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To Be or Not to Be Neuroenhanced?

Personal identity under siege in the age of AI-powered neurotechnology

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ABSTRACT

Recent advances in neurotechnology and AI have expanded the potential to influence brain function beyond traditional medical applications to the enhancement of healthy individuals. Growing investment in consumer neurotech and experimental BCIs signals a future where we may be able to substantially improve our cognitive and emotional capabilities – a prospect that raises profound ethical and legal concerns.

Central to these concerns is the question of how neuroenhancement technologies may impact *personal identity.* The brain is often regarded not just as a biological system, but as the foundation of who we are – shaping our experiences, guiding our decisions and anchoring our sense of self. As individuals voluntarily engage with advanced technologies intended to modulate their cognition and emotions, they may disrupt their psychological continuity. This indicates far-reaching consequences, not just for the person undergoing neuroenhancement but for society at large.

International bodies such as UNESCO and the Council of Europe have begun to discuss and address these risks, yet current governance frameworks remain ill-equipped for the complex and specific scenarios posed by non-therapeutic neuroenhancement. Against this backdrop, this thesis examines whether and to what extent limits should be placed on individual voluntary engagement with neuroenhancement technologies in order to safeguard personal identity.

Using an interdisciplinary approach that incorporates philosophical, ethical and legal perspectives, this thesis seeks to contribute to the growing discourse on neurotechnology governance, advocating for a human-rights based and forward-looking approach.

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List of Abbreviations

AI Artificial intelligence

BCI Brain Computer Interface

CoE Council of Europe

DBS Deep Brain Stimulation

ECHR European Convention on Human Rights

ECtHR European Court of Human Rights

EEG Electroencephalography

EU European Union

EMT Extended Mind Thesis

GDPR General Data Protection Regulation

IBC International Bioethics Committee

NIBS Non-invasive Brain Stimulation

OECD Organisation for Economic Co-operation and Development

para. Paragraph

tACS Transcranial alternating current stimulation

tDCS Transcranial direct current stimulation

TMS Transcranial magnetic stimulation

UDHR Universal Declaration of Human Rights

UN United Nations

UNESCO United Nations Educational, Scientific and Cultural Organization

1. INTRODUCTION

1.1.Research question and relevance of the topic

For centuries, the workings of the human mind have captivated philosophers, scientists and thinkers alike. Yet, it was only in the twenty-first century that neuroscience advanced to a point where neurotechnology – a concept once relegated to science fiction – has become an active and rapidly expanding frontier. [1] Fuelled by substantial investments in research, originally spearheaded by publicly funded initiatives such as the United States BRAIN Initiative (2013) and the European Human Brain Initiative (2013-2023), neurotechnology has already transformed the medical landscape, offering revolutionary treatments for various diseases and disorders of the nervous system.[2] By way of example, recent developments include a brain-spinal interface that allowed a person with chronic tetraplegia to walk again (2023), and a brain-computer interface (BCI) enabling a man with Amyotrophic Lateral Sclerosis (ALS) to operate a smart assistant using only his thoughts (2024). [3]

These medical breakthroughs, however, signify more than just therapeutic possibilities. Increasingly, the convergence between neurotechnology and artificial intelligence (AI) is moving beyond restoring brain function to the *neuroenhancement of healthy individuals*.[4] Emerging consumer-oriented devices now promise to boost concentration, accelerate decision-making, improve memory, and fine-tune emotional states. [5] Further, the trajectory of innovation suggests that more powerful and permanent interventions may become possible in the coming decades.[6] Notably, Musk's Neuralink and similar ventures

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[1] Cara M Altimus et al., 'The Next 50 Years of Neuroscience' (2020) 40(1) *Journal of Neuroscience* 101.
[2] Daniel S Hain et al., *Unveiling the Neurotechnology Landscape: Scientific Advancements, Innovations and Major Trends* (UNESCO 2023).
[3] Henri Lorach et al., 'Walking Naturally after Spinal Cord Injury Using a Brain–Spine Interface' (2023) 618 *Nature* 126; The Business Times, 'Brain Implant Lets Man Control Amazon's Alexa with Thought' (*The Business Times*, 17 September 2024) https://www.businesstimes.com.sg/companies-markets/telcos-media-tech/brain-implant-lets-man-control-amazons-alexa-thought accessed 2 March 2025.
[4] Charles M Giattino et al., 'The Seductive Allure of Artificial Intelligence-Powered Neurotechnology' (2019) Proceedings of the 2019 AAAI/ACM Conference on AI, Ethics, and Society (AIES'19) 397; Timo Istace and Milena Costas Trascasas, 'Between Science-Fact and Science-Fiction: Innovation and Ethics in Neurotechnology' (Research Brief, Geneva Academy of International Humanitarian Law and Human Rights, May 2024), 5 – 7.
[5] Istace and Costas Trascasas (n 4).
[6] Simmone Shah, 'How Implanted Brain Chips Like Neuralink Could Change Our Lives' (Time, 30 January 2024) https://time.com/6590258/nueralink-brain-implant-chip-first-human/ accessed 9 May 2025; Celia Ford, 'Meta's Brain-to-Text Tech Is Here. We Are Not Remotely Ready' (Vox, 19 February 2025) https://www.vox.com/future-perfect/400146/meta-brain-reading-neurotech-privacy accessed 6 March 2025; Millie Turner, 'Eerie New Mind-Controlling Tech Can Manipulate Emotions and Even Appetite

are pioneering invasive BCIs that aim not only to treat neurological conditions but also to unlock 'superhuman' cognitive capabilities [7] – a prospect that carries both a seductive appeal and profound ethical implications.

At the core of a future where widespread advanced neurotechnologies can enhance our cognitive and emotional abilities lies a fundamental concern: the impact on our *personal identity.*

Crucially, more than a mere organ, the brain is often regarded as the seat of our thoughts, memories, values, and sense of self. When individuals voluntarily engage with neurotechnologies that modify their cognitive or emotional landscape, they may risk altering the very continuity of their identity. This raises far-reaching implications not only for the individual but also for society as a whole.

Concerns about the potential of neurotechnologies to threaten personal identity have already reached the agendas of international bodies such as the Council of Europe (CoE),[8] UNESCO, [9] and the UN Human Rights Council. [10] However, the fast pace of neurotechnological evolution, with the devices market projected to reach US $ 24.2 billion by 2027,[11] urgently demands further reflection on how such threats may intensify and evolve in unforeseen ways outside the medical sphere.

Without Any Invasive Surgery' (The Sun, 2 August 2024) https://www.thesun.co.uk/tech/29635902/mind-control-tech-manipulate-emotions-mice-korea-study/ accessed 9 May 2025.

[7] Shah (n 6); Capitol Technology University, 'Neuralink's Brain Chip: How It Works and What It Means' (Capitol Technology University, 9 February 2024) https://www.captechu.edu/blog/neuralinks-brain-chip-how-it-works-and-what-it-means accessed 20 February 2025; GSD Venture Studios, 'How Neural Implants Will Create Superhuman Capabilities' (GSD Venture Studios, 25 June 2024) https://www.gsdvs.com/post/how-neural-implants-will-create-superhuman-capabilities accessed 17 March 2025.

[8] Marcello Ienca, *Common Human Rights Challenges Raised by Different Applications of Neurotechnologies in the Biomedical Field* (Report commissioned by the Committee on Bioethics (DH-BIO) of the Council of Europe, 2021); Eduardo Bertoni and Marcello Ienca, '*The Privacy and Data Protection Implication of the Use of Neurotechnology and Neural Data from the Perspective of Convention 108'* (Consultative Committee of the Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data Convention 108, 2024).

[9] International Bioethics Committee, *Ethical Issues of Neurotechnology: Report, adopted in December 2021* (UNESCO 2022); UNESCO, First Draft of the Recommendation on the Ethics of Neurotechnology (2024) SHS/BIO/AHEG-Neuro/2024/2.

[10] UNHRC Res 51/3, *Neurotechnology and human rights* (6 October 2022) UN Doc A/HRC/RES/51/3; UNHRC Res 58/6, *Neurotechnology and human rights* (2 April 2025) UN Doc A/HRC/RES/58/6.

[11] Hain (n 2) 9.

While tensions between autonomy, identity, and human enhancement have already received considerable scholarly attention, the specific scenarios where one might be able to *voluntarily* induce significant changes to their personal identity through emerging neurotechnologies remain largely understudied. Building on this complex and unresolved dilemma, this thesis investigates the following research question:

Should individual voluntary engagement with neuroenhancement technologies be limited to protect personal identity, and if so, to what extent?

In support of this inquiry, four interconnected sub-questions will be addressed:

- How might neuroenhancement technologies impact personal identity?
- Given this potential impact, what individual and societal risks could emerge if engagement with these technologies is unrestricted?
- Looking specifically at identity modifications, what challenges to informed consent need to be considered to assess voluntariness in the use of such technologies?
- What international policy developments may be needed to address the identified individual and societal implications?

By addressing these questions, this thesis seeks to contribute to the growing body of work on neurotechnology governance, anticipating ethical and legal concerns that may arise when the exercise of personal freedom begins to erode the very foundation of the *self* it aims to protect.

1.2.Methodology

This thesis employs a desk research methodology, focusing on the systematic analysis of scientific literature spanning philosophy, ethics – with a focus on neuroethics and bioethics – and legal theory. In addition to academic sources, the research incorporates grey literature such as reports, policy documents, and soft law instruments issued by international organizations, including UNESCO and the CoE. The research also considers empirical findings from clinical studies that include testimonies of individuals who have voluntarily participated in clinical trials, as well as patients who have undergone neurodevice implantation and/or explantation.

Source material was identified through comprehensive searches across multiple academic databases, including Google Scholar, Elsevier, Frontiers, Philpapers, Springer and J-STOR. Key words used in these searches included: neurotechnology, neuroenhancement, neuroethics, neural implants, AI-driven BCIs, personal identity, psychological continuity, personal autonomy, informed consent, international human rights framework, neurorights, CoE Conventions, and EU legislation. Furthermore, additional literature was collected by reviewing the references cited in the previously identified articles.

1.3. Outline

The thesis is organized into six chapters, inclusive of this introduction and the final concluding observations.

In Chapter 2, we provide an overview on neuroenhancement, beginning with a general definition that clarifies both its means and targets, with a focus on emerging neurotechnologies. We then outline the conceptual challenges underlying the distinction between therapy and enhancement, emphasizing their practical repercussions, namely for regulation. The chapter concludes by linking present developments to the future of neuroenhancement possibilities, especially focusing on the convergence between neurotechnology and AI. The purpose of Chapter 2 is to provide the necessary background information, which will enable the reader to comprehensively follow the rest of the analysis.

Chapter 3 focuses on whether, how, and to what extent personal identity may be affected by neurotechnology, along with the ethical and legal implications of such impact. It draws on empirical insights interpreted through the philosophical foundations of personal identity – specifically, the psychological continuity account of identity. The chapter further examines how unrestricted possibilities for self-modification of identity outside the medical sphere could have disruptive effects on our legal systems. It also explores the concept of the *hybrid mind* and how the functional integration between our minds and AI-driven neurodevices may raise specific ethical and legal challenges regarding personal identity. The chapter ends with an analysis of the right to identity under international human rights law, acknowledging how it may need to adapt in response to advances in neuroscience and the increasing use of neuroenhancement technologies. This discussion establishes key dimensions of the relationship between autonomy and identity from a

human rights perspective, setting the scene for further development in the chapters that follow.

In Chapter 4, we dive deeper into the complex role of autonomy in the age of neuroenhancement technologies. The chapter begins with a brief introduction to the principle of autonomy, followed by an exploration of two main theoretical justifications for its limitation: the protection of the individual and the prevention of harm to others. We then connect these considerations to both conservative and liberal arguments on whether individuals should have the option to use enhancement technologies. Building on this, we explore how some of these arguments may interact and expand in scenarios of radical enhancements endorsed by transhumanist thought. In doing so, we consider the role of those who cannot or do not want to use neuroenhancement technologies in bringing new considerations for the limits of this use. The chapter concludes by examining the challenges to informed consent in the neurotechnological age, highlighting their significance as fundamental ethical constraints to the use of neuroenhancement technologies.

Chapter 5 builds on the preceding analysis to explore policy implications and recommendations for the governance of neurotechnology. In this vein, we consider how these proposals might evolve and adapt to the context of voluntary neuroenhancement. The discussion also explores the need for rights-based regulation on neurotechnologies, which specifically protects personal identity and ensures psychological continuity. Accordingly, the chapter concludes by outlining three guiding principles – precaution, self-determination and human dignity – which address the core concerns raised throughout the thesis and underscore the imperative to safeguard fundamental human rights in future regulation in the field.

Chapter 6 is dedicated to concluding observations.

2. BACKGROUND ON NEUROENHANCEMENT: CONCEPTUAL AND TECHNOLOGICAL LANDSCAPE

Human enhancement is at least as old as civilization itself, yet it remains one of the most debated topics in modern bioethics.[12] From ancient myths – such as Icarus' ill-fated flight – to the enduring appeal of superheroes, the aspiration to transcend human limitations has been a constant theme of our collective imagination.[13] Even in our everyday life, activities such as drinking caffeinated beverages have long been widely accepted forms of enhancement.[14]

Nevertheless, rapid technological advancement has significantly expanded the scope of what human enhancement can entail. Today, ongoing discussions on interventions from cosmetic surgery and genetic manipulation have been joined by discussions on 'neuroenhancement'. Existing debates on personal identity and how it might be affected by biotechnological innovations now turn to the possibility of directly influencing the human mind.

In this chapter, we provide a general conceptualization of neuroenhancement within the context of emerging neurotechnologies. This will include examining the blurred boundary between therapy and enhancement and the practical implications it may entail. We then turn to the increasing integration of mind and machine – captured in the concept of the 'hybrid mind' – to briefly consider what the future of neuroenhancement might entail. These considerations will lay the groundwork for a deeper investigation into the potential impact of neurotechnology on the nature and continuity of personal identity and whether such implications may justify placing limits on the access and use of neuroenhancement technologies.

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[12] Jan-Hendrik Heinrichs et al., 'Neuroenhancement' in Dieter Sturma and Dirk Lanzerath (eds), *DRZE Expert Reports* vol 21 (German Reference Centre for Ethics in the Life Sciences 2022) 33.

[13] David Masci, 'Human Enhancement: The Scientific and Ethical Dimensions of Striving for Perfection' (Pew Research Center, 26 July 2016) https://www.pewresearch.org/religion/2016/07/26/human-enhancement-the-scientific-and-ethical-dimensions-of-striving-for-perfection/ accessed 16 May 2025.

[14] Hanna Maslen, Nadira Faulmüler and Julian Savulescu, 'Pharmacological Cognitive Enhancement – How Neuroscientific Research Could Advance Ethical Debate' (2014) 8 *Frontiers in Systems Neuroscience*.

2.1. The concept of neuroenhancement: *means and targets*

Neuroenhancement can be broadly understood as the improvement of mental capacities, either through traditional methods such as education or through biomedical means.[15] In a narrower sense, and most significant for this thesis, neuroenhancement specifically pertains to the latter.

The International Bioethics Committee (IBC) of UNESCO provides a detailed version of this narrower understanding of 'neuro-cognitive enhancement', describing it as:

> interventions designed to improve **mental** and **emotional** performance considered as 'normal', using recent advances in neuroscience and neurotechnology involving the brain tissue itself, as well as the neurophysiological mechanisms that govern cognitive functions, including psychotropic drugs affecting mental processes, **neuroimaging technologies** to assess or alter brain function via neurofeedback, **neurostimulation technologies** to transiently alter brain function, such as transcranial magnetic stimulation or transcranial direct current stimulation applied over the cortex, or surgically embedding brain implants and employing a **brain-computer interface**. [16] [emphasis added]

Adopting this definition leads to two preliminary sets of distinctions regarding the *targets* and the *means* of neuroenhancement. First, regarding the *targets* of neuroenhancement, two main neural dimensions can be identified: cognitive (or mental) and affective (or emotional) dimensions.[17] In the absence of an agreed definition,[18] cognitive enhancement typically refers to the augmentation of a specific class of information-processing functions – the cognitive functions –, including attention, perception, reasoning, memory, understanding and creativity.[19] In contrast, affective enhancement involves changing aspects of personality in ways that are socially valued, boosting mood, dulling or erasing

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[15] Alexandre Erler and Cynthia Forlini, 'Neuroenhancement' (Thematic, *Routledge Encyclopedia of Philosophy*, online edn, 2020) https://www.rep.routledge.com/articles/thematic/neuroenhancement/v-1 accessed 17 March 2025.
[16] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 34 para 84.
[17] Heinrichs et al. (n 12) 36. Another category which has drawn extensive scholarly attention is moral enhancement; however, it remains unclear how it should be treated as distinct from cognitive and emotional enhancement. In fact, the concept appears to overlap with these categories, as it emphasizes the role of enhancement in social practice rather than relying on the criteria typically used in cognitive science: ibid 38.
[18] Thomas Metzinger and Elisabeth Hildt, 'Cognitive Enhancement' in Judy Illes and Barbara J Sahakian (eds), *Oxford Handbook of Neuroethics* (OUP 2011) 245, 246.
[19] Heinrichs et al. (n 12).

painful memories, increasing motivation, and influencing romantic connections between individuals.[20] Both dimensions are interconnected, meaning that in practice, an improvement in emotional states can positively influence cognition, and vice versa.[21] Thus, while devices may have a primary target, this interdependence suggests a need for flexibility in how we interpret labels such as 'mood enhancers' or 'cognitive enhancers'.

Second, concerning the *means* of neuroenhancement, we can distinguish pharmacological neuroenhancement and non-pharmacological neuroenhancement via neurotechnology devices and methods. Pharmacological neuroenhancement**,** also referred to as 'brain doping', 'academic performance enhancement' or 'cosmetic neurology' describes the use of psychoactive drugs (the so-called 'smart drugs') to improve cognition via enhancement of several cognitive sub-domains, such as vigilance, fatigue, concentration and memory, on healthy subjects.[22] Indeed, one of the earliest documented cases of high-tech neuroenhancement dates back to World War II, when soldiers on both sides were administered amphetamines – such as Pervitin or Benzedrine – to remain alert and combat-effective during prolonged military operations.[23]

Despite the long history and ongoing societal relevance of such pharmacological approaches, this thesis focuses on non-pharmacological neuroenhancement via emerging neurotechnologies – which, unlike smart drugs, entail direct interaction with the brain, representing a new rapidly evolving frontier in neural modification. Thus, while excluding natural neuroenhancers such as sleep or exercise, the expression 'non-pharmacological neuroenhancement' is here used to refer to the emerging devices and methods highlighted in bold in the IBC definition above: namely, neuroimaging, neurostimulation, and brain-computer interfaces (BCIs).

These three different types of emerging neurotechnologies can be either *invasive*, requiring surgical intervention to implant the device inside the skull, or *non-invasive*,

[20] Erler and Forlini (n 15).
[21] Metzinger and Hildt (n 18).
[22] Sean R Jensen et al, *SIENNA D3.1: State-of-the-art Review: Human Enhancement* (2018) 10 citing Andreas G. Franke, Robert Northoff and Elisabeth Hildt 'The Case of Pharmacological Neuroenhancement: Medical, Judicial and Ethical Aspects from a German Perspective' (2015), 48 *Pharmacopsychiatry* 256
[23] Sean R Jensen et al., *SIENNA D3.1: State-of-the-art Review: Human Enhancement* (2018)10 citing Norman Ohler, *Blitzed: Drugs in the Third Reich* (Mariner Books 2018).

consisting of wearable devices, such as caps, hats, helmets or wristbands.[24] More specifically:

- **Neuroimaging** refers to the monitoring and recording of brain structure and functioning.[25] Possibilities of neuroenhancement emerge, for instance, through neurofeedback devices based on electroencephalography (EEG) – a non-invasive method which has already been incorporated in devices such as Muse's headband, providing brain tracking to improve focus.[26]
- **Neurostimulation (or neuromodulation)** aims to directly modify, bypass or substitute existing neural structures or processes by exposing the brain to electrical currents or magnetic fields.[27] It encompasses:

  Non-invasive Brain Stimulation (NIBS), comprising transcranial Direct Current Stimulation (tDCS), transcranial alternating current stimulation (tACS), transcranial Magnetic Stimulation (TMS), electroencephalography Neurofeedback (EEG-NF) and cognitive training with Brain-Computer Interfaces (BCIs), has been found to impact perception, cognition, mood, motor activities, and other brain functions, both in healthy humans and patients.[28] For example, in 2019, neuroscientists Reinhart and Nguyen conducted a study on the effects of non-invasive stimulation on memory.[29] They used a combination of EEG and tACS to monitor and stimulate the brains of two groups of participants: young adults aged 20–29 and older adults aged 60–76. The older adults showed weaker memory and brain synchronisation, but after 25 minutes of tACS stimulation to both their frontal and temporal cortices, their brain synchronisation improved to the point that

[24] Sjors Ligthart et al., 'Minding Rights: Mapping Ethical and Legal Foundations of "Neurorights"' (2023) 32(4) *Cambridge Quarterly of Healthcare Ethics* 461, 463.
[25] Istace and Costas Trascasas (n 4), 2.
[26] InteraXon, 'Muse: The Brain Sensing Headband' https://choosemuse.com/?srsltid=AfmBOope1V4HT4ymvgtoL101mKPLNT4aO9lpVDcZQFf0GWihHEg4Jji9 accessed 16 May 2025.
[27] Istace and Trascasas (n 4) 3.
[28] Andrea Antal et al., 'Non-invasive brain stimulation and neuroenhancement' (2022) 7 Clinical Neurophysiology Practice 146, 148.
[29] Robert MG Reinhart and John A Nguyen, 'Working Memory Revived in Older Adults by Synchronizing Rhythmic Brain Circuits' (2019) 22 *Nature Neuroscience* 820.

they achieved comparable memory test results to those of younger participants.[30]

Currently, it is already possible to purchase non-invasive brain stimulators that monitor and enhance cognitive capacities such as memory and focus, and promote 'feelings of well-being'.[31]Furthermore, as NIBS becomes part of the expanding market of neurotechnological products for consumer use,[32] they have given rise to a movement of 'self-enhancement' of neurocognitive functions with home-made devices in non-clinical settings (the so-called 'neurohackers' movement).[33]

Deep Brain Stimulation (DBS), an invasive method used to treat conditions such as Parkinson's disease, dystonia or major depression, has also been mentioned in the enhancement context, particularly concerning its effect on a person's mood.[34]As it requires implantation within the cranium, the risks of the intervention are not easily compensated for by potential benefits of enhancement. Although most scholars remain sceptical about its practical viability in the near future, there has been discussion about possible use of DBS for enhancement purposes.[35]

- **Brain-computer interfaces (BCIs)** are designed to facilitate bi-directional communication between the brain and external devices.[36] They have been considered the most technologically groundbreaking and fastest-growing sub-family of neurotechnologies,[37] as they introduce the possibility of controlling external devices solely by brain activity. Companies such as Neuralink are

[30] Ienca, *Common Human Rights Challenges* (n 8) 18.
[31] Istace and Costas Trascasas (n 4) 7.
[32] For example, the company Flow Neuroscience offers a tDCS headset aimed at treating depression by stimulating specific brain regions: David Cox, 'Is a brain-stimulation headset the answer to depression?' The Guardian (London, 11 January 2025) https://www.theguardian.com/society/2025/jan/11/is-a-brain-stimulation-headset-the-answer-to-depression accessed 2 March 2025.
[33]Anna Wexler, 'The Social Context of "Do-It-Yourself" Brain Stimulation: Neurohackers, Biohackers, and Lifehackers' (2017) 11 *Frontiers in Human Neuroscience*; Francesco Fisicaro et al., '"Self-Neuroenhancement": The Last Frontier of Noninvasive Brain Stimulation?' (2019) 16(1) *Journal of Clinical Neurology* 158.
[34] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 34 para 83.
[35] Heinrichs et al. (n 12) 63 citing Jonathan Pugh, Hannah Maslen and Julian Savulescu, 'Deep Brain Stimulation, Authenticity and Value' (2017) 26(4) *Cambridge Quarterly of Healthcare Ethics* 640.
[36] Istace and Trascasas (n 4) 3.
[37] Davide Valeriani, Francesca Santoro and Marcello Ienca, 'The Present and Future of Neural Interfaces' (2022) 16 *Frontiers in Neurorobotics*.

currently developing wireless implantable brain chips [38] to give humans 'superhuman' cognition through AI-driven enhancement.[39] Invasive BCIs have also been used to control the actions of laboratory animals, such as mice, with similar processes enabling artificial implantation of memories or images into their brain, effectively triggering 'hallucinations' and 'false memory of fear' that, crucially, are 'indistinguishable from the real world.'[40] To date, BCIs mostly have been used on an individual brain-machine basis, though experiments on brain-to-brain communication are ongoing. Already in 2019, a study using an electroencephalography (EEG)-based interface enabled three participants to collaboratively play Tetris [41] and, more recently, a California-based start-up claimed to have established the first ever two-way communication between individuals during lucid dreaming.[42]

2.2.Blurring the line between therapy and enhancement

The meaning of 'enhancement' and the exact range of technologies that fall under this term have long been subjects of intense scholarly debate, with no clear consensus to date.[43] This enduring conceptual ambiguity largely stems from the fragile and often controversial distinction between therapy and enhancement.

While neuroenhancement methods can be invasive and non-invasive and with short- or long-term consequences, which can affect both cognitive and affective dimensions, they are often defined by one common goal: to improve human capabilities 'beyond' therapy.[44] This, in turn, presupposes a distinction between pathology and normality to separate

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[38] In 24th of January 2024, Musk announced that Neuralink had officially implanted their first device in a human: Reuters, 'Neuralink's first human patient able to control mouse through thinking, Musk says' (20 February 2024) *Reuters* https://www.reuters.com/business/healthcare-pharmaceuticals/neuralinks-first-human-patient-able-control-mouse-through-thinking-musk-says-2024-02-20/ accessed 5 March 2025.

[39]Rafael Yuste, Jared Genser and Stephanie Herrmann, 'It's Time for Neuro-Rights: New Human Rights for the Age of Neurotechnology' (2021) *Horizons* Winter Issue No 18 154.

[40] Ibid 158.

[41] Linxing Jiang et al*.,* 'BrainNet: A Multi-Person Brain-to-Brain Interface for Direct Collaboration Between Brains' (2019) 9 *Scientific Reports* 6115.

[42] Chrissy Newton, 'Lucid Dreaming Breakthrough: Startup Claims First-Ever Two-Way Dream Communication' (The Debrief, 8 October 2024) https://thedebrief.org/lucid-dreaming-breakthrough-startup-claims-first-ever-two-way-dream-communication/ accessed 4 March 2025.

[43] Henrichs et al. (n 12), 41.

[44]International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 34 para 84. In other words, the aim should be to improve human performance 'beyond what is necessary to sustain or restore good health': Eric T Juengst, 'What Does Enhancement Mean?' in Erik Parens (ed), *Enhancing Human Traits: Ethical and Social Implications* (Georgetown University Press 1998) 29.

medical treatment or therapies, as aiming *toward* normality, and (neuro)enhancement, as aiming *beyond* that standard. The subjective perception of 'normality', however, persists in most attempts at defining neuroenhancement, largely due to the influence of different social and cultural perceptions.[45] For instance, some groups of deaf people consider that the condition of deafness does not need to be labelled as a disease.[46] On the other hand, what is deemed a 'normal brain' may as well vary across different domains and dimensions of the mind, such as sensorimotor performance, moral reasoning, and face perception.[47] For example, in the context of high-performance groups, such as athletes, musicians or dancers, future neurodevices promise to change sensimotor 'normality' by providing all manner of performance enhancements in the sensorimotor domain.[48]

While in-depth discussion on normality paradigms falls outside the scope of this thesis, it is important to consider that, ultimately, the statistical and descriptive features of 'normal mental functioning' or 'normal age-related cognitive decline' are poised to change as science progresses.[49]

Among questions of normality, some authors warn that labelling any non-therapeutic benefits conferred by an intervention as enhancement might be an easy way of avoiding further practical nuances which demystify the idea that enhancement can (always) begin when therapy ends.[50] For example, one might question whether enhancement begins when a treatment simply exceeds the typical extent of repair or if there is a requirement to go beyond some specific 'upper limit'.[51]

These blurred lines between therapy and enhancement have already impacted the regulatory scene, as non-medical devices, such as non-invasive neurostimulators, enter the consumer market. For instance, the same wearable neurostimulator for the treatment of insomnia and anxiety – the 'Modius Sleep' device, designed by the company Neurovalens – has been considered a wellness application in some jurisdictions (e.g. in

[45] Henrichs et al. (n 12), 41.
[46] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 39 – 40, para 105.
[47] Henrichs et al. (n 12), 41; International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 34 para 83.
[48] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 47).
[49] Metzinger and Hildt (n 18) 247.
[50] John R Shook and James Giordano, 'Defining Contexts of Neurocognitive (Performance) Enhancements: Neuroethical Considerations and Implications for Policy' in Fabrice Jotterand and Veljko Dubljević (eds), *Cognitive Enhancement: Ethical and Policy Implications in International Perspectives* (Oxford University Press 2016) 80.
[51] Ibid.

the United Kingdom and in EU member-states), whereas in others (e.g. in the United States) it requires approval under the medical device regulation. [52] Similarly, advertisements of the same products on the market range between being presented as medical devices, and others as wellness and enhancement tools.[53]

In this context, engaging in the neuroenhancement debate through the prism of personal identity demands us to consider that any attempt to define or regulate enhancement cannot escape the shifting boundaries of what it means to be 'normal'. Stated shorty, it involves not only evolving scientific possibilities, but also societal and cultural values, and personal aspirations – reminding us that enhancement may be as much about who we are as it is about who we wish to become.

2.3. A window into the future of neuroenhancement

Now that we have introduced neuroenhancement, explored today's neurotechnological tools, and examined the blurred boundary between enhancement and therapy, we arrive at a critical juncture, where we must link the present to the future.

Importantly, the developments we see today – ranging from NIBS to experimental implantable BCIs – signal a deeper, more consequential shift: the gradual commodification of the convergence between human cognition and artificial cognitive systems. While some of these innovations may appear innocuous from a personal identity perspective, such as wearable devices for wellness,[54] others, particularly invasive devices, such as BCIs, already prompt significant concerns.[55]

In particular, the emergence of AI-driven neurotechnology devices raises questions about their impact on 'users' perception of the self, and on the user's experience of their own mental contents'.[56] This combination between neurotechnology and artificial intelligence

[52] Istace and Costas Trascasas (n 4) 7–8 ; Neurovalens, 'Modius Sleep Receives FDA clearance for medical device to treat insomnia'https://neurovalens.com/products/modius-sleep accessed 27 April 2025.
[53] Istace and Costas Trascasas (n 4) citing Shirley Fecteau 'Influencing Human Behavior with Noninvasive Brain Stimulation: Direct Human Brain Manipulation Revisited' (2022) 29(3) *The Neuroscientist* 317.
[54] Questions raised by existing consumer products for wellness (e.g. those designed to improve sleep) generally revolve around data privacy: Jared Genser, Stephen Damianos, and Rafael Yuste, 'Safeguarding Brain Data: Assessing the Privacy Practices of Consumer Neurotechnology Companies' (April 2024).
[55] See for example: International Bioethics, *Ethical Issues of Neurotechnology* (n 9); Ienca, *Common Human Rights Challenges* (n 8); Committee on Legal Affairs and Human Rights, *The brain-computer interface: new rights or new threats to fundamental freedoms?* Report Doc. 15147, 24 September 2020, Council of Europe.
[56] Surjo R Soekadar et al., 'On the Verge of the Hybrid Mind' (2021) 1 *Morals and Machines* 30.

has given rise to the concept of the hybrid mind – a condition in which the brain and neurotechnologies functionally merge, resulting in a dynamic process of mutual adaptation between the individual and the technology.[57] According to Soekadar and colleagues, 'simple forms' of hybrid minds already exist in the context of experimental neurological and psychiatric treatments.[58] One example in the field of sensory perception is a robotic arm controlled by both the user's brain activity and an AI system that can detect and precisely locate objects of daily living.[59]

Going across and beyond picturing *hybridity* outside the medical sphere, some authors envision our continued existence in *posthuman* states, where we have been so profoundly enhanced that it may no longer be clear whether we continue to be human. [60]

While these scenarios will merit further exploration in sections 3.5. and 4.3., they raise an immediate and pressing question: should a person be allowed, without any restrictions, to use neuroenhancement devices – even to the point of becoming a *hybrid mind* or a *posthuman*? Or is there a human essence to be protected? If we consider this essence to be rooted in personal identity, we must then ask: how might neurotechnology reshape, reinforce, or erode that identity?

To answer these questions, we must first go back to the philosophical and legal foundations of personal identity. The following chapter will undertake this task, establishing a conceptual basis for evaluating the implications of neurotechnology on identity, while also advancing concerns about its unrestricted use for neuroenhancement.

[57] Ibid 33.
[58] Ibid 32.
[59] Ibid 34–35.
[60] Ralph Stefan Weir, 'The Personal Identity Dilemma for Transhumanism' (2024) 99 (3) *Philosophy* 351, 351–352; for the notion of 'posthuman': Humanity+, The Transhumanist FAQ: v3.0, https://www.humanityplus.org/transhumanist-faq accessed 29 April 2025.

3. PERSONAL IDENTITY UNDER SIEGE

The enhancement of human cognitive and emotional capacities challenges traditional views of personal identity, which often describe it as a stable set of unique traits that distinguish one individual from another.[61] Such traits are generally identified through subjective assessment as the 'properties to which the subject feels a special sense of attachment or ownership' and are typically linked to a notion of personhood (that is, the status of being a person, rather than a non-person). [62]

This foundational subjectivity, however, raises profound questions about what it means to protect personal identity in the neurotechnological age: is it about preserving its current form, enabling its evolution, or upholding a person's right to redefine it entirely?

This chapter examines whether, how, and to what extent personal identity is influenced by the use of emerging neurotechnologies. To this end, it draws on empirical insights interpreted through the philosophical foundations of personal identity – specifically, the psychological continuity account of identity. Recognizing the potential impact of these technologies on different conceptions and dimensions of personal identity, the chapter then explores their implications from a legal perspective.

3.1.Insights from empirical evidence

Neurotechnology's ability to modify certain psychological features has already gathered substantial empirical evidence in the clinical sphere. Research has particularly focused on the effects of brain stimulation and modulation techniques, such as tDCS, TMS, and DBS.[63]

Cases reported in scientific literature include findings that patients undergoing DBS exhibited behavioural changes such as increased impulsivity, aggression,[64] and altered

[61] Marcello Ienca, 'On Neurorights' (2021) 15 *Frontiers in Human Neuroscience*, Sec. Brain-Computer Interfaces 5.
[62] Ienca, *Common Human Rights Challenges* (n 8) 53; Lynne Rudder Baker, *Persons and Bodies: A Constitution View* (Cambridge University Press 2000).
[63] Sjors Ligthart, 'Towards a Human Right to Psychological Continuity? Reflections on the Rights to Personal Identity, Self-Determination, and Personal Integrity' (2024) 5 *European Convention on Human Rights Law Review* 199, 211; Marcello Ienca and Roberto Andorno, 'Towards New Human Rights in the Age of Neuroscience and Neurotechnology' (2017) 13(5) *Life Sciences, Society and Policy,* 20.
[64] Michael J Frank et al., 'Hold Your Horses: Impulsivity, Deep Brain Stimulation, and Medication in Parkinsonism' (2007) 318 *Science* 1309; M Sensi et al., 'Explosive-Aggressive Behavior Related to Bilateral Subthalamic Stimulation' (2004) 10(4) *Parkinsonism and Related Disorders* 247.

sexual behaviour,[65] with one 2006 study revealing most patients observed feeling 'strangeness and unfamiliarity with themselves after surgery'*('I do not feel like myself anymore' or 'I feel like a robot'*).[66] In contrast, a 2017 study carried out by Gilbert et al. found that most Parkinson's patients with implanted DBS that were interviewed did not consciously notice the device while it operated in the background, with some even describing it as feeling like '*part of me'*.[67]

While DBS may still be far from being applied in non-medical contexts, and therefore from being used for neuroenhancement purposes, other forms of brain stimulation have also revealed potential to interfere with a person's psychological characteristics. In 2015, a study found that using non-invasive TMS to reduce or suppress activity in a specific brain region could influence a person's political and religious beliefs.[68] Similar studies relate to the psychological implications of using neurotechnologies such as optogenetics[69] to remove, alter, add or replace individuals' memories.[70] For instance, experiments with animal models have already shown optogenetics' capacity to reactivate and deactivate even very remote and firmly consolidated memories by targeting hippocampal neurons.[71]

Beyond neuromodulation techniques, more recently, in 2023, Glibert, Ienca and Cook reported a case of a patient experiencing 'persistent agential discontinuity' due to the explantation of an AI-driven BCI. *('that [device] made me a different person', 'it became me', 'they took away that part of me'*).[72] The authors ultimately conclude that 'pairing AI with neurotechnology suggests the prospect of using brain stimulation for targeting a variety of symptoms, by keeping or not a user in the decisional loop.'[73]Importantly, clinical studies have shown that, beyond inducing significant changes in a person's

[65] Houeto J et al., 'Behavioural Disorders, Parkinson's Disease and Subthalamic Stimulation' (2002) 72 *Journal of Neurology, Neurosurgery & Psychiatry* 701.
[66] M Schüpbach et al. 'Neurosurgery in Parkinson Disease: A Distressed Mind in a Repaired Body?' (2006) 66 *Neurology* 1811.
[67] Frederic Gilbert et al., 'I Miss Being Me: Phenomenological Effects of Deep Brain Stimulation' (2017) 8(2) *AJOB Neuroscience* 96, 101.
[68] Colin Holbrook et al., 'Neuromodulation of Group Prejudice and Religious Belief' (2015) 10 *Social Cognitive and Affective Neuroscience* 721.
[69] Optogenetics is an 'invasive neuromodulation technique involving the use of light to control the activity of individual brain cells': Przemysław Zawadzki and Agnieszka K. Adamczyk, 'Personality and authenticity in light of the memory-modifying potential of optogenetics' (2021) 12 AJOB Neuroscience 3.
[70] Zawadzki and Adamczyk (n 69); Muriel Leuenberger, 'Why Authenticity Hinges on Narrative Identity' (2021) 12 *AJOB Neuroscience* 43.
[71] Inbal Goshen et al., 'Dynamics of Retrieval Strategies for Remote Memories' (2011) 147 *Cell* 678.
[72] Frederic Gilbert, Marcello Ienca and Mark Cook, 'How I became myself after merging with a computer: Does human-machine symbiosis raise human rights issues?' (2023) 16 *Brain Stimulation* 783, 786.
[73] Ibid 788.

psychological traits, neurotechnology can also influence how individuals perceive and evaluate those changes. In a 2019 study by Mosley et al. investigating the side effects of DBS, a patient described profound and 'apparently negative' behavioural changes – ranging from crude language and irritability to overt sexualization – as voluntary and positively experienced.[74]

Thus, as the evidence above demonstrates, neurotechnology has the capacity to alter core aspects of an individual's psychological profile – ranging from memory and belief systems to behaviour and sense of self. This has prompted scholars to rethink long-standing philosophical frameworks of personal identity. The urgency of this reassessment becomes even more apparent when considering the intentional use of neurotechnological interventions to modify psychological features for the purpose of enhancement. In what follows, we shall therefore examine how different philosophical conceptions of personal identity may serve as thresholds to determine when this identity has been affected by neurotechnology. Understanding these thresholds is crucial to evaluate whether, and to what extent, individual engagement with neuroenhancement technologies should be limited.

3.2. (Re)thinking personal identity: philosophical foundations

3.2.1. Theories of personal identity – a psychological continuity perspective

The enduring pursuit of understanding our essence as humans has inspired a diverse range of philosophical theories of personal identity. Each of these theories result in a distinct threshold for evaluating how neurotechnologies may affect it.[75] Here, four theories are outlined, with the final one warranting particular consideration.

The first theory proposes a *biological continuity* approach to personal identity. It emphasizes our existence as a biological entity – that is, it considers our personal identity to depend on the physical continuity of our neural architecture or bodily makeup. [76] From

[74] Philip E Mosley et al., '"Woe Betides Anybody Who Tries to Turn Me Down." A Qualitative Analysis of Neuropsychiatric Symptoms Following Subthalamic Deep Brain Stimulation for Parkinson's Disease' (2019) *Neuroethics.*
[75] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 26 para 45.
[76] Marya Schechtman, 'Personal Identity', in Routledge Encyclopedia of Philosophy (2011) https://www.rep.routledge.com/articles/thematic/personal-identity/v-2 accessed 27 April 2025; Eric T. Olson, *The Human Animal: Personal Identity Without Psychology* (Oxford University Press 1997).

this perspective, the key criterion for evaluating neurotechnological impact is whether an intervention disrupts or preserves these biological foundations.[77]

Second, *narrative identity* theories suggest identity lies in the incorporation of experiences over-time into self-told stories about our sense of self and our ability to turn them into a coherent autobiographical narrative.[78] Thus, when applying this lens, the concern is whether a neurotechnological intervention impairs how individuals understand and construct their personal stories — in short, whether neurotechnology becomes a 'substitute'.[79]

Third, identity has also been examined through a social lens, with *social identity* perspectives emphasizing how our identity is shaped to some extent by the interaction patterns we maintain with others.[80] Here, the evaluation of neurotechnological influence centres on how observable changes in behaviour or personality affect others' perceptions of the individual's identity.[81]

However, it is a fourth approach – the *psychological continuity* account of identity – which has garnered the most attention[82] in scholarly discussions on neurotechnology, particularly as they intersect with broader human rights discourse.[83]

This approach emphasizes one specific feature of personal identity: its 'temporal quality of persistence'.[84] The notion of 'psychological continuity' finds its roots in John Locke's

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[77] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 26 para 45.
[78] Ibid. See also: Marya Schechtman, The Constitution of Selves (Cornell University Press 1996); Marya Schechtman, 'The Narrative Self', in The Oxford Handbook of The Self, Shaun Gallagher (ed), (Oxford University Press 2011) 394.
[79] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 26 para 45.
[80] Ibid 26 para 44.
[81] Ibid 26 para 45.
[82] This does not mean this account of identity is universally accepted among scholars. For example, within the enhancement debate, DeGrazia advocates for a biological perspective, which he regards as 'metaphysically more plausible, coherent, and consistent with "educated common sense"'. Accordingly, it may be argued that other approaches can better articulate the concerns raised by neurotechnology-induced brain alterations. For example, the narrative conception of identity has achieved considerable prominence in debates about the identity effects of DBS. See: LLE Bolt, 'True to Oneself? Broad and Narrow Ideas on Authenticity in the Enhancement Debate' (2007) 28 *Theoretical Medicine and Bioethics* 285, 289 citing David DeGrazia*, Human Identity and Bioethics* (Cambridge University Press 2005), 47; Françoise Baylis, '"I Am Who I Am": On the Perceived Threats to Personal Identity from Deep Brain Stimulation' (2013) 6 *Neuroethics* 513; Marya Schechtman, 'Making the Truth: Self-Understanding, Self-Constitution, Neuroscience, and Narrative' (2012) 3 *AJOB Neuroscience* 75.
[83] Grounded in this account of personal identity, scholars Ienca and Andorno propose the 'neuroright' to psychological continuity, among other novel neuro-specific human rights aimed at safeguarding our minds from unwanted neurotechnological interferences. See: Ienca and Andorno (n 63); Gilbert, Ienca and Cook (n 72) 787. Neurorights proposals shall be further examined in Chapter 5.
[84] Ienca, *Common Human Rights Challenges* (n 8) 53.

relational memory criterion.[85] According to this criterion, persons at different times are identical to one another because they present some kind of psychological or physical relation between them.[86] Locke regards the personal identity relation as uniquely unifying temporally distinct person-stages via a self-reflective consciousness.[87] In other words, from this perspective, someone qualifies as a person only if they possess the capacity to perceive themselves as continuous with their past self and maintain psychological characteristics that constitute their identity, regardless of temporal or spatial changes.[88]

Objections to this criterion – notably the difficulty in accepting that identity would cease to exist with the loss of memory (as in cases of amnesia)[89] – have led to a significantly revised version, materialized in the concept of 'psychological continuity'. Such an account of personal identity emphasizes the idea of a strong chain of overlapping psychological features besides memory, including desires, beliefs and intentions – as portrayed in Derek Parfit's influential input.[90] Parfit maintains that for *X* and *Y* to be the same person at different times, there must be an overlapping chain of enough ('strong') psychological connectedness between *X* today and *Y* sometime in the past or future.[91] He contends that there is a strong connectedness when the number of psychological connections to oneself 'over any day, is at least half the number of direct connections that hold, over every day, in the lives of nearly every actual person'.[92]

In the context of emerging neurotechnologies, the main concern is that they may ultimately 'break' this continuous psychological chain that makes us *us* by replacing or altering at least half of these connections – such as memories, desires, beliefs – we hold

[85] John Locke, 'Of Identity and Diversity', in *An Essay Concerning Human Understanding*, John Locke (ed), (Oxford University Press 1694).
[86] David Shoemaker, 'Personal Identity and Ethics', in *The Stanford Encyclopedia of Philosophy*, Edward N. Zalta and Uri Nodelman (eds), (Fall 2021) https://plato.stanford.edu/entries/identity-ethics/ accessed 2 July 2025.
[87] Ligthart (n 63), 209.
[88] Ienca, *Common Human Rights Challenges* (n 8) 54.
[89] Ibid.
[90] Ligthart (n 63), 209; Derek Parfit, Reasons and Persons (Oxford University Press, 1984).
[91] Parfit (n 90) 206.
[92] Ibid.

with our former selves.[93] Essentially, by inducing profound changes in these psychological features, these technologies would lead us to become different 'persons'.[94]

Despite compelling empirical evidence, as discussed above in section 3.1., authors such as Pugh, Gilbert, Viaña and Ineichen remain sceptical about whether neurotechnology has progressed to the point of disrupting psychological continuity.[95] This scepticism has raised the question of whether psychological continuity ought to occupy a central role in debates surrounding brain stimulation and identity.[96] Pugh, for instance, argues that potential threats posed by DBS appear 'far more plausible' under the perspective of narrative identity.[97]

The key question, then, is: are we currently capable – or will be in the future – of changing the psychological traits that ensure our continuity? In order to provide a comprehensive response, a detailed examination of each individual case would be required. Although it is not feasible to conduct a full analysis here, current research points to a preliminary conclusion: namely, at least three key aspects of psychological continuity can already be modified through neurotechnological means – desires, beliefs and memories.[98]

This conclusion encourages us to complement the threshold of psychological continuity with other conceptual distinctions that may provide further insights on the spectrum of identity modifications through neurotechnology. One such distinction is that between qualitative identity and quantitative (or numerical) identity to which we now turn.

3.2.2. Qualitative *versus* quantitative identity

Identity, as an inherently complex concept, exhibits multiple dimensions. A traditional distinction in philosophy – particularly relevant when assessing which brain modifications might warrant identity protections – involves the *qualitative* and *numerical*

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[93] Ibid. See also: Jon Sebastian Holmen, 'A Note on Psychological Continuity Theories of Identity and Neurointerventions' (2022) 48 *Journal of Medical Ethics* 742, 743.
[94] Holmen (n 93).
[95] Jonathan Pugh, 'Clarifying the Normative Significance of 'Personality Changes' Following Deep Brain Stimulation' (2020) 26 *Science and Engineering Ethics* 1655, 1661; Frederic Gilbert, JNM Viaña and C Ineichen, 'Deflating the "DBS Causes Personality Changes" Bubble' (2021) 14 Neuroethics (Suppl 1) 1. See also: Françoise Baylis, '"I Am Who I Am": On the Perceived Threats to Personal Identity from Deep Brain Stimulation' (2013) 6 *Neuroethics* 513; Marya Schechtman, 'Making the Truth: Self-Understanding, Self-Constitution, Neuroscience, and Narrative' (2012) 3 *AJOB Neuroscience* 75.
[96] Ligthart (n 63), 212.
[97] Pugh (n 95) 1658.
[98] Holmen (n 93).

(or *quantitative*) aspects of identity.[99] Qualitative identity means that two separate things share the same features or characteristics. For example, two statues made of the same material and depicting the same figure would be qualitatively identical. Yet, they are not the same object, and the degree of *sameness* can vary, depending on the properties shared. In contrast, numerical identity requires absolute qualitative identity – if two things are identical, every characteristic possessed by one is also possessed by the other.[100]

In the context of neurotechnology, scholars have recently discussed scenarios where enhancement of cognitive functions or memory may lead to changes in both the qualitative and quantitative aspects of personal identity.[101]On the one hand, such changes could allow an individual to acquire skills or memories that make them *qualitatively* similar to another individual. However, the extent to which these alterations preserve or alter personal identity seems to require some caution in the analysis. For instance, it is questionable that changes in personal qualities, such as improved focus level or memory capacity will provoke changes in the 'core' of an individual's identity. Astobiza and Beriain frame these nuances in a spectrum of identity alterations, involving:

> *Minor modifications*: such as cognitive improvements that maintain essential aspects of a person's personality.
>
> *Moderate modifications*: such as more substantial cognitive enhancements that could affect how someone perceives and interacts with the world.
>
> *Profound modifications*: such as deep cognitive changes that significantly transform a person's thinking patterns. [102]

In this context, while *profound modifications* would most likely have implications on psychological continuity, as defined in the previous section, thus calling for normative caution with regard to identity, it remains more uncertain whether enhancements involving *minor modifications* would demand such safeguards.[103] Nevertheless, we may

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[99] Harold Noonan and Ben Curtis, 'Identity' in Edward N. Zalta & Uri Nodelman (eds.) *The Stanford Encyclopedia of Philosophy* (Fall 2022 Edition) https://plato.stanford.edu/entries/identity/ accessed 5 May 2025.
[100] Ibid.
[101] Aníbal M Astobiza and Iñigo de Miguel Beriain, 'From Neurorights to Neuroduties: The Case of Personal Identity' (2024) 2 *Bioethics Open Research* 7.
[102] Ibid.
[103] Ibid.

consider the possibility of minor alterations accumulating or interacting in unpredictable ways.

On the other hand, from a quantitative perspective, alterations brought about by neurotechnology may be construed as compromising the distinctive, intrinsic attributes that numerically differentiate one individual from another.

The perspective of a person completely transforming – thinking, feeling or remembering things differently – to entirely become 'someone else' seems to currently belong to a futuristic scenario of neuroscientific evolution;[104] still, one might wonder what the emerging issues would be if enhancing individuals' cognitive or emotional traits could, at some point, be seen as disrupting numerical identity. One of those issues is, for instance, that this 'new identity' emerging may be susceptible to harm – as Astobiza and Beriain note, they 'may have to bear the burden of a disease (such as diabetes) or any other harm of which he or she is not the originator or cause'.[105]

Ultimately, from a qualitative standpoint, the integration of new cognitive or emotional capacities via neurotechnology may theoretically serve to enhance an individual's functional abilities while preserving the continuity of personal identity. Conversely, from a quantitative perspective, such neurotechnological modifications might be viewed as compromising the distinct, intrinsic attributes that constitute an individual's numerical identity over time – thus, disrupting such continuity.

Beyond these theoretical thresholds and distinctions, however, lies a deeper, value-laden concern: does the *self* that emerges from neurotechnological modification remain *authentic*? The next section will outline the current debate on authenticity, with the purpose of broadening the spectrum of what can be seen as an 'interference' with one's personal identity.

[104] Indeed, as Bublitz and Merkel note, 'with today's enhancing methods and those of the foreseeable future, the numerical identity of a person is preserved', identifying cases that involve (inadvertent) complete amnesia as an exception: Jan Christoph Bublitz and Reinhard Merkel, 'Autonomy and Authenticity of Enhanced Personality Traits' (2009) 23 *Bioethics* 360.
[105] Astobiza and de Miguel Beriain (n 101).

3.2.3. The debate on authenticity

In philosophical and neuroethical literature, the concept of authenticity is often used interchangeably with personal identity, especially when discussing the normative importance of preserving specific aspects of a person's self.[106] It is thus important to understand how this notion can be considered negatively impacted by technological neuroenhancement.

In its 2022 IBC report, UNESCO points out risks posed to 'personal identity and authenticity of the self'.[107] According to this report, 'authenticity can mean that a person is fully themself when he or she acts according to their desires and preferences, or that if a person acts independently, responsibly, and sincerely, they are acting authentically'.[108]

In this context, authenticity appears to encompass a principle often emphasized in both personal development and social discourse: the imperative to 'remain true to oneself' and to 'try to realize oneself'.[109] In line with this somewhat ambiguous imperative, Charles Taylor articulates a 'moral ideal of authenticity', which fundamentally involves individuals discovering and defining their own unique way of being in the world. 'If I am not [true to myself]', he asserts, 'I miss the point of my life, I miss what being human means for *me*'.[110] This would then correspond to a primary argument for the normative value of authenticity: the idea that being authentic is 'inherently worthy in itself'. [111]

A second line of argument, however, would justify the need to preserve authenticity because it is a necessary means to achieve other ends – most notably, autonomy.[112]

Before turning to this instrumental justification in light of neurotechnological interferences, however, we must address a crucial conceptual question dividing scholars in the context of neuroenhancement: does augmentation of neural functions distance

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[106] Zawadzki and Adamczyk (n 69) 7. See also: n 104; Catriona Mackenzie and Mary Walker, 'Neurotechnologies, Personal Identity, and the Ethics of Authenticity' in Jens Clausen and Neil Levy (eds), *Handbook of Neuroethics* (Springer, Dordrecht 2015) 373; Erik Parens, 'Authenticity and Ambivalence: Toward Understanding the Enhancement Debate' (2005) 35(3) *Hastings Center Report* 34; LLE Bolt, 'True to Oneself? Broad and Narrow Ideas on Authenticity in the Enhancement Debate' (2007) 28 *Theoretical Medicine and Bioethics* 285; Allen Coin and Veljko Dubljević, 'The Authenticity of Machine-Augmented Human Intelligence: Therapy, Enhancement, and the Extended Mind' (2021) 14 *Neuroethics* 283.
[107] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 25 para 47.
[108] Ibid 25 para 46.
[109] Metzinger and Hildt (n 18) 253.
[110] Charles Taylor, *The Ethics of Authenticity* (Harvard University Press 1991) 29.
[111] Zawadzki and Adamczyk (n 69) 7.
[112] Ibid.

individuals from their 'authentic selves', or, conversely, can it facilitate the realization of their 'true identity'? [113]

Importantly, given its inherent subjectivity, authenticity has integrated arguments invoked by both proponents and critics of enhancement technologies – though implying different understandings of the concept.[114]

For *essentialists*, authenticity is compromised by anything that causes a person to deviate from their 'true self' – a relatively stable and pre-determined set of characteristics uncovered through an introspective process of *self-discovery*. [115] In contrast, *existentialists* view authenticity as a matter of *self-creation*, where individuals define and shape their own identity according to personal ideals – the control over one's own development is seen as an essential aspect of what it means to be a person. [116]

These differing views lead to two different positions on whether authenticity is threatened by neuroenhancement technologies. On the one hand, essentialists view *inauthenticity* as an inevitable consequence of deliberate modifications to one's mental characteristics. By separating us from our essence, such modifications would result in individuals living a life that it is 'not really' their own (a kind of artificial or 'cheating' version of themselves)[117], resonating with warnings about eventual *dehumanization*.[118] On the other hand, existentialists argue that these technologies can help users become who they want to be, thus facilitating self-fulfilment.[119] Accordingly, for existentialists, the very notion that humans have a fixed essence, such as the 'true self' – which may be necessarily

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[113] Metzinger and Hildt (n 18) 253 citing, among others:
Carl Elliott, 'The Tyranny of Happiness: Ethics and Cosmetic Psychopharmacology' in Erik Parens (ed), *Enhancing Human Traits: Ethical and Social Implications* (Georgetown University Press 1998) 177;
Carl Elliott, 'Pursued by Happiness and Beaten Senseless: Prozac and the American Dream' (2000) 30 *Hastings Center Report* 7;
Erik Parens, *Enhancing Human Traits: Ethical and Social Implications* (1998) Georgetown University Press, 263;
Erik Parens, 'Authenticity and Ambivalence: Toward Understanding the Enhancement Debate' (2005) 35(3) *Hastings Center Report* 34;
Maartje Schermer, Ineke Bolt, Reinoud de Jongh and Berend Olivier, 'The Future of Psychopharmacological Enhancements: Expectations and Policies' (2009) 2 *Neuroethics* 75.
[114] Erik Parens, 'Authenticity and Ambivalence: Toward Understanding the Enhancement Debate' (2005) 35(3) *Hastings Center Report* 34, 35.
[115] Zawadzki and Adamczyk (n 69) 7.
[116] Jan Christoph Bublitz and Reinhard Merkel, 'Autonomy and Authenticity of Enhanced Personality Traits' (2009) 23 *Bioethics* 360, 361.
[117] See n 113; President's Council on Bioethics, *Beyond Therapy: Biotechnology and the Pursuit of Happiness* (US Government Printing Office 2003) 253.
[118] President's Council on Bioethics (n 117) 8.
[119] Bublitz and Merkel (n 116).

undermined through the use of neuroenhancement technologies – seems to be 'an act of self-deception'.[120]

An example of an essentialist position can be found in the influential report of George W. Bush's President's Council on Bioethics, where enhancement is seen as a potential threat to our sense of human dignity and what it means to be naturally human.[121] Similarly, Carl Elliott argues that neuroenhancement inevitably undermines authenticity –'It would be worrying if Prozac altered my personality, even if it gave me a better personality, simply because it isn't *my* personality'(quoted in DeGrazia).[122]

Meanwhile, an extreme version of existentialism is evident in Jean-Paul Sartre's work.[123] While he acknowledges there are some concrete features or 'facticity' making us who we are, he essentially argues that individuals may well distance themselves from that facticity through self-interpretation. Denying that power of choice would be an act of 'badfaith', negligent to one's own freedom.[124] This illustrates how existentialist positions often suggest a close intersection between authenticity and personal autonomy. In line with this, most contemporary theories of autonomy view authenticity as a 'precondition' that ensures an agent's actions come from their 'own character'.[125] In order to be *autonomous,* one would then have to be *authentic*.

Accordingly, Adomaitis and Grinbaum point out that while neurotechnologies are designed to boost autonomy by supporting self-determination, they may undermine or alter a deeper sense of autonomy tied to personal authenticity.[126] This suggests two different conceptions of autonomy. On the one hand, *autonomy stricto sensu* – as self-determination – refers to the ability to make choices and control one's actions.[127] On the other hand, *autonomy as authenticity* – as argued by Gerald Dworkin –, requires 'higher-

[120] Zawadzki and Adamczyk (n 69), 8.
[121] President's Council on Bioethics, *Beyond Therapy: Biotechnology and the Pursuit of Happiness* (US Government Printing Office 2003).
[122] David DeGrazia, 'Prozac, Enhancement, and Self-Creation' (2000) 30(2) *Hastings Center Report* 34, 35 citing Carl Elliott, 'The Tyranny of Happiness: Ethics and Cosmetic Psychopharmacology' in Erik Parens (ed), *Enhancing Human Traits: Ethical and Social Implications* (Georgetown University Press 1998).
[123] Jean-Paul Sartre, *Being and Nothingness* (Simon and Schuster 1992).
[124] Zawadzki and Adamczyk (n 69), 8.
[125] Bublitz and Merkel (n 116).
[126] Laurynas Adomaitis and Alexei Grinbaum, 'Neurotechnologies, Ethics, and the Limits of Free Will' (2024) 58 *Integrative Psychological and Behavioral Science* 894.
[127] Ibid 898.

order identification with one's first-order desires'. [128] This means that actions and choices must reflect an individual's core values and constitute a reflective endorsement of their motives, 'free of alienating influences'. [129] In this light, it may be argued that neurotechnology's capacity to alter one's psychological traits can pose a threat to autonomy understood as authenticity.

Ultimately, authenticity introduces the debate on whether we have an unchangeable essence that ought to be protected, or whether we should be able to 'create' and shape our own identities so long as our autonomy to do so is preserved. As we will see in Chapter 4, from the perspective of autonomy, existentialist and essentialist theses overlap with the general arguments for and against human enhancement – so-called *meliorist* (pro-enhancement) and *anti-meliorist* (anti-enhancement) views.

3.2.4. Social identity and the 'rights of others'

The relational or social dimension adds yet another layer of complexity to discussions on 'preserving' personal identity against neuroenhancement technologies. In this context, the social approach of personal identity described earlier in this chapter focuses on how third parties might perceive psychological changes induced by neurotechnology. In this vein, when considering the social importance of authenticity, Merkel and Bublitz note that interpersonal relationships 'are built on stable and enduring conceptions of other people'. [130] In other words, they rely on expectations of *continuity* in personality, behaviour, and emotional responsiveness.[131] Having this in mind, it appears clear how psychological changes induced by neuroenhancement technologies might jeopardize the stability of social relationships and thus the interests of people around the neuroenhanced individual.

Let us imagine a hypothetical scenario in which an introvert uses neurotechnology to enhance extroverted traits with the aim of improving their social networking abilities, or conversely, an extrovert uses the same (or similar) technology to cultivate their introverted characteristics for a greater capacity to enjoy solitude. Let us further suppose

[128] LLE Bolt, 'True to Oneself? Broad and Narrow Ideas on Authenticity in the Enhancement Debate' (2007) 28 *Theoretical Medicine and Bioethics* 285, 293.
[129] Ibid.
[130] Bublitz and Merkel (n 116) 374.
[131] Louis Cozolino, *The Neuroscience of Human Relationships: Attachment and the Developing Social Brain* (2nd edn, WW Norton & Company 2014).

that after the voluntary use of such enhancement technologies the individuals observed feel 'more like themselves', 'more authentic', in the way they can now take greater advantage of specific dimensions of their personality. Yet, their friends and family do not share this perception and think that these persons have drastically changed their 'own way' of interacting with the world; to the point they do not recognize them *as them* anymore.[132] These differences in perception towards an individual's psychological changes lead us to question the extent to which the 'rights of others' – that is, their interest in maintaining stable interpersonal relationships – might constraint a person's freedom to alter psychological elements that subjectively form their personal identity.[133]

3.3. Preliminary conclusions

Taken together, the psychological continuity approach to identity, the distinction between qualitative and quantitative identity, the concept of authenticity and the social dimension discussed here, allow us to draw five preliminary conclusions.

First, Parfit's psychological continuity account offers a robust and useful framework for identifying the minimal conditions of personal identity. It proposes that personal identity is not fixed biologically, narratively or socially, but rather is sustained by the persistence of significant psychological characteristics, such as memories, beliefs, desires, and intentions. Neurotechnologies capable of modifying these traits have the potential to weaken or even disrupt this continuity.

Second, while it may be argued that empirical evidence does not conclusively prove that neurotechnology can disrupt psychological continuity, it demonstrates that at least some essential psychological components can be modified. Special attention has been recently given to the pairing of neurotechnology with AI and how implanted (AI-driven) neurodevices may be perceived as part of one's *new* identity. This suggests that, although we may not yet be able to create entirely different persons through neurotechnological interventions, the groundwork for significant *identity transformations* may already be taking place. Therefore, the debate is no longer a purely theoretical one – it now requires careful ethical consideration in light of real-world technological capacities. Within the philosophical domain, psychological continuity emerges as a critical benchmark for

[132] Metzinger and Hildt (n 18) 254; Bublitz and Merkel (n 116) 362.
[133] Astobiza and de Miguel Beriain, (n 101) 8.

evaluating ethical boundaries in the context of advancing neuroenhancement technologies.

Third, the distinction between qualitative and quantitative identity provides a useful framework for evaluating the extent of identity change. Enhancements that lead to minor or moderate modifications – especially if they are isolated or one-time interventions – may not warrant the same normative scrutiny as those causing profound psychological transformations.

Fourth, the concept of authenticity reflects a certain level of subjectivity involved in assessing identity changes provoked by neurotechnology, revealing that what one perceives as self-realization may be viewed by others as negatively impacting an individual's essence.

Fifth, the social dimension of identity reveals that changes to an individual's psychological traits may not only affect self-perception but also disrupt how others recognize and relate to them. This raises ethical concerns about the impact of neuroenhancement on interpersonal relationships and the rights of others to stable social expectations.

Having now examined the multiple ways in which neurotechnology may affect personal identity from a *philosophical* and *metaphysical* point of view, it is now essential to consider how these potentially disruptive effects may extend into the legal domain.

The next section will therefore consider the potential implications of unrestricted voluntary alterations from the prism of *legal identity*, as a step forward in answering our research question.

3.4. Legal identity and voluntary brain alterations

From the perspective of the law, identity serves as the fundamental basis for all rights, obligations, and relationships. Article 6 of the Universal Declaration of Human Rights (UDHR) states that 'everyone has the right to recognition everywhere as a person before the law', thereby marking a condition of legal personhood as an international human right.[134] Although its precise definition and regulation may vary, legal personhood is

[134] Jan Christoph Bublitz, 'Might Artificial Intelligence Become Part of the Person, and What Are the Key Ethical and Legal Implications?' (2024) 39 *AI & Society* 1095, 1907.

traditionally established at birth and extinguished at death, with both events formally recorded by the state – leaving no room for one's legal identity to be 'lost' in between.[135] In this sense, the legal conception of identity is fundamentally shaped by biological considerations.

Overtime, a shift in social and cultural traditions has led to greater flexibility in registered-at-birth components of personal identity – such as name, sex and parentage – particularly in cases that challenge biological assumptions.[136] This is evident, for example, in the recognition of gender identity in cases involving transgender individuals, where legal identity is adapted to reflect self-identification rather than biological determinism.[137] Yet, one's individuality *per se* never disappears. The continuity of legal identity remains unbroken even in cases such as degenerative neurological conditions like Alzheimer's disease, where profound changes in cognition, memory, and personality occur – although legal instruments such as diminished capacity or legal guardianship may be employed to address capacities' limitations, the individual's legal identity remains intact.[138] This enduring nature of legal identity means that, in a future where we may be able substantially improve aspects of our personal identity, such neurotechnology-induced transformations would not be recognized as such under our current legal systems – even if the individual desires such a legal change.

However, this does not mean that no legal consequences may arise; in the scenario where a 'new' technologically neuroenhanced identity emerges 'replacing' the previous one questions could emerge on how specific rights and responsibilities (e.g. contractual obligations, criminal responsibility, familial duties) would (or should) 'transfer' to this new identity.[139] Potential disruptive effects are particularly evident in the case of criminal law. If someone were to significantly alter their identity – for example erasing memories of the crime – during a legal investigation or while serving a sentence, this could have drastic implications on the delivery of justice.[140] Notably, the principle that 'every offender must face justice for their actions and only for their actions' would most likely

[135] Ibid.
[136] Jill Marshall (ed), *Personal Identity and the European Court of Human Rights* (Routledge Studies in Law and Humanity, Routledge 2022), 2.
[137] Concerning the legal recognition of gender identity see for example *Christine Goodwin v the United Kingdom* (ECtHR, 11 July 2002) App no 28957/95 (Grand Chamber) and *I v the United Kingdom* (ECtHR, 11 July 2002) App no 25680/94 (Grand Chamber).
[138] Astobiza and de Miguel Beriain (n 101) 12–13.
[139] Ibid.
[140] Ibid.

conflict with one's identity transformation via neurotechnology.[141] As with interpersonal relationships, legal systems also rely on the continuity of identity for holding individuals responsible for past actions. If a person voluntarily alters significant psychological connections to their previous self, can they still be regarded as the same legal agent? Or does profound psychological transformation – even if self-induced – negate culpability? On a similar note, voluntary brain alterations could severely undermine the administration of justice, especially with respect to the ongoing risk to society; indeed, *in extremis*, penalties may lose their meaning for a profoundly altered defendant and, as a result, fail to serve their intended deterrent effect. Additional concerns would arise if other participants in the criminal process, such as witnesses, could also undergo substantial identity transformations during the investigation or trial. Particularly if memories are modified or erased, that could compromise the reliability of testimonial evidence and hinder cross-examination, thereby jeopardizing the integrity and fairness of judicial proceedings. And we can go even further in this exploration. What if legal systems were to recognize neurotechnological transformations as grounds for changing legal identity? Since criminal responsibility is of 'personal character', allowing an individual to declare themselves 'dead' in favour of a new, profoundly enhanced, identity could open a dangerous loophole for escaping accountability.[142]

Beyond criminal law, permitting legal identity to change in tandem with psychological transformation would create a level of legal uncertainty that our current systems are not equipped to manage. Ultimately, recognizing fluid or discontinuous legal identities could render core legal concepts – such as culpability, contractual obligation, and personal responsibility – simply unworkable.

Currently, debates on the practical repercussions of voluntary neurotechnological interventions on legal identity remain limited by the current state of neuroscientific development and represent a largely unexplored area in academic discourse. Yet, these emerging concerns reveal how evolving scenarios of unrestrained self-modification through neurotechnologies may profoundly challenge how human identity itself is recognized and constructed in the eyes of the law. This already points to a significant conclusion regarding the research question at the heart of this thesis: namely, limits on

[141] Ibid.
[142] Ibid.

voluntary neuroenhancement may be necessary, insofar as identity transformations could have drastic and possibly unmanageable consequences for our legal systems.

Expanding on this foundation, the next section delves into a more specific dimension of this challenge: the questions arising from the functional integration between the human brain and AI-driven neurodevices. In Chapter 2, we framed the concept of the *hybrid mind* under what might be considered the future of neuroenhancement possibilities. In the following discussion, we dive deeper into what the concept actually entails, examining the practical implications it raises, which may further challenge one's freedom to neuroenhance.

3.5. On the boundaries of the 'hybrid mind'

The notion of the hybrid mind is grounded in the widely discussed Extended Mind Thesis (EMT) – a theoretical and philosophical framework suggesting that cognitive processes are not confined to what is inside our brains but can also extend into the external world (the environment). According to the EMT, tools such as notebooks or smartphones can become an integral part of our cognitive system if they function analogously to internal mental processes.[143] In this sense, the mind and these external artifacts could form a 'seamlessly unified entity'.[144] The EMT famously asks: 'where does the mind stop, and the rest of the world begin?'[145] – a question that becomes increasingly relevant as machine intelligence forms a closer connection with the human mind.

One claim that has been increasingly associated with the EMT is that biotechnological hybridity is inherent to the human mind[146] – that is, it is an 'aspect of our humanity which is as basic and ancient as the use of speech'. [147]In this context, the term *hybrid intelligence* has been increasingly used to describe 'coalitions' of human and machine intelligence, where the unique strengths of each are integrated to enhance overall effectiveness.[148] A particularly transformative example of this hybrid intelligence is the concept of the *hybrid mind,* which describes a functional integration of the human brain with AI-powered

[143] Andy Clark and David Chalmers, 'The Extended Mind' (1998) 58(1) *Analysis* 7.
[144] Luis Enrique Echarte Alonso and Miguel García-Valdecasas Merino, 'Identity and Conflicts in the Ethics of Neural Implants' (2014) 25 *Cuadernos de Bioética* 415.
[145] Soekadar et al. (n 56), 33.
[146] Ibid.
[147]Andy Clark, 'Towards a Science of the Bio-Technological Mind' (2002) 1(1) *International Journal of Cognition and Technology* 21, 22.
[148] Ibid 33; Soekadar et al (n 56), 33.

neurotechnologies.[149] Through such integration, the boundaries between biological and artificial intelligence could become significantly blurred, raising numerous questions rooted on how we perceive the boundaries of the self. [150]

For instance, can an AI-device or machine – with its own cognitively *analogous* processes and functional integration into the human brain – be considered as part of the person and thus an element of their identity?

Chief among the challenges of defining the boundaries of the person with a hybrid mind is the disruptive effect on current legal categorization, as our legal systems draw sharp distinctions between persons and objects. For example, the law treats damage to property differently from physical or psychological harm to a person, and – except in rare circumstances – does not permit parts of a person to be bought or sold like ordinary objects.[151]

Other challenges arising concern agency and responsibility, as well as cybersecurity and manipulation. Human agency is often defined as 'an individual's ability to make and communicate choices, often through action.'[152] Neurotechnology and its integration with AI challenges this conception 'by affecting the individual's attention, inhibitory control, or other important functions'.[153] Notably, Ienca and Haselager suggest that when BCI control involves intelligent algorithmic components, it can become difficult to determine whether the resulting behaviour output was actually carried out by the user.[154]

Among other potential implications, this introduces a principle of indeterminacy in the cognitive process that goes from intention to execution. As a result, assigning individual moral or legal responsibility for the action may become uncertain. [155] Yet, while individuals might be exonerated from responsibility due to the 'autonomous' inputs of

[149] Soekadar et al. (n 56), 33.
[150] Maria Buthut et al., 'HYBRIDMINDS – Summary and Outlook of the 2023 International Conference on the Ethics and Regulation of Intelligent Neuroprostheses' (2024) 18 *Frontiers in Human Neuroscience*, sec. Brain-Computer Interfaces 2.
[151] Soekadar et al. (n 56), 33.
[152] Sara Goering et al., 'Recommendations for Responsible Development and Application of Neurotechnologies' (2021) 14 *Neuroethics* 365, 368.
[153] Soekadar et al. (n 56) 39.
[154] Ibid citing Marcello Ienca and Pim Haselager, 'Hacking the Brain: Brain–Computer Interfacing Technology and the Ethics of Neurosecurity' (2016) 18 *Ethics and Information Technology* 117.
[155] Soekadar et al. (n 56) 39.

machines, a machine itself cannot be morally or legally charged.[156] Who should, then, bear responsibility for the harm provoked by the user's actions? An answer to this question would involve navigating the complex and 'multipolar relations between producers and programmers of devices, operators and users, those harmed by the technology and other stakeholders'.[157]

On the other hand, hybrid minds reinforce risks of so-called 'brainjacking', 'neurohacking' or 'malicious brain hacking'[158], where the potential manipulation of our brain processes could interfere with our sense of identity. As Ienca and Adorno explain, the risks go beyond mere 'information theft' or violations of mental integrity; brainjacking could lead to the 'alteration of impulse control, modification of emotions or affect, induction of pain, or modulation of the reward system', all of which could severely impact one's psychological continuity.[159]

Crucially, hybrid minds involve not only a flow of information from the brain to the device, but also from the device to the brain. This means that neurotechnology enables a new way to *access* and *influence* the user, which, in turn, comes with an additional vulnerability to malicious disruption or manipulation.[160] While it has been demonstrated that BCIs share many security risks common to other digital technologies – such as wearables and smartphones – their vulnerabilities uniquely extend cyber threats into the realm of the mind.[161] As a result, BCIs may pose more profound and less easily detectable risks to users.[162] The integration of AI compounds this issue, considering its opacity or lack of explainability – also known as the 'black-box problem' – can facilitate exploitation of BCI's security vulnerabilities.[163]

This short outline of the most pressing questions arising in the context of hybrid minds shows us the risks that are likely to extend to broader neurotechnological contexts as AI becomes increasingly integrated into both implantable and non-implantable

[156] Christoph Bublitz et al., 'Legal liabilities of BCI-users: Responsibility gaps at the intersection of mind and machine?' (2019) 65 *International Journal of Law and Psychiatry* 101399, 1.
[157] Ibid.
[158] Soekadar et al. (n 56) 39.
[159] Ienca and Andorno (n 63) 21.
[160] Soekadar et al. (n 56) 38.
[161] Marcello Ienca and Pim Haselager, 'Hacking the Brain: Brain–Computer Interfacing Technology and the Ethics of Neurosecurity' (2016) 18 *Ethics and Information Technology* 117; Surjo R Soekadar et al., 'On the Verge of the Hybrid Mind' (2021) 1 *Morals and Machines* 30, 38.
[162] Ibid.
[163] Soekadar et al. (n 56) 39.

neurodevices.[164] It follows, then, that normative frameworks governing neurotechnology must take seriously both the ethical concerns over voluntary changes to psychological continuity and personal identity and the potential legal implications of such changes. This is especially evident when considering not only the broader legal implications of self-modification via neurotechnologies, addressed in the previous section, but also the specific consequences of functionally integrating an AI-device into our minds.

In light of these preliminary arguments, which suggest the need for normative safeguards on personal identity in the context of neuroenhancement, the final section of this chapter will examine how international human rights frameworks protect the 'right to identity'. This analysis is essential to further understand the complex relationship between autonomy and identity – concepts that, rather than being in opposition, are often interdependent and mutually reinforcing. The analysis will focus on how existing legal and conceptual frameworks – particularly within the CoE – may need to adapt in response to advances in neuroscience and the increasing use of neuroenhancement technologies. This exploration will lay the groundwork for the next chapter, dedicated to a more thorough examination of the role of autonomy in the use of these technologies.

3.6. The 'right to identity' as (also) a *right to change* under international human rights law

The 'right to identity' – understood both as a shared attribute of human dignity and a reflection of individual uniqueness – has been consistently recognized and protected in contemporary human rights law. For instance, Article 22 of the UDHR sets conditions indispensable for an individual's dignity and the free development of personality, while Article 17 of the International Covenant on Civil and Political rights (ICCPR) protects an individual's identity and self-autonomy. On the other hand, Article 8 of the Convention on the Rights of the Child (CRC) ensures children's rights to preserve their identity.

Within the European framework, the respect for one's private life enshrined in Article 8 of the European Convention on Human Rights (ECHR) has been interpreted by the European Court of Human Rights (ECtHR) to include 'personal identity' and 'personal

[164] Soekadar et al. (n 56) 40.

development' within its encompassing scope.[165] Accordingly, ECtHR case law has addressed the protection of personal identity across a wide range of contexts – spanning gender, biological, and genetic identity[166], as well as ethnic, religious, and national identity[167] – generally reflecting 'a kind of self-determined and fluid conception of identity and personal freedom'.[168] Particularly relevant regarding protections of the mind, the Court has emphasised the role of 'mental stability' as '*an indispensable pre-condition*[169] to effective enjoyment of the right to respect for private life'.[170]In this vein, Marshall notes that 'our inner mind, the biological space for thought production, needs security and protection legally so we can be our own person'.[171] This would then include protecting the human brain and how it is shaped within different social spaces.[172]

Additionally, in the biomedical context, Article 1 of the CoE's Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine (Oviedo Convention) determines that the states parties 'shall protect the dignity and identity of all human beings and guarantee everyone, without discrimination, respect for their integrity and other rights and fundamental freedoms with regard to the application of biology and medicine'.[173]

Drawing on the above, it can be said that, although a specific 'right to identity' is not expressly codified in international human rights law, it has been broadly inferred from, and integrated into, other legal provisions, particularly those concerning the respect for private life. In essence, the right to identity would then presuppose a freedom to define and pursue one's own life plan, which would, in turn, require the protection of one's inner mind, ensuring their ability and capacity 'to think reflectively without interference; to be in control of their own faculties' (e.g. thoughts, beliefs, desires).[174] Crucially, protections

[165] See for example: *Reklos and Davourlis v Greece* App No 1234/05 (ECtHR 15 January 2009) para 39; *Basu v Germany* App No 215/19 (ECtHR 18 October 2022) para 2; *Breyer v Germany* App No 50001/12 (ECtHR 30 January 2020) para 73.
[166] See for example *A D and Others v Georgia* App nos 57864/17, 79087/17, and 55353/19 (ECtHR, 1 December 2022) para 48; *Parrillo v Italy* [GC] App no 46470/11 (ECtHR, 27 August 2015) paras 158-159.
[167] See for example *S.V. v Italy* App no 55216/08 (ECtHR, 11 October 2018) para 54; *Ghoumid and Others v France* App no 52273/16 and others (ECtHR, 25 June 2020) para 43.
[168] Sjors Ligthart (n 63) 96.
[169] *Odièvre v France* [GC] App no 42326/98 (ECtHR, 13 February 2003) para 29.
[170] Sjors Ligthart (n 63) 215.
[171] Marshall (n 136) 18.
[172] Ibid 19.
[173] Council of Europe, *Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine* (adopted 4 April 1997, entered into force 1 December 1999) ETS No 164, art 1.
[174] Marshall (n 136) 19. See also: Ligthart (n 63) 215.

of 'free development of personality' suggest that personal identity, rather than necessarily entailing an 'unchanging foundational core that may be prohibitive',[175] can comprehend a fundamental *right to change.* As Marshall observes, international human rights law not only plays an important role in protecting existing identities but is also crucial in enabling *identity formation* by fostering the social conditions necessary for individuals to develop their personalities – which is something they cannot achieve on their own.[176]

Given this fundamental role of individual autonomy in shaping one's *personal* and *self-defined* life, it is reasonable to conclude that a protection of identity could extend to the use of enhancement neurotechnologies as tools for shaping that life path. Such an interpretation of a right to identity would also be consistent with the ECtHR's 'living instrument doctrine', which advocates for a dynamic and evolving interpretation of international norms to ensure their continued relevance in contemporary social contexts.[177] In fact, the right to identity has already begun to be adapted to address emerging challenges posed by technological innovation, as reflected in existing ECtHR case law on surveillance.[178] For example, in *Bărbulescu v. Romania*, the ECtHR ruled that employers cannot conduct unrestricted surveillance of their employees' electronic workplace communications. [179] Therefore, it appears inevitable that the ECtHR's case law will have to grapple with the adaptation of existing norms to address the new possibilities introduced by neuroscientific progress.

Importantly, if we accept a broad interpretation of the right to identity – particularly one that encompasses the right to develop one's personality – and perceive neurotechnologies not just as potential threats but as tools to uphold such a right, then limiting the use of neuroenhancement technologies might not just restrict personal autonomy, it could also interfere with the right to identity itself. This conclusion would nonetheless warrant substantial scrutiny, especially when comparing this autonomy-based perspective with other protective dimensions that have been interpreted as part of a right to identity. Notably, the ECtHR's interpretation of the right to private life as encompassing a person's

[175] Marshall (n 136) 26.
[176] Ibid.
[177] *Tyrer v United Kingdom* App no 5856/72 (ECtHR, 25 April 1978) para 31.
[178] Ligthart (n 63) 217.
[179] *Bărbulescu v Romania* [GC] App no 61496/08 (ECtHR, 5 September 2017) para 69 – 81. See also: *Reklos and Davourlis v Greece* App no 1234/05 (ECtHR, 15 January 2009) para 40.

entitlement to 'mental stability', along with Marshall's argument recognizing the importance of 'control over one's own faculties', has led Lighthart to conclude that:

> If the right to personal identity implies the preservation of a person's *mental stability*, and if it aims to guarantee *control of one's own mental faculties*, then such a right seems (perfectly able) to cover the protection of a person's psychological connections to oneself, in terms of memories, intentions, beliefs, goals, desires, similarity of character, for instance.[180]

This suggests that the right to identity under Article 8 of the ECHR could be interpreted to include the philosophical notion of psychological continuity, as discussed in Chapter 3, thereby addressing potential neurotechnological threats to personal identity.

Ultimately, we seem to face a duality of perspectives on the right to identity in the context of voluntary use of neuroenhancement technologies: on the one hand, *identity as autonomy* (a freedom to shape one's *own identity*) and, on the other hand, a protective stance over one's inner mind from external intrusion.

Given that neuroscience is not explicitly mentioned in international human rights law,[181] academic literature, as well as official reports,[182] have emphasized the need to clarify the specific meaning and scope of terms used in legal texts and jurisprudence – including 'identity' and 'personality'.[183] In the context of the CoE's framework, Lighthart raises the question of whether this kind of conceptual clarification should be left entirely to the casuistic jurisprudence of the ECtHR. He observes that the protection of the mind is closely connected to 'moral philosophical ideas on rights, freedoms, and the mind', as well 'metaphysical issues', which are not 'typically the primary concerns of the ECtHR'.[184] This suggests that discussions need to first occur 'outside the courtroom', through an interdisciplinary lens which could then shape future jurisprudence.[185] This underscores the argument being made in this thesis: namely that there is a pressing need for a principled and forward-looking interpretation of identity and autonomy in light of

[180] Ligthart (n 63) 215.
[181] Ienca and Andorno (n 63) 8.
[182] See for example: International Bioethics Committee *Ethical Issues of Neurotechnology* (n 9) 70 para 186; Bertoni and Ienca, *Privacy and Data Protection Implication of the Use of Neurotechnology and Neural Data from the Perspective of Convention 108'* (n 8) 19.
[183] Ligthart (n 63) 228.
[184] Ligthart (n 63) 228-229.
[185] Ibid.

advancing neurotechnology for neuroenhancement – a line of inquiry which will be developed in chapters 4 and 5.

4. AUTONOMY TO NEUROENHANCE

We have explored how personal identity might be impacted by the use of neurotechnology from both a philosophical and ethico-legal perspective, namely highlighting how the protection and interpretation of a 'right to identity' under existing human rights frameworks does not fully address these emerging scenarios.[186] We must now link these conclusions to more in-depth considerations on the role of individual autonomy in the use of neuroenhancement tools. This is fundamental to understand how the principle of respect for one's autonomy may be reconciled with identity-related concerns arising from the use of increasingly effective and powerful neurotechnologies.

In this chapter, we begin by briefly introducing the principle of autonomy and highlighting two main theoretical justifications for its limitation. We then connect these considerations to both conservative and liberal positions on the choice to (neuro)enhance. From there, we explore how some of these arguments extend to maximized scenarios of neuroscientific evolution – in particular, radical enhancements endorsed by transhumanist thought. Finally, we examine the challenges posed to informed consent in the neurotechnological age, underscoring how these issues represent fundamental ethical constraints to the use of neuroenhancement technologies. This analysis will add new layers to our earlier conclusion that there *should* be limits to the use of neuroenhancement technologies to protect personal identity, by emphasizing that such limits must be grounded in a robust and nuanced understanding of autonomy.

4.1. The principle of autonomy and justifiable interference

The principle of autonomy is a foundational concept in philosophy, bioethics and law, generally referring to an individual's ability to live according to their own choices.[187] In liberal traditions, autonomy is rooted in the idea of *self-governance* or *self-legislation*: individuals should be able to elect to act or not to act according to their beliefs and convictions, provided they do not harm others.[188] Autonomy thus implies self-

[186] The reference to an ethico-legal perspective prompts us to clarify our position on the relation between law, ethics and human rights. In particular, this thesis considers international human rights law as a global ethical discourse which finds expression in law. In this sense, it regards human rights as both ethical and legal.
[187] Marshall (n 136) 77.
[188] Jill Marshall, *Personal Freedom through Human Rights Law? Autonomy, Identity and Integrity under the European Convention on Human Rights* (Martinus Nijhoff Publishers 2009) 57; David DeGrazia and Joseph Millum, *A Theory of Bioethics* (Cambridge University Press 2021) 102 – 112.

determination that is free from coercion, undue influence, or external manipulation.[189] According to Marshall, personal autonomy is closely tied to one's identity and sense of self, as owning our choices gives our lives coherence and meaning.[190]

In pluralist societies, individual choices often intersect with the rights, interests, and well-being of others, as well as with broader societal norms and obligations.[191] Because of these intersections, interferences with autonomy interests may not only be permissible but also be inherently justified. Under international human rights law this is clear, for instance, when such interference is necessary to safeguard the rights of others. In *A Theory of Bioethics*, DeGrazia and Millum explore two broad categories of justification to interfere with an individual's autonomy, which we consider particularly relevant when addressing the use of emerging neuroenhancement technologies: (i) interference for someone's *own benefit* (so-called paternalistic justifications); and (ii) and the prevention of harm to others.[192]

Looking first at (i), paternalism is generally defined as interfering with someone's choices or decision-making 'for their sake but without their consent'.[193]Much like the case in which someone hides the cigarettes of a friend so that they do not harm their own health, institutions may also be paternalistic.[194] Thus, as the authors point out, public institutions such as the U.S. Food and Drug Administration (FDA) prohibit the sale of food, drugs and medical devices where there is not sufficient evidence of their safety, efficacy and security.[195]

Diving deeper, we can distinguish hard paternalism from soft paternalism.[196] Whereas hard paternalism is generally described as 'one party interfering with the voluntary, relevantly informed actions or decision-making of an autonomous agent for the sake of that agent', soft paternalism involves an interference with the actions or decision-making

[189] DeGrazia and Millum (n 188).
[190] Marshall (n 136) 77 citing Gerald Dworkin, The Theory and Practice of Autonomy (Cambridge University Press 1988), 20.
[191] Marie-Claire Foblets, Michele Graziadei and Alison Dundes Renteln, 'Introduction: Individual Autonomy in Contemporary Plural Societies – How to Reconcile Competing Normative Standards?' in Marie-Claire Foblets, Michele Graziadei and Alison Dundes Renteln (eds), *Personal Autonomy in Plural Societies: A Principle and its Paradoxes* (Routledge, 2018).
[192] DeGrazia and Millum (n 188) 113.
[193] Ibid.
[194] Ibid.
[195] Ibid; US Food and Drug Administration, 'What We Do' https://www.fda.gov/about-fda/what-we-do#mission accessed 10 June 2025.
[196] Ibid.

of someone *who is not competent*[197] for that individual's sake.[198] Both forms of paternalism require justification, though hard paternalism bears a greater burden in this regard.[199]

Importantly, authors such as Seana Shiffrin provide a revised analysis of what DeGrazia and Millum classify as hard paternalism.[200] Among other amendments, Shiffrin suggests that rather than necessarily involving the agent's well-being, paternalism may relate to *others* well-being.[201] For example, one may act paternalistic towards a person to prevent harm to their family. What would bring these phenomena together under the concept of hard paternalism is that the individual or institution acting paternalistically replaces the other party's judgement or actions with their own 'in a sphere over which the other party has legitimate control'.[202]

Ultimately, while soft paternalism is generally regarded as compatible with respect for individual autonomy, hard paternalism is highly controversial and often rejected for its perceived *incompatibility* with personal autonomy.[203] Notably, an 'anti-paternalistic' approach has informed the 'value' of autonomy in medical settings, where it is often appealed to 'as a means of justifying allocating decision-making authority over medical interventions to the person undergoing them'.[204]

Nonetheless, while paternalism has justifiably acquired a negative connotation within the patient-doctor relationship, it may warrant renewed consideration in the context of emerging neurotechnologies – where (side-)effects may be *unpredictable*, especially concerning potential changes to personal identity and psychological continuity. In this vein, when considering cases of emerging technologies used outside the medical sphere

[197] A person who is not competent lacks the capacity to act autonomously. This would apply first and foremost to children and people mentally incapacitated, either temporarily or permanently. Accordingly, in bioethics, the capacity for autonomous actions is often assessed as a 'global capacity' (someone is either competent or not). However, among other nuances that should be considered, competence can also be assessed in relation to specific tasks or domains. For instance, legal systems often assign different rights and responsibilities at different ages – e.g. in the United Kingdom the legal age to vote is eighteen, while the age of consent for sexual intercourse is sixteen: DeGrazia and Millum (n 188) 101.
[198] Ibid.
[199] Ibid.
[200] Ibid 114.
[201] Seana Valentine Shiffrin, 'Unconscionability Doctrine, and Accommodation' (2000) 29(3) *Philosophy & Public Affairs* 205, 216.
[202] DeGrazia and Millum (n 188) 114.
[203] Michael Kühler and Veselin Mitrović, 'For Your Own Good? History, Concept, and Ethics of Paternalism' (2023) 6 *Zeitschrift für Ethik und Moralphilosophie* 123, 124.
[204] Joseph T F Roberts, 'Autonomy, Competence and Non-interference' (2017) 30 *HEC Forum* 235, 238.

– and while noting risks of 'radical paternalism' – Lavazza and Inglese argue for 'a certain amount of paternalism':

> It is not a question of introducing paternalistic prescriptions in the belief that people do not know how to choose what is best for them. Rather, in the face of increasingly powerful and invasive neurotechnologies, we may find ourselves in situations so new and remarkable that no one could really be aware of their consequences for one's identity and psychological continuity.[205]

Aligning with this view, and appealing to notions of safety and unpredictability, we can anticipate that certain types of interventions or devices may indeed justify prioritizing the protection of the individual over the presumption or requirement of consent.

Turning now to the second category of justification outlined (ii), an individual's 'sovereignty over their own life' is most typically limited for the sake of other people.[206] As in foundational (liberal) conceptions of autonomy, the boundaries of one's *own life* are usually defined at 'the point where a person's actions would pose excessive risk of harming another or would otherwise violate their rights'.[207] Indeed, ethical limitations to an individual's autonomous actions in order to protect others' rights and interests are widely accepted – even by those who oppose hard paternalism.[208]

According to JS Mill's 'harm principle', preventing harm to others would not only be a clear limitation to one's autonomy but it would be *the only* justifiable limit.[209] Rejecting paternalism as a limit to the liberty of autonomous individuals, Mill argues that 'the only purpose for which power can be rightfully exercised over any member of a civilized community, against his will, is to prevent harm to others. His own good, either physical or moral, is not a sufficient warrant.'[210] The 'harm principle' would also imply the rejection of *legal moralism* (i.e. the idea that an individual's actions offend others or are contrary to their moral beliefs) as a legitimate reason to limit someone's actions.[211] In this

[205] Silvia Inglese and Andrea Lavazza, 'What Should We Do With People Who Cannot or Do Not Want to Be Protected From Neurotechnological Threats?' (2021) 15 *Frontiers in Human Neuroscience* 5.
[206] DeGrazia and Millum (n 188) 116.
[207] Ibid.
[208] Ibid.
[209] Ibid.
[210] John Stuart Mill, *On Liberty*, in John Gray and Gordon Smith (eds.*), JS Mill's on Liberty in Focus* (Routledge, 2012) 30.
[211] DeGrazia and Millum (n 188) 117.

sense, the simple fact that people are 'disgusted' or morally offended by ideas such as that of human cloning – or, in our case, artificial neuroenhancement – would also be insufficient to interfere with someone's liberty, if we adopt this principle. [212]

DeGrazia and Millum disagree with Mill's view, arguing that preventing harm to others is neither necessary nor sufficient to interfere with an individual's autonomy.[213] It would be *unnecessary* because autonomy interests may be limited even if others are not subject to harm.[214] They give the example of exploitative wage offers and how the government can legitimately prohibit them and impose a minimum wage, even if no one is harmed by that unfair level of compensation.[215] Additionally, harm to others would be *insufficient* because 'If the benefits to others of overriding someone's rights – including autonomy rights – are sufficiently great, then this can, [in principle] justify doing so.'[216] This principle is reflected in many aspects of everyday life, where exposing nonconsenting individuals to a low risk of harm is often considered justifiable.[217]

In the context of neuroenhancement technologies, in Chapter 3 we examined how changes to one's personal identity might undermine the rights of others to stable social relationships. Importantly, we also noted how changes to one's psychological connections to their previous self may have disruptive legal consequences (e.g. on responsibility), indicating not only the need to prevent harm to others but to protect society as a whole.

Overall, these two doctrinal justifications together form a useful framework to understand the type of limitations that should be considered in the context of voluntary use of neuroenhancement technologies: the protection of the user and the prevention of harm to others (including society as a whole). Building on this, the next section will examine arguments for and against neuroenhancement, which intersect with this two-fold perspective. This analysis will be essential to understand how the value placed on individual autonomy and the justifications for its limitation can be influenced by deeper

[212] Ibid.
[213] Ibid.
[214] Ibid.
[215] Ibid.
[216] Ibid.
[217] Ibid: For instance, it is generally accepted that parents may take their children on car rides, even when there is no direct benefit to the children themselves – the cost of the parents restricting their liberty would be too great.

ideological divides. Ultimately, this will highlight the complexity of determining appropriate boundaries for individual engagement with neuroenhancement technologies.

4.2. Meliorist *versus* anti-meliorist theories of enhancement

Neurotechnology challenges traditional understandings of autonomy by enabling a direct intervention into an individual's cognitive and emotional processes thereby raising questions about the extent to which individuals can – and should – retain control over their own mental states and functions.[218] Accordingly, while neuroenhancement technologies may offer an appealing opportunity to achieve self-fulfilment, there is significant academic debate over (i) whether individuals should have a choice to use such neurotechnologies and (ii) whether that choice could ever be autonomous.[219] The second issue is closely tied to the complexities of informed consent, which will be explored later in this chapter.[220] The first question, however, invites an examination of the various theoretical perspectives on the freedom to neuroenhance.

On the one hand, the concept of 'cognitive liberty' – originally developed by Sententia[221] and Boire[222] and further explored by Farahany[223] and Bublitz[224] – supports the availability and use of neuroenhancement technologies by affirming 'every person's fundamental right to think independently, to use the full spectrum of his or her mind, and to have autonomy over his or her brain chemistry'.[225] It includes both the right to reject neurotechnological interference and the freedom to voluntarily 'alter one's mental states with the help of neurotools'.[226] This perspective is coherent with arguments in favour of enhancement (often referred to as the *liberal* or *meliorist* approach[227]), which view improvement as consciously or unconsciously, part of human development, individual or

[218] Timo Istace and Milena Costas Trascasas, 'Between Science-Fact and Science-Fiction: Innovation and Ethics in Neurotechnology' (Research Brief, Geneva Academy of International Humanitarian Law and Human Rights, May 2024) 10.
[219] Ibid.
[220] See section 4.4. below.
[221] Wrye Sententia, 'Neuroethical Considerations: Cognitive Liberty and Converging Technologies for Improving Human Cognition' (2004) 1013 *Annals of the New York Academy of Sciences*.
[222] Richard Glen Boire, 'On Cognitive Liberty' (2001) 2 *Journal of Cognitive Liberties* 7.
[223] Nita A Farahany, 'Incriminating Thoughts' (2012) 64 *Stanford Law Review* 351.
[224] Jan Christoph Bublitz, 'My Mind Is Mine!? Cognitive Liberty as a Legal Concept' in Harald Franke (ed), *Cognitive Enhancement* (Springer, Berlin 2013) 233.
[225] Sententia (n 221) 223.
[226] Bublitz (n 224) 234; Ienca and Andorno (n 63) 10.
[227] Cynthia Forlini and Wayne Hall, 'The Is and Ought of the Ethics of Neuroenhancement: Mind the Gap' (2016) 6 *Frontiers in Psychology* 1998, 1.

social opportunity, 'whether the enhancement is natural or artificial (pharmaceutical or technological)'.[228] Taking this idea further, the theory of 'enhancement evolution'[229] views enhancement possibilities as a stage of progress 'allowing man and humanity to attain and realize their full potential, in order to balance the effects of what, in physical and social terms, is a natural lottery'.[230] According to this theory, beyond morally defensible, enhancement could be seen as *morally obligatory*.[231] This reasoning closely aligns with transhumanist thought, a perspective that will be explored in the next section.

On the other hand, critics of enhancement (i.e. the *conservative* or *anti-meliorist* approach)[232] typically argue that the choice to enhance ought not to exist. Their arguments largely stem from the notion of 'human dignity' and how it is threatened by attempts to surpass the limits of 'human nature'.[233] According to Heinrichs et al. the argument concerning the moral worth and dignity of the enhanced agent can be summarized as follows:

> the use of enhancement techniques affects key features of human nature that are responsible for generating moral worth and dignity so that the enhanced individual either fails to have dignity or has less dignity than unenhanced individuals.[234]

Accordingly, anti-meliorists emphasize that technologies used to improve natural abilities carry a potential for 'serious harm' that outweighs the 'expected benefits of fulfilling subjective desires'.[235] Enhancement via neurotechnologies would also undermine a sense of achievement associated with developing and realizing potential naturally, while instigating societal pressure on individuals to 'adapt to standards of mental efficiency'.[236] In this light, a push for technological enhancement would threaten to resurrect eugenic

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[228] International Bioethics Committee *Ethical Issues of Neurotechnology* (n 9) 35, para 89 citing John Harris, *Enhancing Evolution: The Ethical Case for Making Better People* (Princeton University Press 2010) and Julian Savulescu, Ruud ter Meulen and Guy Kahane (eds), *Enhancing Human Capacities* (John Wiley & Sons 2011).
[229] John Harris, *Enhancing Evolution: The Ethical Case for Making Better People* (Princeton University Press 2010).
[230] International Bioethics Committee *Ethical Issues of Neurotechnology* (n 9) 36, para 89.
[231] Harris (n 229) 3.
[232] Forlini and Hall (n 227).
[233] International Bioethics Committee *Ethical Issues of Neurotechnology* (n 9) 35, para 90 citing Francis Fukuyama, *The End of History and the Last Man* (Free Press 2006), Michael J. Sandel, *The Case Against Perfection* (Harvard University Press 2007) and Leon R Kass, *Life, Liberty and the Defense of Dignity: The Challenge for Bioethics* (Encounter Books 2002).
[234] Heinrichs (n 12) 65.
[235] Ibid.
[236] Ibid.

thinking 'disguised as the fulfilment of the wish for a better, improved life'.[237] In this case, eugenics would be understood as the 'selection of the best' on the basis of neurocognitive characteristics.[238] Reflecting this concern, already in 2002 Leon Kass cautioned that 'human nature itself lies on the operating table, ready for alteration, for eugenic and neuropsychic "enhancement", for wholesale redesign'.[239]

Overall, meliorist and anti-meliorist perspectives offer contrasting yet useful insights to address the ethical and legal challenges posed by the increasing availability of neuroenhancement technologies. From one side, it seems that an outright ban on neuroenhancement technologies, as may be suggested by anti-meliorist arguments, could not only stifle innovation but also risk being ineffective. As Yuste notes, a full prohibition on the use of certain neurotechnologies could simply push them underground.[240] Meanwhile, an uncritical embrace of neuroenhancement technologies, as might follow from meliorist views, could have significant societal consequences – some of which we have already examined through the lens of personal identity. Positioned at the radical end of meliorist theories, transhumanism thought amplifies these risks. Thus, by critically analysing this approach, the next section aims to broaden the arguments for limiting an individual's freedom to drastically change their cognitive or emotional characteristics.

4.3. Inside transhumanism: the role of those who cannot or do not want to be radically enhanced

Transhumanism belongs to a group of post-human studies, involving many different movements, including antihumanism, new materialism, and object-oriented ontology – all of which place human enhancement at the centre of their agenda.[241] In all its forms, namely democratic transhumanism, libertarian transhumanism, and extropianism, transhumanism consistently views science and technology as tools for 'radical progress'[242] towards 'vastly greater [human] capacities'[243] – a reflection of humanity's

[237] International Bioethics Committee of UNESCO, *Report of the International Bioethics Committee of UNESCO (IBC) on Updating Its Reflection on the Human Genome and Human Rights* (UNESCO 2015) 26.
[238] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 35 para 89.
[239] Leon R Kass, *Life, Liberty and the Defense of Dignity: The Challenge for Bioethics* (Encounter Books 2002) 4.
[240] Rafael Yuste et al., 'Four Ethical Priorities for Neurotechnologies and AI' (2017) 551 *Nature* 159, 162.
[241] Ibid.
[242] Ibid.
[243] Nick Bostrom, 'Human Genetic Enhancements: A Transhumanist Perspective' (2003) 37 *Journal of Value Inquiry* 493.

inherent drive to transcend its own limitations. In the early phases, such progress would include brain implants to boost cognitive abilities or nanotechnology-based treatments to prolong lifespan. At this stage, humans evolve into 'transhumans', existing in an intermediate phase of the process of going beyond their traditional human state. Ultimately, transhumanists' long-term vision is far more transformative: a future of *posthumans* where people have been so profoundly enhanced that they are 'no longer unambiguously human by our current standards'.[244] This would include transferring a person's consciousness into a digital system or incrementally substituting the nervous system with artificial elements through methods like 'neuron replacement therapy' or advanced 'neural prosthesis'.[245] The ultimate scenario would be one in which posthumans possess the cognitive abilities of superintelligent AI.[246] The growing prominence of neurotechnologies within transhumanist discourse has given rise to the term 'transhumanist neurotechnologies' used to refer to technologies that aim to radically enhance or modify human capabilities; these would include, for example, neural implants and advanced BCIs.[247]

From another perspective, transhumanism regards human enhancement not only as a natural aspiration but as a duty incumbent upon our species.[248] In this sense, it fully embraces the technological imperative prescribing that if a certain (enhancement) technology can be created it should be used. [249] Yet, in a scenario where radical neuroenhancements are possible and can produce a conscious being – a premise itself highly contested and open to challenge – one fundamental question arises: what happens to those who cannot or do not want to become posthuman? This question prompts us to reflect more broadly on scenarios where the possibility to radically alter core features to one's identity becomes widespread. Envisioning such scenarios, Fukuyama called transhumanism the most dangerous idea in the world.[250] He argues that human equality is

[244] See n 60.
[245] Weir (n 60).
[246] Weir (n 60) 358.
[247] Maximiliano Andrés Nitto, 'Neurotecnologías con fines transhumanistas: la brecha del futuro entre seres humanos "mejorados" y no "mejorados"' (2025) 63 *Revista de Bioética y Derecho* 4, 11.
[248] Francesca Ferrando, 'To Be or Not to Be Enhanced? Just Ask the Moon – In Posthuman Terms' in Fabrice Jotterand and Marcello Ienca (eds), *The Routledge Handbook of the Ethics of Human Enhancement* (1st edn, Routledge 2023) 30, 32.
[249] Istace and Costas Trascasas (n 4) 12 citing Hans Lenk, *Technokratie als Ideologie: Sozialphilosophische Beiträge zu einem politischen Dilemma* (Kohlhammer 1973).
[250] Francis Fukuyama, *Our Posthuman Future: Consequences of the Biotechnology Revolution* (Farrar, Straus and Giroux 2002).

under threat, as enhanced individuals may demand greater rights than those without enhancements, in this way pressuring the unenhanced to go against their moral values or personal beliefs and follow suit to avoid being marginalized.[251] Annas complements these concerns with further warnings about the rapid development of neuroenhancement technologies and its potential impact on social cohesion.[252] In his view, history enables us to envisage a future in which either enhanced humans will regard non-enhanced humans as 'the others' and attempt to control or destroy them, or vice versa.[253] This would lead to a dynamic where enhanced individuals would either become the oppressors or the oppressed.[254]

In this context, socioeconomic disparities would be both a catalyser and a product of such divide. History has shown how unequal access to transformative technologies such as computers, or the internet benefitted those who could afford and access these technologies in the earlier stages.[255] In the case of neurotechnology capable of provoking changes and improvements to one's key identity features, the potential implications in terms of equal opportunities and social equity appear even more troubling.[256] Indeed, we can envision a world where only the neuroenhanced enter in high-rank universities, reach higher positions within companies, or hold influence over critical societal decisions, thereby deepening a power divide between an 'enhanced elite' and the naturally endowed majority.

Such a transhumanist future would arguably undermine one of the more progressive promises of enhancement neurotechnologies: their potential to act as an 'equalising force' in benefit of those with genetic or biological disadvantages.[257] As Nitto exemplifies, one could imagine neurotechnologies being used to 'correct' differences in academic performance of a student with Attention-Deficit/Hyperactivity Disorder (ADHD) and their neurotypical peers.[258] Yet, this would not only require access to these neurotechnologies be limited to individuals with some form of cognitive or emotional

[251] Ibid. Pressures to enhance will be further analysed under the prism of informed consent to the use of neuroenhancement technologies (section 4.4.).
[252] Nitto (n 247) 22 citing George Annas, 'The Man on the Moon, Immortality and Other Millennial Myths: The Prospects and Perils of Human Genetic Engineering' (2000) 49 *Emory Law Journal* 753.
[253] Ibid.
[254] Ibid.
[255] Nitto (n 247) 23.
[256] Ibid.
[257] Nitto (247) 24.
[258] Ibid.

'impairment', but would also pose serious ethical difficulties related to the therapy-enhancement distinction. Who would decide which conditions merit intervention and how would we ensure that access to these technologies does not create new forms of inequality? In this light, issues relevant to neurodiversity would warrant further examination.[259]

Ultimately, the practical impact of transhumanist thought amid neurotechnological evolution reveals a deeper moral and social concern tied to considerations on human identity: the kind of future we are creating, and for whom. Nick Bostrom articulates this concern acutely.[260] He imagines a future society that is technologically advanced, filled with highly intelligent and intricate systems, yet entirely devoid of beings whose welfare has moral significance. In such a world, even though complex machines may remain, the beings we care about – conscious entities with interests and experiences – could vanish.[261] 'The catastrophe', he writes, 'would be that such a world would not contain even the right kind of machines, i.e. ones that are conscious and whose welfare matters.'[262] In this light, concerns about a posthuman future are not merely about the external consequences resulting from the potential disruption of one's psychological continuity, but ensuring that moral relevance, and the capacity for meaningful experience is preserved.

To conclude this part of the discussion, reflecting on transhumanist theories forces us to consider how far we, as humans, are willing to go in embracing (neuro)enhancement when values and principles such as identity, dignity, equality and non-discrimination are at stake. More specifically, how should society address the divide between those eager to capitalise on radical scientific advancements, and those who are unwilling to accept the associated risks in the pursuit of neuroenhancement?[263] How can we bridge this gap, which could give transhumanists an unfair competitive advantage if they are able to act on their ideals? What if, in the process of enhancing their psychological traits, they endanger the mental integrity of others? Inglese and Lavazza prompt us to consider in this regard the example of neuroenhancement tools which can detect the emotions or

[259] UNESCO has mentioned the need to consider issues relevant to neurodiversity: International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 39 – 40, para 105.
[260] Nick Bostrom, 'The Future of Human Evolution' (2004) 5.
[261] Ibid.
[262] Ibid.
[263] Inglese and Lavazza (n 205).

thoughts of others for the purpose of enhancing the users' social interaction skills – technologies which would violate the right to mental privacy of the people observed.[264]

These hypotheses emphasize the idea that, in order to safeguard the rights and interests of 'non-transhumanists', limits may need to be imposed on transhumanists' autonomy to use technologies that can drastically neuroenhance – and thus alter – the cognitive and emotional traits that form their personal identity.

Building on these considerations, the next section will examine a future of widespread neuroenhancement technologies through a different lens: whether decisions to neuroenhance can *truly* be considered autonomous. This analysis expands considerations on the limits to the use of neuroenhancement technologies by examining how identity-related risks intersect with challenges to key elements of informed consent.

4.4.Challenges to informed consent

To fully comprehend the intricate relationship between personal identity and autonomy, we must address the challenges of defining what counts as an autonomous decision to use neuroenhancement technologies. This section briefly explores the notion and relevance of informed consent in relation to neurotechnology. It further considers how the use of such technologies – particularly when employed outside the medical sphere and for neuroenhancement purposes – may undermine the standard requirements for informed and autonomous decision-making.

4.4.1. Can we *truly* consent to neuroenhancement technologies?

As an expression of autonomy, prior free and informed consent is internationally recognized as a basic principle of modern bioethics.[265] From the CoE's Oviedo Convention (1997) to the UNESCO's Universal Declaration on Bioethics and Human Rights (UDBHR, 2005), it stands as the centre pillar of the respect for human rights and human dignity.

[264] Ibid.
[265] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 30, para 62.

According to most medical and legal literature, the notion of informed consent includes five key elements:[266]

1) disclosure: patients must receive clear and comprehensive information about (i) the nature and purpose of the procedure, (ii) the potential risks and benefits, (iii) available alternatives (including the option to refuse treatment) and (iv) implications of declining the procedure and/or the alternatives.

2) understanding: the patient must understand the provided information, requiring the physician to address language barriers, literacy levels or cultural differences.

3) voluntariness: consent must be free from coercion, undue influence, or pressure.

4) capacity: consent requires legal and mental capacity. For minors or those adults lacking capacity, Article 6 of the Oviedo Convention establishes specific safeguards, such as a 'direct benefit' of the intervention and authorization given by their 'representatives or an authority or a person or body provided for by law'.

5) right to withdraw: individuals can revoke their consent at any time without penalty (Article 5, §3 of the Oviedo Convention, Article 6 UDBHR).

Originally developed to address ethical issues in medicine and clinical research, informed consent has become essential in preserving a person's mental and physical integrity, as well as their privacy, across various fields – including technology. [267] Given the challenges posed by neurotechnologies to mental autonomy (i.e. the ability to 'control our own mental capacities and processes'), the extent to which people can truly give free and informed consent to their use remains a sensitive issue yet to be fully examined and

[266] Tom L Beauchamp and Ruth R Faden, 'Informed Consent: II. Meaning and Elements of Informed Consent' in Warren Thomas Reich (ed), *Encyclopedia of Bioethics* (rev edn, Simon and Schuster Macmillan 1995) 1238.

[267] Brian Pickering, 'Trust, but Verify: Informed Consent, AI Technologies, and Public Health Emergencies' (2021) 13(5) *Future Internet* 132.

understood.[268] For instance, in Chapter 3 we observed how implanted AI-powered BCIs may result in what Gilbert, Ienca and Cook refer to as 'agential discontinuity' – a disruption in the user's sense of agency, where it becomes unclear whether decisions originate from the person or the device.[269] More broadly, the thesis has identified how neurotechnological interventions can alter (at least) a person's memories, desires and beliefs.[270] Thus, when considering the context of neuroenhancement, one central question remains: can someone consent to a change that alters the *basis* of future consent? If neuroenhancement alters fundamental aspects of a person's identity – thereby influencing future decision-making processes – to what extent can consent given prior to these changes remain valid or authoritative after neurotechnological intervention?

UNESCO has highlighted these concerns, stressing that 'the potential for changes in perception of personal identity and cognitive abilities' demand 'additional safeguards and robust, context-specific informed consent procedures' in the use of neurotechnologies.[271] These specially-tailored frameworks are relevant in both medical and non-medical contexts but become particularly critical in the latter. Unlike clinical settings – where decisions to undergo neurotechnological procedures are typically motivated by health-related needs and guided by strict medical oversight – the largely unregulated context of neuroenhancement exposes individuals to greater vulnerability at the moment of consent.[272] This vulnerability may stem from several factors, including: unclear risk-benefit profiles, which may imply potentially harmful and irreversible (side-)effects; poorly informed or unrealistic personal expectations; and societal pressure to attain a certain level of neurocognitive performance.[273]

In the absence of regulatory frameworks specifically addressing the non-medical use of neurotechnologies, it becomes all the more important to scrutinize related vulnerabilities through the well-established elements of informed consent in the medical field. In this analysis, we will assume *capacity* to consent is met, as exploring its complexities would introduce separate issues beyond the scope of the thesis' research question.[274]

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[268] Istace and Costas Trascasas (n 4) 10-11.
[269] Gilbert, Ienca and Cook (n 72) 783.
[270] Holmen (n 93) 743.
[271] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 69 para 183.
[272] *The Mind and the Machine | Davos 2024 | World Economic Forum* (World Economic Forum, 17 January 2024) https://www.youtube.com/watch?v=KeyJmpgQKEE accessed 11 May 2025.
[273] Istace and Costas Trascasas (n 4)11.
[274] For instance, the growing availability of enhancement tools outside the medical sphere has deepened concerns over the use of neurotechnology by children. In June 2024, UNICEF published a working paper

With this in mind, we must start by highlighting how the *disclosure* and *understanding* elements are dependent on whether 'clear and comprehensive' information is already scientifically known. Thus, the current lack of information about the exact short- and long-term effects and risks associated with procedures such as brain stimulation inevitably undermines the disclosure process, raising the question of whether a decision to use neurotechnologies could ever be 'informed' at present.[275]

On the other hand, even if such information were to be fully available and disclosed, users might still struggle to comprehend it, with this 'novelty' status furthering gaps in knowledge and language between scientific discourse and lay understanding. Potential tendencies for an acritical stance towards innovation from those naturally inclined to use neurotechnology devices might reinforce these concerns. As Giattino et al. remark, both neuroscience and AI explanations seem to foster some level of blind trust in innovation – even when individuals have just witnessed a system failing to meet performance expectations.[276]

Accompanying this fundamental lack of information is the influence of internal and external pressures, which may compromise the *voluntariness* and *right to withdraw* elements. The ways in which these pressures manifest as neurotechnologies become more embedded in societal structures will be examined more closely in what follows.

4.4.2. Internal and external pressures to enhance

The growing availability of neuroenhancement technologies is poised to normalize their use, increasingly becoming crucial for competitiveness in societal domains such as education or employment.[277] In this scenario, individuals which initially refused to be enhanced as a matter of personal choice, may eventually feel pressured to resort to these technologies if their success – whether in a school exam or on a job interview – relies on it.

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which highlighted that children, who are often unable to provide meaningful consent, may be subject to decisions made by parents or caregivers that do not necessarily align with their best interests and could negatively impact their brain development and identity formation: Eleonore Pauwels, *Neurotechnology and Children* (UNICEF Innocenti – Global Office of Research and Foresight, June 2024) 3.

[275] Istace and Costas Trascasas (n 4) 11.

[276] Giattino et al. (n 4).

[277] Istace and Costas Trascasas (n 4) 11.

A parallel can be drawn in this regard with empirical evidence found on pharmacological neuroenhancers. Studies in this area have revealed how some stakeholders expressed feeling compelled to use neuroenhancers, perceiving it as their only option to maintain a certain level of performance, even though they also believe the decision should ultimately be a personal one.[278] While other studies conclude for opposite effects of this external pressure,[279] it has been noted that users are generally more willing to resort to neuroenhancers if they believe their peers are doing the same, as they fear being at social disadvantage otherwise.[280]

Risks of coercion may increase when 'power dynamics' are at stake – for instance, the relation between employee and employer or, even more critically, within military hierarchies.[281] Indeed, in a culture where productivity and profit are the primary metrics of success, many workplaces already mandate the use of new technologies to optimize efficiency and achieve these goals – while employers themselves also adopt these tools to achieve their professional objectives.[282] Increasingly, neurotechnologies are becoming part of this new 'toolkit', in which they are particularly promising given their capacity to directly – and therefore more effectively – augment intended capabilities.[283]

Ultimately, pressure to consent to the use of neuroenhancement devices may be driven by individuals' growing dependency on these technologies.[284] Similar to other contexts of addiction (e.g. drugs, alcohol), a person fully dependent on the use of a neurostimulator that improves mood, for example, arguably loses ability to genuinely choose whether they want their mood to continue being artificially regulated.[285] In other words, the capacity

[278] Forlini and Hall (n 227) 3 citing Cynthia Forlini and Eric Racine, 'Added Value(s) to the Cognitive Enhancement Debate: Are We Sidestepping Values in Academic Discourse and Professional Policies?' (2012) 3 *AJOB Primary Research* 33.
[279] Forlini and Hall (n 227) citing Cynthia Forlini et al., 'Knowledge, Experiences and Views of German University Students toward Neuroenhancement: An Empirical-Ethical Analysis' (2015) 8 *Neuroethics* 83
[280] Forlini and Hall (n 227) citing Andreas Franke et al, 'Attitudes Toward Cognitive Enhancement in Users and Nonusers of Stimulants for Cognitive Enhancement: A Pilot Study' (2012) 3 AJOB Primary Research 48 and Sebastian Sattler et al., 'Impact of Contextual Factors and Substance Characteristics on Perspectives Toward Cognitive Enhancement' (2013) 8 PLoS ONE e71452.
[281] Istace and Costas Trascasas (n 4) 11; International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 34 para 83.
[282] Patrick D Hopkins and Harvey L Fiser, '"This Position Requires Some Alteration of Your Brain": On the Moral and Legal Issues of Using Neurotechnology to Modify Employees' (2017) 144 *Journal of Business Ethics* 783.
[283] Ibid.
[284] Alessio Tacca and Frederic Gilbert, 'Why Won't You Listen To Me? Predictive Neurotechnology and Epistemic Authority' (2023) 16 *Neuroethics* 22.
[285] Istace and Costas Trascasas (n 4) 11.

to want to want to stop is affected, compromising a 'right to withdraw' essential to informed consent frameworks and personal autonomy as a whole.

4.5. Conclusion

In this chapter, we have addressed theoretical justifications for interfering with personal autonomy, as well as liberal and conservative theories on enhancement. We have also considered concerns over transhumanist thought and the challenges posed to informed consent. When examined alongside the more detailed philosophical and legal analysis of personal identity presented in Chapter 3, our inquiry supports the conclusion that the freedom to use neuroenhancement technologies must be *subject to stringent normative constraints*. This conclusion transcends the familiar debate over protecting the intrinsic value of 'human nature' – a view deserving of individual exploration, and which we discussed in relation to both essentialist notions of authenticity (3.2.3.) and anti-meliorist critiques of enhancement. It draws on broader justifications for restricting individual autonomy in the use of neuroenhancement technologies – justifications grounded not only in the protection of the individual user but also in the prevention of harm to others.

In Chapter 3, we emphasized how identity modification through neurotechnologies could impact interpersonal relationships and challenge core legal concepts, such as legal responsibility, which rely on the continuity of the person. Building on that analysis, we can now conclude that the potential for such neural modifications may pose a fundamental threat to autonomy itself (i.e. the decision to neuroenhance). In particular, the following risks must be considered:

(i) Unpredictability and irreversibility of effects: the potential for unpredictable and irreversible impacts on personal identity raises significant ethical concerns, particularly given the novelty and limited understanding of many neurotechnologies. These risks may challenge the idea that individuals can fully grasp or consent to both short and long-term consequences of such interventions.

(ii) Coercion and social pressure: if identity-altering enhancements become widespread, social or economic pressures might coerce individuals to modify core psychological features to fit expectations, even if such use goes against their personal values or beliefs.

(iii) Dependency: continued reliance on neuroenhancements may lead to a form of behavioural dependency, which compromises an individual's autonomous decision to continue to be neuroenhanced.

(iv) The legitimacy of ongoing consent: If neuroenhancement fundamentally alters a person's psychological characteristics, such as beliefs, memories, or desires, it becomes unclear whether the 'enhanced self' can validly consent to future interventions. Decisions made by this transformed identity may conflict with the values and intentions of the 'original self,' raising serious concerns about the continuity and legitimacy of informed consent.

In addition to these risks, it should also be noted the potential socio-economic inequalities that may confer an unfair advantage to those who have means to access neurotechnologies for neuroenhancement, especially in high-stakes environments (e.g. job recruitment, academic examinations). In this light, limits to the engagement with neuroenhancement technologies should not only consider the direct consequences of interfering with personal identity itself but also the ability to access these technologies and consent to their use.

5. POLICY IMPLICATIONS AND RECOMMENDATIONS

As we move to the final chapter of this thesis, focusing on policy implications and recommendations, it is important to revisit earlier discussions on the philosophical thresholds to assess personal identity interferences. We argue that these foundational considerations are of crucial normative importance, when seeking for practical solutions. In particular, we propose that psychological continuity should be regarded as a minimum core, cutting across all the risks and concerns explored throughout this thesis — including those related to autonomy and consent. As previously discussed, a disruption to this core, in light of Parfit's account, would imply substantial psychological changes, enough to conclude that a person has lost crucial *connections* to their previous self after neurotechnological intervention. This represents the extreme scenario of neuroenhancement technologies affecting personal identity and should be seen as a strict, non-negotiable limit – leaving no doubt about the legal, social, and individual consequences involved.

As for other (qualitative) changes to personal identity, which may not compromise psychological continuity, a deeper, interdisciplinary review is needed to assess what limits may be legally or socially justified in light of possible harm to the individual and to others. For example, certain restrictions appear especially necessary in relation to the criminal field. To safeguard foundational legal principles, such as fair trial, it seems that any self-modification of individuals involved in a criminal trial (victims, offenders, witnesses, etc.) through neurotechnology should await the resolution of criminal liabilities.[286]

From another viewpoint, the imminent divide between enhanced and non-enhanced, likely to be exacerbated by existing socio-economic factors, would require that the use of certain enhancement neurotechnologies should be strictly regulated and monitored in highly competitive and consequential settings (such as job recruitment or academic examinations). This could help preserve fairness and equal opportunity, especially safeguarding the rights of those who do not want or cannot afford to artificially modify their psychological characteristics.[287]

[286] Astobiza and Beriain (n 101) 13.
[287] Goering et al. (n 152) 380.

In this sense, international and national governing bodies will need to further distinguish between *prohibitive* uses of neuroenhancement technologies (those that cross ethical and legal boundaries) and *limiting* uses (those that require contextual analysis, considering both individual and societal risks).[288]

Building on these considerations, the next sections will explore emerging human rights frameworks, guiding principles and recommendations that could be taken into account in future governance of neuroenhancement technologies. Section 5.1. introduces emerging neurorights proposals and examines how these may evolve to safeguard psychological continuity as a minimum core, in line with the argument made at the beginning of this chapter. Section 5.2. briefly outlines how current European regulatory frameworks might already apply to the case of neuroenhancement technologies, and thus the extent to which they may already safeguard psychological continuity and personal identity. Section 5.3. proposes three core principles to guide future neurotechnology governance, ensuring it adequately safeguards personal identity in accordance with human rights standards.

5.1. Introducing neurorights: towards an *inalienable* and *non-renounceable* right to psychological continuity

A growing number of scholars have begun advocating for the recognition of so-called neurorights – neuro-specific human rights essentially designed to protect our minds from unauthorized neurotechnological interferences.[289] The concept finds its roots in early 21st-century debates within neuroethics and neurolaw, driven by Boire's and Sententia's initial call for 'cognitive liberty' in the face of rapidly evolving neurotechnologies.[290] Yet it was only in 2017 that the term 'neurorights' was formally introduced by Ienca and Adorno.[291] In line with Boire's 'jurisprudence of the mind',[292] four neurorights were proposed:

(i) The right to cognitive liberty: as previously addressed in Chapter 4 of this thesis in discussions on meliorist and anti-meliorist approaches to enhancement, this right pertains to the freedom to 'alter one's mental states

[288] Ibid.
[289] Ienca and Andorno (n 63); Yuste, Genser and Herrmann (n 39).
[290] Boire (n 222); Sententia (n 221) 222-223.
[291] Ienca and Andorno (n 63); Ienca (n 8) 43.
[292] Richard Glen Boire, 'Mind matters' (2003) 4(1) *Journal of Cognitive Liberties* 7.

with the help of neurotools as well as to refuse to do so'.[293] It is understood as a *conceptual update* of the right to freedom of thought, reflecting the new possibilities to monitor and interfere with our mind even before they are externally manifested.[294]

(ii) The right to mental privacy ensures protection from unwanted disclosure of a specific category of data – brain data or 'neural data' – including information which is not (or is only partly) under voluntary and conscious control.[295]

(iii) The right to mental integrity pertains to an 'individual's mastery of his mental states and brain data so that, without his consent, no one can read, spread, or alter such states and data in order to condition the individual in any way'.[296]

(iv) The right to psychological continuity – grounded in the psychological continuity account of personal identity[297], this right is aimed at preserving 'personal identity and the coherence of the individual's behaviour from unconsented modification by third parties'.[298] .

Shortly after Ienca and Adorno's proposal, the NeuroRights Foundation – a nonprofit advocacy organization – put forward a slightly different set of neurorights that gained traction in legal and policy discussions.[299] Their set of rights include the rights to free will, personal identity, mental privacy, fair access to augmentation and protection against bias.[300] The last two are framed as 'socio-technical instruments' that are necessary for the realization of the other rights.[301]

Amidst these different proposals, the fundamental question driving scholarly debates is whether neurorights should consist of adaptive interpretation and application of

[293] Bublitz (n 224) 234; Ienca and Andorno (n 63), 10.
[294] Ienca and Andorno (n 63), 10.
[295] Ienca and Andorno (n 63)15.
[296] Andrea Lavazza, 'Freedom of Thought and Mental Integrity: The Moral Requirements for Any Neural Prosthesis' (2018) 12 *Frontiers in Neuroscience* 5.
[297] Gilbert, Ienca and Cook (n 72) 787.
[298] Ienca and Adorno (n 63) 20.
[299] Yuste, Genser and Herrmann (n 39); NeuroRights Foundation, 'Mission' (NeuroRights Foundation) https://neurorightsfoundation.org/mission accessed 6 June 2025.
[300] Yuste, Genser and Herrmann (n 39).
[301] Ienca, *Common Human Rights Challenges* (n 8) 62.

established rights[302] or, rather, the introduction of *new* rights is practically needed.[303] Beyond this doctrinal debate, however, the protections conferred by neurorights assume particular relevance, as neuroenhancement technologies become embedded into our everyday life and tend to fall outside the scope of the legal rules that govern medicine and healthcare.[304] Paradoxically, however, it is precisely the neuroenhancement-driven use of these technologies which presents some of the most significant challenges to the protection paradigm underlying neurorights proposals.[305] With proposed rights such as psychological continuity primarily designed to protect our minds from *non-consensual* or *unauthorized* neurotechnological interference, neurorights frameworks offer limited guidance in cases where individuals may *voluntarily* choose to override these very protections in pursuit of neuroenhancement. Indeed, the conditions under which one may exercise the positive dimensions of neurorights, such as cognitive liberty in the positive sense and fair access to augmentation, remain largely underdeveloped in academic discussions. [306]

To explain: the positive right to cognitive liberty affirms the right to *choose* to use neurotechnologies, provided that individuals 'do not subsequently engage in behaviours that harm others'. [307] Yet, this raises additional questions which remain largely unanswered in academic and policy discourse. Beyond the challenge of defining what constitutes 'harm' in this context (e.g. is it limited to unlawful acts?), it seems to overlook other factors – such as potential harm to the individual himself.

Meanwhile, recent discussions on the right to fair access to augmentation, regarded as 'a positive prerequisite for cognitive liberty in the positive sense',[308] have gathered a certain consensus on the need to regulate these neurotechnologies.[309] Drawing a parallel to the

[302] For arguments against the need to introduce new human rights see for example: Frederic Gilbert and Ingrid Russo, 'Neurorights: The Land of Speculative Ethics and Alarming Claims?' (2024) 15(2) *AJOB Neuroscience* 113; Diego Borbón and Luisa Borbón (2021) 'A Critical Perspective on NeuroRights: Comments Regarding Ethics and Law' (2021). 15 *Frontiers in human neuroscience*; José M Muñoz and José Ángel Marinaro, 'Neurorights as Reconceptualized Human Rights' (2023) 5 *Frontiers in Political Science*, Politics of Technology section; Ligthart (n 63).
[303] A third yet not prevalent position in academic literature argues that no evolutionary interpretation or legal reforms are needed: see Sjors Ligthart et al. (n 24) 465.
[304] Genser, Damianos, and Yuste (n 54) 15.
[305] Inglese and Lavazza (n 205).
[306] Ienca, *Common Human Rights Challenges* (n 8) 63.
[307] Ibid.
[308] Ienca (n 61) 8.
[309] See: Ienca, *Common Human Rights Challenges* (n 8); Regulatory Horizons Council, *Report on Neurotechnology Regulation* (UK, 2022); María Isabel Cornejo-Plaza and Chiara Saracini, 'On Pharmacological Neuroenhancement as Part of the New Neurorights' Pioneering Legislation in Chile: A

legal limits placed on gene editing, the right to fair access to augmentation calls on national and international bodies to 'set limits on the augmenting neurotechnologies that can be implemented' and 'define the contexts in which they can be used'.[310] However, as this right begins to be incorporated into national legal frameworks – with Chile being a leading example[311] – it has attracted criticism for its lack of specificity. For instance, Diego and Luisa Borbón argue that its ambiguity could lead to conflicts with other proposed rights, such as free will and personal identity. [312] Their claim, in short, is that by presuming the inevitability of a new norm in social, academic, or professional settings, efforts to promote equal access to neurotechnology risk placing implicit pressure on individuals who would personally *choose* not to be enhanced, while potentially facilitating interferences with a right to personal identity.[313]

Given this need to further develop and clarify the positive aspects of neurorights frameworks, the core argument of this thesis is that *psychological continuity should be central to these discussions*. Whether conceived as a novel right or as a reinterpretation of existing human rights – such as the right to identity[314] – the neuroright to psychological continuity remains one of the least explored in academic discourse. Recently, Ligthart has helped bridge this gap by examining how psychological continuity is already encompassed within existing protections of identity, personal integrity, and self-determination under the CoE's human rights framework.[315] Building on this, the thesis contends, it is now crucial that governing bodies focus on how the right to psychological continuity might be more explicitly articulated, operationalized, and safeguarded in the growing context of neuroenhancement technologies.

Perspective' (2023) 14 *Frontiers in Psychology*; Diego Borbón and Luisa Borbón, 'A Critical Perspective on Neurorights: Comments Regarding Ethics and Law' (2021) 15 *Frontiers in Human Neuroscience*; Jan Christoph Bublitz, 'Novel Neurorights: From Nonsense to Substance' (2022) 15 *Neuroethics* 7; Joseph J Fins, 'The Unintended Consequences of Chile's Neurorights Constitutional Reform: Moving Beyond Negative Rights to Capabilities' (2022) 15 *Neuroethics* 26.

[310] Rafael Yuste et al. (n 240) 162.

[311] In 2021, the Foundation collaborated with the Senate of the Republic of Chile to pass a neurorights law and propose a constitutional amendment. This initiative made Chile the first country in the world to amend its constitution to protect mental integrity and neural data in the context of emerging neurotechnologies. Since then, a considerable number of countries have advanced declarations and legislations (or proposals thereof) aligned with the neurorights framework, including Brazil, Mexico, Spain, Uruguay and the United States: Genser, Damianos, and Yuste (n 54) 15.

[312] Diego Borbón and Luisa Borbón, 'A Critical Perspective on NeuroRights: Comments Regarding Ethics and Law' (2021) 15 *Frontiers in Human Neuroscience* 703121, 2.

[313] Ibid.

[314] See section 3.6.

[315] Ligthart (n 63).

In particular, and consistent with our earlier proposal to treat psychological continuity as a minimum core, this thesis argues that neurorights, specifically the neuroright to psychological continuity, should be considered *inalienable* or *non-renounceable* – at least within the non-medical use of neurotechnologies for enhancement purposes. This position aligns with the analysis by Lavazza and Inglese, who, focusing on risks to mental integrity, advocate 'for some kind of precautionary principle to consider neurorights, at least in a circumscribed version that excludes clinical uses, as inalienable and irrevocable'.[316] In support of this claim, they argue that not only might individuals find themselves unable to draw a comparison with who they were before neurotechnological intervention, they may also find it technically impossible to return to that *status quo* (for example, some implants may be impossible to remove or switch off, or their effects may be irreversible).[317]

In their 2024 article *'From Neurorights to Neuroduties: The Case of Personal Identity',* Astobiza and Beriain go even further than proposing the 'irrevocability or inalienability' of neurorights. While directly challenging the liberal idea of unrestrained personal autonomy, they put forward a compelling and provocative notion: the concept of neuroduty.[318] They use this concept to suggest that we may not only have rights concerning our minds, but also responsibilities, specifically a moral obligation to preserve our personal identity. Focusing on the relation between the law and identity modifications via neurotechnology, they argue that:

> The neurorights initiative restricts the uses of neurotechnology, but in the age of neurotechnology and AI, individuals have the possibility to alter their nervous systems voluntarily. However, the law does not recognize the possibility of transforming personal identity, so there is a neuroduty to preserve identity.[319]

The proposal being put forward by this thesis is therefore that neurorights offer a crucial starting point for further normative examination in the context of voluntary neuroenhancement – either as reinterpretation of existing rights or new rights. They reflect core legal values and fundamental freedoms that warrant protection in the era of emerging neurotechnologies, while allowing room for dynamic co-evolution between law

[316] Inglese and Lavazza (205).
[317] Ibid.
[318] Astobiza and Beriain (n 101).
[319] Astobiza and Beriain (n 101) 13.

and technological development. Recent proposals to rethink this framework provide useful insights into how we shall further 'adjust it' to the new reality where people might be able to routinely and voluntary use neurotechnology for neuroenhancement. In particular, the idea that one cannot *renounce* to entitlements meant to protect their inner minds – including, psychological continuity – and that they may even have a *responsibility* to ensure the protection of their personal identity merit further discussion.

Helpfully, at the international level, several options have already been considered to recognize and protect neurorights. These include: adding protocols to existing international treaties, such as the UDHR, or the CoE's Oviedo Convention; reinforcing the UDHR itself; or drafting a new Universal Declaration on Human Rights and Neurotechnology.[320] In a report commissioned by the Committee on Bioethics (DH-BIO) of the CoE, Ienca identified the Oviedo Convention as the 'most suitable and comprehensive model for future initiatives and international instruments aiming to protect the human brain'. [321] In particular, he highlighted its relevance in the context of neurotechnology, considering its focus on prohibiting the misuse of innovations in biomedicine, safeguarding human dignity and identity, and guaranteeing respect for individual's integrity and fundamental freedoms.[322]

This thesis contends that international governing bodies, particularly UNESCO and the CoE, must act decisively on these considerations – UNESCO for its unique global mandate in setting ethical standards in science and technology, and the CoE for its long-standing institutional expertise in developing legally binding instruments on human rights and bioethics. It is essential that advancements in neurotechnology for neuroenhancement are accompanied by clear, enforceable human rights protections, ensuring psychological continuity and personal identity are sufficiently respected and safeguarded.

5.2. Evolving regulatory frameworks on neurotechnology: the European context

While neurorights protections are crucial, they are not sufficient on their own. Effective governance requires their integration with complementary mechanisms, including self-regulation by neurotechnology stakeholders, the development and application of ethical

[320] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 69 para 184.
[321] Ienca, *Common Human Rights Challenges* (n 8) 69, 73.
[322] Ibid.

guidelines, and the enforcement of binding legal frameworks such as consumer protection and criminal law.[323]

In particular, the need for rights-based international regulation of neurotechnology has never been more urgent, as consumer devices and implantable systems rapidly advance. The dual nature of neurotechnology, serving both medical and non-medical purposes, emerges as a central challenge in governance discussions. As illustrated in Chapter 2, distinguishing between these two types of devices or interventions is not always a straightforward task and may carry significant regulatory implications under present frameworks. Medical devices are usually subject to strict safety requirements before entering the market while non-medical applications, including devices used for enhancement purposes, often lack adequate oversight in terms of their scientific foundations, safety, efficacy and ethical supervision.[324]

In the European context, EU legislation has been central in shaping the regional regulatory landscape, though still lacking specific directives and regulations dedicated to neurotechnology.[325] The medical device regulation (MDR) governs implantable devices like DBS systems but excludes consumer neurotech wearables.[326] Meanwhile, the General Data Protection Regulation (GDPR) has been found to inadequately address the unique sensitivity of neural data, prompting discussions about the need for a distinct category of data protection.[327] Additionally, the EU AI Act provides partial coverage for AI-driven neurotechnologies but lacks neuro-specific risk classifications.[328] One relevant provision of the Act in the case of personal identity and neurodevices which may be used for neuroenhancement is Article 5[1a] of the EU AI Act, which *prohibits* the placing on the market of

> an AI system that deploys subliminal techniques beyond a person's consciousness or purposefully manipulative[…]techniques with the objective, or the effect of

[323] Ienca, *Common Human Rights Challenges* (n 8) 69.
[324] European Brain Council, *European Charter for the Responsible Development of Neurotechnologies* (April 2025).
[325] Anamaria Corca and Jacob von Hodenberg, 'Neurotechnology in the EU: Balancing Innovation with Rights-Based Regulation' (Considerati, 28 May 2024) https://www.considerati.com/publications/neurotechnology-in-the-eu-balancing-innovation-with-rights-based-regulation/ accessed 25 June 2025.
[326] Ibid.
[327] Ibid.
[328] Ibid.

> materially distorting the behaviour of a person[…]by appreciably impairing their ability to make an informed decision thereby causing them to take a decision that they would not have otherwise taken in a manner that causes or is reasonably likely to cause that person[…]significant harm.[329]

Relatedly, Recital 29 specifically highlights the potential of machine-brain interfaces' to distort human behaviour in a significantly harmful manner.[330] This suggests that certain AI-powered neurotechnologies, such as neuromodulation devices, may qualify as 'manipulative' under Article 5[1a].[331] As Bublitz et al. point out, this provision seems to imply that a person cannot give informed consent to be exposed to manipulative techniques.[332] Therefore, by prohibiting the deployment of such neurotechnologies, Article 5[1a] safeguards self-determination and, by extension, core aspects of personal identity, such as desires and beliefs, from being externally influenced or co-opted by technological systems.

In this context, it seems appropriate to revisit clinical studies such as those discussed in Chapter 3, which found that some patients could not consciously notice the background action of an implanted AI-powered BCI, with others describing the device as an integral part of themselves.[333] Risks of *substantial blur* between the mind and the device, maximized by a scenario where *hybrid minds* emerge outside the medical sphere, would appear to fall under this prohibition.

Ultimately, however, the complexity and vagueness of this provision in the EU AI Act, indicates the need to further specify what exactly counts as manipulative techniques and how these considerations should reflect objective requirements to be met by deployers of neurotechnology.[334] Indeed, its potentially broad scope creates significant uncertainty for non-medical neuromodulation devices 'which may, by their very mode of function, fall under it'.[335] Although regulations such as the EU AI Act establish provisions relevant to preserve core features of a person's personal identity and psychological continuity,

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[329] Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 (Artificial Intelligence Act) [2024] OJ L 168/1, art. 5[1a].
[330]Ibid rec 29; Bird & Bird, *European Union Artificial Intelligence Act: A Guide* (7 April 2025) 17.
[331] Christoph Bublitz, Fruzsina Molnár-Gábor and Surjo R Soekadar, 'Implications of the Novel EU AI Act for Neurotechnologies' (2024) 112 *NeuroView* 3013, 3014; Bird & Bird (n 330).
[332] Bublitz, Molnár-Gábor and Soekadar (n 331) 3015.
[333] Gilbert et al. (n 67).
[334] Bublitz, Molnár-Gábor and Soekadar (n 331).
[335] Bublitz, Molnár-Gábor and Soekadar (n 331) 3015.

encompassing neuroenhancement uses of AI-based neurotechnology, more detailed and comprehensive rules for emerging neurotechnologies are needed. In particular, given the specific individual and societal risks involved, neuroenhancement technologies may warrant an autonomous regulatory framework, to ensure their accessibility and use aligns with human rights standards.

5.3. Guiding principles and standards for future governance

As stated in a recent UN Human Rights Council report A/HRC/58/58A, 'fundamental principles are the backbone of any regulation of neurotechnologies, constituting the ethical and legal basis that guides their design, implementation and interpretation'. [336] They ensure regulatory frameworks are coherent, while guiding the adequate application of its provisions.[337] It is thus important to identify core principles that ought to inform regulatory developments on neuroenhancement technologies, particularly concerning the limits to their access and use in relation to personal identity.

Several non-binding instruments on neurotechnology already lay essential groundwork in this regard. The OECD Recommendation on Responsible Innovation in Neurotechnology, adopted in 2019, represents the first international standard in the field, offering a 'toolkit' for governments and innovators that can help them anticipate ethical, legal and social challenges raised by novel neurotechnologies.[338] The recommendation articulates nine principles, including commitments to responsible innovation, safety assessment, inclusivity and scientific collaboration.

UNESCO's IBC report on the Ethical issues of Neurotechnology (2021) also marked a significant step forward in this direction. It proposes different sets of recommendations for UNESCO, the Member States, the research community, industry, the media and the public, with a strong focus on the need to protect a person's sense of self and personal identity, as well as their 'right to act in a self-determined manner'.[339]

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[336] UNHCR, *'Foundations and Principles for the Regulation of Neurotechnologies and the Processing of Neurodata from the Perspective of the Right to Privacy: Report of the Special Rapporteur on the Right to Privacy, Ana Brian Nougrères'* (16 January 2025) UN Doc A/HRC/58/58, para 29.
[337] Ibid.
[338] OECD, *Recommendation of the Council on Responsible Innovation in Neurotechnology*, OECD/LEGAL/0457 (2019).
[339] International Bioethics Committee, *Ethical Issues of Neurotechnology* (n 9) 67 – 75.

At the EU level, the 2023 Léon Declaration on European neurotechnology aligns with these concerns stressing the need for 'a human centric and rights-oriented approach', particularly in relation to non-invasive and non-medical applications.[340] The 2025 European Charter for the Responsible Development of Neurotechnologies further reinforces important safeguards, many of which align with provisions of the EU AI Act and other EU legal instruments. For instance, in accordance with to Annex I and Annex II of the EU AI Act, the Charter recommends the establishment of transparent and effective mechanisms for oversight and monitoring, namely, to identify and address adverse events and anticipate potential misuse.[341] It also encourages an ethical, inclusive and educational communication around neurotechnologies, that avoids 'raising unrealistic expectations or, conversely, unfounded fears', in compliance with the GDPR.[342]

Looking ahead, the forthcoming UNESCO Recommendation on the Ethics of Neurotechnologies (2025), along with the contributions from the European Group on Ethics in Science and New Technologies (EGE) promises to further enrich and broaden the debate on neuroenhancement technologies.[343]

Building on extant contributions in this area, this thesis now nominates and explores three basic principles and standards that should be observed in future regulatory efforts in this field, specially concerning the case of personal identity: precaution, self-determination, and human dignity. While other principles – particularly procedural or technical in nature – should play an important role in shaping regulatory frameworks, the selected three represent foundational ethical and legal commitments that cannot be overstated. These are the principles that must, at a minimum, be respected to ensure that the development and deployment of neuroenhancement technologies align with human rights standards.

[340] Council of the European Union, *León Declaration on European Neurotechnology* (2023).
[341] European Brain Council (n 324).
[342] Ibid.
[343] UNESCO, *First Draft of the Recommendation on the Ethics of Neurotechnology* (2024) SHS/BIO/AHEG-Neuro/2024/2; European Commission, *European Group on Ethics in Science and New Technologies (EGE)* (European Commission, 2024) https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/scientific-support-eu-policies/european-group-ethics_en#ege-opinions-and-statements accessed 27 June 2025.

5.3.1. Precaution

The precautionary principle is often invoked in the governance of emerging technologies, and entails placing 'constraints on the use of technology whose outcomes include potential harms and are characterized by high levels of complexity and uncertainty'.[344]

According to Kaebnick et al., a precautionary position developed in relation to technology, exhibits three components: (i) a preliminary reason to suspect a possible harm, (ii) a preliminary reason to believe that there is uncertainty about the effects, (iii) and a recommendation for precautionary measures (prompted by the first two components).[345] In the case of neurotechnology, Goering et al. emphasize that regulations focusing on long-term impacts of emerging technologies, like neurostimulation, often involve making decisions under significant uncertainty due to the 'lack of longitudinal observations and data'. [346] The central challenge would then be to define how precautionary safeguards should look from the prism of personal identity. If we have a preliminary reason to suspect possible harm resulting from interference with one's sense of self and identity, how should that shape regulatory measures? Crucially, without clearly established definitions of concepts such as identity and psychological continuity, any neurotechnology device could ultimately be perceived as a threat, insofar as any intervention in the brain may cause some alteration in the mind.[347] This raises the risk that a precautionary regulatory approach could end up prohibiting neurotechnologies altogether, potentially forfeiting the benefits they can offer in terms of improving people's life and well-being.[348] Notably, one common objection to precaution is that it imposes 'epistemologically impossible demands' considering uncertainty about outcomes can never be fully resolved.[349]

One preliminary step towards a more balanced and pragmatic precautionary approach, seems to be the development of 'measurable' or 'workable' concepts. To achieve this, and given the interdisciplinary nature of the subject, it would be essential to promote a collaboration between experts from various fields, including neuroscientists,

[344] Gregory E Kaebnick et al., 'Precaution and Governance of Emerging Technologies' (2016) 354 *Science* 710.
[345] Ibid 711.
[346] Goering et al. (n 152) 376.
[347] Borbón and Borbón (n 312) 2.
[348] Ibid. See also: UN Human Rights Council (n 336) para 54.
[349] Kaebnick et al. (n 344) 711.

philosophers, lawyers, psychiatrists and psychologists. As argued earlier in Chapter 3 of this thesis, existing legal concepts such 'identity' or 'personality' still lack significant clarification, particularly in the emerging context of neuroscience. In addition, other notions we have explored – most notably, psychological continuity – are not formally recognized under international law or formally invoked in the interpretation of existing protections. These advancements, taken together with rigorous scientific evidence, could enable the design of risk-assessment frameworks for neuroenhancement technologies, avoiding 'unjustified alarmism' that could hinder innovation. [350]

In this regard, the EU AI Act's risk-assessment framework offers a potentially useful model that could be discussed and adapted to the capabilities of neurotechnology. It establishes four risk categories with corresponding regulatory measures: (i) *unacceptable risk* systems are prohibited outright, (ii) *high-risk* systems are subject to stringent regulatory requirements (e.g. providers and deployers must establish a risk management system that continuously identifies and mitigates risks to health, safety, and fundamental rights of affected persons (Article 9), while ensuring an appropriate level of accuracy, robustness, and cybersecurity (Article 15)[351]), (iii) *limited risk* systems demand specific transparency obligations, (iv) *minimal or no risks* systems are not subject to any regulatory restriction.[352] The criterion is the probability and severity of harm (Article 3[2]), which may be 'material or immaterial, physical, psychological, societal and economic' (Recital 5). In fact, neurotechnologies may already fall into both *unacceptable* (as we have previously seen earlier in this chapter in regard to Article 5[1a]) and *high-risk* practices under the AI Act.[353]

A dedicated, risk-based regulatory framework tailored to neurotechnology devices could ensure more comprehensive, nuanced, and proportionate oversight of neuroenhancement

[350] Istace and Costas Trascasas (n 4) 11.
[351] Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 (Artificial Intelligence Act) [2024] OJ L 168/1, arts 9 and 15.
[352] Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 (Artificial Intelligence Act) [2024] OJ L 168/1, arts 5 - 7, 9 - 29, and 52.
[353] Other examples of how neurotechnologies may fall under the scope of the EU AI Act relate to norms of emotion recognition and the inference of emotions or intentions (Article 3[39] of the EU AI Act). These provisions may apply to neuroimaging devices, which would then be prohibited in the workplace and educational settings – except when used for medical or safety purposes (Article 5[1f]). For all other applications, such devices would be classified as high-risk (Annex III, 1[c]): Bublitz, Molnár-Gábor and Soekadar (n 331) 3014.

uses. Anchored in the precautionary principle, such a framework would aim to balance the prevention of potential harm with responsible promotion of innovation.

While highlighting this need for balance, Erhardt and Štrac note that to favour a 'careful and slow' approach toward neuroenhancement might be difficult for many, considering that the 'promise of a faster progress and a better life might outweigh reasonable caution'.[354] Yet, while a considered version of the precautionary principle does not and cannot possibly aspire to stop the use of neurodevices or neurotechnological evolution in general, it seems essential to prevent them from taking us in unexpected directions. Overall, then, as regards precaution, the proposal of this thesis is that it should be understood as an overreaching principle that ensures the pursuit for neuroenhancement does not compromise other core values and standards – including self-determination and human dignity.

5.3.2. Self-determination

In line with existing soft law instruments, UNESCO's first draft of its upcoming recommendation on the ethics of neurotechnology affirms that 'throughout the whole lifecycle of neurotechnology, the protection and promotion of the rights of freedom of thought and self-determination must be secured.'[355] It reinforces that at all stages of neurotechnology development and application – from initial research and design to deployment, monitoring and end-of-use[356] – ethical safeguards must be in place to ensure respect for personal autonomy. This resonates with the claim made in Chapter 3 that neurodevices have the potential to influence a person's internal mental processes possibly impacting their external behaviours and decision-making. This dynamic reflects the intrinsic link between agency and identity as two interdependent and essential features of human beings.[357] Accordingly, in line both with UNESCO's draft recommendation and the EU AI Act's prohibition of 'manipulative techniques' that significantly impair a person's autonomy (Article 5[1a]), any regulation of emerging neuroenhancement technologies should hold as a principle to safeguard a person's ability to think freely and make their *own* decisions.

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[354] Julija Erhardt and Dubravka Švob Štrac, 'New Tools for Neuroenhancement – What about Neuroethics?' (2016) 57(4) *Croatian Medical Journal* 392, 394.
[355] UNESCO, *First Draft of the Recommendation on the Ethics of Neurotechnology* (2024), para 45.
[356] Ibid para 17.
[357] Goering et al. (n 152) 368.

While this may indeed imply that individuals should not be permitted to consent to certain neurotechnology devices and interventions (i.e. its design and deployment should be prohibited), at least outside the medical sphere, it also underscores the need to adapt and improve informed consent requirements and procedures more broadly. This is especially pressing given that non-invasive neuroenhancement devices such as tDCS are already available on the market on a 'do-it-yourself' basis.[358]

Accordingly, before individuals engage with neuroenhancement devices, they must be provided with clear, comprehensive and accessible information about their effects, risks, benefits, and available alternatives.[359] It must be clear how the device will influence cognitive and emotional processes, to what extent, for how long and for what purpose.[360] To this end, ongoing research into the long-term effects of neurotechnologies must be actively promoted.[361]

Meanwhile, considering the risks identified throughout this thesis, it seems that the information provided should explicitly address even minimal threats to a person's sense of self, personal identity and self-determination. In this regard, it is of paramount importance that questions of dependency are properly disclosed – individuals must be aware of potentially becoming addicted to the neurotechnology they are using and how that may impair their capacity to withdraw.

Consistent with medical consent practices, which require patients to be informed of reasonable alternatives to a treatment or intervention,[362] individuals must likewise be provided with a comprehensive list of reasonable alternatives to the neuroenhancement technology in question. These may include natural methods of neuroenhancement such as regular physical exercise, adequate sleep or cultivating a rich social and cultural life.[363]

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[358] Erhardt and Štrac (n 354).
[359] Erhardt and Štrac (n 354) 378; UNESCO, *First Draft of the Recommendation on the Ethics of Neurotechnology* (2024) para 46.
[360] Goering Sara et al. (n 152) 378.
[361] Ibid.
[362] As outlined in section 4.4.1., providing information about reasonable alternatives is considered as part of the 'voluntariness' element in Beachamp and Faden's widely accepted account of informed consent: Tom L. Beauchamp and Ruth R. Faden, 'Informed Consent: II. Meaning and Elements of Informed Consent' in Warren Thomas Reich (ed), *Encyclopedia of Bioethics* (Rev edn, Simon and Schuster Macmillan 1995) 1238.
[363] Heinrichs et al. (n 12) 24 – 27.

In addition, as Goering et al. recommend, procedural tools should use plain and easily understandable language and be complemented by aids such as visualization where appropriate.[364] Importantly, the user must be informed as to how and when they can revoke initial consent; for this purpose, consent must be revisable overtime, ensuring it remains voluntary and individuals fully understand the ongoing implications for their identity and autonomy.[365]

Finally, future regulation should pay special attention to classic domains of power-asymmetries, such as the workplace and educational institutions, to ensure that a decision to neuroenhance remains genuinely voluntary. As discussed, employment and education are two fields prone to embrace future innovation on neuroenhancement technologies, considering the appeal of improved cognitive and emotional capacities to achieve greater personal and institutional goals. It is therefore crucial that regulation accounts for pressures individuals may face to potentially modify aspects of their identity to conform to social expectations.

5.3.3. Human dignity

Human dignity has been a recurring theme throughout this thesis, invoked in diverse contexts – from the articulation of the right to identity as an expression of human dignity, to addressing anti-meliorist arguments on human enhancement, the challenges posed to informed consent, and neurorights frameworks.

As a normative concept, human dignity is multifaceted, typically serving both as a foundational principle of the entire human rights regime and a 'barrier' against extreme forms of violations, such as torture or genocide.[366] The 1948 UDHR's preamble refers to the 'inherent dignity' of 'all members of the human family', with Article 1 solemnly declaring that 'All human beings are born free and equal in rights and dignity'.[367] Article 1 of the Charter of Fundamental Rights of the EU further states: 'Human dignity is inviolable. It must be respected and protected'.[368]

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[364] Ibid.
[365] Ibid.
[366] Marcus Düwell, 'Human Dignity and the Ethics and Regulation of Technology' in Roger Brownsword, Eloise Scotford and Karen Yeung (eds), *The Oxford Handbook of Law, Regulation and Technology* (OUP 2017) 177, 178.
[367] Universal Declaration of Human Rights (adopted 10 December 1948 UNGA Res 217 A(III) (UDHR) art. 1.
[368] Charter of Fundamental Rights of the European Union [2012] OJ C326/391 art 1.

Despite its prominence, human dignity has long been subject to criticism. It has been dismissed as 'useless' – a rhetorical flourish that offers nothing beyond what concepts like autonomy can already articulate. Others have labelled it as 'empty' or overly malleable notion, one that can be moulded to fit any ideological agenda. Some assume it functions as a *conversation-stopper*, requiring no further justification, once that 'card' is laid on the table. [369] While addressing these criticisms lies beyond the scope of this thesis, we contend that the legal principle of human dignity is posed to play a particularly vital role in regulating neurotechnologies for neuroenhancement and guaranteeing respect for psychological continuity. This is true especially when conceiving human dignity as a constraint imposing prohibitions on practices considered detrimental to the individual, even when they are authorized or requested by the person.[370] In this sense, human dignity reflects a genuine and practical concern about the need to promote respect for the intrinsic value of the human being and for the integrity of the human species.[371] For example, in the domain of bioethics, Article 11(1) of the Universal Declaration on the Human Genome and Human Rights (UDHG) states that 'practices which are contrary to human dignity, such as reproductive cloning of human beings, shall not be permitted'. [372] Relatedly, the Oviedo Convention is designed to preserve the *dignity* and *identity* of human beings in relation to the application of biology and medicine, as aforementioned.[373]

In this light, as neurotechnologies evolve – potentially enabling 'transhumanist' enhancements that push toward a *posthuman* condition – human dignity is likely to become increasingly important as a guiding principle.

As Cortês explains, one clear implication of the principle of human dignity, as an imperative upon others and the state to value every individual as an *end in itself*, is the respect for a person's autonomy, freedom of choice and personality.[374] Yet, human

[369] Düwell (n 366) 179.
[370] Roberto Andorno, 'Human Dignity and Human Rights as a Common Ground for a Global Bioethics' (2009) 34 *Journal of Medicine and Philosophy* 223.
[371] Ibid.
[372] UNESCO, 'Universal Declaration on the Human Genome and Human Rights' (adopted 11 November 1997) art 11(1).
[373] Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine (Oviedo Convention) (adopted 4 April 1997, entered into force 1 December 1999) ETS No 164 art 1.
[374] António Cortês, 'The Legal Meaning of Human Dignity: Respect for Autonomy and Concern for Vulnerability' in José Manuel Aroso Linhares and Manuel Atienza (eds), *Human Dignity and the Autonomy of Law* (Springer 2022) 167, 174 – 175.

dignity also implies recognizing the inherent vulnerability of the human being as an embodied creature.[375] In Cortês' words, human dignity does not seem to grant a 'descontextualized capacity for freedom'.[376] It also demands us to consider that people's bodies – including their brains – their life and their health are naturally vulnerable. Such vulnerability is arguably magnified by our deepening entanglement with technology, posed to transform both our lives and the world around us, the way we relate to which other and the way we relate to ourselves.[377]

In this vein, Düwell stresses that few domains necessitate a more significant role of human dignity than the regulation of technology.[378] We would go further, by arguing that nowhere is this imperative more acute than in the governance of *neurotechnologies*, which by their very nature, interact directly with the brain and may carry the potential to disrupt our psychological continuity.

5.4.Conclusion

As we conclude this chapter, it becomes clear that the right to psychological continuity must be positioned as a normative cornerstone in the governance of neuroenhancement technologies. Building on philosophical foundations and emerging human rights discourse, we have argued that this right is not merely one among others, but rather the threshold beneath which personal identity risks becoming unrecognizable or irretrievably altered. Treating psychological continuity as inalienable and non-renounceable — specifically in non-medical enhancement contexts – provides a necessary safeguard against irreversible transformations of the self. This limit serves as both a legal and ethical *red line*, delineating the boundaries of acceptable intervention while acknowledging the complex interplay between autonomy, risk, and identity.

At the same time, we have emphasized that safeguarding psychological continuity does not imply halting innovation. Rather, it demands that regulation proceed with clear principles – precaution, self-determination, and human dignity – as its guiding pillars. These principles offer the ethical scaffolding needed to design nuanced, risk-calibrated

[375] Ibid.
[376] Ibid 174.
[377] Düwell (n 366) 177.
[378] Ibid 194.

oversight that enables responsible neuroenhancement without compromising personal identity.

6. CONCLUDING OBSERVATIONS

The purpose of this thesis was to explore the limits to individuals' engagement with neuroenhancement technologies, from the perspective of their potential to impact personal identity. As outlined in Chapter 2, neurotechnology offers unprecedented possibilities to modify the brain in far-reaching ways – especially when integrated with AI. Clinical research on implanted neurodevices has already shown that such interventions can influence a person's psychological traits, namely, desires, beliefs, and memories. As explained in Chapter 3, these changes may impact personal identity by altering or even disrupting psychological continuity – a philosophical concept according to which personal identity persists over time through overlapping chains of psychological connectedness.

The thesis went on to demonstrate in Chapters 3 and 4 that the unrestricted use of advancements in neuroenhancement technologies to alter cognitive and emotional landscapes poses risks not only to the individual but also to society as a whole. The potential implications of these alterations on one's sense of self and their ability to act in a self-determined manner are likely to have ripple effects, namely on interpersonal relationships, legal responsibility, and the ability to give informed consent. Furthermore, the unpredictability factor, stemming from the lack of comprehensive longitudinal data inherent to the novel character of these technologies, deepens these risks. We also pinpointed the advent of the *hybrid mind* as a matter of particular concern, considering it blurs traditional boundaries between self and machine, autonomy and automation, agency and algorithm.

From a human rights perspective, the thesis laid bare a fundamental tension between autonomy and identity, extending this analysis to the scope and content of the right to identity itself. In Chapter 3, we saw that, on the one hand, the right to develop one's personality and to use neurotechnologies for self-fulfilment can be seen as an expression of personal freedom. On the other hand, the right to identity may also demand safeguards against irreversible self-modification, to protect one's inner mind and guarantee control over one's *own* faculties.

Crucially, in Chapter 5, the thesis found that existing human rights frameworks are ill-equipped to address the challenge of balancing these different dimensions, and thus lack

clear guidance for determining when, and to what extent, limitations on autonomy to *neuroenhance* may be justified. Concepts such as identity and personality, though extensively referred to by law and jurisprudence, namely under CoE Conventions and ECtHR case law, remain largely undefined. In this light, the thesis has proposed psychological continuity as an essential concept which should be central in future policy discussions. Put differently, it is a normative threshold which needs to be further explored in the adaptation of current frameworks to neuroscientific evolution.

Existing neurorights proposals, encompassing a neuroright to psychological continuity, provide a foundational basis for recognizing this concept of psychological continuity as an *inalienable and non-renounceable right,* in this way addressing the possibility of its voluntary disruption. However, further interdisciplinary research would be needed to clarify and operationalize this concept into a practical framework that can guide the design and deployment of neuroenhancement technologies.

In parallel, in Chapter 5, the thesis advocated that regulation in this field should be guided by three core principles: precaution, self-determination, and human dignity. These principles can ensure that the use of neurotechnologies is both ethically permissible and socially protective: preventing harm, supporting informed and autonomous decision-making, and safeguarding the intrinsic worth of the human person.

Ultimately, this thesis has sought to anticipate scenarios of the future. It is often hard to create rules for new technologies, given their rapid innovation cycles and the uncertainty surrounding their long-term impacts. Legal systems, often reactive rather than proactive, typically struggle to keep pace with scientific progress. Technological neuroenhancement presents an especially intricate challenge, as it intersects with deeply dividing ideas about rights and freedoms and, crucially, the nature of human beings. Conservative and liberal positions on human enhancement, alongside essentialist and existentialist views on authenticity, offer contrasting perspectives that are likely to shape societal responses to innovation and influence policy options. For some, the starting point will be of cognitive liberty and the pursuit of progress; for others, the principle will be to reject innovation, in respect for human dignity and human essence. Thus, perhaps the most important message of this thesis is that society must deal with these tensions openly and deliberately to reach a common ground that upholds and aligns with universal human rights principles.

We cannot stop the wind with our hands, but we can help guide its direction toward a more humane future.

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