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LEGAL PERSPECTIVES ON BRAIN READING TECHNOLOGY IN BRAIN COMPUTER INTERFACE RESEARCH

Questa ricerca approfondisce come le tecnologie cognitive avanzate, come l´EEG e la fMRI, abbinate a sofisticati algoritmi di intelligenza artificiale, contribuiscano alla comprensione dei meccanismi mentali umani. Nello specifico, esamina l´impatto delle Interfacce Cervello-Computer (BCI) nella comprensione delle attività neurali e solleva questioni etiche e legali relative all´uso di tali tecnologie oltre il contesto clinico, in particolare riguardo alla privacy e all´autonomia individuale. Analizzando iniziative come Neuralink e i programmi DARPA, emerge la necessità di stabilire standard tecnici e legali rigorosi per proteggere la mente umana e preservare la dignità e le libertà individuali.

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Articolo Divulgativo

Abstract ENG

This research delves into how advanced cognitive technologies, such as EEG and fMRI, paired with sophisticated artificial intelligence algorithms, contribute to the understanding of human mental mechanisms. Specifically, it examines the impact of Brain-Computer Interfaces (BCIs) in comprehending neural activities and raises ethical and legal concerns regarding the use of such technologies beyond the clinical context, particularly concerning privacy and individual autonomy. By analyzing initiatives like Neuralink and DARPA programs, the need to establish stringent technical and legal standards to protect the human mind and preserve individual dignity and freedoms becomes evident.

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1. The mind-brain duality: from ancient philosophy to cutting-edge neuroscience

The mind-brain relationship is a fascinating and complex topic in today's scientific scenario. Although it has been studied since ancient times, significant progress has been made in understanding this link only with the advent of modern science.

Since the origins of ancient philosophy, there has been debate about the nature of mind and co-science, trying to explain the relationship between mind and body.

According to Platonic philosophy, the mind is a reality independent of the body, capable of perceiving and knowing the world of ideal forms, which goes beyond physical reality. Plato maintains that the mind is eternal and immortal, while the body is only a temporary dwelling[1] .

On the other hand, in the Aristotelian tradition, the mind is considered an integral part of the body, an organ that processes sensory information. Aristotle states that the mind does not exist without the body and that the human intellect develops through experience[2] .

These early theories on the mind-body relationship provided significant insights for subsequent scientific investigations and influenced culture and philosophy for many centuries.

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In 'Rules and Representations', tackling the subject of the philosophy of mind and its current ramifications, Noam Chomsky analyses the two essential components of the human being, the mind and the body, referring to a philosophical tradition that began with Descartes. The French philosopher makes a clear separation between physical mechanism and thought: this is the meaning of the cogito ergo sum and of the very existence of the human being, who would otherwise be indistinguishable from other living beings[3] .

According to Descartes, the body and the immaterial soul, the principle of thought and will, are separate substances that interact through the pineal gland or epiphysis (from the Greek epi-fysin, meaning 'above nature'), 'the seat of the soul and the place where all our thoughts are generated'[4] .

With the advent of modern science, research on the mind and brain has gained a new impetus. Thanks to technological advances, scientists have been able to study the brain in ever greater depth, discovering new information about its structure and functions. Modern neuroscience has shown that the mind and brain are closely interconnected and that many mental functions are the result of the electrical and chemical activity of the brain.

A study published in the journal Nature Neuroscience in 2020 revealed the presence of a specific neural network that facilitates communication between different brain regions, playing a key role in our ability to perceive and understand the external world[5] . These findings have important implications for the understanding of the mind-brain relationship, as they show that perception and understanding of the external world are not the result of the activity of a single brain region, but rather the coordinated interaction between different brain regions, mediated by a specific neural network. In other words, the emergence of the mind depends on the coordinated activity of many parts of the brain, rather than on a single brain region.

Furthermore, molecular biology has provided important insights into brain molecules and their role in regulating human behaviour and mental health. For example, a study published in 2018 in the journal Cell identified a protein called ARC (Activity-Regulated Cytoskeleton-associated protein), which appears to be involved in the process of learning and memory.

This concept is in line with the idea that the mind is an emergent phenomenon, arising from the complex interactions between different parts of the brain, as claimed by many philosophers and neuroscientists; however, the details of how this happens continue to be debated.

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According to philosopher John Searle, mind is a biological phenomenon, which occurs in the same way as digestion or circulation occur in the body[6] . This means that the mind is not separate from the body, but rather is the result of its activity.

The same concept was expressed by neuroscientist Antonio Damasio, who stated that ‘the mind emerges from the activities of the brain and body that are continuously integrated and coordinated[7] .

In summary, reflection on the mind-body relationship has its roots in ancient philosophy, but it is now an extremely active and interdisciplinary field of research. Thanks to advances in neuroscience and psychology, it is possible to better understand how the human brain works and how the mind processes information from the outside world, yet there are still many open questions.

2. The future of neuroscience: uniting BCIs and AI to decode the human brain

Since the 1990s, human intelligence has progressively developed cognitive and technological tools that make it possible to explore the inside of the brain, represent it through neuroimaging, and record, monitor, interpret and modulate the neural correlates of mental processes with increasing precision and resolution[8] .

In addition to traditional techniques such as electroencephalography (EEG), functional magnetic resonance imaging (fMRI) and nuclear magnetic resonance (NMR), other methodologies such as positron emission tomography (PET), magnetoencephalography (MEG), functional near-infrared spectroscopy (fNIRS) and electrocortic imaging (ECoG) have been introduced over time to decode the brain.

In addition to the hardware advancement of these tools, the improvement of information analysis software, based on artificial intelligence systems, has played a key role in the brain decoding process.

The term ‘artificial intelligence’ (AI) is used to refer to the set of scientific methods, theories and techniques aimed at reproducing by means of processing systems the cognitive capacities of the human mind, such as visual perception, language recognition, decision-making and the ability to translate from one idiom to another[9] .

In recent years, the speed at which technology is developing has made these possibilities increasingly concrete, so much so that many are beginning to believe that in the not too distant future, artificial systems will catch up with and surpass human intelligence, even to the point of developing a conscious mind[10] .

In particular, Artificial Intelligence plays a significant role in the analysis of neural data, with Machine Learning enabling an intelligent system to improve its capabilities and performance over time without being explicitly programmed, learning from data and requiring minimal human intervention[11] .

Indeed, processing brain data obtained from EEG, fMRI or fNIRS through machine learning methods can reveal, map and understand cognitive processes and emotional states. This information can be extracted through the creation of mathematical models that identify correlations between large amounts of data.

Neural devices can be used to detect signals from the brain, either through the Brain-Computer Interface (BCI) or to send signals, as in the case of Deep Brain Stimulation (DBS). In the course of research, we have seen the development of ever smaller and more precise chips, as well as the creation of hybrid technologies that allow both the monitoring of brain activity, to decode and collect signals, and the intervention on it[12] .

BCIs are technologies that exploit neural activity to establish direct communication between the brain and an external device, without involving neuromuscular processes[13] .

Neural interfaces have mainly been developed in the field of biomedical engineering and neuroengineering in order to provide functional support and assistance to people with disabilities. EEG, fMRI and fNIRS are some of the technologies used to detect brain activity and create the interface between the brain and the external device.

These technologies are particularly useful for people who have suffered brain injuries or suffer from neurodegenerative diseases such as amyotrophic lateral sclerosis (ALS). For example, thanks to BCIs, it is possible to control electronic prostheses such as mechanical arms without the need for physical movements. In this way, BCIs can improve the quality of life of people with disabilities and help them with everyday activities.

In addition, BCI can also be used for research on brain functions. Electroencephalography (EEG), for example, can detect the electrical activity of the brain and study cognitive functions such as attention, memory and learning. Functional magnetic resonance imaging (fMRI), on the other hand, allows us to detect metabolic activity in the brain and study brain regions involved in processes such as emotion, language and visual perception[14] .

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Modern brain-computer interfaces (BCIs) can be classified into two types: invasive and non-invasive. Invasive BCIs record brain activity by surgically implanting electrodes inside the brain or directly connected to the central nervous system. Non-invasive BCIs, on the other hand, interface brain activity using neuroimaging technologies such as electroencephalography (EEG), which records brain activity through electrodes placed outside the skull. Both invasive and non-invasive BCIs allow direct communication between the user's brain and a computing device.

Research in the field of brain-computer interfaces began fifty years ago at the University of California thanks to major funding from the US Department of Defence[15] . In 1973, Jacques Vidal, a former Belgian Air Force lieutenant, published a pioneering article on direct communication between brain and computer, coining the term 'brain-computer interface' or BCI. In his article, Vidal presented a prototype brain-computer interface capable of translating the electrical activity of the brain into commands for a computer[16] .

The role of BCIs is to decode human intention by acquiring brain signals, analysing them and translating them into commands that are then sent to output devices to perform desired actions. For this reason, they are often referred to as 'brain reading' or 'brain reading' technologies, drawing a comparison with the interpretation of a written text by reading.

In a recent study, researchers used an electroencephalography-based BCI to decode the thoughts of a group of participants while they watched a video. Using machine learning techniques, they showed that the BCI was able to distinguish between thoughts associated with different scenes in the video with good accuracy[17] .

In another study, researchers used a BCI based on functional magnetic resonance imaging (fMRI) to decode the thoughts of a group of participants during a memory task. Using a machine learning model, they showed that the BCI was able to decode the participants' memories with an accuracy of more than 90%[18] .

However, it must be emphasised that at present, neural data analysis software does not provide direct information on the semantic content of thoughts, i.e. their meaning. They cannot truly 'read' thoughts, but can only highlight differences in brain activation during different cognitive tasks and, from these differences, infer possible thoughts.

It is undeniable that technological tools of this kind have the obvious merit of contributing to the prevention and treatment of neurodegenerative diseases: think, for example, of exoskeletons and mechanical arms operated with neurotechnology and, therefore, with mere thought.

It is also true, however, that BCI, when combined with artificial intelligence, can lead to the exploration of the connections between neurological activity, consciousness and identity.

It is precisely the use of these algorithms that hints at the possibility, in the near future, of decoding mental contents such as hidden information, visual experiences, even predictive models of stream-of-consciousness and choices concerning not only neuro-motor programming, but also people's intentions and views[19] .

3. Emerging Research Areas in BCI Applications

In recent years, there has been considerable enthusiasm in both the scientific community and industry for the application of BCI beyond the clinical field. This interest has been stimulated by substantial public and private funding and the growing interest in artificial intelligence and automation. The aim is to develop advanced technologies that can interact reliably and safely with the physical world.

According to a 2019 study published in IEEE Transactions on Neural Systems and Rehabilitation Engineering, there are three main areas of application for BCI, namely: device control, human-computer interaction and artificial intelligence[20] .

BCI technologies can be used to control devices such as wheelchairs, robotic prostheses and domestic appliances. In this regard, a 2021 study published in PLOS ONE showed how BCI can be used to control a drone, enabling users to move around more efficiently and safely[21] .

Another area of application for BCIs outside the clinical setting is human-computer interaction. For example, a 2019 study published in Frontiers in Neuroscience demonstrated how BCIs can be used to control an avatar in a virtual environment, offering users a more immersive and engaging experience[22] .

Finally, BCIs can contribute to the improvement of artificial intelligence, allowing machine learning algorithms to learn from neural signals and improve the ability to understand and interpret data.

In recent decades, there has been considerable interest in understanding ongoing brain

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activity and its actual meaning through the use of brain-computer interfaces. Initially, these interfaces were mainly aimed at providing new communication and control channels for severely disabled people. However, with the considerable improvements in the reliability and usability of BCI systems based on electroencephalography, there has been a growing interest in the field of applications of BCI technologies for healthy users.

This has introduced new types of applications, with the goal of cognitive enhancement, and has brought with it significant challenges. These challenges include the need to develop more reliable and secure interfaces, as well as to ensure the privacy and security of neural data.

Cognitive enhancement refers to the improvement of the processes of acquiring/generating knowledge and understanding the surrounding reality. These processes include attention, knowledge formation, memory, judgement and evaluation, reasoning and calculation, problem solving and decision making, as well as understanding and production of language[23] .

Among the most significant projects in this field is the one initiated by Elon Musk's start-up Neuralink. Their goal is to develop an implantable BCI to link artificial intelligence to natural intelligence in order to realise a 'new augmented cognitive domain'. This type of technology could not only help mitigate the effects of neurodegenerative diseases and enhance cognitive abilities, but also enable the selective storage, amplification or deletion of memories on an external medium[24] .

According to the official Neuralink website, the company is developing a thin electrical filament called 'N1', which can be implanted in the human brain through a minimally invasive surgical procedure. This filament is equipped with electrodes that can record neural activity and stimulate neurons, opening up the possibility of sending electrical signals to the brain and receiving them in response[25] .

A paper published in Nature in 2019 describes how Neuralink has been successful in making probe implants in the brains of rats and pigs, demonstrating the feasibility of this approach. In addition, a surgical robot has been developed that can precisely position the thin filaments in the brain, minimising the risk of damage[26]

Musk presented the vision of Neuralink as a way to overcome the biological limits of the human intellect, enabling a direct connection between the human brain and artificial intelligence, emphasising the potential of these technologies in improving the quality of life of people with neurological disabilities. Indeed, the potential therapeutic applications of Neuralink are very promising, but the area of great interest and debate regarding this

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BCI relates to the enhancement of human cognitive abilities.

Musk has shown a strong interest in human enhancement and has advocated the importance of developing technologies that can improve cognitive performance. Musk's vision is based on the belief that, through research, it will be possible to integrate artificial intelligence and technological capabilities directly into the human brain to improve memory, learning and mental processing speed.

In September 2018, the US Department of Defence pledged to invest $2 billion over the next five years through the Defense Advanced Research Projects Agency (DARPA) to develop a 'neural interface' that allows soldiers to connect with machines through thinking[27] . This military research programme is called N3 (Next-Generation Non-Surgical Neurotechnology) and was initiated with the aim of creating two new BCI technologies for real-time brain monitoring and remote control of external devices.

With the N3 project, DARPA aims to overcome the limitations of traditional BCI that require the implantation of electrodes in the brain through invasive surgery. In this regard, the research focuses on developing a 'neural reader interface' that can monitor brain activity in real time, enabling soldiers to control devices such as drones, autonomous vehicles or complex military equipment by simply thinking about what they want to do.

On the other hand, DARPA is studying a 'neural writing interface' that allows soldiers to send information directly to the brain through external devices. This technology could allow soldiers to receive critical information directly into their brains, improving the speed and efficiency of battlefield communications.

The N3 project represents a major research and development effort in the field of neural interfaces, but it is important to emphasise that the project is still in the development phase and that there are many technical and ethical challenges to be faced before these technologies can be operationally deployed.

Enhancing BCI and neurotechnology is also an area of focus of the China Brain Project, an initiative launched in 2016 by the Government of the People's Republic of China to promote neuroscience research and development[28] . The project aims to better understand how the human brain works and to develop new technologies to improve its understanding and manipulation. To achieve its goals, the China Brain Project is pursuing a number of initiatives, including detailed mapping of the human brain, creating advanced technologies for recording and analysing brain activity, developing new computational models to simulate the brain, and promoting collaboration between scientists and research institutes in China and around the world.

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The project aroused great interest and attracted international attention. It has been compared to the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative in the US and the European Human Brain Project, both of which conduct research aimed at unravelling the mysteries of the human brain.

During the 3rd World Intelligence Congress in Tianjin on 17 May 2019, an important technology in the field of brain-computer interfaces was presented: the world's first chip called BC3 or Brain Talker. This chip, a collaboration between Tianjin University and the China Electronics Corporation, is an innovation with completely independent intellectual property.

The BC3 chip was specifically designed to improve brain-computer interface technology, enabling the decoding of users' mental intentions through neural electrical signals, bypassing the normal neuromuscular pathways of the human body. Thanks to advances in integrated circuit technology and computational neuroscience, the BC3 has been developed with compact dimensions, higher decoding accuracy, greater computing efficiency and faster communication than traditional decoding devices. Cheng Longlong, data scientist at China Electronics Corporation, emphasised that as the performance of the Brain Talker continues to improve, the BC3 may one day find applications in medicine, education, self-discipline, security, as well as the gaming and entertainment sectors.

In addition, several companies are exploring the use of neural interfaces as accessories for their core products. One example of this is the car manufacturer Nissan, which has developed the Brain-to-Vehicle (B2V) system, a wearable EEG-based neurological technology that connects the driver's brain to the vehicle. Through advanced processing algorithms, the system is able to interpret the driver's intentions and reactions in real time. This allows the vehicle to anticipate the driver's actions and adapt its behaviour accordingly.

Nissan's aim with the B2V system is to improve the driving experience, making it more comfortable and safer. For example, if the system detects that the driver is about to press the brake pedal, the vehicle can respond more quickly and efficiently, reducing reaction times and improving safety overall.

Nissan unveiled the B2V system at the Consumer Electronics Show (CES) in 2018, highlighting its commitment to combining neuroscience with automotive technology to create a more intuitive and immersive driving future.

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CTRL-Labs, a company founded in 2015 and specialising in the development of neural interfaces, caught the attention of Facebook, now Meta Platforms, which acquired it in 2019, stating that this technology could be used for a variety of applications, including virtual and augmented reality, wearable devices and more.

CTRL-Labs' approach is based on recording neural signals at the peripheral level, capturing the electrical muscle activity in users' wrists. These signals are then interpreted by advanced algorithms to recognise the user's intention and translate it into commands for the machines. This non-invasive, wearable methodology offers a promising alternative to traditional brain interfaces, which require the implantation of electrodes inside the brain.

The projects mentioned represent only a small part of the numerous studies and developments in the field of BCI and neurotechnology. What these projects have in common is the intention to intervene externally on the brain substrate; thus, the brain is no longer the inscrutable organ it has been for centuries, observable only through post-mortem dissections, when its functions have ceased to function, but instead becomes observable in real time, with good resolution and through a wide range of neural data.

4. BCI: legal and moral challenges beyond health

The brain plays a fundamental role in coordinating the body's vital functions and in supporting the cognitive and mental faculties that define a person's identity. These faculties include consciousness, memory, perception and language. Thus, with the advancement of brain reading technologies, which aim to decode brain activity and neural contents, raises concerns about the potential interference in the most intimate spheres of the individual[29] . If the decoding of brain contents were to become a reality, scenarios would open up in which the secrecy of people's most intimate experiences and thoughts could be compromised. This could lead to the identification of people through neural traces, the use of neurotechnology in interrogations, legal decisions and the prevention of criminal acts[30] .

For these reasons, ethics must be considered a real soft engineering skill. BCI researchers and developers have a responsibility to conduct in-depth studies to understand the effects of BCIs on the human brain and mental health. It is essential to ensure that BCIs are safe, reliable and do not cause unacceptable harm or risk to users. This requires a rigorous ethical approach in the design, development and evaluation of neural interfaces[31] .

In this regard, at the international level, the Universal Declaration of Human Rights comes to the fore; this, adopted by the UN General Assembly in 1948, represents one of

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the main normative references at the international level for the protection of fundamental rights. Although it does not focus specifically on new technologies, the principles set out in the Declaration have a wide and transversal application, including the ethics of new technologies such as ICTs.

The Declaration recognises several rights that are relevant to the ethical development of new technologies. For example:

Human Dignity (Art. 1): Human dignity is a fundamental principle that must be respected in the development and use of ICTs. This implies ensuring that technologies respect people's dignity and do not degrade or instrumentalise them. Non-discrimination (Art. 2): BCIs should not be used for discriminatory purposes or to amplify existing inequalities. It is important to avoid digital divides and ensure that ICTs are accessible to all, regardless of their socio-economic status or disability. All individuals should be treated equally and without discrimination in accessing and using technologies[32]. Privacy (Art. 12)[33] : Privacy is a fundamental human right that should be preserved when using BCIs. Neural data and personal information collected through BCIs should be handled in a way that ensures the protection of individuals' privacy. In addition, the European Commission created an independent advisory body in 1991, the European Group on Ethics in Science and New Technologies (EGE)[34] , which provides ethical advice to the European institutions on issues related to new technologies. The EGE plays an important role in identifying and addressing ethical challenges associated with the development of new technologies and in drawing up recommendations to promote their ethical and responsible use.

In addition, the European Union has promoted initiatives to define specific ethical principles for new technologies. In 2018, the 'Ethics Guidelines for Trustworthy AI' was published, developed by the High-Level Expert Group on AI (AI HLEG) of the European Commission. These guidelines provide principles and recommendations for the ethical development and use of artificial intelligence, including the brain-computer interface.

The Ethics Guidelines for Trustworthy AI are based on seven key principles that should guide the development and use of AI:

Respect for fundamental rights: AI should be developed and used with respect for human rights, including dignity, privacy, non-discrimination and human welfare. Common good: AI should be aimed at promoting human welfare, social justice and sustainable development. Autonomy: AI should be designed to enhance the autonomy of individuals and not limit or manipulate it. Justice: AI should be impartial, ensure fairness and prevent unfair discrimination. Transparency: AI-based algorithms and systems should be

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transparent, understandable and explainable. Diversity, non-discrimination and fairness: AI should promote diversity, avoid the creation or amplification of discrimination and ensure equal access to AI opportunities. Accountability: creators and users of AI must take responsibility for the consequences of their decisions and actions[35] . These guidelines provide an ethical and regulatory framework for the development and use of artificial intelligence in Europe, promoting its reliable development that respects human rights and is in line with European values.

That said, it emerges that the responsibility of BCI researchers and developers also extends to considering the social impacts of these technologies. It is important to consider the implications on mental privacy and the protection of users' neural data. BCIs might collect highly sensitive information about individuals' brain activities, which raises concerns about data security and the potential misuse or violation of their privacy[36] .

In this regard, some regulations and guidelines have addressed these specific issues:

General Data Protection Regulation (GDPR): the EU Regulation 2016/679 provides a legal framework for the protection of personal data, including neural data collected by BCIs. This regulation establishes principles and obligations to ensure data security, informed consent of individuals and transparency in the handling of personal data. Health Insurance Portability and Accountability Act (HIPAA): In the US, HIPAA establishes rules for the protection of individuals' health information. This legislation is relevant to BCI used in the medical context and requires the appropriate protection of patients' neural data. Bioethics and Data Protection Frameworks: Some countries have developed specific regulatory frameworks to address ethical and data protection challenges related to neural technologies. For example, Japan has adopted a set of ethical guidelines for the research and use of neural technologies, including BCIs. The Ministry of Health, Labour and Welfare has established ethical principles for human brain research and neural data management[37] . European Group on Ethics in Science and New Technologies: as mentioned above, the EGE provides ethical recommendations on science and new technologies, including BCIs. The EGE recommendations are often based on fundamental ethical principles such as respect for human rights and human dignity. Looking at the European regulatory environment, the GDPR is a milestone in personal data protection and imposes strict rules on the collection, processing and storage of personal data. This regulation is applicable to all organisations operating in the European Union and provides a solid legal basis for ensuring the privacy and security of personal data, including neural data collected by BCIs. The GDPR emphasises informed consent, transparency in the use of personal data and the need to take appropriate security measures to ensure the protection of sensitive data.

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Thus, the need for a right to mental privacy is strongly affirmed as a necessary prerequisite for the exercise of any other right, which implies that individuals have the right to maintain the confidentiality of their thoughts and emotions, without being subject to intrusion or violation. This has a legal and constitutional basis in various national and international laws.

In Italy, for example, Article 24 of the Constitution protects the right of defence, which includes the right to silence and the inadmissibility of evidence detrimental to self-determination. Article 220 of the Code of Criminal Procedure prohibits the use of criminological expert opinions as an invasive tool in court proceedings. Moreover, Article 48 of the Constitution guarantees the secrecy of voting, which is an example of the protection of mental privacy in the political sphere.

In addition, the rights to inviolability of home (Art. 14 Const.) and secrecy of correspondence (Art. 15 Const.) constitute further guarantees of mental privacy[38] .

In addition to this, Article 9 of the GDPR provides for a general ban on the processing of data revealing, inter alia, political opinions, religious or philosophical beliefs, trade union membership, as well as data relating to a person’s health, sex life or sexual orientation. Specific safeguards are also provided with regard to profiling activities, understood as any automated processing of personal data consisting in their use to analyse or predict aspects concerning, inter alia, the personal preferences, interests, reliability and behaviour of individuals.

The issue of mental privacy and data protection becomes crucial in this context, as neural data could reveal highly intimate personal information. There is a need to establish a regulatory framework that ensures the protection of this highly sensitive information, the informed consent of individuals and the restriction of unauthorised access to this information.

Moreover, the possible use of neurotechnology in the legal and investigative context raises further critical issues. The use of such tools in interrogations could raise questions about coercion and the violation of individual rights. Furthermore, the use of neural information as evidence in legal decisions could raise questions about the scientific validity and interpretation of neural traces as indicators of criminal behaviour or intentions.

With regard to the prevention of criminal acts, while the possibility of identifying neural signals associated with certain behaviour or intentions may seem promising from the point of view of public safety, it is essential to balance the protection of society with respect for

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individual rights, such as the presumption of innocence and the right to privacy.

For all the above, there is no doubt that protecting the human mind and safeguarding its intimacy are issues of paramount importance in the age of new neural technologies.

The mind is the internal place where the ideas, opinions and beliefs that constitute the very essence of an individual are formed. Therefore, it is crucial to ensure that technological innovations respect human dignity and do not invade the individual's mental space. This goal requires the adoption of technical and legal standards that place an inviolable perimeter around the human mind.

It is important to emphasise that ethics and the protection of neural data are not only a regulatory issue, but also require continuous debate and development in the scientific context. Scholars and experts in neuroscience and ethics are addressing these issues through academic publications, conferences and discussions on the ethical and social implications of neural technologies.

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[33] Article 12 states that: "No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, or to attacks on his reputation. Everyone is entitled to the protection of the law against such interference or attacks". This principle also applies to the mental sphere and the right to mental privacy.

[34] The EGE consists of up to 15 independent experts in the field of ethics, science and new technologies. These experts are selected for their expertise and experience in the field of applied ethics and emerging ethical issues. The EGE operates independently and its activities are governed by a code of conduct that ensures the objectivity and impartiality of its evaluations.

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