

Review

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The ethical issues of neurotechnologies

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Abstract. The main objective of the presented article is to consider the features of neuroethics as an emerging scientific problem. Neuroethics is examined from various perspectives. On the one hand, it is presented as a new topic in bioethics, while on the other, it is explored as a component of modern medical innovations known as «human enhancement». The social, economical and political consequences of the use of neurotechnologies in different fields of life are also analyzed. The need for critical reflection and ethical regulation of the use of neurotechnologies, especially directed by organizations as UNESCO are emphasized. This article proposes an enlarged understanding of the neurorights in the Universal Declaration of Human Rights. Neurorights are a new category of rights that protect mental integrity from the exploitation of neurotechnologies. The study's findings are important for understanding modern legal concepts related to neurorights and adapting the existing norms to address ethical and social issues related to new technologies. The authors support the use of ethical concepts such as personal identification, free choice, mental autonomy, equal access and bias prevention. Issues related to mental autonomy include improper information handling, lack of legal security guarantees and violations of medical rights and freedoms. Studying these concerns is crucial for promoting appropriate neurotechnology development and use. The article highlights the importance of establishing clear ethical principles to protect individual rights and promote responsible use of neurotechnologies as well as the necessity to modify current regulatory frameworks to meet ethical and societal concerns related to emerging neurotechnologies.

Keywords: neurotechnology, human improvement, dignity, neurorights, brain imaging, brain enhancement, applied ethics

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Обзор

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Этические проблемы нейротехнологий

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Аннотация. Основная цель представленной статьи – рассмотрение особенностей нейроэтики как новой научной проблемы. Нейроэтика рассматривается с разных точек зрения. С одной стороны, она представлена как новая тема в биоэтике, а с другой – как компонент современных медицинских инноваций, известных как «улучшение человека». Также анализируются социальные, экономические и политические последствия использования нейротехнологий в различных сферах жизни. Подчеркивается необходимость критического осмысления и этического регулирования использования нейротехнологий, особенно под руководством таких организаций, как ЮНЕСКО. В данной статье предлагается расширенное понимание нейроправ во Всеобщей декларации прав человека. Нейроправа – это новая категория прав, которые защищают психическую целостность от эксплуатации нейротехнологий. Результаты исследования важны для понимания современных правовых концепций, связанных с нейроправами, и адаптации существующих норм для решения этических и социальных вопросов, связанных с новыми технологиями. Авторы поддерживают использование таких этических концепций, как личная идентификация, свободный выбор, психическая автономия, равный доступ и предотвращение предвзятости. Проблемы, связанные с психической автономией, включают ненадлежащее обращение с информацией, отсутствие правовых гарантий безопасности и нарушения медицинских прав и свобод. Изучение этих проблем имеет решающее значение для содействия надлежащему развитию и использованию нейротехнологий. В статье подчеркивается важность установления четких этических принципов для защиты индивидуальных прав и содействия ответственному использованию нейротехнологий, а также необходимость изменения текущих нормативных рамок для удовлетворения этических и общественных проблем, связанных с новыми нейротехнологиями.

Ключевые слова: нейротехнологии, улучшение человека, достоинство, нейроправа, визуализация мозга, улучшение мозга, прикладная этика

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1. Introduction

The actuality of neurotechnologies is due to the fact that the complex and contradictory nature of its progress, social, economic and moral changes require a new understanding of the value foundations of human civilization and life itself.

At the first glance, it seems that neurotechnologies are designed to make human life better, and their development should be supported and encouraged in every possible way. However, like any other scientific and technical achievement, its dissemination and expansion of operation is associated with security, privacy and many other bioethical issues. Every progress may have a regress in it.

Humanity today faces the danger of turning into a self-serving technical machine, as a result of which respect and ethical responsibility for all manifestations of life is lost. Under these conditions, all technological achievements in the field of medicine create such problems that are in dire need of ethical analysis.

Throughout history, medical science has recorded many new achievements, but they have never given rise to such confused and conflicting moral opinions as today [1]. The reason for all this is the advancement of the latest scientific achievements, new technologies, to the level of human life management.

The progress of neurotechnology certainly has its positive aspects, but they are not comparable to the explosive situations that humanity may face in the future because of them. Therefore, we have an obligation to control the progress of neurotechnology, keeping it within moral limits.

It has never been possible to stop the progress of ever-developing science, so it remains to use it wisely for its proper purpose [2, p. 189]. The fundamental criterion of regulation in the above field should be the preservation of the spiritual integrity of the person. The modern developments and researches of neurotechnologies should be carried out and applied for the benefit of the development of the spiritual requirements of a person, emphasizing the protection of human sovereignty, self-determination, dignity and fundamental rights and freedoms.

Currently, neurotechnologies are developing at a rapid pace. The volume of public and private investments in this sector is steadily increasing. For their development, various international and local initiatives are created, moreover, very often in the form of public-private sector cooperation. At the same time, the significant potential of neurotechnologies is manifested not only in the treatment of a wide range of diseases and disorders of the nervous system, but also in various scientific studies aimed at improving human nature in general.

We would like to emphasize that our institution, Yerevan State Medical University after M. Heratsi (YSMU), back in 2015, taking into account global development trends and the priorities of the Republic of Armenia's medical field, decided to highlight brain research as a priority scientific direction in order to focus research and consolidate the scientific potential of YSMU. The COBRAIN Research Center, founded for this reason, serves as a platform for neuroscience development, with the goal of providing new impetus to studies on Alzheimer's illness, autism and cerebral palsy. COBRAIN is an advanced research laboratory that conducts scientific and educational activities aimed at healthy brain function and provides an opportunity to bring together neurochemists, neurophysicists, neurobiologists, philosophers, bioethics experts and all scientists interested in neuroscience around a common goal.

However, the uncontrolled use of these technologies can lead to disastrous consequences in terms of preserving fundamental human freedoms and sovereignty. Therefore, the discussion of the development and application of neurotechnologies requires a wide involvement of the ethics, with further implementation of the principles developed by them in the legal acts regulating the field.

It must be admitted that currently the ethical regulation of the development of science and technology lags behind the development process itself, because it is based on a simple response mechanism to specific situations caused by existing or even widely used technologies. There is no doubt that the introduction of these technologies will lead to drastic changes in society and will also lead to some unintended consequences. International organizations, including UNESCO and its advisory body, the Bioethics Committee, have a major role to play in these processes [3]. The works carried out by the latter's expert group and the draft recommendations based on them are definitely a necessary step in the difficult path of defining moral and legal regulations for the sector.

2. What are neurorights

We want to particularly emphasize the definition of the so-called «neurorights» concept and the clarification of its scope. The normative analysis of ethical and legal issues arising from the activities of the sciences engaged in the study of the mind and brain has attracted increased attention in recent years. That happened due to the expansion of philosophical, ethical and legal studies of neurology as a rapidly developing branch of medicine (this particularly concerns research in the fields of neuroethics and neurolaw) from the point of view of the threat of violation of fundamental human rights and freedoms.

The term «neurorights» also arose within the framework of these scientific disciplines and refers to the study

of new methods of treatment and research created in neurology and the moral and legal consequences of their application. Although the scope of possible moral and legal violations and abuses caused by them is quite wide, it is especially necessary to single out all those problems that can arise in the event of restriction of the freedom of an individual's intellectual activity and its distortion. Therefore, by neuro-rights, we mean all internationally accepted normative guidelines of an ethical, legal, and social nature that are designed to preserve and protect human freedom of thought in all its manifestations.

These rights are based on the recognition of the right to physical and mental integrity, privacy of personal data, freedom of thought, free will, and access to scientific progress of all people without discrimination, and the need to protect and promote these rights. They also include the right to make free and responsible decisions about the use of neurotechnologies without any discrimination, coercion or violence. These rights do not simply restate pre-existing human rights frameworks; rather, they offer normative specifications pertaining to the protection of the individual's mental and neurological realm. Furthermore, it supports the idea that the basic freedoms and rights pertaining to the human mind and brain serve as the foundation for all other freedoms and rights. Thus, safeguarding neurorights is a primary responsibility of international human rights law and could help increase the protection of other liberties and rights.

The Republic of Armenia, as a member state of the United Nations, certainly shares the concerns related to the introduction of neurotechnologies and is ready to adopt relevant regulations on the protection of mental health at the state level, as well as ensuring the protection of neurodata as personal data, based on the recommendations of the UNESCO's Bioethics committee [4]. At the same time, we would like to emphasize that there is almost no mention of the application of neurotechnology in the military field. Of course, the simplest and most «positive» use of neurotechnology in the military is the creation of new types of brain-related prostheses for soldiers who have lost limbs or the treatment of neurological disorders such as post-traumatic stress syndrome. However, these technologies can also be used for offensive purposes on the battlefield, causing various ethical, psychological, political, security and other challenges. For example, a computer device can be injected into a soldier's blood that can be magnetically directed to certain areas of the brain. Such soldier will be able to control weapons thousands of kilometers away from him using only his thoughts [5].

The next level may be the use of a device that can directly monitor the behavior of soldiers. In this case, new

ethical challenges will arise in connection with the distortion of our classical perceptions of moral and legal responsibility, which may affect the degree of brutality and the expansion of the scope of war crimes.

Neurotechnologies can also bring hybrid warfare to a new level. If today's battlefield confrontations are aided and abetted by electronic media propaganda, then in neurowarfare it will be possible to literally control the brains of people both on the front lines and behind, threatening the political and social stability of the adversary [6].

Responsible use of neurotechnologies should only take place as a result of close cooperation between representatives of science, legal and ethical fields. When developing neurotechnologies, it is also important to take into account the needs and concerns of the people who will be their direct consumers. Therefore, public awareness of what neurotechnologies are and what consequences can be expected from their development and use, is the main mission of the relevant authorities and organizations.

3. UNESCO and the development of neuroethics as bioethical problem

UNESCO plays a significant role in the field of neurotechnologies, relying on its rich experience in the field of bioethics. It is logical and encouraging that the principles included in the UNESCO document «Universal Declaration on Bioethics and Human Rights» (2005) should also be used in solving neuroethical issues.

In addressing the moral dilemmas brought up by the application of medicine, life sciences and related technology to people, the Declaration grounds the values it upholds in the laws governing respect for fundamental freedoms, human rights and human dignity. The Declaration acknowledges the connection between ethics and human rights in the particular field of bioethics by protecting human life and enshrining bioethics in international human rights [3].

Neuroethics is a young and promising branch, or rather, an interdisciplinary field of research, the subject of which is ethical problems and issues related to neuroscience and the study of the human brain as a whole. In other words, it combines integral neuroscience, modern technologies and ethics in different proportions. This discipline appeared only at the beginning of the 21st century, in response to modern challenges in the field of neurophysiology, but it already covers a fairly large segment of knowledge and most likely will have a future. The faster the sciences and technologies related to human life and consciousness develop, the more they need an ethical assessment and an ethical view of the ongoing progress.

The emergence of new humanitarian disciplines, especially at the intersection of various fields of scientific

knowledge, is a common occurrence today. Among them, neuroethics has a number of features that raise questions of the ultimate methodological level. If we pay attention to the formation of bioethics, to which we will appeal in order to answer the question “How is neuroethics possible?”, then in its history it is quite difficult to identify moments and events that would clearly indicate its beginning. We usually consider as its beginning the Nuremberg Trials of Nazi doctors and the development of the Nuremberg Code, which underlies the modern regulation of biomedical research and is the core of research ethics. Also, such key moments are considered to be the publication of the book by V.R. Potter “Bioethics – bridge to the future” or the first successful heart transplant by the South African Surgeon K. Barnard and the subsequent discussions about the criteria by which a person can be declared dead in order to legitimize the removal of organs for transplantation, and some other events that are separated by decades.

The beginning of neuroethics, unlike bioethics, can be discussed more clearly. Its formation was facilitated, on the one hand, by the rapid development of various methods of neuroresearch itself and the expansion of the scope of neuroscience. On the other hand, it became increasingly obvious that all scientific projects and innovations implemented in the field of biomedicine needed axiological and ethical study by humanitarian disciplines, which also stimulated the advancement of neuroethics. The first such experience was the ethical review of the human genome project, which was formalized in terms such as «gene ethics» or «ethics of genomics». The Human Genome Project (HGP) was a worldwide scientific project that tried to identify, map, and decode every gene in the human genome from a functional and physical standpoint, as well as to identify the base pairs that make up human DNA. Beginning in 1990, it was completed in 2003 [7]. This collaborative biological project was the largest in the world. Although the initiative has a lot to offer for science and healthcare, some authors emphasized that the potential ethical, legal, and social consequences of mapping the human genome needed to be acknowledged.

When neuroscience started to actively develop in the 1990s, it turned out that a precedent for their humanitarian study had already been established. This was due to the institutional consolidation of the practice of humanitarian examination, which led to the assumption that other scientific trends should also have their own ethics. Since the idea of “neuroethics” had been around since the 1970s, the name did not need to be created. Despite this, it was quite specialized and represented medical ethics in the field of neurology. The location of neuroethics, in

most scientists’ opinion, is in the field of philosophy, but by studying the mechanisms of morality, neuroethics conquers new territory from the classical philosophical disciplines [8].

In order to describe the contours of neuroethics, let us consider the main variants of its interpretation. It can be understood, firstly, as a section of bioethics; secondly, neuroethics can be interpreted as applied ethics; thirdly, as an independent type of research or professional ethics in the field of neuroscience and in neurological practice in medicine. Finally, the fourth variant presents neuroethics as the ethics of consciousness or the philosophy of the brain, claiming to declare the final victory of the naturalistic paradigm in understanding morality in the modern society [9].

Neuroethics can be considered as one of the types of bioethics, which from a certain point of view can act as a structural element of research ethics. The basis for inclusion in this case is the general subject – ethical problems arising in neuroresearch and the application of their results not only in medical and clinical practice, but in other areas: in the penitentiary system, in marketing, in education etc. The subject area of bioethics extends to all those areas, if the situation is problematic for a human being – his health, physical and mental integrity, identity, the boundaries of the beginning and end of life. In neuroethics, the question of identity and psychophysical integrity of a person is the most important one [10].

Neuroethics in the aspect of applied ethics, can probably be viewed as a system of provisions regulating possible moral and legal issues in the field of neuroscience, for which the principles enshrined in the main bioethical documents, (for example, the European Convention on Human Rights in Biomedicine (1997), the Universal Declaration of Bioethics and Human Rights of UNESCO (2005)), can serve as a theoretical basis [11].

However, in addition to the above-mentioned international regulations, neuroethics can certainly develop certain norms, principles and methods for managing and solving problems within its own framework, which will be a significant step towards specifying the permissible boundaries of practical research activities in the field of neuroscience in general. Which, in turn, is a weighty argument for many specialists to develop neuroethics as a new and important section of applied ethics [12].

The many specific issues that neuroethics includes are still poorly studied. Their clear description and systematization is very important theoretical and methodological task. We would like to specifically dwell on the two main ethical issues of neurotechnologies, which are brain imaging and brain enhancement related moral and social problems.

4. Neuroethics of brain imaging and brain enhancement

Brain imaging is a crucial technology of modern neuroscience, and its dissemination creates several ethical concerns, particularly when the results are used for non-medical objectives such as marketing, investigative and judicial practice, and so on. The application of brain imaging techniques began in the 1920s. Initially, oxygen was employed as a source to excite the brain while pneumoencephalography was recorded. Then electrical impulses were recorded using EEG. If earlier investigations revealed knowledge about the brain's broad shapes and structural aspects, following ones delved deeper, examining tissues, cells, and intracellular substances. The search for an observable substance, a breakdown that could explain the etiology or character of psychoneurological illnesses, prompted neuronogenetic study. Pneumo- and electroencephalography paved the path for today's high-precision tomographic (layer-by-layer) brain studies. In 1976, computed tomography, which uses X-rays, was introduced. The introduction of electromagnetic waves in MRI, which, by the way, was invented by Reymond V. Damadian – Armenian-American scientist, however, enabled a true breakthrough into the depths of brain matter. In the 21st century, brain imaging technologies allowed for the accurate assessment of the cortex and subcortical components of the brain, as well as its white and gray matter [13].

Computer and magnetic resonance imaging, which records the structural properties of the brain at the cellular level, have created fundamentally new options for neurophysiologists and neurologists. Special cognitive exams were introduced to supplement some of these study possibilities. The development of brain imaging methods today is aimed at further immersion: functional (fMRI) and magnetic resonance spectroscopy (MRS), positron emission tomography (PET), and single-photon emission tomography (SPET), which use high-weight atomic isotopes with a short lifespan as gamma emitters. Multidimensional penetration into brain structures has helped to identify complex morphological changes, which are being studied not only to understand pathogenesis, but also to investigate the possibility of influencing normal brain function and recreating it in neural networks. Diagnostic complication provides a more thorough understanding of the brain's function as a physiological organ, and it is accompanied by the creation of therapeutic impact approaches, which are not always therapeutic in nature, with the goal of improving brain function. Immersion at the molecular-genetic level aligns with a certain epistemic paradigm in the study of mental diseases, which is based on the reduction of behavior and consciousness to neurological bases [14].

In addition to the issues inherent in bioethics, such as the risks of radiation exposure and obtaining informed

consent from the incompetent patients, the medical use of brain imaging raises new problems. For example, drug use, depression and other pathological processes in the brain alter its morphology, which can be detected in a neuroimaging study, increasing the importance of confidentiality and exacerbating the problem of non-interference in the subject's privacy.

Therefore, respecting research subjects' privacy and maintaining their confidentiality is an ethical duty for investigators. Without the data subjects' consent, an investigator should never use test results, identifiable records or other patient data. Researchers that study neuroimaging must be aware of the regulations pertaining to the protection of human subjects, particularly the changing guidelines for maintaining confidentiality and disclosing risks in «non-therapeutic» research. New privacy and confidentiality issues are brought up by methods for producing realistic surface renderings from volumetric anatomical imaging data.

But above all, the social use of brain imaging threatens the personal boundaries that delineate the space of the «sovereign ego», thus eroding the established principles of inviolability on which civil liberties are based. The contradiction between the need to protect personal space and to defend the public interest is exacerbated. When this issue is related to public safety, the use of brain imaging is easily sanctioned, for example, to detect deliberate lies. Note that, as in medicine, confidentiality may be violated in cases where medical information is required to solve crimes or to combat the spread of particularly dangerous infections [2, p. 257].

The use of brain imaging removes the boundaries of the «sovereign ego», while overcoming ethical barriers, and thus opens wide access to technology through commerce, sports, education and other channels. After this, the spread of technology is difficult to regulate, which entails at least two noticeable consequences: firstly, an increase in the trend of medicalization in society, associated with an increase in dependence on medicine, an increase in expenses on it, which are not converted into an increase in the level of health. Secondly, the risk of discrimination against the individual increases, since neurotechnological effects on consciousness and behavior are presented as an act of consumer choice or a desire for self-improvement, which has a positive – improving connotation. That is, an individual autonomously makes his choice in favor of, for example, the use of psychopharmacological agents that improve cognitive abilities, but as a result, his self-identity is called into question. Which manifestation of personality – under the influence of drugs or without them – is true? Does brain enhancement really unlock a person's potential by maximizing

their thinking, memory, ability to concentrate, etc., or does it create an inferiority complex and make a person dependent on means of observation and influence on the brain? [15].

Ethical and legal regulation in this case turns out to be difficult, first because brain enhancement becomes a matter of personal choice, with no possibility of implementing institutionalized control, and second because the value foundation of social norms that must be protected is undermined. Even if internal autonomy is a fundamental value that underpins self-identity and the concept of individual rights, such as the right to personal inviolability and mental integrity, interpersonal competition will play an important role when individual qualities such as creativity, talent, speed, and depth of thinking are valued. Neurotechnologies provide a quick and modern means to achieve the required state of mind and cognitive capacities, and they have become an appealing instrumental value.

The concept of “brain enhancement” is a concretization of a more general term that has come into widespread use in philosophical and bioethical literature – human enhancement. It implies the improvement, strengthening, expansion of a person's capabilities as a result of the converging application of various types of technologies, such as genetic, reproductive, orthopedic, plastic, etc., as well as informational, social, neuropsychological, etc. Human enhancement is defined as the use of technologies not only to fight diseases, but also to increase the capabilities or qualities of normal, healthy people. The greatest attention of scientists and ethicists is focused on technologies for increasing life expectancy, improving mood and cognitive abilities [16].

But from ethical point of view, it is crucial to remember the difference between enhancement and therapy. In many situations, this differentiation can aid in separating the legal and illegal use of different neurotechnologies. Therapy is making something right or repairing something that is wrong, whereas enhancement entails changing something that is not a problem or improving something to a state that we can term better than good. According to this perspective, “therapy”, as it is often understood, is the application of neurotechnologies to treat people who have known illnesses, impairments or disabilities in an effort to return them to a normal level of fitness and health. “Enhancement”, on the other hand, refers to the focused application of neurotechnologies to directly modify not illness processes, but rather the «normal» functioning of the human body and mind in order to enhance or improve their innate abilities and performances [17].

The shift in medicine and technology from therapy to enhancement is a big one, and it brings up a lot of ethical issues regarding the goals of medicine, human dignity

and many other fundamental presumptions about both technological advancement and human rights. The transition from therapy to augmentation should not be taken for granted as the next natural step in the process. Rather, this is an area that necessitates not just analyzing each invention separately, but also analyzing the assumptions that underpin this shift. This, of course, can lead to social and ethical injustice and discrimination, meanwhile the goal of any scientific progress should be the exact opposite, which is providing fair, equitable and appropriate treatment for everyone.

Intensive brain research, initially motivated by the fight against diseases, creates new ethical problems related to methods of cognitive improvement, since it affects how people think and feel and changes a human's personality. In the context of critical analysis of neurotechnologies, traditional bioethical questions about autonomy, cognitive freedom, personal identity, confidentiality are heard in a new perspective.

Therefore, the focus of bioethics turned out to be a variety of tasks: from the search for answers to fundamental questions about the identity of a person in the light of the transformation of his nature in biomedicine, to the creation of institutional and normative practices in which an attempt is made to determine the permissible limits of the application of technologies. However, their spectrum and social implications are continuously expanding.

5. Conclusion

In conclusion we would like to state that with a new turn in the development of neuroscience, around the 1990s, new ways of observing brain activity and its correlation with behavior began to appear. The new data and perspectives that open up together with these perspectives influence the decisions of a person, his cognitive activity, are used not only in medicine, but also in everyday life – in the economy, in trade, in education, etc., as evidenced by the emergence of new scientific and practical fields such as neuromarketing, neuropedagogy, neurolaw and neuroeconomics. The need to assess the consequences and permissible limits of technologies, that began to develop with the ability to «look» under the skull of an individual, to study the unconscious patterns of choices made by a person and his reaction in various situations and then to use this knowledge to manage and control him, led to the emergence of neuroethics.

The dynamics of brain research, coupled with the rapid growth of neurotechnologies, is constantly expanding the range of problems of neuroethics as a bioethical discipline. The development of neuroresearch and the technological implementation of discoveries are transforming society and actualizing the problems of social and humanitarian expertise in the format of neuroethics. That is why the goal of bi-

oethics and neuroethics should be, first of all, critical. At the same time, humanists should first of all listen to the voice of those scientists who do not so much rely on the successes of neuroscience as they are focused on assessing the consequences of their application, such as, for example, the discoverer of mirror neurons, Vittorio Gallese. “I would say that we should focus on the classical philosophical goal of self-knowledge and follow at least a minimal ethical principle: to reduce and prevent suffering, and not to play with scientific evolution, as with fire, which may well get out of control” [18]. The naturalness and immediacy of life cannot be constructed by replacing it with imaginary perfect worlds, therefore neuroethics, in order to preserve its moral principle, must protect these indisputable values.

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