

**BREAKING A CONFIDENCE.** Going along to get along. Telling a “white lie” to protect a friend. Everyone faces ethical dilemmas — in school, at home, and nearly everywhere in everyday life. This is no different for neuroscientists. With the tremendous advances in the field, scientists and nonscientists alike have sensed a critical turning point. Advancing knowledge about how the brain enables normal behavior; how injury, drugs, or disease affect it; and how diagnoses and treatments could change brain function raises serious and novel ethical questions.

For example, some recent brain imaging studies have sought to define areas responsible for phenomena such as deception. The post-9/11 era has created much interest in lie detection for security purposes in screening immigrants. How should privacy be balanced with national security? Is the technology accurate enough to provide useful data upon which to base decisions? Pursuing these lines of scientific inquiry in a responsible way requires neuroscientists to examine how what they do affects the world beyond the laboratory or clinic.

This self-examination makes up a field known as *neuroethics*. Scientists and ethicists are beginning to reflect on the implications of neuroscience in areas of behavioral research such as moral reasoning and decision-making, as well as the implications of new neuroscience technologies such as brain scanning, brain stimulation, and pharmaceuticals to manipulate cognition. While many questions and methods within neuroethics are similar to those in biomedical ethics, neuroethics deals with brain-specific issues that touch no other area of science — our sense of self, our personalities, and our behavior. What’s more, brain science is developing interventions that can change the way our brains function. Neuroethics links the descriptive science — what *can* we do — with the question of what *should* we do, which is guided by individual and shared value systems.

Neuroethics is the subject of a growing body of literature and an increasing number of meetings and conferences that have attracted a wide range of thinkers, students, basic and clinical neuroscientists, economists, philosophers, journalists, sociologists, lawyers, judges, and others. Some major topics include the subjects listed below.

### Personal responsibility and punishment

Neuroscience is teaching us about the neural substrates of human characteristics, such as anger, impulse control, and conscience. It is also giving us insight into the brain mechanisms of conditions such as addiction and other disorders that impair the control of be-

havior. These discoveries will place traditional questions of personal responsibility in a new light. Our understanding of the brain as the control center for all decisions and actions comes into direct contact with concepts of free will as the basis for personal responsibility. If the brain is the source of all action, when the brain is damaged, do we hold the person less responsible for his or her action? Does antisocial behavior itself provide evidence for a maladapted or miswired brain, or do we need physical evidence of trauma or disease? Neuroscience is interested in these questions about criminal behavior but also in the questions of how “normal” members of society create and enforce the laws that criminals violate. Some commentators think that increasing neuroscience knowledge may seriously challenge fundamental tenets of criminal law, while others foresee incremental changes that may lead to more just, accurate, and fair judgments. Neuroethics can help society think about how knowledge of the brain basis of behavior may affect our ideas of the way society *should* be.

### Diagnosis, treatment, and enhancement

Neuroscience already has given rise to drugs and devices, developed for the treatment of illness, that permit healthy people to improve their cognitive performance or alter their emotional states. In the future, drugs may be developed that enhance memory or alter social behaviors. It is critical that scientists engage policy-makers and society at large in discussions about the extension of treatments from the realm of illness to the realm of enhancement. Neuroethical issues in medicine arise where gaps exist between diagnosis and treatment, where treatments may offer tradeoffs in personality or cognitive changes, and where drugs or devices that can help unwell patients also can boost performance of normal people. When diagnostic tests exist for brain-based diseases that have no cure, such as Alzheimer’s, how should this capability be used? Should emergency rooms administer memory-altering drugs to patients who have suffered a trauma and may be at risk for post-traumatic stress disorder? If drugs that are effective for treating attention deficit hyperactivity disorder also improve work or classroom performance of normal people, do we need to regulate access, and do we consider such use to be cheating?

### Social behavior

The neurobiological basis of social interaction is now an exciting topic of research. While a major goal of such research is the treatment of disabling conditions such as autism spectrum disorders,

the knowledge gleaned may also permit us to delve into other kinds of social behavior. Already it is possible to use brain imaging to observe emotional responses to pictures of minority groups within a society. What are we to make of such information? Will it help us understand prejudice, or could it be used to influence decisions about individuals? It is critical that scientists explain the limitations of current technologies and help formulate policies to minimize the chances of misuse.

## Prediction

Neuroimaging and genetic screening may enable us to predict behavior, personality, and disease with greater accuracy than ever before. Neuroimaging technology is also being researched and marketed for lie detection, with consumer targets including national security, employment screening, the legal system, and personal relationships. As individuals and members of groups, people have long been interested in predicting someone else's behavior or detecting whether or not they are truthful. Our approximately 20,000 genes are very distant from our behavior, however, and appear to act in extremely complex combinations in contributing to neural function. Neuroscience technologies that enable more accurate assessment also raise important concerns about privacy and fairness that go beyond those in bioethics. Will we be able to use imaging to measure intelligence? Empathy? Risk for violence? What degree of privacy do we expect to have over our thoughts? If someone has not yet committed a crime but shows brain-based reactions to inappropriate stimuli, such as pictures of children, would we require further monitoring or even preventive detention? The neuroimaging detection of lying has the potential for a major impact on society but will require careful controls and years of research. People lie for different reasons under different circumstances, not all lies cause harm, and even brain correlates of deception will never give us an objective determination of "truth." Predicting individual behavior and determining truthfulness will be major areas of research in neuroimaging and behavioral neuroscience in the coming years, and neuroethics will face many challenges as technologies evolve.

## Informed consent in research

Special care must be taken when scientists seek consent to conduct research and throughout experiments, when individuals have thinking or emotional impairments that might affect their decision-making capacity. Consent is an ongoing process that should involve education of the potential research participant and, when appropriate, family members. Researchers are discussing potential needs to exercise greater scrutiny, ensure safeguards, and enhance participants' grasp of a study, including risks and benefits.

## Effective and ethical science communication and commercial enterprise

Neuroethics will draw from the experience of bioethics in handling scientific communication with the media and responsible transfer of knowledge from basic science to profit-driven venture. A major concern for neuroethicists is the degree to which the media and the public fascination with neuroscience can lead to overstatements and inaccuracies in media communication. Early studies have shown that neuroscience information and pictures of brain images lend excessive credibility to scientific statements in the media, which may underscore "neurorealism" — the idea that anything neuroscientific must be definitive and true. The powerful allure of neuroscience may also entice commercialization of neurotechnologies before full understandings of the risks, benefits, and limitations of the science are in hand. Neuroethics has a critical role in protecting the integrity of neuroscience by promoting responsible and accurate scientific communication in the media, appropriate oversight of commercialized neurotechnologies including accurate advertising, and proactive communication in the popular media to promote public discussion of ethical, social, and legal issues arising from neuroscience knowledge and technology.

At this stage, the field of neuroethics raises more questions than answers. It poses challenges to scientists, ethicists, lawyers, policy-makers, and the public to work through the social implications of new discoveries. The issues are too broad-based to expect that scientists alone will supply the answers. But neuroscientists are well positioned to help shape and contribute to the debate and discussion.

One of the hallmarks of neuroscience has been the drive toward integrating information from disparate fields and specializations to increase knowledge. Sorting through the complex issues captured under the umbrella of neuroethics provides an important opportunity for informed and rich discussions among scientists and with the public. Continuing study of neuroethics will help all segments of society deal with the challenges posed by emerging technologies that investigate the brain and how it works.