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## Brain Research and Neuroethics

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### **Abstract**

In the past year "neuroethics" has begun to command the attention of neuroscientists, ethicists and journalists. Ethical questions associated with new knowledge of the human brain have received extensive coverage in the popular press with cover stories in *The Economist* and *The New Scientist*. There has also been a burst of discussion in the scientific literature (Farah, 2002; Wolpe, 2003), and a number of professional conferences have recently focused attention on the field. The current capability of neuroscience to monitor and alter brain function has profound ethical implications, which scientists and the public have only begun to examine.

### **Comments**

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## **Brain Research and Neuroethics**

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In the past year "neuroethics" has begun to command the attention of neuroscientists, ethicists and journalists. Ethical questions associated with new knowledge of the human brain have received extensive coverage in the popular press with cover stories in *The Economist* and *The New Scientist*. There has also been a burst of discussion in the scientific literature (Caplan, in press, Caplan & Farah, in press; Farah, 2002; Wolpe, 2003), and a number of professional conferences have recently focused attention of the field. The current capability of neuroscience to monitor and alter brain function has profound ethical implications, which scientists and the public have only begun to examine.

### **New knowledge, new ethical challenges**

Recent progress in neuroscience has been fueled by a combination of methodological and theoretical advances. The most obvious factor responsible for the current explosion of knowledge is functional neuroimaging. This set of methods, particularly positron emission tomography (PET) and functional magnetic resonance imaging (fMRI), has allowed the observation of patterns of activity throughout the brain as humans engage in different mental processes (Aguirre, 2003).

The introduction of molecular biology techniques into neuroscience has been responsible for an equally important revolution in understanding the neurochemistry of thought. The past ten years have seen an acceleration in the ability to identify and control, with ever more specificity, the molecular mechanisms of human cognition, feeling, and action (Barondes, 2003).

Finally, there have been important theoretical advances in the behavioral sciences. Intelligent, motivated behavior results from the interplay of multiple systems for cognitive and affective information processing, and it is these systems, rather than the observable behavior, that map most directly onto the brain. With the decline of behaviorism and the ascendance of cognitive science, models of human information processing now exist that provide the needed level of psychological analysis for mediating between behavior and the brain. Recent computational and evolutionary analyses of human behavior have also informed theorizing about mind-brain relations (Gazzaniga, Mangun & Ivry, 2003).

### **Enhancement of normal brain function**

An especially controversial ethical issue at the heart of neuroethics is whether and when it is ethically permissible for normal healthy individuals to use medical and biotechnological means to enhance their mental functioning. While people have always

tried to enhance their functioning in one way or another through ingestion (alcohol, caffeine), new drugs are appearing that greatly increase enhancement potential. On college and high school campuses, the illicit use of Ritalin (methylphenidate) is not uncommon for purposes of increasing attentional focus when studying (Farah, 2002; Wolpe, 2003). Medications that are effective in improving the mood of individuals with depression are sometimes also used as “mood brighteners” by nondepressed people (Kramer, 1993). New drugs are also appearing that allow persons to go without sleep for longer periods of time apparently without as many untoward side-effects as current drugs such as caffeine or methamphetamines.

Several novel drugs for improving memory in dementia are currently in clinical trials, and at least some of them appear to enhance the memory of normal healthy subjects (Farah, 2002). As our understanding of the neurochemistry of cognition and emotion improve further, we can expect newer drugs with ever more specific effects. The reduction in side effects will in turn entice greater numbers of people to enhance their brain function pharmacologically.

Methods of neurocognitive enhancement are not restricted to pharmacology, although at present the nonpharmacologic methods are too rudimentary for enhancement of function in healthy humans. Transcranial magnetic stimulation (TMS), used experimentally in the treatment of psychiatric disorders, might one day be used to activate or inhibit specific cognitive systems for purposes of enhancement. Brain-machine interfaces being developed to augment memory and control robot arms might, in the even more distant future, enhance the cognition of normal individuals (Hoag, 2003).

Is enhancement right or wrong? The answer will almost surely depend on the specific type of enhancement and population, but certain principles seem to apply to the question in the abstract (Farah, 2002; Caplan, in press, Wolpe, 2003). If the benefit to be gained is the improvement of normal function rather than the remediation of disease lower levels of risk seem appropriate especially where children are involved. If enhancement is not to be abused then the prevention of coercion by employers and schools seeking higher performing workers and students is essential. Choice must always be obtained before enhancement can be undertaken in competent adults.

In addition, there will be broader social effects of brain-based cognitive enhancement. One such effect is the socioeconomic advantage likely to accrue to groups that practice enhancement. Policies that promote equal access may prevent the exacerbation of already existing inequities in our society. Loss of diversity, stigmatizing the normal or the disabled and the commodification of human talent are other potential social effects that must be considered. Finally, we must consider the ways in which the fundamental sense of self and agency may be altered when and if neurocognitive self-improvement becomes commonplace (Wolpe, 2003).

### **Neuroimaging of psychological states and traits**

In recent years it has been possible to correlate a surprising number of different personality attributes, attitudes, and predilections with patterns of brain activity,

measured at rest or while performing a task (Canli & Amin, 2003). For example, neuroticism and extraversion are associated with distinctive patterns of brain response to emotionally pleasant or unpleasant pictures. Attitudes toward individuals of other races are associated with patterns of brain response to photographs of same and other-race faces.

Studies, while still rudimentary, have revealed suggestive yet troubling uses for neuroimaging. The likelihood that a violent criminal will act violently in the future can be estimated based on resting brain scans. Intentional deception results in a different pattern of brain activity from truthfulness. These and other examples of potentially sensitive information available from brain scans are discussed by Canli and Amin (2003) and Farah (2002). It should be emphasized that the correlations between psychological variables and brain activity are generally not high enough to make brain scanning a useful tool for screening or assessment. However, it is also the case that some individual scans may be sufficiently distinctive that they do offer reliable information. But those seeking to detect criminal intent or to detain those who may pose a threat to the security of others may be willing to utilize information that is imperfect in lieu of anything else.

Functional brain imaging has the potential to breach the privacy of a person's own thoughts. Privacy is therefore high on the list of ethical issues raised by the new brain scanning technologies. Ironically, the more pressing social issue raised by scanning concerns its inability to measure mental or neural processing meaningfully. The aura of high tech and the impact of visual images may lead judges and juries to put more weight on evidence from functional neuroimaging than is warranted. A better public understanding of the capabilities of imaging is necessary to prevent an over-reliance on this source of information.

The neurological revolution has not drawn quite the same attention as the revolution in genetics in terms of reflection on the ethical and social challenges raised by scientific progress. It should. The chances are that changes in our brains to diagnose or enhance our behavior will take place in our brains just as quickly as they do in our genes.

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