Neurotechnology and *neural rights*

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Abstract. Neurotechnology, which includes a range of devices and procedures that interact directly with the human nervous system, has become a pioneering field with the potential to revolutionize medicine, communication and human development. The rapid progress and constant development poses complex serious ethical and legal challenges. Especially, with regard to human rights such as mental privacy and cognitive freedom. The paper explores the definition and examples of neurotechnologies and its applications, their impact on cognitive behavior and emotions, the human rights they affect, and the emerging concept of *neural rights*. Existing systems are analyzed through a legal lens and the need to balance between innovation and ethical imperatives is sought.

Keywords: neurotechnology, human rights, mental privacy, ethics, neurolaw.

1 Introduction

Neurotechnology encompasses a variety of methods and devices designed to create a direct interface between technical systems and the nervous system. These systems, which include electrodes, computers and advanced prosthetic devices, perform two main functions: they record neural signals and translate them into operational commands for external systems, or they actively modulate the brain's activity through electrical or optical stimulation [1]. They have applications in medicine [2], neuroscience [3], the development of artificial intelligence [4], and even in everyday technologies such as wearable brain monitoring devices. From deep brain stimulation to direct Brain-Computer Interfaces – neurotechnologies are opening up new possibilities for treating neurological disorders, improving people's quality of life and even enhancing cognitive abilities. However, technological advances are also accompanied by major ethical, legal and social challenges that require comprehensive regulation and proper control of their ethical use.

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The emergence of increasingly advanced neurotechnologies raises fundamental questions about data protection, informed consent, risks of discrimination and even possible fraudulent practices. One of the main issues is mental privacy. If a person's brain activity data is made available without his or her consent, there is a risk that it could be used for commercial, political or even criminal purposes. In addition to that, the impact on cognitive freedom is also relevant: will there be a future possibility of manipulating people's thoughts, attitudes or behavior and if so - what will be the legal safeguards?

The development of neurotechnologies is not only relevant in a scientific and/or medical context, but also in the wider public discourse. The scientific community is approaching this topic through the prism of neuroethics and neurolaw. Neuroethics research, as developed by authors such as Rafael Yuste, Marcello Ienca and Nita Farahany, examines the impact of neurotechnologies on personal autonomy, mental privacy and cognitive freedom. In the field of neurolaw, attention has been paid to legal instruments that can protect human rights in the context of neurotechnologies such as the International Covenant on Civil and Political Rights or The Universal Declaration of Human Rights. However, the concept of "neurorights" is not (yet) incorporated into international legal norms although there has already been a debate on the regulation of neurotechnologies in the EU [5].

The aim of this study is to undertake a comprehensive analysis of existing legal frameworks, to assess their relationship to the protection of human rights, and to assess the extent to which these rights are effectively guaranteed in the context of neurotechnology. Particular attention is paid to the most sensitive and vulnerable areas where existing legal mechanisms may be lacking or in need of considerable improvement. By exploring the interaction between advances in neurotechnology and fundamental human rights, this study seeks to identify potential legal gaps and propose solutions that ensure a balanced approach that promotes both innovation and security. It focuses on the most sensitive areas. In the light of these concerns, the study seeks to answer the key question: how can human rights protection be ensured in the context of the rapid development of neuro-technologies, and what legal mechanisms can most effectively strike a balance between innovation and security? In order to achieve this goal, the paper formulates a number of key objectives. First, it defines the concept of neurotechnologies and provides examples of their application

in order to highlight their impact on different areas of society. Secondly, the impact of neurotechnologies on human behavior and emotions is analyzed, assessing the potential risks and benefits. Thirdly, it examines whether existing human rights safeguards are sufficient to ensure human integrity, freedom of thought and personal autonomy. Fourthly, it presents possible avenues for legal solutions, identifies the areas most in need of improvement and compares existing legal frameworks to determine their effectiveness. The study is based on a literature analysis, comparative and legal research methods.

2 Defining neurotechnology

Neurotechnology is a multidisciplinary field that integrates neuroscience, biomedical engineering, computer science, and artificial intelligence to develop tools and methodologies that interact directly with the nervous system. Neurotechnology refers to devices, systems, and procedures — encompassing both hardware and software — that directly access, monitor, analyze, predict or modulate the human nervous system in order to understand, influence, restore, or anticipate its structure, activity, function, or intentions (speech). Neurotechnology combines elements of neuroscience, engineering, and computing [6].

In recent years, applications have expanded considerably, from medical applications to everyday use. Functional applications of these technologies are particularly obvious and practically relevant such as:

Brain-computer interfaces (BCIs): these are devices that allow direct communication between the brain and external devices, enabling individuals to control computers or prostheses using neural signals. For example, BCIs have been developed to help paralysed people control digital interfaces or robotic limbs. A recent example is a 64-year-old ALS patient who, using a brain implant developed by Synchron, is able to control Amazon Alexa with his thoughts, thus regaining his lost independence [7].

Deep Brain Stimulation (DBS): This is a medical procedure that involves implanting electrodes in specific areas of the brain to treat movement disorders such as Parkinson's disease and, more recently, psychiatric conditions such as depression. DBS modulates neural activity to relieve symptoms. The reviewed studies show preliminary evidence toward fine-tuning DBS surgery to help improve depressive symptoms that are highly

associated with a debilitating disease, thus, providing hope for improving quality of life [8].

Neuroimaging technologies: Techniques such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) allow the visualization and monitoring of brain activity. These tools are essential for both clinical diagnosis and research on brain function. For example, EEG is used for real-time monitoring of brain waves to help diagnose epilepsy and other neurological conditions [9].

3 Impact on human behavior

We are already intimately connected to our machines. Researchers at Google calculated this year [Aut. Note – in 2017*] that the average user touches their phone nearly one million times annually* [10]. This close relationship inevitably has an impact on overall human development. The aforementioned technologies can improve concentration, memory and decision-making processes by targeting specific brain areas associated with higher cognitive functions. They also allow for enhanced information processing and even the creation of direct mechanisms for translating thoughts into actions, which can lead to faster learning and improved cognitive skills.

However, such long-term external modulation of brain activity can lead to neuroadaptive changes that can affect a person's independent thinking, decision-making autonomy, or even lead to unwanted side-effects such as headaches, epileptic seizures, or even destabilization of the emotional state [11]. In addition, data security is at stake: if neurotechnologies collect and analyze brain activity data, there is a risk that this data could be used illegally, violating mental privacy rights [12]. For instance, brain implants like DBS are vulnerable to attack by third parties who want to exert malicious control over the users' brain activity. This risk of modification of a person's brain activity through unauthorized use of neurodevices by third parties, also called as "brainjacking". "Brainjacking" can lead to several harmful consequences, such as: the unauthorized extraction of neural information, violating a person's right to mental privacy. As well as interference with neural implants, such as interruption of stimulation, drainage of battery power, tissue damage or impairment of motor functions, thus violating the right to mental integrity [13].

4 Neural rights

Article 15 of the International Covenant on Economic, Social and Cultural Rights stipulates right of everyone to *enjoy the benefits of scientific progress and its applications*. However, the technological advances are thus having an increasing impact on human rights, with both positive and negative consequences, especially in the areas of mental privacy, cognitive freedom, mental integrity and protection against discrimination. The technologies, capable of interacting directly with the human brain, have the potential to improve health, cognitive abilities and overall quality of life, as mentioned above, but at the same time they raise existential questions about the autonomy of the individual and the right to the integrity of his or her mental processes. Insufficiently regulated development of neurotechnologies can open the way to abuse with potentially irreversible consequences.

Mental Privacy is becoming one of the most vulnerable aspects due to the ability to monitor and interpret brain activity in real time. Traditional data protection measures have been designed to protect information that is consciously shared by the individual, but neurotechnologies are changing this paradigm as they are able to extract unconsciously generated information that even the individual may not be fully aware of, and in some cases even unaware of at all. This problem becomes even more serious when the technologies are used on a mass scale, for example in the workplace or in educational institutions, where employers or school administrations can monitor the cognitive activity of employees and students to assess their productivity, interactions with each other or even their psychological state. Such practices can violate not only the right to mental privacy, but also human dignity, by turning internal thought processes into readable data that can be used without explicit consent [14]. The right to privacy itself is unarguably a fundamental human right, recognized in article 12 of the Universal Declaration of Human Rights stating that: *no one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honor and reputation. Everyone has the right to the protection of the law against such interference or attacks*, as well as, article 17 of the International Covenant on Civil and Political Rights (ICCPR) and in many other international and regional human rights instruments. According to the United Nations Human Rights Council (HRC), *privacy presumes that individuals should have an area of autonomous development, interaction, and liberty. People should have a "private sphere" with or without interaction with*

others, free from state intervention as well as excessive unsolicited interventions from other uninvited individuals [15]. That gives a glimpse of the legal security to a human private sphere of any kind, including brain. Article 17 ICCPR covers to all interferences with a person's privacy, regardless of whether they emerge from state officials or natural or legal persons. However, the right to mental privacy has not yet been explicitly recognized as a specific human right. And the privacy to any mental states seems to have only implicit protection under distinctive human rights and freedoms, such as, the right to privacy, the right to freedom of thought, and the right to freedom of expression. Nevertheless, the right to mental privacy is a specific right through the lens of neurotechnology and ought to be a potential candidate for a right that is given a particularly high priority.

The right to cognitive liberty could also be referred to as the right to "mental self-determination" [16]. Which refers to the individual's right to control his or her thoughts, decisions and cognitive abilities without external intervention, is also a subject of debate in the context of neurotechnology. *If the right to mental privacy may help protect the mind from external access and inspection, the principle of cognitive liberty has been invoked to protect mental states from external influence and interference* [17]. While technologies can help treat neurological disorders and improve certain cognitive abilities, they can also be used to modify attitudes, behaviors or even patterns of beliefs. In this view, the right to cognitive liberty encompasses a broad spectrum of freedoms and rights such as the *freedom of thought and rumination, the right to self-access and self-alteration, and to consent to or refuse changes to our brains and our mental experiences* [18].

If the power to subtly manipulate people's thinking through neuro-technology were to be acquired by the state or private organizations, it could pose a serious threat to democratic values and individual autonomy. For example, one can imagine situations in which political forces use techniques to influence voter behavior or corporations that apply cognitive assistance to certain employees to make them more productive but lose the ability to independently assess their working conditions and express critical thinking. According to article 9 of the European Convention on Human Rights *Everyone has the right to freedom of thought, conscience and religion; this right includes freedom to change his religion or belief and freedom*. This right has both an internal and an external dimension. The internal aspect – freedom of thought, conscience and religion - is absolute and cannot be

legally restricted. While in contrast, the external dimension - the right to express one's beliefs - can be restricted in certain circumstances. The nature of the internal dimension ensures that no one can interfere with individuals' most private thoughts, whether by forcing them to change their beliefs or by using methods to expose their private thoughts. As the drafters of Article 9 of the European Convention on Human Rights pointed out, this protects individuals not only against state-imposed confessions, but also against forced examinations, judicial practices, or anything that undermines intellectual autonomy and conscience [18].

While the right to mental integrity is explicitly recognized in established human rights frameworks, its precise scope and limitations remain undefined. Its application in the context of neurotechnology therefore remains unclear. However, certain foundational principles have begun to emerge in the European legal area in relation to mental integrity, which provide valuable insights into the ongoing discourse on neurotechnologies and their potential consequences. For example, case law [19] relating to Article 8 of the European Convention on Human Rights emphasizes that mental health is an essential component of private life, which is linked to mental integrity. Furthermore, the European Court of Human Rights has confirmed [20] that mental integrity covers not only physical integrity but also many aspects of a person's identity, including gender identity, sexual orientation, the right to a name and the right to control one's image. That leads also to the importance of non-discrimination as every person has the right to have his physical, mental, and moral integrity respected.

Advances in neurotechnology and artificial intelligence are transforming understanding of the human mind by blurring the boundaries between cognitive processes and technological intervention. These developments are not only redefining the scope of our mental life, but also raising fundamental questions about the relevance of existing human rights protection. As the analysis show, there is a growing recognition that mental privacy, mental integrity and cognitive liberty are fundamental moral principles that need to be addressed more clearly by a legal framework that is more responsive to these technological developments.

5 Conclusion

Neurotechnology is emerging as one of the fastest growing areas of science and technology, offering revolutionary solutions for treating neurological

disorders, enhancing cognitive abilities, and creating human-machine interfaces. The potential of these technologies is enormous: not only can they make everyday life easier, but they can also open up new horizons in the fields of artificial intelligence, analysis of brain activity and even cognitive behavior of a human. However, these advances are accompanied by fundamental ethical and legal issues related to the protection of human rights.

One of the most important challenges is mental privacy, as modern technologies are able to directly collect, analyze and interpret brain activity data. This raises the risk that information obtained without an individual's consent may be used for commercial, political or even criminal purposes, making traditional data protection measures inadequate in this area. Cognitive freedom, meaning, the right to form and express one's thoughts without control, is also an increasingly important issue, as it can be used not only for therapeutic purposes, but also to adjust people's behaviors, attitudes and even decisions without people knowing it. If not properly regulated, these technologies could become a new tool for governments or corporations to manipulate the public mind.

In addition, mental integrity, which includes the right to the integrity of one's own neurological condition, is threatened by possible cyber-attacks on brain implants and the vulnerability of neurotechnological devices. Technological advances open the way not only to brain stimulation, but also to potentially forced interventions that can alter a person's identity or even will. To add, important area is protection against discrimination, as the development of neuro-technologies can reinforce social exclusion dividing people by their race, sexuality or brain capacities.

Implementing more precise and technologically relevant rights would lead to a more efficient legal system. This would allow more effective access to justice in cases of violation of rights, strengthening both individual autonomy and public confidence in technological progress, while maintaining the necessary balance between innovation and security.

All in all, many challenges come with the latest innovations - for ethics, morality and human rights. These include not only data protection, informed consent mechanisms or fairness in access to technology, but also the broader discourse on the direction in which human-technology interactions should evolve in the future. And they should definitely do so in a human-centric way.

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