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Neurorights in BCI Applications: a Private Law Perspective

Lucilla Gatt,[*] Ilaria Amelia Caggiano,[**] Maria Cristina Gaeta[***] and Anna Anita Mollo[****]

Abstract

This paper explores brain–computer interface (BCI) applications under a private law perspective with the aim of demonstrating how the legal issues deriving from the use of these technologies can be dealt with through the interpretation of the existing regulatory framework at the supranational and national levels (neurorights and fundamental freedoms), in the latter case, making reference to Italian law. We adopt a right-based approach not only to lay the legal foundations for a safe, reliable and trustworthy technology, but also to evaluate its impact on human decisions and juridical acts, and to assess how much of the human will remains in these hypotheses. The paper includes three case studies related to vulnerabilities or disabilities of current and prospective BCI users, with a particular focus on the Italian legal system.

Keywords: neurorights, AI Act, regulatory perspectives, legal-ethical compliance by design, FRIA.

[*] Full Professor of Private Law and Director of the Research Centre in European Private Law (ReCEPL), Università degli Studi Suor Orsola Benincasa, Naples, Italy, author of section 1 and co-author of section 4.

[**] Full Professor of Private Law and Vice Director of the Research Centre in European Private Law (ReCEPL), Università degli Studi Suor Orsola Benincasa, Naples, Italy, author of section 5.

[***] Ph.D., Appointed Lecturer in Private Law, Scientific Secretary and Senior Researcher of the Research Centre in European Private Law (ReCEPL), Università degli Studi Suor Orsola Benincasa Naples, Italy, author of sections 2.2 and 3.

[****] Ph.D., Post-doc Research Fellow, Scuola Superiore Meridionale University Institute for Doctoral Training and Researcher of the Research Centre in European Private Law (ReCEPL), Università degli Studi Suor Orsola Benincasa Naples, Italy, author of sections 2.1 and 2.3, co-author of section 4.

1. An Overview on Neurorights in Private Law

The term 'neurorights' was used for the first time between 2015 and 2017[1] to describe the emerging category of those basic human rights related to the mental and neurocognitive sphere. In particular, the four dimensions of protection that defined neuro-specific human rights (cognitive freedom, privacy of mind, integrity of mind and psychological continuity) were initially delineated, then further elaborated and categorised, to refer to the specific set of human rights with which to address the ethical and legal challenges posed by neurotechnologies. Since that moment, a broad and complex international debate has emerged regarding the appropriateness of recognising neurorights to protect the brains and minds of human beings.[2] Some scholars assert the necessity of the establishment of new, explicitly defined rights, emphasising the need for specificity and targeted protection that considers the possibility of neurotechnologies reading, influencing and potentially altering brain activity. This would give individuals the right to decide how their brain could be accessed.[3]

Other scholars argue that existing human rights frameworks, if adequately interpreted and enforced, are sufficient to protect individuals from these emerging threats. Indeed, introducing new rights with specific reference to neurotechnologies could lead to the improper application of the existing regulations.[4]

Similarly, but in a private law perspective, we argue that the legal foundations of neurorights were already present (almost prophetically) in the existing fundamental Charters and European and national regulations.

The hard law regulatory framework, indeed, could provide the necessary answers to the questions of protection and preservation of the human brain and mind. Several existing human rights are potentially relevant and adoptable regarding the use of neurotechnologies.

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[1] Marcello Ienca, Roberto Andorno, 'Towards New Human Rights in the Age of Neuroscience and Neurotechnology' [2017] *Life Sciences, Society and Policy* 1; Marcello Ienca, 'On Neurorights' [2021] *Frontiers in Human Neuroscience* 1 ff*;* Marcello Ienca, 'Common Human Rights Challenges Raised by Different Applications of Neurotechnologies in the Biomedical Field' [2021] Report committed by Bioethics Committee of the Council of Europe.

[2] Eric García-López, Josè M. Muñoz, Roberto Andorno, 'Neurorights and Mental Freedom: Emerging Challenges to Debates on Human Dignity and Neurotechnologies' [2021] *Frontiers in Human Neuroscience* 790; Pablo López-Silva, Luca Valera, *Protecting the Mind: Challenges in Law, Neuroprotection, and Neurorights* (Springer Nature 2022); Rafael Yuste, Tomas Salcedo, 'Neuro-Rights and New Charts of Digital Rights: A Dialogue Beyond the Limits of the Law' [2023] *Indiana Journal of Global Legal Studies*; Sjors Ligthart et al, 'Minding rights: Mapping ethical and legal foundations of neurorights' [2023] *Cambridge Quarterly of Healthcare Ethics* 1.

[3] Nita A. Farahany, *The battle for your brain: defending the right to think freely in the age of neurotechnology* (St. Martin's Press 2023).

[4] Jan Christoph Bublitz, 'Novel Neurorights: From Nonsense to Substance' [2022] *Neuroethics* 6; Jan Christoph Bublitz, 'Neurotechnologies and human rights: restating and reaffirming the multi-layered protection of the person' [2024] *The International Journal of Human Rights* 782.

2. Current Legal Regulation in the Framework of the Fundamental Right

2.1 International and European Charters of Fundamental Rights

As mentioned above, many of the principles and values that underpin the legal foundations of neurorights in private law are already recognised at the European level. The Treaty of the European Union is based on the values of human dignity, freedom and equality (article 2); the Treaty on the Functioning of the European Union fights discrimination based on disability (article 10); the Charter of Fundamental Rights of the European Union expressly recognises the right to human dignity (article 1), the right to the personal integrity (article 3), the prohibition of all forms of discrimination (article 21) and the right to integration of persons with disabilities (article 26).

At the international level, the European Convention on Human Rights asserts respect of private life (article 8). The International Covenant on Civil and Political Rights expresses the right to liberty and security of person (article 9), and the right to privacy (article 17). Finally, particular attention should be given to the UN Convention on the Rights of Persons with Disabilities (UNCRPD), which at article 2 states that 'communication' includes spoken and signed languages, and other forms of non-spoken languages.

2.2 From Product Safety to Risk Impact Assessment in the EU Approach

Neurotechnologies are products and, as such, are regulated according to existing regulations. These regulations were initially focused on safety, but the need to protect individuals who interact with new technologies has since required the provision of new, stricter regulations. These are currently based on risk impact assessment.

Concerning safety, products (including smart products) have to conform to the applicable laws and comply with the existing European Union (EU) health and safety requirements. Consequently, at the European level, hard law regulation, standards and supervision by competent public authorities have been developed.[5]

The concept of 'safety' includes in a broad sense of both safety and (cyber)security, both of which are already regulated. 'Safety' is concerned with the users of neurotechnology applications, as well as that of other human beings and the surrounding environment during such use. 'Security', in contrast, relates to the functioning of the IT systems. Of particular relevance is cybersecurity, which aims to protect smart products from hacking and algorithmic bias. Furthermore, adequate security compliance also includes privacy compliance, as data have to be protected. This also requires having in place adequate technical and organisational measures to

[5] European Commission policy on 'Product safety and requirements' and, in particular, 'non-food product safety, <https://commission.europa.eu/business-economy-euro/product-safety-and-requirements_en> accessed 27 May 2025.

guarantee the security of the products and avoid unauthorised intrusions, and the use and manipulation of personal data.

Historically, security has been provided in the existing product regulations such as the old Product Liability Directive (Directive 85/374/EEC, currently repealed by Directive 2024/2853/EU) and, in Italy, the Italian Consumer Code (article 114 ff) and Italian Civil Code (articles 2043 ff and 2059). Cybersecurity, instead, is regulated by different regulations, the most important of which is the Network and Information Security (NIS2) Directive (Directive 2022/2555/EU, which has replaced Directive 2016/114/EU), which aims to achieve a high common level of cybersecurity across the EU, guaranteeing the protection of smart products that are connected online.[6]

There is also a new package of EU regulations centred around risk assessment. This package includes the General Data Protection Regulation (GDPR) (Regulation 2016/679/EU, implemented in Italy through the amendment of the Italian Legislative Decree no 193/2006 and subsequent amendments) and the Artificial Intelligence Act (AI Act) (Regulation 2024/1689/EU). The regulatory framework on artificial intelligence (AI) liability, particularly in view of the new risk assessment- and management-based approach, has been completed by the proposed AI Liability Directive (AILD) (COM/2022/496/final) on liability for damage caused by AI, which had the ambitious goal of harmonising the rules on non-contractual civil liability for damage caused by AI throughout Europe. However, the proposal was beset with critical issues – such as the terms of the liability attribution criteria and the harmonisation of national laws – and was withdrawn in February 2025.

In order to measure and manage the impact of AI on the fundamental rights of individuals, article 9 AI Act provides the risk management system for high-risk AI systems. Article 27 provides the fundamental rights impact assessment (FRIA) for specific high-risk AI systems. These high-risk systems are defined in the same articles. This method of measurement and management founded on the risk-based approach is increasingly at the centre of regulatory techniques and requires a multidisciplinary approach. Furthermore, it goes beyond the security requirements provided at the European level, adapting the legal regulation of AI systems according to the level of risk they pose for the individuals. Risk levels are assessed by measuring the impact of AI technologies on human rights, classifying them according to their potential concrete risks and dividing them into prohibited, high-risk and low-risk AI.

The provisions of the AI Act and its annexes could prevent certain risks to the individual. In this way, the AI Act completes the existent regulation and, in particular, the rules on product safety, privacy and (cyber)security, as well as on the rights of individuals, from self-determination to communication, guaranteeing trustworthy AI systems in all domains, including that of neurotechnology (as BCIs). Effective

[6] Maria Cristina Gaeta, 'La protezione dei dati personali nell'Internet of Things: l'esempio dei veicoli autonomi' (2018) 1 *Diritto dell'Informazione e dell'informatica* 147.

regulation represents the legal basis for the expression of fundamental rights and not only the prevention of harm.

2.3 National Charters of Fundamental Rights and Law(s)

To complete the current analysis, we must take into consideration many principles that are also recognised in national charters.

In the Italian legal system, with specific reference to persons who are able to express their will only through BCIs, the *right to communication* (article 21 Constitution) became relevant in the realm of neurorights. It is recognised that these devices not only enable people to communicate, ensuring social interaction, but can also guarantee legal interactions, overcome specific legal barriers (e.g. the formalism of a juridical act). Furthermore, the right to free economic initiative (article 41 Constitution) is highly relevant. Indeed, if we consider that private autonomy is a necessary instrument for the exercise of the free economic initiative, we could say that freedom of negotiation is a constitutional value and its limitations must be socially justified, otherwise they infringe a fundamental personal right.

Internationally, there have also been recent legislative initiatives in Chile and Colorado. In the first case, Ley n. 21.383, adopted in October 2021, which modified article 19 of the Chilean Constitution, states that scientific and technological development must respect physical and *mental integrity* to protect 'brain activity, as well as the information derived from it'.[7] Moreover, the General Assembly of the State of Colorado, in House Bill 24-1058, includes *neural data* in its definition of 'sensitive data', modifying the Colorado Privacy Act enacted in 2021 with Senate Bill 21-190.[8]

3. The Bridge between Rights and Neurorights

Starting from this overview, it is also possible to apply the existing legislation to new phenomena involving the most sophisticated AI technologies, in compliance with article 12 Preliminary Provisions of the Civil Code.[9] Specifically, it appears possible to provide an extensive interpretation of the existing legislation (article 12(1)) or to apply the principles of *analogia legis* or *analogia iuris* (article 12(2)). From this perspective, even following the transition from traditional rights to neural rights, the existing legal framework guarantees an adequate regulatory framework, which may

[7] Anna Anita Mollo, 'Emessa in Cile il 9.8.2023 la prima sentenza al mondo sui neurodiritti (a proposito di "Insight" un dispositivo neurotecnologico non terapeutico e non invasivo in commercio del tipo elettroencefalogramma mobile progettato per ottenere informazioni sull'attività cerebrale)' [2023] *Persona e Mercato* 603.

[8] Anna Anita Mollo, 'La recente legge adottata dallo Stato del Colorado sul trattamento dei dati neurali nel contesto dei dispostivi neurotecnologici destinati al mercato dei prodotti di consumo: *Colorado House Bill 24-1058*' [2024] *Persona e Mercato* 776.

[9] Maria Cristina Gaeta, Livia Aulino, Emiliano Troisi, 'The possible relationships between law and ethics in the context of artificial intelligence regulation' [2023] 44 *Humana.Mente* 163.

be supplemented by sector-specific regulation (e.g. on BCI applications),[10] as well as technical legislation (i.e. standards) or ethical principles, where necessary. Indeed, standards are technical rules with different contents and effects, and may represent referral legislation by a hard law, with regard to specific technical criteria for which a standard (such as safety or reliability standard) can provide concrete indications.[11] At the same time, ethical principles can be a criterion for a complete interpretation of the law and should be compliant with hard law (i.e. *secundum legem*).

Concerning AI regulation, the introduction of ethical principles has proceeded that of legal principles and some of these ethical principles have subsequently been transposed into European regulation. In this way, the ethical principles implemented in European regulations have become binding rules. In order to demonstrate the applicability of the existing regulation not only to traditional rights but also to cyberights and neurorights, two domains will be analysed below. These fall within the scope of the rights of the individuals ('*diritti della personalità*') and are, more specifically: self-determination; and neuroprivacy and mental privacy.

3.1 Self-determination

The principle of self-determination is the recognition of the individual's capacity for autonomous and independent choice, emphasising his/her personhood and, in particular, personal identity. It is the right to make choices about one's own life and implies a human being's freedom of thought and expression as well as the free choice of aspects of one's relational life. This principle is expressly recognised in international, European and national charters of fundamental rights, notably article 1 Universal Declaration of Human Rights (UDHR) and article 3 Charter of Fundamental Rights of the European Union (2000/C 364/01), which regulates the right to personal integrity. In the Italian legal system there are also references in the Constitution (articles 2, 3, 13, 15 and 21), as well as both the Civil Code (articles 5 and 428) and the Criminal Code (articles 582, 594, 595, 610 and 613).

This normative framework can be extended to certain neurorights, which are essential for safeguarding individual autonomy and control over one's mental and cognitive states, which include:

(i) Mental integrity – the right to control one's decision-making processes without external manipulation through neurotechnologies.

[10] Lucilla Gatt, Ilaria Amelia Caggiano, Maria Cristina Gaeta, Anna Anita Mollo, 'BCI Devices and Their Legal Compliance: A Prototype Tool for Its Evaluation and Measurement', in IEEE International Conference Proceedings 2022 Metrology for Extended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE) 551 ff; Lucilla Gatt, Ilaria Amelia Caggiano, Livia Aulino, Emiliano Troisi, Luigi Izzo, Davide Silvio D'Aloia, 'BCI Devices and Their Capacity to Express Human Will Having Legal Value: A Model of Risk-Based Classification', in IEEE International Conference Proceedings 2022 Metrology for Extended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE) 577 ff.

[11] Gherardo M Marenghi, *Standard e regolazione condivisa* (Giappichelli 2018).

(ii) Personal identity and psychological continuity – the right to maintain a sense of self and behavioral control, preventing feelings of loss of control or identity breakdown, especially as neurotechnology increasingly interacts with digital networks.
(iii) Cognitive liberty and free will – the right to make autonomous decisions about undergoing or refusing neurointerventions, such as neurostimulation or neuro-enhancement, in accordance with personal values and preferences.

Regulating these neurorights is crucial to ensure individuals retain their autonomy. Applying the principle of self-determination involves recognising the right to make independent choices regarding mental integrity, protecting personal identity from technological disruption, and safeguarding cognitive freedom from coercive or intrusive practices. This approach emphasises that individuals should have the freedom to consent to or refuse neurotechnologies, maintaining control over their mental and cognitive states in an evolving technological landscape.

3.2 Neuroprivacy and Mental Privacy

Privacy is a fundamental right of the individual and is now highly topical due to the development of new technologies, including neural technologies. Privacy regulation plays a very important role in governing the legal use of neurotechnologies in relation to neural and mental data. As advancements in neuroscience and BCIs allow for the access and manipulation of neural information, it becomes imperative to establish clear guidelines to protect individual mental privacy.[12]

Currently, privacy regulation is provided by the GDPR. While neural data can be regulated under GDPR, the inclusion of mental data in the application of the GDPR is still uncertain. Indeed, neural data are related to the structure and functioning of the brain and can reveal information on the human clinical condition (health, and more in general, well-being), being regulated by article 9 GDPR. Mental data, instead, are additional data concerning the more intimate and personal spheres of the subject (e.g. inner speech, memories, emotions and intentions) which, although not always associated with health, would nonetheless be considered sensitive. When it comes to neural and mental data, privacy regulations must address issues such as consent,[13] data ownership, data security and data-sharing. Individuals should have the right to determine how their neural and mental data are collected, stored and utilised. Informed consent processes are essential to ensure that individuals understand the

[12] Italian Data Protection Autority proceedings [2021] 'Privacy e neurodiritti. La persona al tempo delle neuroscienze'; Pasquale Stanzione, 'Neurodiritti: Stanzione, definire uno statuto giuridico ed etico. Tra i compiti della protezione dati c'è la promozione di un'innovazione sostenibile' [2022] Italian Data Protection Autority press communication, https://www.garanteprivacy.it/home/docweb/-/docweb-display/docweb/9770820 accessed 23 May 2025,

[13] Lucilla Gatt, Roberto Montanari, Ilaria Amelia Caggiano (eds), 'Privacy and Consent. A Legal and UX&HMI Approach' (Suor Orsola University Press 2021).

implications of sharing their neural information and have the autonomy to make free decisions based on their intentions and preferences.

Data ownership is another critical aspect that privacy regulations need to consider. Individuals should have control over their neural and mental data, and should be able to dictate who has access to it and for what purposes. Moreover, clear rules regarding data security must be in place to prevent unauthorised access, misuse or breaches that could compromise the privacy of sensitive information, as well as privacy roles to better guarantee individuals' privacy rights.[14]

Finally, privacy regulations should address the potential risks of data-sharing and data linkage. Indeed, neurotechnologies have the power to gather highly personal and sensitive information about individuals' thoughts, emotions and cognitive processes. Therefore, adequate regulations are necessary to prevent the misuse or exploitation of mental and neural data for commercial, political or unethical purposes.

This brief analysis highlights the importance of safeguarding privacy for neural and mental data and emphasises the role of the GDPR where applicable. However, it also points out that the GDPR framework is not comprehensive enough to cover all aspects of this highly specialised field which is that of neurotechnologies.

4. Case Studies

The case studies below concern different applications of neurotechnology, in particular of BCI, and demonstrate the application of existing legislation in the resolution of the cases.

4.1 Right to Neural Communication with BCI

BCIs enable the direct measurement of brain activity, allowing it to be translated into text, synthesised speech or, in the most recent developments, real-time facial movements of a digital avatar displayed on a screen. While these technologies allow individuals to communicate – thus facilitating social interaction – they may not necessarily support legal interactions due to specific legal and formal barriers.

Consider the following scenario: an individual with a neurodegenerative disease (such as amyotrophic lateral sclerosis, ALS) or severe paralysis, who retains full cognitive capacity, is only able to communicate through a speech-based BCI device. This technology decodes and translates their brain signals into written text or spoken words. The individual wishes to autonomously and confidentially express their will in order to carry out a legally valid act, such as entering into a telephone contract, issuing advance healthcare directives, or drafting a last will and testament.

[14] Maria Cristina Gaeta, 'Hard law and soft law on data protection: What a DPO should know to better perform his or her tasks' [2019] 2 *European Journal of Privacy Law and Technology* 61.

This situation raises several important questions: can this form of communication be considered a new mode of expressing one's will – perhaps described as *neural language*? Should *neural language* be recognised as a new fundamental right? Can *neural language* influence the validity of legal transactions entered into using such means? Does the current legal framework on formal requirements for contracts and declarations adequately protect the right of persons with disabilities to express their will through technological aids?

To address these questions, it is necessary to examine the current Italian legal framework, with particular reference to the Constitution and the Civil Code.

First, regarding formalism in legal transactions, starting with oral contracts: in light of the principle of freedom of form, no legal obstacle arises in concluding a valid telephone contract orally. Similarly, no issue emerges with Advance Treatment Provisions (ATP), as the 2019 law permits the use of 'video recordings or devices that enable persons with disabilities to communicate' to express their will regarding certain healthcare decisions in the event of future incapacity.

However, the situation becomes more complex when we examine legal acts that require written form – such as those governed by inheritance law (Book II Civil Code). If a testator does not have a disability, they may freely choose the form in which to make their will. This freedom, however, does not extend to individuals with disabilities: a holographic will (article 602 Civil Code) must be handwritten, dated and signed personally by the testator, and thus cannot be created by someone who is unable to write; a public will (article 603) requires the testator to express their will orally before a notary and witnesses, making it inaccessible to someone who cannot speak; while a secret will (article 604) must be written and sealed by the testator or another person on their behalf, but it still presumes the testator's ability to read and write.

These provisions show that, although a person may have full cognitive capacity, the formal requirements for written legal acts exclude the possibility of using assistive technologies, such as BCIs, to express a legally valid and binding will. This incompatibility highlights a form of discrimination based on disability, as prohibited by article 1 UN Convention on the Rights of Persons with Disabilities (UNCRPD).

In this regard, a recent study conducted by the Italian National Council of Notaries[15] has taken an evolutionary approach to interpreting articles 56 and 57 Notary Act, in light of the principles enshrined in UNCRPD. The study concludes that notaries may, under certain conditions, waive the strict application of these provisions and proceed with the formalisation of a public deed without the need for an interpreter. This is permitted only where the notary is certain that the assistive device is functioning

[15] Serena Metallo, 'Sul superamento degli articoli 56 e 57 della legge notarile per i malati di Sindrome Laterale Amiotrofica (SLA)' [2024] Studio del CNN, n. 174-2022/P, 1–16.

correctly and that the will expressed through the device genuinely reflects the individual's autonomous and informed intention.

This development highlights a key issue: the need for *trustworthy* BCIs. Ensuring the reliability of such technologies shifts the focus toward product safety regulations as a fundamental component in safeguarding the right to communication. Trustworthy BCIs could form the legal basis not only for enabling the exercise of a fundamental right – the right to communicate – but also for ensuring the validity of legal acts, rather than merely serving to prevent potential harm.

Accordingly, it is essential to orient the design and development of BCIs toward devices capable of supporting legally relevant communication. This requires a rigorous evaluation of their technical characteristics and error margins, and the risks associated with the thought-to-speech (or to-text) translation process. The aim is to assess whether such devices can be considered functionally equivalent to traditional verbal or written communication in contexts free of critical conditions.

From this perspective, the *right to neural language* may be understood as the right to express oneself not only in social contexts but also within legal relationships. It can be seen as the digital evolution of the already recognised right to communication – an expansion of traditional categories protected both by the Italian Constitution (articles 21 and 41) and the UNCRPD (article 2); that is, *signs of language* are 'those that in the social environment are considered to be appropriate means of communication'.[16]

Framing the right to neural language in this way could open the door to significant legislative innovation aimed at enhancing the legal protection of persons with disabilities. One such proposal could be the introduction into the Italian legal system of a *video-recorded digital will in oral form*. This new testamentary form would enable people with disabilities to record a video in which they express their final wishes using a BCI.

Such a development would allow us to move beyond the current requirement of written form for the validity of wills, recognising instead the legal validity of expressions made through assistive technologies.

In this way, we could overcome the current need for the written form to make a valid will and we could recognise as valid, from a legal point of view, the will expressed through BCIs, making the right to communication (i.e. the right to neural language) really effective in practice.[17]

[16] Cesare Massimo Bianca, *Il contratto. Diritto Civile V* (Giuffrè editore 2019).

[17] Anna Anita Mollo, 'Il testatore vulnerabile e le esigenze di rinnovamento delle norme sulla successione a causa di mote a tutela dei diritti delle persone con disabilità: il testamento digitale videoregistrato' [2023] *Familia* 671.

4.2 Neuromarketing through BCI Technologies

A notable application of BCIs can be found in the field of neuromarketing,[18] which employs neuroimaging techniques – such as functional magnetic resonance imaging (fMRI) and, more commonly, electroencephalography (EEG) – to investigate and interpret consumer behaviour. EEG, in particular, is widely used due to its high temporal resolution, non-invasiveness, ease of use, wireless capabilities, and relatively low operational and maintenance costs.[19]

The primary objective of neuromarketing is to identify the neural correlates of consumer decision-making processes. By doing so, it seeks not only to understand the underlying motivations driving certain purchasing behaviours but also to predict – and often influence – future consumer choices. This establishes a direct link between neural activity and consumer behaviour,[20] thereby creating a new frontier in the analysis of how commercial stimuli interact with brain functions.[21]

In this field, both academic researchers and specialised marketing firms have, over the past decades, conducted experimental studies using neuroscientific methods. Neuromarketing companies, which often operationalise these findings, are typically profit-driven entities working on behalf of large corporations. In some cases, they also engage in private research involving vulnerable populations, such as children. A notable example is Disney, whose research facility, Disney Lab, reportedly employs neurotechnologies to analyse audience responses to their films prior to public release.[22]

However, the rapid advancement of research methodologies and technologies capable of recording, interpreting and even predicting consumer behaviour gives rise to significant legal and ethical concerns.[23]

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[18] Cassiana Maris Lima Cruz et al, 'Neuromarketing and the advances in the consumer behaviour studies: a systematic review of the literature' [2016] *International Journal of Business and Globalization* 330.

[19] Loredana Robaina Calderín, Josefa D Martín-Santana, 'A review of research on neuromarketing using content analysis: key approaches and new avenues' [2021] *Cognitive Neurodynamics* 923.

[20] Fabio Babiloni, Patrizia Cherubino, 'Consumer Neuroscience: A Neural Engineering Approach', in Nitish Thakor, V (eds), *Handbook of Neuroengineering* (Springer 2022).

[21] Patrizia Cherubino et al, 'Consumer behavior through the eyes of neurophysiological measures: State-of-the-art and future trends' [2019] *Computational intelligence and neuroscience* 1.

[22] Anna Carla Nazzaro, 'Aspetti giuridici del neuromarketing: privacy, profilazione e genuinità del consenso del consumatore, in Myriam Caratù, Patrizia Cherubino (eds), *Neuromarketing, società e tutela del consumatore* (Aracne 2023); Amani Al Abbas et al, 'The Impact of Neuromarketing Advertising on Children: Intended and Unintended Effects' [2019] *KnE Social Sciences* 1.

[23] European Commisison (2023) 'State of the art on neuromarketing and its ethical implications', <https://op.europa.eu/en/publication-detail/-/publication/43754ac8-26aa-11ee-a2d3-01aa75ed71a1/language-en> accessed 23 May 2025.

The AI Act plays a fundamental role in shaping the regulatory framework for emerging neurotechnologies, particularly in terms of risk impact assessment and the consequent classification of such technologies. Under this framework, technologies that include applications within neuromarketing and immersive environments such as the metaverse may be classified as *high-risk* – or, in some cases, even as *prohibited* – due to their potential to significantly influence or manipulate human decision-making and personal identity.[24]

From another perspective, the analysis of human behaviour and decision-making in economic transactions through BCI technologies may have significant implications for contract law, particularly in relation to the validity of legal transactions entered into by individuals. Consider the case of a consumer making a purchasing decision in response to an advertising campaign developed based on neuromarketing research, or when exposed to a commercial environment deliberately designed to influence behaviour using neuroscientific insights.

In such instances – where the probability of influencing human behaviour reaches statistically significant levels – it becomes necessary to question whether the consumer's choice can truly be considered free and autonomous. Has their self-determination been so substantially altered by neuromarketing that it raises doubts as to whether the related transactions can be deemed valid?

This concern becomes even more acute if, in the foreseeable future, BCI technologies are directly applied to individuals during transactions or while making purchases. In such a scenario, the very process of will formation could be subject to external interference.

In the Italian legal system, this phenomenon finds regulation under articles 428 and 1425 Civil Code. Specifically, article 428 provides that if a person performs a juridical act while in a state of *natural incapacity* – that is, a temporary condition in which they are unable to understand or to will – the act may be annulled. This provision is further connected to article 1425, which sets out that a contract entered by a person lacking the capacity to act is voidable.[25]

So investigating the traditional category of natural incapacity (article 428) would be appropriate to provide adequate protection in all cases where it can be shown that the consumer's purchasing choices have been determined by an alteration of the decision-making obtained by applying the results of neuromarketing research through BCI. This is also in the context of broader reflections on how to understand

[24] Anna Anita Mollo, 'Neurorights. Una prospettiva di analisi interdisciplinare tra diritto e neuroscienze', in Salvatore Orlando, Giuseppina Capaldo (eds), *Annuario 2022. Osservatorio Giuridico sulla Innovazione digitale, Collana Materiali e documenti* (Sapienza Università Editrice 2022).

[25] Mirzia Bianca, 'Il principio di effettività e la nuova categoria della vulnerabilità', Lectio magistralis, 7 March 2024, Università Suor Orsola Benincasa (forthcoming).

the category of legal capacity and natural incapacity in the light of the use of BCI for neuromarketing.[26]

4.3 The Frontier of Cerebral Organoids

Another frontier that has opened for neurorights is that of cerebral organoids. They produce brain activity and are detached from the body of a human being. Organoids, briefly and simply stated, are miniature replicas of human organs and tissues: they derive from induced pluripotent stem cells (iPSC) or from adult cells and tissues, including tumours. They represent an important tool for personalised medicine and drug testing in general. The legal framework is currently incomplete and the focus is rather on ethical issues and the protection of privacy. However academic literature has demonstrated how the legal framework can be applied for qualifying answers that can combine research development and protection of the person.[27]

Indeed, in this field, it is first necessary to proceed with a qualification of the cerebral organoid and then with the individuation of the legal framework, which includes consent of the donor privacy and intellectual property.

5. Conclusions

Acknowledging the so-called neurorights (i.e. the legal principles of freedom or entitlement related to a person's cerebral and mental domain), as embedded in the existing human rights, freedoms and principles recognised by the constitutions of states and supranational charters, is not only systematically coherent from a strictly legally theoretical point of view, but it is also effective in guaranteeing the protection of individuals in the rapidly evolving landscape of neuroscience and emerging neurotechnologies.

Neurorights such as mental privacy, mental integrity and cognitive freedom, which emerged in relation to the development of neurotechnology, are already lodged in the freedoms and rights of self-determination, dignity, privacy and freedom of expression, which are seen as a right to communication. Legal doctrines and decisions on the latter points may be helpful for reasoning on issues of neurotechnologies on a right-based approach, and highlighting legal solutions for new cases, or identifying where specific *ad hoc* legislation may be required.

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[26] Anna Anita Mollo, 'Il valore giudico delle emozioni nell'espressione della volontà negoziale da parte delle persone con disabilità in ambiente digitale: prime riflessioni su *affect recognition* e applicazioni di neuromarketing', in Salvatore Orlando (ed), *Profili giuridici del neuromarketing Annuario 2023–2024. Osservatorio Giuridico sulla Innovazione digitale, Collana Materiali e documenti* (Sapienza Università Editrice 2024).

[27] Sara Landini, Lucilla Gatt, Albina Candian, Simona Viciani, Emilia Giusti, Catria Mugelli, Valentina Lunesu, Federica Gattillo, Elisabetta Cerbai, 'Ethical-legal aspects of organoids and their use in research. Manage risks and legal constraints for the development of ethical research' (2023) 1 *European Journal of Privacy Law and Technology* 34.

The use of neurotechnologies, and especially BCIs, raises a number of legal issues, as outlined in this paper: the protection of individuals from the use of devices, which recalls product safety legislation for safe, reliable and trustworthy devices in order to avoid injuries; it raises concerns regarding the influence of human will on juridical acts and the validity of legal transactions, particularly when self-determination may be compromised by neurotechnology applied to individuals, potentially affecting their capacity to understand and to will.

In addition, application of the existing rules may make it possible to assess how much of the human will remain in the formation of legal transactions, either through the use of BCI (e.g. *neural communication in the case of disability*) or even only as a result of the application of BCI studies conducted in the context of research on other subjects (e.g. *neuromarketing*).

Facing these questions is crucial for integrating technologies (and neurotechnologies) into society in a responsible manner and protecting individuals who can be considered vulnerable with respect to technologies and neurotechnologies.[28] Moreover, when it comes to people with disabilities, the already existing imbalance between the individual and technologies is reinforced and asks for specific consideration.[29]

[28] Lucilla Gatt, Maria Cristina Gaeta (eds), *Costruire una nuova strategia per un diritto europeo protettivo in ambiente digitale (Building a New Strategy for European Protection Law in a technological environment)* (Suor Orsola Benincasa Università Editrice 2023); Lucilla Gatt, 'Legal anthropocentrism between nature and technology: the new vulnerability of human beings' [2022] 1 *European Journal of Privacy Law and Technology* 16 ff.

[29] Anna Anita Mollo, 'Vulnerabilità e sostenibilità: primi spunti per uno studio dell'impatto sulle persone con disabilità e sulle future generazioni dei dispositivi [neuro]tecnologici' [2023] *European Journal of Privacy Law and Technology* 28; Anna Anita Mollo, 'La vulnerabilità tecnologica. Neurorights ed esigenze di tutela: profili etici e giuridici [2021] 1 *European Journal of Privacy Law of Technology* 199; Anna Anita Mollo, 'Profili di un'analisi etica e giuridica delle neurotecnologie in funzione di tutela delle persone con disabilità' in Fabio Dell'Aversana, Lorenzo Fattori, Anna Anita Mollo, Domenico Napolitano (eds), *Note sulla disabilità* (Editoriale scientifica 2022).