

Op-Ed

Neuroethics

An overview of the burgeoning field of neuroethics, which encompasses the myriad ways in which developments in basic and clinical neuroscience intersect with social and ethical issues.

Martha Farah, PhD

Five years ago the word "neuroethics" was rarely used, and when it was it denoted the classic issues of clinical bioethics—informed consent, resource rationing and the like—in the context of neurology. Recently the word has gained wider currency and its meaning has changed. In this brief article I will review the burgeoning field of neuroethics and highlight one particular issue likely to affect practicing neurologists in the very near future.

Neuroethics encompasses the myriad ways in which developments in basic and clinical neuroscience intersect with social and ethical issues. The field is so young that any attempt to define its scope and limits now will undoubtedly be proved wrong in the future, as neuroscience develops and its implications continue to be revealed. At present, however, we can discern 2 general categories of neuroethical issue: those emerging from *what we know*, and those emerging from *what we can do*. In the first category are the ethical problems raised by our growing understanding of the neural bases of behavior, personality, consciousness, and states of spiritual transcendence. In the second category are the ethical problems raised by advances in functional neuroimaging, brain implants and brain-machine interfaces, and psychopharmacology.

The "What We Know" Issues

Responsibility and blame. The idea that behavior is determined is hard to reconcile with the intuitive notions of free will and moral agency on which our legal systems are based. 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 don't 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.

Science and the soul. Most people are Cartesian dualists: they believe that body and mind are not made of the same "stuff." Until recently, neuroscience did not pose a strong challenge to this view. Revealing the neural mechanisms of color vision puts color vision in the realm of the body, as opposed to the mind, but so what? You can still believe in what Arthur Koestler called "the ghost in the machine" and simply conclude that color vision is carried out by the machine for the benefit of the ghost. However, as neuroscience begins to reveal the mechanisms of personality, character, and even sense of spirituality, this Cartesian line of interpretation becomes strained. If these are all features of the machine, why have a ghost at all? By raising questions like this, it seems likely that neuroscience will pose a far more fundamental challenge to religion than evolutionary biology.

The "What We Can Do" Issues

Imaging and mental privacy. Functional neuroimaging has evolved from clinical use to an indispensable tool for basic neuroscience, and in recent years has been applied to the understanding of personality. With these developments comes a serious potential threat to privacy. The ability to estimate someone's personality, attitudes, and preferences would be welcomed by employers and marketers. The search for better lie detection and behavior prediction has led the intelligence and criminal justice communities to pursue fMRI (functional MRI) and ERP (event-related potentials, derived from EEG) methods. 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. We must work to give the public more accurate and accessible explanations of functional neuroimaging.

Cyborg brains. Two lines of research are paving the way for the possibility of electronic brain augmentation. The first is research on brain and vagus nerve stimulation, currently at various stages of clinical utility and acceptance in the treatment of Parkinson's disease, epilepsy, and depression. These methods are capable of affecting mood and cognition, and in the future may gain wider use for those purposes. The second line of research is on brain-machine interfaces, carried out mainly but not exclusively in animals. Here the goals are primarily to enable information from the world to be transduced into neural activity and to enable neural activity to be transduced into information that is externally useful for communication or robotic control. Although both lines of research conjure up futuristic and frightening science fiction scenarios for many people, the ethical issues they raise are of a familiar nature, from informed consent for patients undergoing invasive treatments to the enhancement-related problems discussed in the next section.

Medical enhancement (as opposed to therapy). Many neuropsychiatric illnesses occur along a spectrum that includes normal variations of functioning, and this raises the question: if treatment X can relieve a clinically significant deficit of psychological function Y, what can it do for normal healthy people? To be more specific, if we can treat depression with SSRIs and ADHD with stimulants, can we enhance the mood or attention of normal people by the same means? And should we? This is the topic of the remainder of the present article as well as Anjan Chatterjee's companion article, "[Cosmetic Neurology](#)."

In his article, Dr. Chatterjee focuses on the aspects of brain enhancement that are most directly relevant to medicine as a profession, asking how enhancement relates to the goals of medicine and the role of physicians. I will cover a complementary set of issues here, relevant to physicians and lay people alike.

Enhancing Brains: Current Capabilities and Their Bioethical Implications

Peter Kramer's popular book, "Listening to Prozac" first drew society's attention to the potential of psychopharmacology for enhancing the lives of healthy people. The patients he described, though far from satisfied with their lives, were not clinically depressed. Yet Prozac helped many of them to feel better. Surprisingly little is known about the effects of SSRIs on people who are not depressed. It seems clear that SSRIs are not happy pills, shifting depressed people to normalcy and normal people to bliss. Rather, for most people they seem to leave positive affect unchanged while attenuating negative affect—for example, reducing the subjectively experienced "hassle" factor.

In addition to mood, vegetative functions such as sleep, eating, and sex can be influenced pharmacologically, and there is a large demand for ways of enhancing these functions. The wakefulness-promoting agent modafinil, approved in the US for treatment of certain sleep disorders, is prescribed off label for a panoply of other conditions and is said to be favored by some ambitious professionals as a way of packing more work into a day. Although a safe and effective appetite suppressant is at present just a goal, such a drug will undoubtedly find a huge market when it comes along. Even after it became clear that the Phen-Fen combination could be fatal and it was pulled from the market, there was a constituency of consumers that fought for continued access to it. Finally, although currently popular medications for erectile dysfunction do not achieve their effects by altering brain function, newer neurally active drugs are in

development, aimed at improving both male and female libido. If society's experience with sildenafil (Viagra, eg) is any indication, many people without sexual dysfunction will seek these drugs to enhance their sex lives.

The treatment of cognitive disorders has also begun to shade into cognitive enhancement for healthy people. Two main cognitive systems have become targets for enhancement, attention or executive function (an umbrella term for flexible attentional control of cognition and necessary for organization, planning and problem-solving) and memory. Stimulant medication, which has been shown to improve the executive function of individuals with ADHD, also enhances normal performance on a variety of executive function tasks. Although methylphenidate (Ritalin) and amphetamine (Aderall) are ostensibly prescribed mainly for the treatment of ADHD, sales figures suggest that they are not uncommonly used for enhancement. Methylphenidate is currently widely used by college students, many of whom obtain it from friends or campus dealers as a recreational drug and study aid.

The most commonly used method of memory enhancement involves manipulation not of memory circuits per se but of cerebrovascular function. Herbal supplements such as Ginkgo Biloba affect memory mainly by increasing blood flow within the brain. However, a huge research effort is now being directed to the development of memory-boosting drugs. The candidate drugs affect various stages in the molecular cascade that underlies memory formation, including the initial induction of long-term potentiation and the later stages of memory consolidation. Although this research is aimed at finding treatments for dementia, there is reason to believe that some of the products under development would enhance normal memory as well, particularly in middle and old age when a degree of increased forgetfulness is normal.

Ethical Issues in Enhancement

The ethical issues surrounding brain enhancement can be grouped into 3 general categories. The first is practical: safety. Side effects and unintended consequences are a concern with all medications and procedures, but in comparison to other comparably elective treatments such as cosmetic surgery, neuroscience-based enhancement involves intervening in a far more complex system. We are therefore at greater risk of unanticipated problems when we tinker. In addition, drug safety testing does not routinely address long-term use, and relatively little evidence is available on long-term use by healthy subjects.

The second category of ethical issue is social: how will the lives of all individuals, including those who choose not to enhance, be influenced by living in a society with widespread enhancement? In competitive situations such as SAT testing, we may end up needing the equivalent of the regulations surrounding performance-enhancing drugs at sports events. Even in everyday work and school contexts, enhancement is likely to touch all of us.

The freedom not to enhance may be difficult to maintain in a society where one's competition is using enhancement. American courts have already heard cases involving parents coerced by schools to medicate their children for attentional dysfunction. Given that in some school districts the proportion of boys taking methylphenidate exceeds the most generous estimates of ADHD prevalence, it seems likely that some parents feel their child will be at a disadvantage in school without stimulant medication, whether or not they have a diagnosis of ADHD.

Conversely, barriers such as cost will prevent some people who would like to enhance from doing so. This could exacerbate the disadvantages already faced by people of low socioeconomic status in education and employment.

The third category of ethical issue could be called philosophical, in that it concerns our values and our sense of self. Cosmetic neurology raises many profound questions at this level. We generally view self-improvement as a laudable goal. At the same time, improving our natural endowments for traits such as attention span runs the risk of commodifying those traits. We generally encourage innovations that save time and effort, because they enable us to be more productive and to direct our efforts toward potentially more worthy goals. However, when we improve our productivity by taking a pill, we may also be undermining the value and dignity of hard work, medicalizing human effort, and pathologizing a normal attention span. The self-transformation we effect with a mood-enhancing drug can be seen either as self-actualizing or as eroding our personal identity. Neither the benefits of brain enhancement nor the dangers are trivial.

A final point concerning all 3 types of ethical problem is that many of the same issues arise when more familiar substances are used for enhancement, for example drinking coffee or smoking tobacco to focus attention or drinking alcohol to relax.

Conclusions Regarding Enhancement

Many of the patients now taking stimulants to improve attention and antidepressants to improve mood would not have been considered reasonable candidates for medication 2 decades ago because of the mildness of their complaints. By the standards of the 1980s, such patients are practicing enhancement. Even by today's diagnostic standards there is now an active market for attention enhancement. Is this good, bad, or a mixture of the two?

I do not believe that the answer to this question can be discovered a priori by reflecting on general principles such as "people have a right to do what they want to their own brains" or "people should not interfere with the basic design of humanity." Rather, I believe that the answer will emerge as we learn more about the long-term safety of these medications, the ways in which users in fact come to incorporate them into their work and family lives, the success with which society can rise to the challenges of equalizing access to enhancement and protecting the rights of people who choose not to enhance, and our ability to preserve a sense of personal autonomy, responsibility, and identity even as we experiment with unprecedented methods of self-transformation.

Martha J. Farah is a professor in the Department of Psychology and director of the Center for Cognitive Neuroscience at the University of Pennsylvania, Philadelphia, Pa.

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