Review Article

Neuroethics: history and relevance

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Abstract

The brain holds a special status as the core of our selfhood and autonomy. Manipulating the function of the brain is fundamentally different from manipulating the function of other organs like the heart or the kidney and raises several distinct ethical issues. Progress in neuroscience is rapidly increasing about neural correlates of the mind. New ethical issues are arising as neuroscience gives us unprecedented ways to understand the human mind and to predict, influence and even control it. Neuroethics encompasses two broad areas. One is fundamental neuroethics also called the neurosciences of ethics and the other is applied neuroethics, which is called the ethics of neurosciences. Analysis of the current body of literature reveals that brain research is presently focusing on neuroimaging, neuropharmacology, neurogenetics and neurotechnology. All these novel technologies are dual-use, making them very prone to abuse. Neuroethics is the term coined to tackle problems resulting from brain research, whether fundamental or applied.

The progress in neurosciences continues in such a breakneck speed that it calls for an urgent requirement to embrace this field which is very essential to channelize brain research. Duty of neuroethics is not only to protect the society from neurosciences abuse but also guard the neuroscientists from society's criticism. World over there has been a technological explosion making it difficult for the physician to keep pace with evolving trends in neurosciences.

This paper attempts to trace the birth and evolution of neuroethics. An attempt has been made to classify the areas which it encompasses, define its current status and predict its future relevance.

Keywords: ethics, magnetic resonance imaging, neurology, neurosurgery

History and evolution of neuroethics

Neuroethics is a term initially coined in the early 1970s to describe over neglected questions of biomedical ethics that were encountered in basic and clinical neuroscience [1]. Crawford used the word neuroethicist for the first time in 1989 while referring to a neurologist, whom he called an ethical agent. Meeting at the Stanford Center for Biomedical Ethics from Stanford University and the University of California was carried out in May 2002 [2].

The interdisciplinary meeting in Canada led to the opening of a formal field of interdisciplinary research and social practices in 2002, following a series of meetings in Canada and the USA [3]. The group broadly mapped their field into four groups: (I) the implications of neuroscience for notions of the self, agency and responsibility; (II) social policy applications that make new resources such as healthcare

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and education available to society; (iii) therapeutic intervention through advances in clinical practice; and (iv) public discourse and training. At this time, there was an emergence of collective interest to evaluate this promising two-way dialogue between ethics and neuroscience, which involved both ethics of neuroscience and neuroscience of ethics. The term ethics often designates a discipline and the neuroscience of ethics is sometimes misinterpreted as taking this discipline as its object. However, it would be more accurate to understand the neuroscience of ethics as referring to a neuroscience of morality, since the neuroscience of ethics does not investigate ethics per se (that is, the philosophical discipline that takes morality as its object) but only certain aspects of morality such as moral judgments, moral emotions, moral intuitions and moral behaviors. In this paper, neuroscience of ethics refers to contributions from both behavioral and brain sciences. Neuroscience research has raised new ethical questions and also promised to address certain ethical concepts and discussions. Neuroscience can further our understanding of moral reasoning and behavior. In the 1850s, phrenologists claimed that their methods would revolutionize moral education. Leading German neuroanatomists in the early 1900s claimed that neuroscience would provide a new foundation for humanism, and by 1960s proposals were made to include medical education with lessons learned from the neuroscience of empathy. However, new technological tools used in neuroscience such as functional magnetic resonance imaging (fMRI) have realized the potential for a much more robust program to rigorously investigate potential mechanisms underlying moral judgment and decision making, a proposal heralded by both leading neuroscientists and philosophers. Around the same period, ethics was developing an unprecedented interest in empirical research (for example, empirical ethics) and experimental philosophy. From this perspective, neuroscience, therefore, served another empirical perspective which would herald the transformation of ethics as an empirical and practical discipline. Neuroethics has been considered as a new discipline that offers an area of consideration for neuroscientific knowledge and actions regarding human beings as individuals and society as an organization. Within its framework, we can distinguish two branches: fundamental neuroethics and applied neuroethics. Fundamental neuroethics deals with research work on neurosciences and with its relation to the understanding of moral phenomena and of human behavior. Applied neuroethics entails carrying out the ethical evaluation of research and also of diagnostic and therapeutic applications within the area of the neurosciences. Current research is not directed primarily at healing but rather aims at searching for perfectibility. Attempts are being made to have a perfect or human or Superhuman through the “increase” of neurocognitive faculties that are artificially induced by using drugs or noninvasive magnetic stimulation of the cerebral cortex. Fundamental research concerns the impact of neuroscience on our ethical practice and concepts, e.g., identity, consciousness and free will. For this reason, it has been defined as a “neuroscience of ethics”. Applied research focuses on the ethical implications of contemporary neuroscientific applications, e.g. neuroimaging, lie-detection and mind-reading. For this reason, it has been defined as an “ethics of neuroscience”. Among the general public ethics of neuroscience seems to be the most popular meaning of neuroethics. Today, some issues seem only a part of science fiction movies but the fact is they will soon become a reality. Very soon we will be considering neuronal restoration with stem cells or brain chip implants to replace certain cerebral functions. A patient would request to be implanted with a chip to learn a subject without having to study. Selective erasing of painful or traumatic memories may become a reality. More neuroethical issues wait to confront the head transplant with a spinal linkage proposal known as head anastomosis venture project. Neuroethics demands to be on the alert and encourage interdisciplinary exchange programs, involving our society to participate, thereby reaching ethical opinions by the census and working on strong moral grounds on the dilemmas that are already emerging. As genetics was for the 20th century, so will neuroethics be for the 21st century. The 2009 report of UNESCO estimated that nearly 30% of the population suffered from diseases of the nervous system which included mental health, neurology or neurosurgical diseases. This represented approximately 35% of the health expenses. Three of the most common ethical principles that are used to guide research around the world are, respect for persons, concerns for welfare and justice. The same principle applies to neuroethics too. More than 1,000 disorders of the brain and nervous system result in more hospitalizations than any other disease group, including heart disease and cancer. In 2007, the World Health Organization estimated that neurological disorders affected up to one billion people worldwide. In fact, neurological diseases make up 11% of the world’s disease burden, not including mental health and addiction disorders. The promise of the neuroscience of ethics quickly materialized with research that tackled topics of philosophical and ethical relevance. Libet's experiments on free will in the early 1980s certainly foreshadowed a renewed conversation among neuroscience, psychological science, ethics and philosophy. While the question “Does free will exist?” may not be an ethical question in the classic sense, it is often construed as a precondition for ascribing moral responsibility. Landmark investigations soon followed, which reported the impact of orbitofrontal cortex lesions on moral reasoning. This proposed relationships between normal moral behavior and affective function. Emotional engagement in the resolution of moral dilemmas was investigated using functional MRI (fMRI). The neuroscience of ethics gained broad appeal and now represents an important field of neuroscience research. Current topics being investigated...
attempt to distinguish between moral reasoning and emotions in the formation of moral judgments and the distinctive neural processes that may be implicated in various moral theories (for example, utilitarianism, deontology, virtue ethics) [29]. Moral reasoning and moral agency have been investigated in diverse pathological states including autism [30-32], addiction [33], psychopathy [34]. Since the introduction of the neuroscience of ethics as a key component of neuroethics fifteen years ago [35], hundreds of neuroscience articles have been published. Additionally, the refinement of research tools has facilitated new ways to investigate problems within the neuroscience of ethics. Four main areas of study which encompass neuroethics are;

1. Brain Science and Self Research highlighting cognitive enhancement. The term cognitive enhancement refers to the improvement of thinking skills when there is not an inherent problem with thinking. Healthy people also use these medications, because they want to improve their memory or ability to learn as well. This is called cognitive enhancement. Four issues which are a cause of concern are-Safety i.e. whether these cognitive enhancers have any long-term or short-term side effects. Secondly, will it be unfair to those who cannot afford it? It will induce pressure on the have not's who need to keep up with the competition. Lastly, it will raise issues about considering such a person worthy of his achievements.

2. Brain Science and Social Policy Research laying grounds for clinical trials of antipsychotic medications for use in children. One needs to critically analyze if children should be included as part of these experimental studies.

3. Ethics and Practice of Brain Science Research need to give due weight to the incidental findings which arise during research.


The current focus of neuroethics

Now let us examine the various fields of research where neuroethics concept will play an important role:

**Neuroimaging**

Recent developments in modern neuro-imaging techniques such as computed tomography (CT), fMRI and positron emission tomography (PET) allow us to examine the structure and function of the brain [36,37]. It has offered several advantages: newer imaging technology has redefined the diagnosis, definition and understanding of various disorders of consciousness such as the vegetative and minimally conscious states. Neuroscientists have started to untangle mechanisms of recovery after brain injury and tackle and struggle with ancient questions about brain, mind, their correlates, neural mechanisms and consciousness.

**Neuromarketing**

One of the most widely discussed new applications of imaging is based on correlations between brain activity and intentional deception (as in the context of a lie detector) [38]. Neuromarketing is catching the world's fascination wherein people's conscious or unconscious desire for certain products can be deciphered and also be predicted. These ventures might lead to neuro manipulation which will require control.

**Neuro-realism**

Another misconception emerging is termed neuro-realism. The findings of neuroimaging are considered real and authentic as it can be measured with brain imaging and electronic equipment [39-41].

Stephen Morse warns that colorful images of the brain such as those produced by fMRI might blind people to the fundamental legal assumption that “people are conscious, intentional and potentially rational agents” and therefore responsible for their actions. He has proposed the exercise of due cautions while using neuroscientific evidence in assessing responsibility or in determining the punishment for criminals’ acts.

**Brain interventions**

The potential benefits of applying neuroimaging, deep brain stimulation and other advanced neurotechnology methods to the mentally ill patients and healthy subjects have to be carefully balanced against their potential harm [42]. Being newer modalities, there long-term effects on the body, mind and personality are yet to be discovered.

**Stem cell research**
In general, although the future looks promising for stem cell application in the field of neurology but still the probable complications prevail in overall ethics of the use of stem cells, including recipient rejection as well as over-proliferation of cells likely causing possible brain tumors [43]. Research needs to conclusively prove that the benefits clearly outweigh the harm. Neuroethics needs to ensure that.

Gene therapy

Altering the primary germline has the chance of altering one’s psyche and personality. It also raises a concern about privacy regarding one’s genome. Genethics, a branch emerged out from bioethics, has its own proprietary issues, among which are questions raised by the potential of making genetic changes to the germline, that would affect not only the person but also future generations and, in unlikely scenarios probably the entire human race [44].

So far, these studies have yet to demonstrate a definitive neural basis of morality or consciousness. They reveal the complex and closely interrelated mechanisms that underlie emotion, values and thought. Research findings that identify physiological links between functional genetic polymorphisms and information processing through imaging genomics further highlight the complexity of and close links between thought and emotion [45,46].

Why does society need to be involved?

Examples of implied responsibilities include experimental reproducibility of potentially complex data, civic involvement in promoting public understanding of neuroscience findings and leadership in the democratic debate regarding the appropriate use of research results [47].

Conclusion

The current advances in neurotechnology are exploring and evolving novel applications of newly acquired knowledge. From neurosciences, they may appear scientific and pertinent but they also need to be tempered from the socio-moral and ethical context. Neuroethics needs to ensure that the outcomes, ultimately provides tangible benefits to humanity.

In the United States, the Presidential Commission for the Study of Bioethical Issues has been set up since 2014 which advises the President of the United States on bioethical issues arising from advances in biomedicine and related areas of science and technology. Their decisions take into consideration the public opinion and ethical considerations of neuroscience research and the application of neuroscience research findings [48,49].

It’s high time that India and other developing countries too form advisory bodies that will not only monitor neuroscientific research but also safeguard the interests of the neuroscientific community. The group must constitute experts from various fields of neurosciences, legal experts and also social activists.

Conflict of interest

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