing them in the many invitations to self-diagnosis through the checklist approach of Direct-to-Consumer antidepressant advertisements (Dumit 2010).

In this logic, one first identifies 'susceptibility' and then intervenes to minimize the chances of that unwanted eventuality coming about, in order to maximize both individual and collective well-being and to reduce the future costs of mental health problems. Who could be opposed to early identification for those liable to develop mental disorders or neurodegenerative diseases?[23] Who could be opposed to screening

children, followed by preventive intervention to steer potential psychopaths from a pathway that will lead to anti-social behaviour and crime? Earlier is especially better, it is thought, in the case of children, for the brain of the developing child is more 'plastic', believed to be at its most open to influences for the good (and for the bad). Should we not develop policies based on neuroscience, and seek to find the biomarkers that will identify those 'at risk' as early as possible – those liable to show anti-social, delinquent, pathological or criminal behaviour or at risk of developing a 'mental health problem' – and intervene in order to divert them from that undesirable path?

These strategies of preventive intervention sound highly repressive to some. But in the era of the neuromolecular and plastic brain, those who advocate such strategies of prediction and pre-emption think of neurobiology not as destiny but opportunity and the imperative to intervene not as coercion but a duty of self-care, a 'somatic ethic' (Rose 2007b: 7). They believe that to discover the seeds of problematic conduct in the brain will reduce stigma rather than increase it, despite research showing the reverse (Phelan 2002, 2006). Further, those researching biomarkers for psychopathy, even when they believe that there is a clear, genetically based, neurobiological basis for anti-social conduct, argue that neurobiology informs one about susceptibility but not inevitability. Their wish to identify the gene–environment interactions which provoke vulnerability into frank psychopathy is linked to a hope for protective strategies, for 'the goal of early identification is successful intervention' (Caspi et al. 2002; Kim-Cohen et al. 2005; Odgers et al. 2008). Interventions sometimes involve behaviour therapy, cognitive therapy and psychopharmaceuticals. But the preferred route to the problematic child – as so often in the past – is through the parents. In the age of the plastic brain, many undesirable neurobiological traits appear to be malleable by changing the ways parents deal with their vulnerable children (Dadds et al. 2005; Hawes and Dadds 2005, 2007).

Such arguments have been strengthened by the proliferation of brain images seeming to show the consequences of early adverse environments on the developing brain of the child (Perry 2008). These images seem to provide powerful rhetorical support for early intervention into the lives of the most disadvantaged families, in the name of the individual, familial and social costs of the developing brain, and hence future lives, of their children. But we are already familiar with the controversies over such strategies – the false positives and false negatives, the transformation of identities based on the allocation of risk status based on probabilities, the doubts about the claims that 'screening and intervening' will actually fulfil the economic hopes vested in it (Singh and Rose 2009). And further, in situating the origins of all manner of social and individual problems so firmly in neurobiology, even in a neurobiology that is itself shaped by environment, we see a repeat of a familiar strategy to prevent social ills by acting on the child through the medium of the family: social disadvantage is explained as the outcome of poor brain development resulting from the inadequate parenting provided by the socially deprived.

Our Brains, Our Selves?

What, then, of subjectification? Are new ways emerging of conceiving of and acting on personhood? How, where, for whom and in relation to what questions are these cerebral ways of imagining and acting upon ourselves gaining traction? Many critics have

suggested that the rise of neuroscience is leading to a kind of 'reductionism' in which mental states are reduced to brain states, human actions are regarded as generated by brains not conscious individuals, and the key dimensions of our humanness – language, culture, history, society – are ignored (Tallis 2011). It is true that many popularizers of neuroscience do make such reductionist arguments. But it is hardly radical to suggest that human beings are swayed by forces that come from beyond their consciousness: belief in fates, passions, instincts and drives, unconscious dynamics and the like is not uncommon. Individuals have been urged, and taught, to govern these forces in the name of self-control, whether by spiritual exercises (Hadot and Davidson 1995), by prayer and mortification, by the inculcation of habits, by learning how to 'govern one's will' (Rose 2007a), through 'inhibition',[24] by understanding the dynamics of projection and denial, by 'consciousness raising' or a multitude of other techniques. The same is true in the current emphasis on the brain, as we can see in the array of new technologies that are now being promoted for managing our brains in the service of a better life.[25]

Neuroscientific research emphasizing the role of non-conscious neural processes and habits in our decisions and actions, has not overturned long-standing ideas about choice, responsibility and consciousness. We are not witnessing an epochal transformation in our relations with ourselves in which personhood has become 'brainhood' – where the condition of being a person is considered identical with the condition of that person's brain (Ortega and Vidal 2011). More complex configurations are taking shape in which neurobiological conceptions of personhood have latched on to the many sites and practices that were colonized by psychology across the twentieth century – from child-rearing to marketing – and transformed them, but they have certainly not effaced beliefs in an internal mental and psychological domain in which they have their effects. While many suggest that human thoughts, feelings, desires and actions are underpinned and shaped by non-conscious neurobiological processes, few argue that humans are mere puppets of their brains.

This focus on the brain and its role in shaping our forms of life is a further manifestation of the contemporary 'somatization' of the human. As with our bodies, so now with our brains. A range of new practices is emerging around the governing of human 'embrained' existence – new experts advising us how to live with, manage and improve our brains; biopolitical activism and identity formation around capacities or disorders located in the brain; new modes of responsibilization urging individuals to care for their brain; and a new consumerization of the brain, offering us all manner of products, devices, exercises and the like to keep our brains healthy and maximize our brain power. In what some have termed 'the age of neurological reflexivity',[26] we are urged to recognize not only that our brains shape us, but also that we can and should act on our brains through our conscious decisions: reshaping our brains to reshape ourselves.

In this emerging neuro-ontology, the claim is not that human beings *are brains*. The argument is different – that our selves are shaped by our brains but can also shape those brains. And indeed, references to neuroplasticity are used to underpin the argument that our brains are open to change across our lives, and that we can take conscious control of the ways in which those changes happen – we can learn the techniques to 'rewire' our brains . It is in this form that neuroscientific arguments are impacting upon conceptions

of personhood and practices of self-fashioning. The pedagogies of 'brain awareness' and the rise of practices and devices for working on the brain in the service of self-improvement thus fit comfortably with a more general array of techniques for working on the somatic self in the name of maximizing our well-being. In the name of improving the well-being of our societies, each of us is now urged to learn the techniques to manage our plastic, open, mutable brains in order to live a responsible life. The technologies of the neurobiological self fit comfortably with contemporary beliefs that we can improve ourselves by knowing and managing our somatic, bodily, embrained selves.

Conclusion

Are we then seeing the birth of a 'neurobiological complex' in which 'psy' has been displaced by 'neuro'? At present, the movement of neuroscientific arguments into the everyday world is hesitant and their success is hard to predict. In some cases, notably the rise of psychopharmacology, interventions on the brain preceded clear neurobiological identification of pathways, and seem likely to outlive the inadequate hypotheses that once gave them scientific legitimacy. The fate of the neurotransmitter hypotheses of mental disorder should alert us to beware 'brain overclaim syndrome' – that is to say, exaggerated and premature claims about the extent of our knowledge about neural processes and their role in our everyday lives, and related claims to base interventions on such knowledge. We need continual careful analysis and examination of evidence, and a critical evaluation of the four 'imaginaries' – of psychopharmacology, of visualization, of plasticity and of genomics. We also need to recognize that the researchers themselves are not the only people responsible for brain overclaim: the translational imperative that is now laid on all those receiving grants to fund their work – the requirement that they predict the impact of their work and the benefits it will produce – is an unfortunate feature of our current funding climate and one that is likely to lead to disillusionment in science as the promised results do not appear within the unrealistic timescales that seem to be required.

Further, we need to react with caution to the claims about the 'burden of brain disorder' and the language within which they are framed. We know that these claims are in part rhetorical: they are used to make appeals to politicians and others about the urgency of funding research and the scale of the problem. But the framing of the issues in this way is not innocent. It is not only that it is misleading to unify conditions from anxiety to Alzheimer's as disorders of the brain. Nor is it merely that the language of burden has troubling historical resonances; to critique this by pointing to the way in which analogous arguments were made in eugenics would be facile. But there is an ethical issue here, for the demand that others place upon us – characterized by such words as burden and dependency – is the other side of our care for others: to care for others is indeed to accept the claims that they might and will make on one. And we can contest the idea that mental disorders are merely negative without falling into the opposite trap of romanticising them.

To conclude, we do not think evidence currently suggests that neuroscience will produce a 'revolution' in what it is to be human. Despite the excitable claims of some popularizers – and some researchers themselves – humans remain conceived by them

as persons with minds, intentions, mental states, etc. But those mental states are, hesitantly, being premised on new forms of knowledge and new conceptions of the 'unconscious' forces that shape human conduct and mental life. We are gradually seeing the emergence of new forms of expertise, not only in the frenetic world of the internet, and the enthusiastic self-promotion of some wishing to turn their truth claims into money, but more gradually in the field of social policy, especially in relation to children and families and in the empire of risk. We are seeing new possibilities for understanding and governing ourselves in terms of our brains, but these are being shaped in ways that are entirely compatible with contemporary notions of responsibilized, somatic individuals who have accepted the obligation to care for their brains as their own desire.

The social sciences have been largely hostile to the rise of these neuro-knowledges and ethical imperatives. Critique is necessary, but is becoming unproductive. A different approach might be needed to engage in a more productive and constructive 'critical friendship' that recognizes the importance of recent advances in neurobiological knowledge, but pays close attention to the justification of the truth claims that are being made, and warns against 'translation fever'. We must recognize that neuroscience has not solved the problem of the mind–brain relationship, and that we do not even have the language to begin to translate brain states into mental states. At root, however, neuroscience poses as radical a challenge to received wisdom as did structural linguistics and psychoanalysis, challenging beliefs about the primacy of the ego, the unity of the subject, the autonomy of will, intention and choice. Neurologists have long recognized the fictional character of the autonomous, discrete, bounded and unified individual so beloved of practices from economics to criminal justice. Consciousness flatters itself when it considers itself the master in its own house. What is happening here is potentially a transformative moment in the half-century-long disciplinary stand-off between the life sciences and the social sciences, as the former seek to shake off the legacy of reductionism and to challenge the fundamental distinction between what the French physiologist Claude Bernard called the *milieu intérieur* and the *milieu extérieur* (Bernard 1878). For humans are, after all, animals, albeit rather special ones, but nonetheless shaped crucially by their character as vital, living organisms in constant transaction with a *milieu* that they themselves constitute and transform. There are great opportunities here for radical thought. But these would be the topic of another article.[27]

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Notes

1. Of course, the 'we' here is disingenuous: there is no singular 'we' . Space here does not permit a discussion of how relations to ourselves differ across time, space, gender, ethnicity, region and much more. The evidence we give here relates largely, though not entirely, to those regions that we have termed 'advanced liberal' (Rose 1993).
2. See <http://europa.eu/rapid/press-release_IP-13-54_en.htm?locale=en> (accessed 1 December 2013).
3. The BRAIN Initiative (Brain Research through Advancing Innovative Neurotechnologies) at <http://www.nih.gov/science/brain> (accessed 1 December 2013).
4. See <http://vitals.nbcnews.com/_news/2013/04/02/17565983-white-house-pitches-brain-mapping-project?lite> (accessed 1 December 2013).
5. See <http://www.loc.gov/loc/brain> (accessed 1 December 2013).
6. For example, <http://www.telegraph.co.uk/health/healthnews/9127801/Dementia-is-next-global-health-time-bomb.html> (accessed 1 December 2013).
7. Twenty years ago, some were calling for such a 'Human Brain Project': (Huerta et al. 1993)
8. From Santiago Ramon y Cajal in 1906 to John Eccles, Alan Hodgkin and Andrew Huxley in 1963.
9. Data from <http://www.sfn.org/static/amstats/amstatsgraph.html> (accessed 1 December 2010). By the end of the decade, annual attendance at this event was over 30,000 scientists, and around 4,000 non-scientists, including many staffing industry or pharmaceutical displays.
10. Of course, many other ways of framing this relation are possible, and there are some areas that I have not considered here, for example 'evolutionary psychology' and cybernetics and artificial intelligence.
11. Actually Mountcastle wrote 'what makes man human is his brain'.
12. We discuss this in detail in Chapter 3 of Rose and Abi-Rached 2013.
13. It also led to the triumph of the chemical view of neurotransmission over the electrical view that had previously been dominant (Valenstein 2005)
14. This became very evident in numerous discussions with brain imagers in the course of our research and in their presentations to the 'neuroschools' that were conducted under the auspice of the European Neuroscience and Society Network: see <http://www.kcl.ac.uk/sspp/departments/sshm/research/ensn/European-Neuroscience-and-Society-Network.aspx> (accessed 1 December 2013).
15. This remark is quoted by Nikos Logothetis, who also sets out many of the criticisms that we note in this paragraph (Logothetis 2008).
16. Several of these cases are discussed in detail in Chapter 8 of Rose 2007b.
17. There is much to be said about the genealogy of what is now thought of as epigenetics, which differs in many key respects from that introduced in the classic arguments of Waddington (Waddington 2012). For a good discussion of contemporary epigenetics see (Carey 2012).
18. The Silver Spring Monkey case provoked the foundation of PETA (People For The Ethical Treatment Of Animals) and their view of the issue can be found at <http://www.peta.org/issues/animals-used-for-experimentation/silver-spring-monkeys/>. Alex Pacheco, who brought the condition of these experimental animals to light, gives his account at <http://www.animal-rights-library.com/texts-m/pacheco01.htm> (accessed 1 December 2013).
19. For Taub's official biography at the University of Alabama, which makes a rather brief reference to the research on monkeys, see <http://www.uab.edu/psychology/primary-faculty/11-primary-faculty/27-dr-edward-taub>; for the therapy, see <http://www.taubtherapy.com/> (accessed 1 December 2013): 'Providing The Most Effective Stroke Therapy In The World. Taub Therapy, widely recognized as the most innovative form of CI therapy, empowers people to improve the use of their limbs, no matter how long ago their stroke or traumatic brain injury (TBI) occurred. The most effective stroke rehabilitation

programme in the world, Taub Therapy has been proven to be over 95% successful in helping patients in the clinic regain significant movement. Through the one-on-one encouragement of a therapist, patients can relearn to use their affected limb by restricting the use of the unaffected one. By causing neurons to "rewire" themselves, Taub Therapy not only changes the brain, it changes lives. […] Taub Therapy gives patients hope that they can recapture the life they had before suffering a stroke or TBI. *Edward Taub, Ph.D., Director of Taub Therapy Clinic*.'

20. For Scientific Learning ('Fit Brains Learn Better') see <http://www.scilearn.com/our-approach/our-scientists/merzenich/> (accessed 1 December 2013); for Posit Science, see 'Proven In Labs and Lives: The Posit Science Brain Fitness Programs dramatically improve cognitive performance' at <http://www.positscience.com/science/global-science-team/merzenich> (accessed 1 December 2013).
21. See <http://www.nimh.nih.gov/about/director/index.shtml> (accessed 1 December 2013). NR discusses these developments in detail in an unpublished paper available on line at: <http://nikolasrose.com/wp-content/uploads/2013/07/Rose-2013-What-is-diagnosis-for-IoP-revised-July-2013.pdf> (accessed 1 December 2013).
22. We discuss this in detail in Chapter 6 of Rose and Abi-Rached 2013.
23. There is much to be said about attempts to predict and pre-empt the dementias, the regular announcements of tests claiming to identify those at risk, the rise of the 'prodromal' category of 'Mild Cognitive Impairment', the growing number of 'memory clinics' to diagnose such brain states and prescribe interventions to ameliorate them, and much research, so far largely unsuccessful, to find effective forms of intervention into the dementing brain (Whitehouse and George 2008).
24. On 'inhibition' see Smith 1992.
25. A few moments on the internet will produce hundreds of products offering brain improvement, from 'Happy Neuron' (<http://www.happy-neuron.com/>) to the Brain Gym (<http://www.braingym.org/>) (both accessed 1 December 2013), underpinned by more or less explicit references to neuroscience, most of which are of dubious veracity.
26. See <http://www.thersa.org/events/video/archive/matthew-taylor> (accessed 1 December 2013).
27. Some of these issues are pursued in more detail in Rose 2013, and in ongoing research in the Department of Social Science, Health and Medicine at King's College London: <http://www.kcl.ac.uk/sspp/departments/sshm/research/Research-Groups/Biomedicine-Ethics-and-Social-Justice/BESJ-Projects/Urban-Brain-Lab.aspx> (accessed 1 December 2013).

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