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Revista de Ciências Jurídicas
e-ISSN: 2317-2150
Universidade de Fortaleza

Neurorights as Fundamental Rights in the 1988 Federal Constitution[1]

Neurodireitos como Direitos Fundamentais na Constituição Federal de 1988

Neuroderechos como derechos fundamentales en la Constitución Federal de 1988

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Abstract

Advances in neurotechnology have enabled a better understanding of how the human mind and central nervous system work, providing new tools capable of revolutionizing people's lives, especially in the areas of health, education, entertainment and well-being. On the other hand, neurotechnological devices have the potential to read, interpret and alter human thoughts, perceptions and emotions generated by the brain, raising ethical and legal issues that concern the international community, especially with regard to their implications for human dignity and, notably, the fundamental rights to freedom, privacy, personal integrity and physical and mental health. The 1988 Federal Constitution and the international human rights treaties internalized in the national legal system were not designed to protect human beings from the neurotechnological threat, which is why it is essential to recognize and enforce a new set of rights to protect the human brain. In this context, the purpose of this scientific article is to propose, based on deductive, bibliographical and documentary research, that neurorights are enshrined in the Brazilian legal system as implicit fundamental rights, including cognitive freedom, mental integrity, mental privacy and psychological continuity as constitutionally protected assets.

Keywords: Neurorights; Implicit Fundamental Rights; Brazilian Federal Constitution.

Resumo

O progresso da neurotecnologia tem permitido uma melhor compreensão acerca do funcionamento da mente humana e do sistema nervoso central, de modo a oferecer novas ferramentas capazes de revolucionar a vida das pessoas, especialmente nos campos da saúde, educação, entretenimento e bem-estar. Por outro lado, os dispositivos neurotecnológicos têm a potencialidade de ler, interpretar e alterar o pensamento, as percepções e as emoções humanas geradas pelo cérebro, levantando questões éticas e jurídicas que preocupam a comunidade internacional, sobretudo no que pertine a suas implicações à dignidade da pessoa humana e, notadamente, aos direitos fundamentais à liberdade, à privacidade, à integridade pessoal e à saúde física e mental. A Constituição Federal de 1988 e os tratados internacionais de Direitos Humanos internalizados no sistema jurídico nacional não foram concebidos para proteger o ser humano da ameaça neurotecnológica, razão pela qual deve se reconhecer e efetivar um novo conjunto de direitos vocacionados à proteção do

[1] Texto traduzido a partir de Inteligência Artificial.

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cérebro humano. Nesse contexto, o presente artigo científico tem por objetivo propor, a partir de uma pesquisa dedutiva, bibliográfica e documental, que os neurodireitos estão consagrados no ordenamento jurídico brasileiro, na qualidade de direitos fundamentais implícitos, a compreender a liberdade cognitiva, a integridade mental, a privacidade mental e a continuidade psicológica como bens constitucionalmente tutelados.

Palavras-chave: *Neurodireitos; Direitos Fundamentais Implícitos; Constituição Federal brasileira.*

Resumen

El progreso de la neurotecnología ha permitido una mejor comprensión del funcionamiento de la mente humana y del sistema nervioso central, de modo que ofrece nuevas herramientas capaces de revolucionar la vida de las personas, especialmente en los campos de la salud, la educación, el entretenimiento y el bienestar. Por otro lado, los dispositivos neurotecnológicos tienen el potencial de leer, interpretar y alterar el pensamiento, las percepciones y las emociones humanas generadas por el cerebro, planteando cuestiones éticas y jurídicas que preocupan a la comunidad internacional, sobre todo en lo que respecta a sus implicaciones para la dignidad de la persona humana y, en particular, para los derechos fundamentales a la libertad, la privacidad, la integridad personal y la salud física y mental. La Constitución Federal de 1988 y los tratados internacionales de Derechos Humanos incorporados al ordenamiento jurídico nacional no fueron concebidos para proteger al ser humano de la amenaza neurotecnológica, razón por la cual debe reconocerse y efectivarse un nuevo conjunto de derechos orientados a la protección del cerebro humano. En este contexto, el presente artículo científico tiene por objetivo proponer, a partir de una investigación deductiva, bibliográfica y documental, que los neuroderechos están consagrados en el ordenamiento jurídico brasileño, en calidad de derechos fundamentales implícitos, comprendiendo la libertad cognitiva, la integridad mental, la privacidad mental y la continuidad psicológica como bienes constitucionalmente tutelados.

Palabras clave: ***N****euroderechos; Integración Regional; Constitución Federal Brasileña*

1 Introduction

Neurotechnological advances have provided human beings with new opportunities in the areas of medicine, education, well-being and entertainment, with the potential to revolutionize people's lives. However, for this, technological devices and systems need to interact with the human brain and the central nervous system, in order to understand their functioning or modulate a person's brain activity, which can bring risks to dignity and Human Rights, since neurotechnology can directly interfere with the individual's mental and cognitive functions and, in this way, reading, interpreting and altering human thought.

Neurotechnology represents a challenge to Human Rights, so it is necessary to recognize and enforce the so-called neurorights, consisting of a set of rights aimed at protecting the brain. They were affirmed, for the first time, as fundamental rights in Chile, in 2021.

In Brazil, despite the initiative of the State of Rio Grande do Sul to include the protection of the mental integrity of human beings in its State Constitution, neurorights are not enshrined as autonomous fundamental rights, at least explicitly, in the constitutional text.

In this context, the purpose of this scientific article is to address the following problems: is it possible to affirm the existence of neurorights, as fundamental rights, in the Brazilian legal system even before they are formally integrated into the constitutional text? If so, what is its scope of protection?

The main objective of this work is to propose, based on a deductive, bibliographic and documentary research, that neurorights are positive in the Brazilian legal system in the quality of implicit fundamental rights. Thus, as specific objectives, it was established: a) to analyze the need to identify new rights aimed at the protection of the human brain, due to the risks and threats to Human Rights arising from neurotechnology; (b) demonstrate that neurorights can be recognised as fundamental rights implicit in the national legal system; and c) reflect on the scope of protection of the neurorights.

2 Neurotechnology: opportunities and risks for humans

In the United States of America, during the Barack Obama Administration, the so-called Brain Research Through Advancing Innovative Neurotechnologies Project was created, which can be translated into Portuguese as Brain Research through the Advancement of Innovative Neurotechnologies, also called Brain Project. The initiative aims to expand the understanding of the human brain (Paredes, 2024, p. 32), by conducting research aimed at mapping its functioning and learning how brain cells interact and, with this, understanding how human beings think and learn, also contributing to discovering the causes and appropriate treatments for brain diseases (Salinas, 2015, p. 1.087).

The Brain Project has accelerated scientific and technological development, so that neurotechnical advances are redefining human life and the role of the individual in society by leaps and bounds, since for the first time in the history of humanity, technological devices have the potential to read, interpret and alter human thought, perceptions and emotions generated by the brain (Yuste; Genser; Hermann, 2021, p. 154-155).

Neurotechnology can be defined as "any tool or technique capable of manipulating, recording, measuring and obtaining information from the brain"[2] (Ausín; Death; Astobiza, 2020, p. 1), that is, any technological method or device that interacts with the nervous system to monitor or modulate neural activity (Gulyaeva; Farinella, 2022, p. 281). *Experts* in

[2] […] any tool or technique capable of manipulating, recording, measuring, and obtaining information from the brain.

neuroscience are producing neurotechnology capable of treating mental illnesses. On the other hand, companies and states are developing neurotechnological devices that allow people to communicate through thoughts and read the minds of others by accessing their mental and brain data through the so-called brain-computer interface, also known by the acronym "BCI" (*Brains-Computer Interface*). This process allows the human brain to be connected to a computer or other electronic device external to the human body, such as a *smartphone* or *tablet* (Yuste; Genser; Hermann, 2021, p. 155). In this regard,

> A BCI is a computer-based system that acquires brain signals, analyzes them, and translates them into commands that are relayed to an output device to carry out a desired action. Thus, BCIs do not use the brain's normal output pathways of peripheral nerves and muscles. This definition strictly limits the term *BCI* to systems that measure and use signals produced by the central nervous system (CNS). Thus, for example, a voice-activated or muscle-activated communication system is not a BCI. Furthermore, an electroencephalogram (EEG) machine alone is not a BCI because it only records brain signals but does not generate an output that acts on the user's environment. It is a misconception that BCIs are mind-reading devices. Brain-computer interfaces do not read minds in the sense of extracting information from unsuspecting or unwilling users but enable users to act on the world by using brain signals rather than muscles. The user and the BCI work together. The user, often after a period of training, generates brain signals that encode intention, and the BCI, also after training, decodes the signals and translates them into commands to an output device that accomplishes the user's intention[3] (Shih; Krusienski; Wolpaw, 2012, p. 268).

The brain-computer interface establishes a "direct connection between neural activity and the external environment, decoding brain electrical signals and converting them into commands to control electronic or computational devices" (Cruz; Cross; Pereira Júnior, 2024, p. 60), even allowing the control of brain activity by the machine (Cruz; Cross; Pereira Júnior, 2024, p. 60). Neurotechnological devices can be both invasive and non-invasive. These are pieces of equipment worn on the human head without the need for internal access, such as goggles, helmets, halos, or even bracelets. Such equipment allows people to communicate with each other through thoughts, that is, the sharing of words allocated solely in the human

[3] An ICC is a computer-based system that acquires brain signals, analyzes them, and translates them into commands that are relayed to an output device to perform a desired action. Thus, ICCs do not utilize the normal outflow pathways of the brain, peripheral nerves, and muscles. This definition strictly limits the term CHF to systems that measure and utilize signals produced by the central nervous system (CNS). So, for example, a voice-activated or muscle-activated communication system is not an ICC. In addition, an electroencephalogram (EEG) machine by itself is not an ICC only because it records brain signals, but does not generate an output that acts in the user's environment. It is a misconception that CCIs are mind-reading devices. Brain-computer interfaces do not read minds in the sense of extracting information from unsuspecting or reluctant users, but allow users to act on the world using brain signals rather than muscles. The user and the ICC work together. The user, often after a period of training, generates brain signals that encode the intention, and the ICC, also after training, decodes the signals and translates them into commands for an output device that carries out the user's intention.

mind, as well as enabling a quadriplegic to drive a Formula 1 car (Yuste; Genser; Hermann, 2021, p. 156-157)

In turn, the invasive ones are installed inside the human skull and, therefore, "require surgery to place electrodes directly into a person's brain. The electrodes send brain data to a computer, where it can be analyzed and decoded" (Yuste; Genser; Hermann, 2021, p. 156),[4] being used, for example, for the treatment of mental illnesses, quadriplegia or to allow blind people to see again, even with primitive vision.

Sun and Ye (2023, p. 2) describe two types of brain-computer interfaces: *read-out* BCIs and *write-in* BCIs. The so-called *write-in* devices are those designed to manipulate brain activity and work through electrical or optical stimulation by sending signals to the nervous tissue, being primarily used for therapeutic purposes (Sun; Ye, 2023, p. 2). In turn, the so-called *read-out* devices are those that "receive and record brain signals, decode them using algorithms and decoders, and convert them to various representations of intentional activities that can be used to control effectors such as prostheses or wheelchairs"[5] (Sun; Ye, 2023, p. 3). By the way:

> [...] read-out BCIs interpret the users' intentional activity and translate it into actual actions where the users take control of these activities. On the other hand, write-in BCIs input intended action into users, and stimulate them to generate intentional action brain signals, whereby the device is the initiator of the intention-generating activity, not the users. […] In conclusion, while both read-out and write-in BCIs can convert user intentions into actual activities, the former is a self-generated activity by the users, while the latter is a device-initiated activity that raises technical challenges and ethical considerations that differ from those of read-out BCIs[6] (Sun; Ye, 2023, p. 3).

The use of technology for the treatment and rehabilitation of neurological diseases, through computerized systems controlled by the brain, robotic limbs, cognitive orthoses, or auditory and optical implants, for example, is a reality today, with the potential to improve the quality of life of patients, reduce the workload of family members and caregivers, and reduce the costs of the Unified Health System (SUS) (Ienca, 2015, p. 51). However, despite its use

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[5] […] They receive and record brain signals, decode them using algorithms and decoders, and convert them into various representations of intentional activities that can be used to control effectors such as prosthetics or wheelchairs.

[6] [...] Read-out ICCs interpret users' intentional activity and translate it into actual actions, where users take control of those activities. On the other hand, *write-in* CCIs insert intentional actions into users and stimulate them to generate intentional action brain signals, whereby the device is the initiator of the intention-generating activity, not the users. […] In conclusion, while *read-out* and *write-in* ICCs can convert user intents into actual activities, the former is a self-generated activity by users, while the latter is a device-initiated activity that raises technical challenges and ethical considerations that differ from those of *read-out* ICCs .

for therapeutic purposes, neurotechnology has also been used for other purposes unrelated to medicine, such as for military purposes (Munyon, 2018), educational, recreational, and business purposes (Ausín; Death; Astobiza, 2020, p. 2). By the way:

> In 2018, the MIT Media Lab used an invasive BCI to transcribe human thoughts into typed messages. And Neuralink, owned by Elon Musk, announced it is developing a wireless implantable chip to link human minds to computers to create "superhuman" cognition by enhancing humans with AI. Scientists have already discovered how to use invasive BCIs to control the actions of laboratory animals, including mice. While a mouse is performing an action, such as eating, the BCI records its brain data. Scientists can then use this data to reactivate and stimulate the same parts of the mouse's brain that were previously recorded and cause the mouse to eat again—even if the mouse did not want to eat. This same process has already been used for the artificial implantation of memories or images into a mouse's brain, generating hallucinations and false memory of fear that, importantly, are indistinguishable from the real world (Yuste; Genser; Hermann, 2021, p. 156).[7]

Neurotechnological devices are used, as stated elsewhere, to decode brain activity and, consequently, to read and record human thought, identifying images and speeches contained in the person's mind, and can even modify the individual's memory, thoughts, emotions and personality in a few years, as is already the case today with mice (Yuste; Genser; Hermann, 2021, p. 157).

Sun and Ye (2023, p. 4) teach that neurotechnology can alter the individual's thinking, behavior, and self-perception, impacting human identity. In addition, it can negatively affect the autonomy of the person, which constitutes the ethical element of human dignity (Barroso, 2013, p. 81), since individuals, by receiving electrical signals through neurotechnological devices, will be able to perform behaviors that they cannot control. Likewise, it poses risks to human privacy, insofar as the brain-computer interface has the ability to collect mental and behavioral data from users, a threat that arises not only from the use of neurotechnological devices, but also from the illicit use of *malware*, such as *brain spyware*, to access private data generated by users' minds.

Neurotechnological devices, such as brain-computer interfaces, are potentially vulnerable to a new type of cybercrime, neurocrime (Ienca; Haselager, 2016), such as the

[7] In 2018, the MIT Media Lab used an invasive BCI to transcribe human thoughts into typed messages. And Elon Musk-owned Neuralink has announced that it is developing a wireless implantable chip to connect human minds to computers to create "superhuman" cognition, enhancing humans with AI. Scientists have already figured out how to use invasive BCIs to control the actions of laboratory animals, including mice. While a mouse performs an action, such as eating, BCI records its brain data. The scientists can then use this data to reactivate and stimulate the same parts of the mouse's brain that were previously recorded and get the mouse to eat again – even if the mouse doesn't want to eat. This same process has already been used for the artificial implantation of memories or images in the brain of a mouse, generating hallucinations and false memories of fear that, more importantly, are indistinguishable from the real world.

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so-called *brain-hacking*, which consists of the illicit access and manipulation of the individual's neural information, is to say, "it exploits the neural device to get illicit access to and eventually manipulate information in a manner that resembles how computers are hacked or cracked in computer crime"[8] (Ienca, 2015, p. 52), providing real risks to people's mental integrity.

The possibility that private companies and the State read human thought and decode images, intentions and emotions contained in the brain puts in check the human right to privacy, in this specific case, the privacy of mental data, which "refers to the presumption that the contents of a person's mind are only known to that person"[9] (Yuste; Genser; Hermann, 2021, p. 159), but that, "in the age of neurotechnology, the presumption of mental privacy is no longer a certainty"[10] (Yuste; Genser; Hermann, 2021, p. 159), a situation aggravated by the fact that "most brain data generated by the body's nervous system is unconsciously created and outside a person's control. Therefore, it is plausible that a person would unknowingly or unintentionally reveal brain data while under surveillance"[11] (Yuste; Genser; Hermann, 2021, p. 159-160).

Neurotechnology, therefore, brings opportunities for human development and health, but, on the other hand, it also brings new risks to the dignity of the human person and to Human Rights, such as freedom, the free development of personality and privacy, since it can be used for good or for evil (Yuste, 2019, p. 25). It creates new challenges to Human Rights never imagined by the Brazilian constituent legislator or even by those who wrote the main normative instruments of International Human Rights Law, such as the Universal Declaration of Human Rights, the American Convention on Human Rights, the International Covenant on Civil and Political Rights and the International Covenant on Economic Rights. Social and Cultural (Yuste; Genser; Hermann, 2021, p. 155).

Although, on December 20, 2023, the protection of the mental integrity of human beings was introduced in article 235, sole paragraph, of the Constitution of the State of Rio

[8] […] It exploits the neural device to gain illicit access and eventually manipulate information in a way that resembles the way computers are hacked or hacked in cybercrime.

[9] […] It refers to the presumption that the contents of a person's mind are known only to that person. (our translation).

[10] In the age of neurotechnology, the presumption of mental privacy is no longer a certainty.

[11] Most of the brain data generated by the body's nervous system is created unconsciously and outside of the person's control. Therefore, it is plausible that a person would unknowingly or unintentionally reveal brain data while under surveillance. (our translation).

Grande do Sul[12], in a pioneering way in Brazil, the truth is that the Brazilian legal system does not offer, at least expressly, specific instruments to protect the dignity of the human person in the face of the risks caused by neurotechnology.

For example, the scope of protection of the right to privacy, enshrined in the Federal Constitution and in the American Convention on Human Rights, does not explicitly include the protection of the privacy of mental data, as can be seen from the reading of article 11 of the Pact of San José, Costa Rica, which states that "no one may be the object of arbitrary or abusive interference in his or her private life, in that of his family, in his home or in his correspondence, nor of illegal offenses to his honor or reputation".

Furthermore, neurotechnology can be used, as previously emphasized, to stimulate the functioning of the human brain, with the potential to alter human thoughts, emotions, memories, and behaviors, thus revealing itself to be a real threat to individual autonomy and freedoms (Yuste; Genser; Hermann, 2021, p. 160). The possibility of external control of human behavior represents a real threat to self-determination and personal identity (Ienca, 2015, p. 52).

Although there is a doctrinal position in the sense that there is no deficiency of protection within the scope of international human rights law with regard to the threatening potential of neurotechnology (Carranza, 2025), the truth is that the Federal Constitution of 1988 and the international human rights treaties already internalized in the Brazilian legal system were not conceived or drafted to protect human beings from the neurotechnological threat.

The fundamental rights expressly enshrined in the Constitution and the international human rights treaties to which the Federative Republic of Brazil is a signatory are ineffective in protecting the individual from the threats and risks inherent to neurotechnology, especially because the rights to freedom, privacy, free development of personality, physical and mental integrity, and equality do not directly address the issue (Yuste; Genser; Hermann, 2021, p. 161), making it necessary to recognize and enforce the so-called neurorights, consisting of a "new set of human rights to protect the brain"[13] (Yuste; Genser; Hermann, 2021, p. 160), to understand the rights to mental integrity, mental privacy, cognitive freedom, and psychological continuity.

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[12] Scientific and technological policy and research shall be based on respect for life, health, human dignity, the mental integrity of the human being and the cultural values of the people, the protection, control and recovery of the environment, and the use of natural resources.

[13] […] new set of human rights to protect the brain.

However, in the case of Brazil, neurorights are not, for the time being, expressly affirmed in the Federal Constitution of 1988. In this context, it seeks to answer the following question: is it possible to affirm the existence, even if implicitly, of the neurorights in the Brazilian legal system?

3 Neurorights in the Federal Constitution

Fundamental rights can be classified into: formally fundamental rights and materially fundamental rights. The formal fundamentality of rights is, in the lesson of Sarlet (2015, p 78), directly related to positive constitutional law and results from the special legal regime of protection established by the Constitution, a regime that elevates them to the condition of rights of a constitutional nature, limits to the reforming derived constituent power and directly applicable norms (Sarlet, 2015, p. 75-76).

Merely formal fundamental rights are those recognized as such by the Magna Carta (Sarlet, 2015, p. 76), regardless of their content (Alexy, 2008, p. 68). In this sense, it is clear that the following are formally fundamental rights, although some are also materially fundamental, those affirmed in Title II of the Federal Constitution of 1988, which are: a) individual rights and duties; b) collective rights and duties; c) social rights; d) rights to nationality; and e) political rights.

In any case, the list of the aforementioned Title II of the Magna Carta is not exhaustive, so that there are materially and formally fundamental rights dispersed in the Constitution, that is, in addition to articles 5 to 17 of the Constitutional Text (Sarlet, 2015, p. 117). Fundamental rights are not only those formally enshrined and recognized in the Constitution, since it admits the existence of the so-called materially fundamental rights, which can be identified based on the open concept of fundamental rights adopted by article 5, paragraph 2, of the Federal Constitution.

This constitutional provision enables the recognition of fundamental rights affirmed in other parts of the constitutional text or in international treaties, and even in the identification of unwritten fundamental rights, whether they are implicit in the Magna Carta or derive from the regime and principles adopted by the Constitution (Sarlet, 2015, p. 76).

The definition of fundamental right, proposed by Sarlet (2015, p. 78), allows the interpreter to identify and, consequently, to enforce and protect formally and materially fundamental rights, rights that are only formally fundamental and fundamental rights that are exclusively material.

However, the identification and characterization of a law endowed with material fundamentality are not easy tasks for the interpreter and applicator of the law, as they do not result only from the simple reading of the constitutional text, since "only an analysis of its content allows the verification of its material fundamentality" (Sarlet, 2015, p. 76).

Thus, rights are recognized that, although not formally affirmed in the list of Title II of the Federal Constitution, due to their content, importance and meaning, can be considered fundamental and, for this very reason, inserted in the Constitutional Charter, producing all legal effects (Sarlet, 2015, p. 80).

The rule of article 5, § 2, of the Constitution of the Republic, translates the idea that, in addition to a formal concept of the Constitution, there is a material concept (Sarlet, 2015, p. 80), in the sense that the contemporary constitutionalization of law, strongly influenced by post-positivism, is not limited to the formal and express text of the Constitution, encompassing implicit principles and international human rights treaties (Schier, 2015), which become integral elements of the material Constitution, conceptualized by Canotilho (2011, p. 1.139) as:

> […] the set of aims and values constituting the effective principle of the unity and permanence of a legal system (objective dimension), and the set of political and social forces (subjective dimension) that express these aims or values, ensuring their pursuit and implementation, sometimes beyond the written constitution itself. Contrary to what is often thought and seen written, the material constitution does not lead to a simple "de facto power" ("relations of power and influence", "pure political fact"), since the material constitution also has an ordering function. The so-called normative force of constitution (K. Hesse) presupposes, most of the time, the will to constitution, that is, the explicitness in the written or formal constitution of the complex of aims and values agitated by the political and social constellations at the level of the material constitution.

The substantive Constitution is composed of the norms relating to the structure of the State, the organization of powers, and fundamental rights and guarantees (Sarlet; Marinoni; Mitidiero, 2015, p. 71) and allows the opening of the Constitution to other fundamental rights not listed in Title II of the Magna Carta, as well as to Human Rights affirmed in international treaties.

The Constitution is an open system of rules and principles (Miranda, 2011, p. 204) that goes beyond the formal Constitution, the result of constituent power. The Magna Carta of 1988 expressly recognizes, in its article 5, § 2, the existence of other sources of law outside the Constitution itself (Barboza, 2014, p. 178), which makes it possible to incorporate constitutional norms not expressed in the constitutional text into Brazilian law. In this regard, Barboza (2014, p. 179) teaches:

> In Brazil, it is possible to identify the existence of an invisible Constitution, especially with regard to the implicit principles, the general principles of law and the Human and fundamental Rights, in view of what is established in article 5, § 2, of the Constitutional Charter.

The openness of the constitutional system prevents the deduction of implicit or deriving fundamental rights from being carried out solely from a Cartesian-reductionist view of the legal system and legal science, since Law, as an object and knowledge, is open and, therefore, influences and is influenced by the other fields of scientific knowledge and by the environment in which it is inserted. which is why it must be understood, inseparably, from its context (Morin, 2011, p. 47).

Legal norms, which are within the legal system, have their content dependent on interactions with the environment and with other social systems (Folloni, 2015). Like this

> [...] the meaning of certain legal norms may depend, to a greater or lesser extent, on elements that belong to the environment of the legal system [...] in cases like this, the understanding of the system depends on the understanding of the environment – including, eventually, on non-legal scientifically specialized understanding (Folloni, 2015).

The meaning of normative texts, including those related to fundamental rights, emerges from the interactions that exist within the legal-normative system and between the legal system, the environment and other social systems, and it is insufficient to understand normative texts solely through the scientific analysis of the legal system (Folloni, 2015).

The interpretation of normative statements does not depend only on the text, but on its conversation with other legal devices, with other scientific knowledge and with the historical, social, cultural, economic and political context, so that these facts cannot be understood in isolation (Folloni, 2014, p. 206-207).

It is for no other reason that fundamental rights are variable in time and space. In addition, the material opening clause of article 5, § 2 provides a permanent process of identifying new rights (Sarlet, 2015, p. 85), which can be deduced from the

legal-constitutional system, that is, they can be identified based on fundamental principles and rights, such as the dignity of the human person, free development of personality, privacy, intimacy, and protection of personal data (Sarlet, 2020, p. 184).

The dignity of the human person is not itself a fundamental right (Sarlet, 2012, p. 84), but, as a structuring principle of the Brazilian State, it is the source and foundation of fundamental rights and Human Rights (Sarlet, 2012, p. 95). It acts as a criterion for identifying materially fundamental rights that may exist in the Brazilian legal system, so that it is a true "positive legal source of fundamental rights, giving them unity and coherence" (Sarlet, 2015, p. 110).

The possibility of accessing and processing mental data – including the manipulation of thought, emotions and desires – represents a concrete threat to the dignity of the human person, especially its ethical element: autonomy, understood as the mental capacity to make decisions without coercion and manipulation (Barroso, 2013, p. 81-82). Such a possibility interferes with the self-determination of individuals, who can be prevented from exercising their will fully freely.

Thus, it can be stated that there is, in the Brazilian legal system, a set of implicit fundamental rights, called under the term neurorights, which is intended to protect the brain, thus being subject to a reinforced legal-constitutional regime of protection. In other words, neurorights, as fundamental rights, have immediate applicability, become a parameter for controlling the constitutionality of laws, impose themselves as material limits to the reforming constituent power, guide the actions of the Executive, Legislative, and Judicial Branches, and are endowed with radiating effectiveness, in order to guide the interpretation and application of infra-constitutional legislation (Sarlet, 2020, p. 186-198).

The ownership of neurorights is eminently of human beings, not reaching legal entities because they do not have brains, the central object of the protection of neurorights. They are governed by the characteristic of the university, not limited to its ownership to Brazilians and foreigners residing in Brazil, despite the provisions of article 5, *caput*, of the Federal Constitution of 1988, in order to reach foreigners who are not resident in the country and the heimatlos.

In turn, the recipients are the State and private individuals because threats to the human brain can emerge from the actions and omissions of public agencies and entities as well as from companies and individuals. In this sense, neurorights imply for the Government – and, to a certain extent, for individuals – the constitutional obligations to respect the right, that is,

not to violate them, to protect them from the aggressions of third parties and to promote them (Resende, 2019, p. 87).

But what are neurorights? What is its scope of protection?

4 Neurotechnology and Human Rights: neurorights and their scope of protection

Neurorights are presented, albeit implicitly in the Federal Constitution of 1988, as a set of specific fundamental rights, which comprise all possible manifestations of protection of the human brain against the threats of neurotechnology. In short, they reach all conducts and institutes that promote or expand in any way the sphere of protection of the human mind.

Rafael Yuste, Jared Genser, and Stephanie Hermann (2021, p. 160) propose that neurorights include the right to mental integrity, the right to autonomy or mental freedom, the right to mental privacy, the right to fair and equal access to the benefits of neurotechnologies, and the right to protection against algorithmic biases, although there is no consensus regarding the latter two because they can be easily extracted from other rights, such as the right to equality and non-discrimination. For this reason, Ienca and Andorno (2021, p. 7), as well as Gulyaeva and Farinella (2022, p. 284) propose – as specific neurorights – cognitive freedom, mental privacy, mental integrity, and psychological continuity, aiming to directly and immediately protect the human mind.

In the lesson of Sarlet (2015, p. 159), "fundamental rights constitute complex legal positions, in the sense that they can contain rights, freedoms, claims and powers of the most diverse nature", that is, "every fundamental right has a scope of protection (a field of normative incidence or factual support)" (Sarlet, 2015, p. 405).

The scope of protection refers to "what the norm of fundamental right prima *facie guarantees*" (Alexy, 2008, p. 302), thus reaching acts, facts, states and legal positions that can be extracted and, in this way, protected by the norm of fundamental right (Silva, 2017, p. 72).

In this context, what is the scope of protection of the neurorights?

4.1 Right to cognitive freedom

The achievements achieved by neuroscience and neurotechnology, especially in the field of medicine, have been accompanied by new threats directed at the human brain. Gulyaeva and Farinella (2022, p. 285-286) report that neuroscientists have developed a technique called Transcranial Direct Current Stimulation. This technique is used for the treatment of patients with neurological injuries or mental disorders, through the application of a direct electric current of low intensity in the cerebral cortex, but which has the potential to increase the individual's mental capacity and to alter the patient's personality, who may have his mind manipulated for purposes other than the treatment of the disease, including for criminal purposes.

Devices designed to improve the cognitive capacity of the individual may be used to tamper, without their prior knowledge and consent, their capacity for thought and choice. For this reason, cognitive freedom, also called mental self-determination, that is, "individuals must have freedom of thought and free will to choose their own action" [14] (Neurorights Foundation, 2024).

The right to cognitive freedom is directly related to the sphere of autonomy of the person, that is, to the person's ability to pursue, in his or her own way, his or her life goals (Barroso, 2013, p. 81), corresponding, therefore, to the individual's ability to think, decide and make choices for himself, without undue external manipulation (Borbón; Muñoz, 2024, p. 114). But not only that, the possibility of using neurotechnological devices to increase the capacity for cognition and, likewise, of not being subjected to coercive use or without prior, free and informed consent (Gulyaeva; Farinella, 2022, p. 286).

It is the right to have control of one's own consciousness and personality or, in other words, as stated by Bublitz (2015, p. 1.317), cognitive freedom comprises the right of the person to alter their own mind, not only with the use of natural instruments or abilities, but also through neurotools and, at the same time, of not having the capacity for cognition modified without authorization.

4.2 Right to mental integrity

Ienca and Andorno (2021, p. 168) warn that new neurotechnologies make it possible to modify neuronal processes and, consequently, alter, for example, people's thinking and

[14] Individuals should have freedom of thought and free will to choose their own actions.

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emotions, who are especially vulnerable to criminal activities, such as *brain-hacking*, consisting, as already highlighted, in the malicious "hacking" of neurotechnological devices with the purpose of manipulating the user's brain activity. There is even the risk that memories present in the minds of individuals may be erased or selectively boosted (Gulyaeva; Farinella, 2022, p. 291), which is why "the forced intrusion and the alteration of the neuronal processes of a plantean persona una amenaza sin precedents a su integridad mental" [15] (Ienca; Andorno, 2021, p. 168).

The protection of mental integrity is not to be confused with the protection of physical integrity or mental health (Prats, 2023, p. 5). Bodily integrity refers to the right not to interfere without consent in the human body, while mental integrity involves the right not to interfere without authorization in the human mind (Prats, 2023, p. 6). In turn, the right to health, enshrined in the Federal Constitution of 1988, includes the right to prevention, diagnosis and treatment of psychiatric and psychological illnesses. Thus, one must recognize, as already held, a specific implicit fundamental right to mental integrity.

The right to mental integrity ensures that the use of neurotechnologies does not cause harm to the user, as well as prohibits the illicit manipulation of brain activity through the non-consensual and informed use of neurotechnology. In other words, it is a matter of protecting the human being from unwanted intrusion and from the alteration of non-consented neuronal activity (Gulyaeva; Farinella, 2022, p. 290-291). In this regard,

> Este derecho reconceptualizado debería proporcionar una protección normativa específica contra posibles intervenciones habilitadas por la neurotecnología que implican la alteración no autorizada de la computación neuronal de una persona, potencialmente resultar en un daño directo a la víctima. Para que una acción X califique como una amenaza a la integridad mental, tiene que: i) implicar el acceso directo y la manipulación de las señales neuronales; ii) not to be authorized – es decir, it must be produced in the absence of informed consent of the señal generator; iii) give way to a psychological damage. As neurotechnology becomes part of the digital ecosystem and neural computing enters the infosphere, the mental integration of individuals will be increasingly more amenazada if specific protection measures are not applied (Ienca; Andorno, 2021, p. 169).[16]

[15] The forced intrusion and alteration of a person's neural processes pose an unprecedented threat to their mental integrity.

[16] This reconceptualized right should provide specific normative protection against potential neurotechnology-enabled interventions that involve unauthorized alteration of a person's neural computation, potentially resulting in direct harm to the victim. For an action X to qualify as a threat to mental integrity, it must: i) involve direct access to and manipulation of neural signals; ii) it is not authorized – that is, it must occur in the absence of informed consent from the generator of the signal; iii) cause psychological damage. As neurotechnology becomes part of the digital ecosystem and neural computing enters the ionosphere, the mental integrity of individuals will be increasingly threatened if specific protective measures are not implemented.

Mental integrity consists, as can be seen, in the individual's mastery of his mental state, so that no one can access, interpret, diffuse, and alter a person's psychic state in order to condition him or her in any way (Prats, 2023, p. 7). It must be ensured that "individuals must have the ability to control their mental integrity and sense of self"[17] (Neurorights Foundation, 2024), so that whenever there is manipulation of neuronal activity without the prior, free and informed consent of the person generating the neuronal signal, it will be a case of violation of the right to mental integrity (Gulyaeva; Farinella, 2022, p. 291).

4.3 Right to mental privacy

Neurotechnological devices, invasive or non-invasive, especially when connected to the internet, make it possible to read the mental activity of individuals, which can encourage companies and the State to search for information contained in people's brains, especially because the information built from personal data becomes more accurate when based on neural data, which are patterns of activity of human neurons associated with certain states of attention (Gulyaeva; Farinella, 2022, p. 289).

Brain data are personal data because they are related to an identified or identifiable natural person, after all "the señales del cerebro allowen distinguishing or tracking the identity of an individual"[18] (Ienca; Andorno, 2021, p. 162). The electroencephalogram is an exam that records and analyzes the electrical activity of the brain, providing information about its functioning. The electrical signals obtained through this examination can be used as biometric identifiers of the patient and, based on this, have been used by biometric systems for the recognition of individuals (Ienca; Andorno, 2021, p. 162). Furthermore, mental data should be qualified as "ultra-sensitive" personal data because, as Ienca and Andorno (2021, p. 162) argue, brain data are deeply and directly related to the individual's most intimate "interior", that is, to their secrets, thoughts, emotions, and anxieties.

Currently, there is a wide variety and availability of neurotechnological devices, including those sold over the internet, which has facilitated easy access to such equipment and made people frequent users of neurological devices (Gulyaeva; Farinella, 2022, p. 289). These devices make it possible to monitor brain activity and control it, generating benefits for users, such as cognitive improvement (Ienca; Andorno, 2021, p. 158).

[17] Individuals must have the ability to control their mental integrity and sense of self.
[18] Brain signals make it possible to distinguish or track the identity of an individual.

However, brain data and information recorded in a neurotechnological device can be accessed without the user realizing it (Gulyaeva; Farinella, 2022, p. 289-290), that is, "brain waves can potentially be recorded without the individual's knowledge and therefore in the absence of a real capacity of the person to consent to the collection and use of this information"[19] (Ienca; Andorno, 2021, p. 162), which is aggravated by the fact that neurotechnological tools are exposed to malicious activities by third parties, especially when they have the same vulnerabilities to which other technologies are subjected (Ienca; Andorno, 2021, p. 159). In other words, the data and information generated by the human mind, including in the subconscious, may be collected and processed without the prior authorization of the holder, which is why they deserve to be legally protected.

On the other hand, it is not enough just to protect mental data and information, it is also necessary to protect the person's neuronal activity, which is the generating source of brain data (Gulyaeva; Farinella, 2022, p. 290), because "datos neuronales es que la *información* a proteger no es fácilmente distinguible de la *fuente* misma que produjo los datos: el procesamiento neuronal del individual"[20].

The Neurorights Foundation (2024) defines mental privacy as "individuals must have the ability to keep data about their mental activity protected from unwanted disclosure".[21] Thus, the right to mental privacy aims to protect human thought and mind, in other words, to protect the individual from access to and processing of data and information contained in the human brain, including neuronal activity, without the prior, free and informed consent of the holder (Gulyaeva; Farinella, 2022, p. 290).

4.4 Right to psychological continuity

The misuse of neurotechnology can put at risk not only mental privacy, mental integrity, or free will, but the very perception that each individual has of himself, that is, of his own identity, since, as Ienca and Andorno (2021, p. 172) point out, brain stimulation has caused changes in social and sexual behavior, as well as in the personality of individuals, making them, for example, more impulsive and aggressive (Gulyaeva; Farinella, 2022, p. 294); with

[19] Brainwaves can potentially be recorded without the individual's knowledge, and thus in the absence of the person's actual ability to consent to the collection and use of this information.
[20] Neural data is information whose protection is made difficult because it is not easily distinguishable from the very source that produced it: the individual's neural processing.
[21] Individuals must have the ability to keep data about their mental activity safe from unwanted disclosure.

direct negative impacts on the person's identity, by withdrawing, modifying, replacing or including the thoughts, emotions and private memories that are important for their self-recognition.

A "personal identity consists of experiencing oneself in time as the same person"[22] (Gulyaeva; Farinella, 2022, p. 292-293) and neurotechnological devices, when used to stimulate or modulate brain function, can cause changes in the person's personality and, consequently, affect personal identity (Ienca; Andorno, 2021, p. 173). Therefore, personal identity must be protected from non-consented alterations of its brain, through the right to psychological continuity (Lopes, 2024, p. 450), which is intended to "avoid the induced alteration of neuronal functioning, so that personal identity is not altered by third parties through the misuse of neurotechnology without the knowledge or consent of the owner"[23] (Gulyaeva; Farinella, 2022, p. 293).

The right to continuity is closely related to the right to mental integrity, insofar as both are intended to protect human beings from unconsented modifications of their minds. However, they are not to be confused: the right to psychological continuity has an eminently preventive function, consisting of avoiding damage to personal identity, while the right to mental integrity presupposes the occurrence of damage (Ienca; Andorno, 2021, p. 176).

5 Final considerations

The present research work aimed to propose – from a deductive, bibliographic and documentary research – the idea that neurorights are positive in the Brazilian legal system as implicit fundamental rights.

It was based on the premise that neurotechnology, despite bringing benefits to individuals, produces risks to the dignity of the human person and to Human Rights, such as freedom, free development of personality and privacy. However, the Constitution of the Republic and the international human rights treaties to which the Federative Republic of Brazil is a signatory are insufficient for the effective protection of the human brain, since such normative instruments and, consequently, the rights enshrined in them were not designed and structured to protect the individual from the threats arising from neurotechnology.

[22] Personal identity consists in experiencing oneself in time as the same person (our translation).

[23] […] To prevent induced alteration of neuronal functioning, so that personal identity is not altered by third parties, through the misuse of neurotechnology without the knowledge or consent of the owner.

It is understandable, then, that the recognition and enforcement of neurorights – understood as a set of legal positions – are necessary. These actions aim to protect the human brain, encompassing the rights to mental integrity, mental privacy, cognitive freedom, and psychological continuity. Such recognition does not depend on its formal insertion in the formal text of the Constitution by means of constitutional amendment, in view of the clause of material openness provided for in article 5, § 2, of the Magna Carta.

Thus, it is concluded that neurorights are identified as fundamental rights implicit in the Brazilian legal system, as they are necessary for the effective protection of the dignity of the human person, which guarantees the application of a legal regime of reinforced protection of the human brain.

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How to cite:
RESENDE, Augusto César Leite de. Neurorights as Fundamental Rights in the Federal Constitution of 1988. **Pensar – Revista de Ciências Jurídicas**, Fortaleza, v. 29, n. 4, p. 1-10, jan./mar. 2025. DOI: https://doi.org/10.5020/2317-2150.2025.15935

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Received: 01/13/2025
Accepted on: 03/10/2025