2010

Neuroethics, An Introduction with Readings

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Suggested Citation:
Farah, M.J. (2010). Neuroethics: An Overview. In M. Farah (Ed.), Neuroethics, An Introduction with Readings. Cambridge, MA: MIT Press, 2010.

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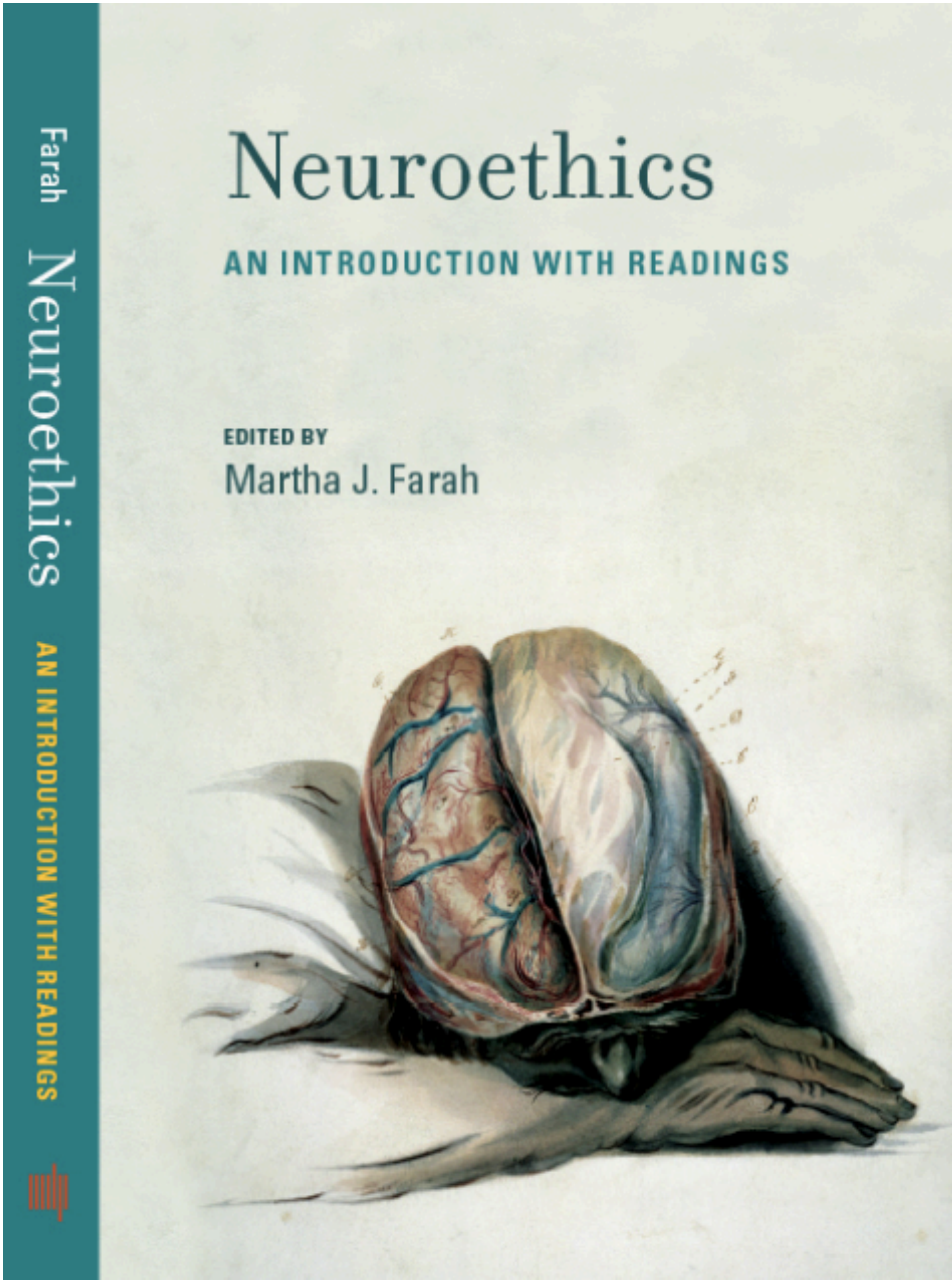

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Neuroethics: An Overview

Chemists can tell us how molecules interact and change according to general principles rooted in physics. No surprise there—the relation between chemistry and physics is a textbook example of intertheoretic reduction in the philosophy of science. Beginning in the mid-twentieth century, biologists began to explain the functions of cells in terms of the molecules that make them up. This has been worked out in detail for many cellular functions and in gist for the rest. Even those special cells called neurons, with their special tricks of signaling and changing connections to one another, are being explained in terms of more fundamental physical and chemical processes.

While cellular neuroscientists are steadily filling in our understanding of what neurons do and the molecular machinery by which they do it, systems neuroscientists armed with computational models are showing us how groups of these cells in combinations can do even more tricks. The behavior of large ensembles of neurons can, in turn, be studied by neuroscientists and psychologists by putting people in scanners, stimulating specific brain areas, or observing the effects of brain lesions. Perception, memory, decision making, and many other mental functions have been associated with the activity of specific sets of localized populations of neurons. At this relatively molar level of description, the brain's operations can be linked upwards to psychology as well as downwards to biology.

It is here, at this juncture between psychology and the natural sciences, that neuroethics comes in. In principle, and increasingly in practice, we can understand the human mind as part of the material world. This has profound implications for how we regard and treat ourselves and each other. It gives us powerful new ways to predict and control human behavior and a jarringly material view of ourselves. Neuroethics is the field that grapples with these developments.

1.1 A New Name for a New Field

Does the field of neuroethics really need its own name, distinct from philosophy of mind or bioethics? Newly named fields evoke skepticism and even disdain in the academic world, and some authors have questioned whether there is anything fundamentally new in neuroethics besides the name (Schick, 2005; Wilfond & Ravitsky, 2005). As academics we are shocked, shocked by attempts to market academic work, and nothing seems more like marketing than a brand name. But I have come to believe that the field is distinct enough from other established disciplines that a distinct label is warranted.

To be sure, virtually all bioethical issues concerning any organ system or medical specialty have counterparts involving the brain, neurology, and psychiatry. These issues, some of which will be discussed later in this chapter, make up part of neuroethics and could easily enough retain the label "bioethics" rather than form part of a newly designated field. They will have a familiar ring to bioethicists, and the principles and precedents of bioethics have an important contribution to make toward understanding these cases. But there is more to neuroethics than classic bioethics applied to neuroscience. New ethical issues are arising as neuroscience gives us unprecedented ways to understand the human mind and to predict, influence, and even control it. These issues lead us beyond the boundaries of bioethics into the philosophy of mind, psychology, theology, law, and neuroscience itself. It is this larger set of issues that has attracted so many new and established scholars to the area and earned it a name of its own: neuroethics.

This book is an introduction to the field of neuroethics, with an emphasis on the second type of neuroethical issue just described. Although the more familiar bioethical issues are important and invariably acquire interesting new twists when manifest in the context of neuroscience, it is the relatively newer neuroethical issues that are most in need of explication.

1.2 Understanding Neuroethics

What, specifically, do people need to know to understand these issues? Based on my experience teaching neuroethics to undergraduates and graduate students, as well as talking to people about it everywhere from professional meetings to the local dog run, I believe that one important body of knowledge is neuroscience itself. In each of the following five chapters, I have therefore tried to summarize the key ideas and findings from neuroscience that are relevant to the neuroethical issues discussed in this book. These include very brief overviews of neurotransmission and psychopharmacology, the neural bases of emotional memory and personality, principles of brain imaging, the neuropsychology of responsible behavior, and recent work on imaging consciousness in the damaged brain. I have tried to identify the most relevant parts of neuroscience for understanding the neuroethical issues of each section and the specific readings in particular. My hope is that this information will ground the reader's understanding of the neuroethical issues in real science (as opposed to vague abstractions about smart pills and science fiction scenarios about cyborgs) and might even inspire and embolden non-neuroscientist readers to learn more.

If a grasp of neuroscience is one essential component of understanding neuroethics, then an appreciation of the ethical issues is the other. By "ethical" issues I mean to include the full range of concerns regarding the impact of neuroscience on the individual human person and on society as a whole, including the moral, legal, and policy implications of that impact. My goal is not to deliver a comprehensive review of this subject matter but to offer readers a representative sample of the most interesting and well-articulated ethical issues and to give them a sense of the diversity and nuance of different perspectives on those issues.

Whereas neuroscience is largely a matter of fact, the ethical implications of neuroscience can be seen very differently by different people. For this reason, the bulk of this book is made up of the writings of others, in some cases abridged to highlight a specific neuroethical theme within the author's broader original topic. The field of neuroethics has some singular voices, and I wanted to let them speak for themselves here. There are nevertheless commonalities and unifying themes among the most opposed viewpoints presented here, and these are highlighted in the chapters that precede each set of readings.

1.3 Classic Bioethical Issues in Neuroethics

The remainder of this chapter is an overview of the many and varied issues of neuroethics, beginning with the relatively familiar or "classic" bioethical issues of neuroethics and concluding with the newer ethical challenges posed by contemporary neuroscience. I characterize some issues as classic bioethical issues because, although they involve neuroscience, the ethical issues are not fundamentally different from those arising in other branches of life science. That is, although the brain is central to these issues, from an ethical perspective its role is not substantially different from that played by other organ systems in analogous situations. These issues are no less interesting and important for having underlying commonalities with other issues in bioethics, as the examples reviewed here will show.

The development of predictive tests for incurable neurodegenerative diseases raises a variety of ethical concerns. For example, brain imaging has enabled researchers to better understand vulnerability to Alzheimer's disease, mechanisms of disease onset, and treatment response. Positron emission tomography (PET) scanning (see chapter 4), in particular, measures relevant brain function more sensitively than conventional behavioral tests of clinical dementia research. PET research has revealed neuroimaging correlates of incipient Alzheimer's disease, which in some cases may herald the clinical onset several years in advance (Scheltens & Korf, 2000). With the enthusiastic backing of PET scanner manufacturers, the medical community has been encouraged to consider using this method as a diagnostic test in the differential diagnosis of patients already showing signs of cognitive decline. In 2004, the U.S. government agreed to provide Medicare reimbursement for such scans under specific circumstances.

No one has yet proposed scanning asymptomatic elderly individuals to predict future disease or mental status, but one can imagine numerous motivations for doing so. For insurance companies, personnel departments, and even the individual himself or herself, prediction of Alzheimer's disease would allow for more rational planning for the future. The ethical question, of course, is what price this added planning capability. The knowledge that one is bound to develop Alzheimer's disease is a terrible burden, particularly as there is no cure. Although this dilemma results from recent advances in neuroscience, relevant ethical analyses have been developed by bioethicists working on the implications of genetic testing (Bell, 1998). The main ethical concerns are privacy rights (should your insurance company or boss know the test results?) and quality of life (what are the effects on patient well-being of knowing versus not knowing?). These are common to genetic and neuroimaging-based prediction.

Another important ethical issue raised by neuroscience is the safety of some of its newly developed research methods. One such method is transcranial magnetic stimulation (TMS), which alters brain function using powerful magnetic fields. It is noninvasive in the sense that the magnet remains outside the head, but the magnetic fields pass through the skull and other tissue and induce electrical currents in cortical tissue. For some applications, a single pulse (onset followed by offset of magnetic field) is used, but more commonly repetitive pulses are used (rTMS). The effects of TMS vary according to where the field is focused, its strength, and its pulse frequency and can either increase or decrease cortical activity near the stimulation site as well as in other brain regions to which the stimulated area projects.

The ability to target specific brain areas for temporary activation or deactivation makes TMS a valuable research tool, and cognitive neuroscientists have embraced it (Sack & Linden, 2003). The impressive ability of TMS to bring about scientifically informative brain changes raises the question: What other kinds of brain changes does it cause? Concern about the side effects of TMS, especially rTMS, has accompanied its use from the start. We now know that high-frequency, high-intensity rTMS can provoke seizures, even in people with no seizure history, although guidelines developed in the 1990s have succeeded in eliminating this phenomenon (Wasserman, 1997).

TMS also shows promise as a treatment modality for a variety of neuropsychiatric illnesses (Loo & Mitchell, 2005) and was approved in 2008 by the U.S. Food and Drug Administration (FDA) for the treatment of depression in specific kinds of patients. FDA regulation of medical devices is generally less stringent than regulation of drugs. This was all too apparent, in the view of many, when the FDA in 2005 approved vagal nerve stimulation as a treatment for depression based on extremely weak evidence of effectiveness. Brain stimulation with TMS and with implanted devices are among the most promising new therapeutic modalities, which lends urgency to questions of clinical trial design and the approval process for devices. Safety, efficacy, and regulatory controls on brain stimulation are neuroethical issues, as they concern the way in which society manages advances in clinical neuroscience, but their ethical, legal, and social dimensions do not differ substantially from those in the evaluation and regulation of other biotechnologies.

A more widely used application of magnetism in neuroscience is functional magnetic resonance imaging (fMRI). As will be discussed in chapter 4, this has been the workhorse of cognitive neuroscience research since the 1990s, thanks to its ability to measure brain activity with a useful degree of spatial and temporal resolution, without the need for radioactive tracers or injected contrast media. Current research involves placing the human subject in a magnetic field of strength 1.5 or 3 tesla, and all indications are that this is safe. Until recently, technical limitations prevented the use of stronger fields; they could be created only across spaces too small to accommodate a human head. However, it is now possible to scan humans at 7 tesla and higher.

Strong static magnetic fields can affect blood pressure, cardiac function, and neural activity. In addition to static fields, image acquisition with MRI involves exposure to varying magnetic fields and radiofrequency fields, which pose risks that range from activation of nerves and muscles to heating of tissue. Subjects in high-field scanners sometimes report seeing lights as a result of induced currents in their retinas and/or optic nerves. Although safety studies have suggested that such effects are benign, little is known about the long-term effects of these newer and more powerful scanning protocols.

As with TMS, high-field MRI raises important questions about the risks to which we put human research subjects. How thoroughly should such methods be tested for safety before they are used in research with humans? Who should decide? These are important ethical questions that must be addressed as researchers push the envelope of brain fMRI. However, they are not substantially different from questions regarding the safety of new methods for studying any other part of the body. Although high-field scanning is mainly of interest in the study of brain function, the ethical issues it poses are not fundamentally different from those surrounding any new scientific method that has potential risks and benefits and that is used in the study of any organ system.

Another bioethical issue that arises in connection with fMRI concerns brain abnormalities found by chance in the course of research scanning. fMRI studies generally include a nonfunctional scan of brain structure to enable localization of the brain activity revealed by fMRI relative to the anatomy of each research subject. The structural scans are of sufficient sensitivity and resolution that anatomic abnormalities and signs of disease will often show up. This raises the question of what researchers should do with these incidental findings. There is currently no universally accepted procedure for dealing with incidental findings from research scans (Illes et al., 2004). Of course, the ethical issues raised by incidental findings from brain scans are not fundamentally different from those that would be raised by imaging other organ systems. Indeed, one of the most relevant legal precedents does not come from imaging at all but from testing of blood lead levels. In 2001, a Maryland state appeals court decided that researchers studying the effects of lead abatement should have notified families of children with dangerously high levels of lead in their blood.

The issues just reviewed are the most commonly discussed "classic" bioethical issues of neuroethics, but they are not the only ones. Most bioethical issues have some intersection with neuroscience. For example, stem cell therapy has been the focus of much discussion in bioethics, and therapeutic targets include neurologic diseases such as Alzheimer's and Parkinson's diseases (Goldman, 2005). Future genetic technologies for selecting or altering the traits of a child are likely to include mental traits such as intelligence and personality, which are functions of the brain, as well as other physical traits (Chapman & Frankel, 2003). Issues of drug industry marketing, regulation, and safety are nowhere more relevant than with drugs for neuropsychiatric illness, as the chronic nature of such illnesses make treatments more profitable and questions of long-term safety more pressing (Antonuccio, Danton, & McClanahan, 2003).

1.4 New Ethical Challenges from Neuroscience

In contrast with the issues just reviewed, some neuroethical issues arise specifically because the brain is the organ of the mind. Neuroscience is giving us new, and in some instances very powerful, ways to understand people and to control their behavior. Of course, nothing is entirely without precedent if one describes it in abstract enough terms. My point here is simply that some neuroethical issues are *relatively* novel and emerge *primarily* because of the very special status of the brain in human life. These issues are the focus of this book.

One set of such issues emerges from recently developed technologies for monitoring and manipulating the brain. It remains to be seen how these developments will intersect with our strongly held beliefs about the value of privacy, freedom, fairness, and responsibility. One of the main tasks of neuroethics is to assess the likely impact of neuroscience on these and other moral and cultural ideals. This requires a realistic understanding of the capabilities of neuroscience as well as an awareness of the ways in which society already compromises one ideal for the sake of another (e.g., trading freedom for safety).

The use of psychopharmacology to change or enhance normal brain function raises a host of neuroethical issues, discussed in chapters 2 and 3 and the readings that accompany them. These issues are not hypothetical; use of prescription neuropsychiatric medications by healthy persons is at an all-time high. In addition to concerns about safety and distributive justice, which might belong in the "classic bioethical issues" category, neuropsychological enhancement raises profound questions about human effort and just deserts (did I earn my A if used Ritalin?) and personal identity (am I the same person off Prozac as on?).

Other new ethical issues arising from the application of neurotechnology include those posed by fMRI and other brain imaging methods. The main concern in these cases is not with safety or incidental findings but with privacy of thought. Unlike imaging other bodily organs, imaging the brain reveals information about the mind. Researchers have found imaging correlates of individual differences in personality and intelligence, which can be applied outside the research laboratory; for example, by employers and marketers. fMRI and other methods are being adapted for lie detection and behavior prediction, which has attracted attention from the intelligence and criminal justice communities. These trends raise new questions about whether, when, and how to ensure the privacy of one's own mind.

Of course, to the extent that functional neuroimaging is not up to the task of reliably delivering such information—and at present it is not—another problem arises: The high-tech aura of brain images leads many people to accept them uncritically. The danger is that people will be judged based on wrong information about their personalities, abilities, truthfulness, or behavioral dispositions. The neuroethics of brain imaging is the focus of chapter 4 and its accompanying readings.

Some of the most profound ethical challenges from neuroscience come not from new technologies but from new understandings. Neuroscience is calling our age-old understanding of the human person into question. In place of the folk psychology with which we have traditionally understood ourselves and each other, neuroscience is offering us increasingly detailed physical mechanisms. Personality, self-control, responsibility, consciousness, and even states of transcendent spiritual experience have become subjects of study in cognitive neuroscience. Much as the natural sciences became the dominant way of understanding the world in the eighteenth century, so neuroscience may be responsible for a kind of second enlightenment in the twenty-first century, naturalizing our understanding of humanity and transforming the way we think about ourselves. Such a transformation could help bring about a more understanding and humane society, as people's behavior is seen as part of the larger picture of causal forces surrounding them and acting through them. But it could also reduce us to machines in each other's eyes, mere clockwork devoid of moral agency and moral value.

Although many people believe that, in principle, human behavior is the physical result of a causally determined chain of biophysical events, most of us also put that aside when making moral judgments. We do not say, "But he had no choice—the laws of physics made him do it!" However, as the neuroscience of decision making and impulse control begins to offer a more detailed and specific account of the physical processes leading to irresponsible or criminal behavior, the amoral deterministic viewpoint will probably gain a stronger hold on our intuitions. Whereas the laws of physics are a little too vague and general to displace the concept of personal responsibility in our minds, our moral judgments might well be moved by a demonstration of subtle damage to prefrontal inhibitory mechanisms wrought by, for example, past drug abuse or childhood neglect. This has already happened to an extent with the *disease model* of drug abuse. The implications of neuroscience for morality in general and the law in particular are discussed in chapter 5 and the readings that follow.

Our intuitive understanding of persons includes the idea that they have an essence that persists over time. The changes wrought by normal development and life experience are understood as elaborations on a foundational personal identity that is constant throughout life. We also have the intuition that persons are categorically either alive or dead. Furthermore, most people also believe that persons have a nonmaterial component such as a spirit or soul. Yet none of these beliefs fit with the idea that a person is his or her brain. As physical objects, brains can and do change in countless ways in response to injury, disease, drugs, and, less commonly but no less realistically, implants, grafts, and other surgical interventions. There is no principled limit to the ways in which a brain can physically change and thus no immutable core to the neural substrates of a person. How can this fact be squared with the notion of an enduring personal identity or essence? As for life and death, there exists a continuum of levels of function linking the brains of fully living beings like you and me, and those of indisputably cold, dead corpses. Legal systems and religions have both grappled with the question of where to draw the line between us and those corpses, in part because any particular place is somewhat arbitrary. The standard medicolegal definition of death, which can apply to a warm, breathing body, seems counterintuitive to most. Finally, as neuroscience reveals progressively more about the physical mechanisms of personality, character, and even sense of spirituality, there is little about a human being left to attribute to an immaterial soul. The incommensurate realms of personhood and brain function, which figure indirectly in all of the neuroethical issues discussed in this book, are the focus of chapter 6 and the readings that accompany it.

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