

# Neuroprivacy and Mental Integrity in the Age of Neurotechnology: Rethinking Fundamental Rights and Legal Futures

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## **Abstract**

*Neurotechnology is reshaping the boundary between mind and data and generating sustained legal and ethical controversy. Technologies that decode neural signals, predict cognitive states, or influence behaviour raise difficult questions about mental privacy, identity, and cognitive autonomy. This article examines neuroprivacy at the intersection of law, ethics, neuroscience, and technology and situates it within the wider debate on legal futures and transdisciplinary regulation. It argues that neural data differ qualitatively from conventional personal data because of their intimacy and their potential use in cognitive profiling, behavioural manipulation, and commercial exploitation. Drawing on legal theory, bioethics, science and technology studies, and developments in neurotechnology and artificial intelligence, the analysis evaluates the adequacy of existing data-protection and human-rights frameworks. It concludes that existing rights should be interpreted and strengthened immediately, while carefully defined neuro-specific safeguards may also be required. The article therefore proposes an anticipatory, interdisciplinary regulatory approach grounded in human dignity, mental integrity, cognitive liberty, and effective control over neural data.*

**Keywords:** *neurorights; neurotechnology; mental privacy; cognitive autonomy; artificial intelligence; fundamental rights.*

**JEL Classification:** K24, K38, O33, I18

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## 1. Introduction

Neurotechnology offers considerable promise for diagnosing, treating, and preventing neurological and mental disorders. At the same time, because it can access and influence neural activity, it raises risks that extend beyond conventional health technology and data processing.<sup>2</sup> The brain is a complex organ that plays a crucial role in shaping individuality.<sup>3</sup>

The brain shapes identity, autonomy, emotions, behaviour, and well-being and is closely connected to what it means to be human. Neurotechnology can interact with the brain by monitoring or modulating neural activity. It promises to improve the lives of people with disabilities caused by brain-related conditions, but its misuse may also threaten human rights and fundamental freedoms.<sup>4</sup>

Neuroscience and digital technology converge in the rapidly developing field of neurotechnology.<sup>5</sup> Broadly understood, neurotechnologies are tools capable of reading, recording, or modifying mental activity by acting on its neural correlates.<sup>6</sup>

The rapid development of neurotechnology is fundamentally reshaping the relationship between the human mind and data. Technologies capable of decoding neural signals, predicting cognitive states, or influencing behaviour increasingly blur the boundary between internal mental processes and external technological intervention. Their capacity to act on the brain calls for vigilance in two areas: respect for mental autonomy and protection of neural data. A central question is whether existing human-rights law adequately protects mental privacy or whether neuro-specific rights must be recognized.<sup>7</sup> Unlike many other emerging technologies, neurotechnology can directly access or influence brain activity. It therefore raises concerns about mental privacy, autonomy, freedom of thought, identity, and psychological integrity and intensifies debate about the adequacy of existing legal safeguards.<sup>8</sup>

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<sup>2</sup> International Bioethics Committee of UNESCO, *Ethical Issues of Neurotechnology* (Paris: UNESCO, 2021), <https://doi.org/10.54678/QNKB6229>.

<sup>3</sup> Dov Greenbaum and Mark Gerstein, “The Control and Privacy of Your Most Intimate Information: Navigating the Battle for Your Brain,” *AJOB Neuroscience* 14, no. 3 (2023): 328–31, <https://doi.org/10.1080/21507740.2023.2225464>.

<sup>4</sup> Daniel S. Hain et al., *Unveiling the Neurotechnology Landscape: Scientific Advancements, Innovations and Major Trends* (Paris: UNESCO, 2023), <https://unesdoc.unesco.org/ark:/48223/pf0000386137>.

<sup>5</sup> Catherine Vidal, “Neurotechnologies under the Eye of Bioethics,” *eNeuro* 9, no. 3 (2022): E-NEURO.0072-22.2022, <https://doi.org/10.1523/ENEURO.0072-22.2022>.

<sup>6</sup> Andrea Lavazza and Rodolfo Giorgi, “Philosophical Foundation of the Right to Mental Integrity in the Age of Neurotechnologies,” *Neuroethics* 16 (2023): article 10, <https://doi.org/10.1007/s12152-023-09517-2>.

<sup>7</sup> Vidal, “Neurotechnologies under the Eye of Bioethics.”

<sup>8</sup> Hain et al., *Unveiling the Neurotechnology Landscape*.

Neurotechnology includes a range of devices and procedures that interact directly with the human nervous system. It has become a pioneering field with the potential to revolutionize medicine, communication, and human development. Therefore, the rapid progress and constant development pose complex ethical and legal challenges.<sup>9</sup>

These transformations extend beyond traditional data protection frameworks, as neural data reflects highly intimate dimensions of human existence, including thoughts, emotions, and intentions. In this context, the concept of neuroprivacy emerges as a necessary response to the growing need for safeguarding mental information as a distinct and sensitive category.

In August 2023, the Supreme Court of Chile addressed neurotechnology and privacy in *Girardi Lavín v. Emotiv Inc.*, Case No. 105065-2023. The court ordered the deletion of neural data collected through Emotiv's device and emphasized that scientific and technological progress must serve human beings.<sup>10</sup> Chile had already amended its Constitution in 2021 to protect brain activity and the information derived from it against technological interference.<sup>11</sup>

Invasive neurotechnologies are a recurrent subject in neuroethics. Deep-brain stimulation and implantable brain–computer interfaces hold considerable promise for health and well-being, but they also raise questions about autonomy, safety, stigma, privacy, and agency. Although the terms “invasive” and “invasiveness” are widely used, the underlying concept is rarely defined with precision.<sup>12</sup>

The concepts of cognitive liberty and neuroprivacy respond to neuroscientific advances that create unprecedented capacities to observe brain processes and manipulate brain function.<sup>13</sup>

This article examines the legal implications of neurotechnology at the intersection of law, ethics, and emerging technological practices. It focuses on the protection of mental integrity and on the adequacy of existing fundamental rights in addressing the risks associated with neural data processing.

The article examines whether current legal frameworks remain sufficient to address the specific risks posed by neurotechnology. These risks include unauthorized access to neural data, cognitive profiling, behavioural manipulation, and

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<sup>9</sup> Ieva Andrijauskaitė, “Neurotechnology and Neural Rights,” *Vilnius University Open Series* (2025): 7–15, <https://www.journals.vu.lt/open-series/en/article/view/41911>.

<sup>10</sup> Javier D. Briceño, “Privacy in the Age of Neurotechnology: Guido Girardi Lavín v. Emotiv, Inc.,” *Global Privacy Law Review* 5, no. 2 (2024): 88–92, <https://doi.org/10.54648/GPLR2024013>.

<sup>11</sup> UNESCO Courier, “Chile: Pioneering the Protection of Neurorights,” October 13, 2023, <https://courier.unesco.org/en/articles/chile-pioneering-protection-neurorights>.

<sup>12</sup> Benjamin Collins and Eran Klein, “Invasive Neurotechnology: A Study of the Concept of Invasiveness in Neuroethics,” *Neuroethics* 16, no. 1 (2023): article 11, <https://doi.org/10.1007/s12152-023-09518-1>.

<sup>13</sup> Paul Root Wolpe, “Neuroprivacy and Cognitive Liberty,” in *The Routledge Handbook of Neuroethics*, ed. L. Syd M. Johnson and Karen S. Rommelfanger (New York: Routledge, 2017), 214–24, <https://doi.org/10.4324/9781315708652-16>.

the commercialization of mental activity.

Against this background, the article explores the reconceptualization of mental privacy as an autonomous legal category. It also analyzes the role of neurorights in shaping future legal responses capable of addressing the challenges generated by technological convergence.

The discussion also addresses the commercialization of brain data, including ownership, consent, and the commodification of cognitive processes.<sup>14</sup> It examines the extent to which neural data differ from ordinary personal data.

Furthermore, it evaluates whether the existing human rights framework is sufficiently developed to protect mental autonomy and mental privacy in light of neurotechnological developments.

Neural data possess distinctive characteristics that exceed the scope of traditional personal data protection frameworks. This may require the recognition of neuroprivacy and mental integrity as autonomous dimensions of fundamental rights protection.

The research adopts an interdisciplinary and qualitative methodology situated at the intersection of law, neuroscience, ethics, and technology studies. The analysis combines doctrinal legal research with normative and comparative approaches in order to examine the adequacy of existing legal frameworks governing neurotechnology and neural data processing.

The study relies on the analysis of international and European legal instruments, including data protection regulations, AI governance frameworks, and emerging neurorights initiatives. It also integrates ethical and theoretical perspectives derived from bioethics and science and technology studies.

In addition, the article incorporates illustrative case studies involving consumer neurotechnologies and brain-computer interface systems, including neurofeedback devices and cognitive monitoring technologies. These case studies illustrate practical risks related to mental privacy, cognitive autonomy, and mental integrity.

Through this interdisciplinary approach, the research evaluates whether existing legal protections remain sufficient in the context of technological convergence. It also proposes forward-looking regulatory responses adapted to the distinctive nature of neural data.

The analysis is guided by two questions: To what extent do neural data differ from ordinary personal data? Is the existing human-rights framework sufficiently developed to protect mental autonomy and mental privacy in light of neurotechnological change?<sup>15</sup>

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<sup>14</sup> Ujwal Chaudhary, "Neuroethics for Neurotechnology," in *Expanding Senses Using Neurotechnology*, vol. 2, *Brain-Computer Interfaces and Their Applications* (Cham: Springer, 2025), 381–404, [https://doi.org/10.1007/978-3-031-78991-5\\_10](https://doi.org/10.1007/978-3-031-78991-5_10).

<sup>15</sup> Timo Istance, "Human Rights Law: An Incomplete but Flexible Framework to Protect the Human Mind against Neurotechnological Intrusions," *Law, Innovation and Technology* 16, no. 1 (2024):

## 2. Conceptual Foundations

Just as smartphones and the Internet transformed everyday life, brain interfaces may reshape human interaction over the coming decades. They may enable closer collaboration between brains and technology and augment sensory, motor, communicative, and cognitive capacities. Recent research and funding priorities suggest that non-invasive and minimally invasive brain-interface technologies may advance substantially.<sup>16</sup>

Neurotechnology challenges traditional understandings of the human mind as a private and protected domain, introducing new forms of access to cognitive processes. Neurotechnologies raise ethical and human rights considerations as they challenge notions of personal identity and require new protections.<sup>17</sup>

Developments such as brain-computer interfaces and neuromarketing technologies enable direct interaction with neural activity. They transform the conditions under which mental information can be accessed and interpreted.

Neuroimaging techniques such as functional magnetic resonance imaging (fMRI) also raise concerns about mental privacy. In one University of California study, researchers used machine learning to reconstruct viewed movie content from fMRI data.<sup>18</sup> Neurotechnology creates at least three distinct privacy challenges. First, it can generate large quantities of personal data during ordinary use. Second, some information may be collected or inferred without the user's conscious awareness. Third, neural data may disclose health conditions, preferences, and other highly identifying information. These features call for proactive safeguards beyond clinical and research settings.<sup>19</sup> In addition, some patients experience postoperative neuropsychiatric changes, including feelings of self-alienation that may affect identity.<sup>20</sup>

Existing human rights create several layers of protection around the person. The rights to bodily and mental integrity and to privacy form a foundational layer that can encompass technological interference with the central nervous system. Yet those rights may be balanced against competing rights and interests.

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309–40, <https://doi.org/10.1080/17579961.2024.2313796>.

<sup>16</sup> Kate S. Gaudry et al., “Projections and the Potential Societal Impact of the Future of Neurotechnologies,” *Frontiers in Neuroscience* 15 (2021): 658930, <https://doi.org/10.3389/fnins.2021.658930>.

<sup>17</sup> Dragoş Alexandru Maior, “Mental Integrity and Ethics in the Development of Neurotechnologies,” *Curentul Juridic* 99, no. 4 (2024): 111–17, <https://doi.org/10.62838/cjjc-2024-0033>.

<sup>18</sup> Shinji Nishimoto et al., “Reconstructing Visual Experiences from Brain Activity Evoked by Natural Movies,” *Current Biology* 21, no. 19 (2011): 1641–46, <https://doi.org/10.1016/j.cub.2011.08.031>.

<sup>19</sup> Yang Wu, “A Review on the Ethical Issues in Neurotechnology,” in *Proceedings of the 2nd International Conference on Biological Engineering and Medical Science (ICBioMed 2022)* (Oxford, 2022), 7–13, <https://doi.org/10.54254/2753-8818/4/20220689>.

<sup>20</sup> Wu, “Review on the Ethical Issues in Neurotechnology.”

Freedom of thought, conscience, religion, and opinion adds protection for particular mental domains, including thought formation, opinion, and other important cognitive processes.<sup>21</sup>

This capacity to observe and potentially influence brain activity raises questions regarding autonomy, identity, and human dignity. It also destabilizes the distinction between internal mental life and external technological influence, which has traditionally underpinned legal protections of privacy and personal integrity.

Neural data differ qualitatively from conventional personal data because of their depth, sensitivity, and interpretive scope. They may reveal subconscious processes and latent cognitive patterns beyond an individual's awareness or control.

At the same time, neurotechnology introduces a continuum between therapeutic applications and enhancement or manipulation, complicating the legal assessment of its uses. This ambiguity raises concerns regarding consent, agency, and the potential erosion of individual self-determination.

A precautionary approach may justify treating narrowly defined neurorights, particularly outside clinical contexts, as inalienable and non-waivable. The point is not to impose paternalistic choices but to recognize that increasingly powerful neurotechnologies may create consequences for identity and psychological continuity that users cannot fully anticipate.<sup>22</sup>

Limits on an individual's ability to waive mental integrity may also be justified by the practical irreversibility of some interventions. Certain implants may be difficult to remove or disable, and a radical change to psychological continuity may undermine the very standpoint from which a person could compare the altered state with the prior one.<sup>23</sup>

One proposal treats neural data as unavailable for unrestricted alienation, by analogy with legal limits on the sale of human organs. Neural data concern an exceptionally intimate sphere and are experienced from a unique first-person perspective. On this view, they should not be freely transferred or commercialized without robust safeguards.<sup>24</sup>

These concerns support the development of coordinated international standards, implemented through national law, to address neurotechnological risks. Such standards should define substantive safeguards and practical imple-

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<sup>21</sup> Christoph Bublitz, "Neurotechnologies and Human Rights: Restating and Reaffirming the Multi-layered Protection of the Person," *International Journal of Human Rights* 28, no. 5 (2024): 782–807, <https://doi.org/10.1080/13642987.2024.2310830>.

<sup>22</sup> Silvia Inglese and Andrea Lavazza, "What Should We Do with People Who Cannot or Do Not Want to Be Protected from Neurotechnological Threats?," *Frontiers in Human Neuroscience* 15 (2021): 703092, <https://doi.org/10.3389/fnhum.2021.703092>.

<sup>23</sup> Inglese and Lavazza, "What Should We Do?"

<sup>24</sup> Inglese and Lavazza, "What Should We Do?"

mentation duties, including privacy- and security-by-design requirements for devices placed on the market.<sup>25</sup>

All technological devices that aim to modify, improve, and control the human brain challenge individual liberty.<sup>26</sup> Debates on these topics have recently crystallized around the notion of “neurorights” such as the rights to mental privacy (to protect brain data against their unauthorized collection),<sup>27</sup> to mental integrity (against harmful manipulation of brain activity), and cognitive liberty (freedom of thought and conscience).<sup>28</sup>

Consequently, mental integrity has become a central concern in contemporary legal discourse. The question is whether new legal rules are necessary to ensure effective protection amid rapid technological change.

### **3. Neurotechnology in Practice: Consumer Devices and Cognitive Monitoring**

The Mind Uploading Project,<sup>29</sup> popularized in contemporary media, takes the idea of technological replacement to an extreme. Related narratives are reinforced by medical interventions such as transplantation and prosthetic implantation. Although therapeutic technologies may be beneficial, their use can still influence how people understand embodiment, identity, and personhood.<sup>30</sup>

The rapid expansion of consumer neurotechnology has transformed neurotechnological devices from experimental medical instruments into commercially accessible products integrated into everyday life. Devices such as Muse, neurofeedback systems, and brain-computer interface technologies illustrate the growing convergence between neuroscience, artificial intelligence, and digital consumer technologies.<sup>31</sup> These systems operate through the collection, interpretation, and processing of neural signals capable of revealing cognitive states, emotional reactions, attention levels, and behavioural patterns.

Unlike traditional forms of personal data, neural data possess an intimate and sensitive character because they are connected to mental activity and cogni-

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<sup>25</sup> Inglese and Lavazza, “What Should We Do?”

<sup>26</sup> Vidal, “Neurotechnologies under the Eye of Bioethics.”

<sup>27</sup> Marcello Ienca, Pim Haselager, and Ezekiel J. Emanuel, “Brain Leaks and Consumer Neurotechnology,” *Nature Biotechnology* 36, no. 9 (2018): 805–10, <https://doi.org/10.1038/nbt.4240>.

<sup>28</sup> Rafael Yuste et al., “Four Ethical Priorities for Neurotechnologies and AI,” *Nature* 551, no. 7679 (2017): 159–63, <https://doi.org/10.1038/551159a>.

<sup>29</sup> “Mind uploading” refers to the hypothetical transfer or emulation of an individual consciousness in a computational system.

<sup>30</sup> Luis Enrique Echarte Alonso, “From Neuroethics to Neo-romanticism: Aldous Huxley in Response to Current Proposals for Ethical and Legal Regulation of Neuroscience,” *Scio* 21 (2021): 113–48, [https://doi.org/10.46583/scio\\_2021.21.783](https://doi.org/10.46583/scio_2021.21.783).

<sup>31</sup> Muse, “Research,” accessed August 27, 2026, <https://choosemuse.com/pages/muse-research>.

tive processes. Neurotechnological devices do not merely collect external behavioural information but increasingly enable forms of cognitive monitoring capable of identifying patterns associated with concentration, emotional vulnerability, fatigue, or decision-making processes.<sup>32</sup> Consequently, the distinction between bodily privacy and mental privacy becomes progressively more difficult to maintain in technologically mediated environments.

Consumer neurotechnology frequently relies on artificial-intelligence systems that interpret brain activity through predictive analytics and probabilistic inference. Neural data therefore become economically valuable resources that may be aggregated, commercialized, or repurposed beyond the original purpose of collection. This creates concerns about informational asymmetry, opaque processing, and behavioural influence based on cognitive patterns.

The widespread integration of cognitive tracking technologies also raises questions concerning autonomy and cognitive freedom. Systems capable of monitoring attention, emotional responses, or neurological performance may gradually normalize intrusive forms of surveillance within educational, professional, or domestic contexts.<sup>33</sup> Such technologies risk transforming mental states into measurable and governable categories, potentially affecting individual self-determination and freedom of thought. The possibility that neurotechnological systems could influence behaviour through adaptive feedback mechanisms further complicates traditional understandings of consent and voluntary participation.

Current legal frameworks are not fully equipped to address the specific risks associated with neurotechnology and neural-data processing. Existing data-protection rules conceptualize personal data through categories that do not fully capture the intimate and potentially manipulative nature of neural information. Although some applications fall within medical-device regulation or emerging AI-governance frameworks, gaps remain concerning mental privacy, cognitive integrity, and protection against neurotechnological manipulation.

These developments demonstrate the urgent need for interdisciplinary governance models capable of responding to the legal, ethical, and societal implications of neurotechnology. The growing accessibility of consumer neurodevices<sup>34</sup> suggests that neuroprivacy can no longer be treated as a speculative or futuristic concern. Instead, it represents an emerging dimension of fundamental rights protection requiring legal recognition and regulatory safeguards adapted to the realities of technological convergence.

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<sup>32</sup> Team TrialX, “Clinical Trial Awareness: 5 Clinical Trials Focused on Advancing Brain Health Research,” August 8, 2025, <https://trialx.com/5-clinical-trials-focused-on-advancing-brain-health-research/>.

<sup>33</sup> Forbrain, “Learning Device for Speech, Attention and Memory,” accessed August 27, 2026, <https://www.forbrain.com/>.

<sup>34</sup> Neuralink, “Pioneering Brain–Computer Interfaces,” accessed August 27, 2026, <https://neuralink.com/>.

Consequently, neurotechnology requires a shift from traditional data protection models toward cognitively-oriented rights frameworks.

### **3.1. Neurotechnology, Privacy Policies, and GDPR Transparency Duties**

The commercialization of consumer neurotechnology raises concerns about compliance with the transparency duties in Articles 13 and 14 of the GDPR.<sup>35</sup> Neurotechnological devices and cognitive-monitoring systems may process sensitive data revealing emotional states, attention, behavioural reactions, cognitive performance, and neurological patterns. The adequacy of privacy notices is therefore especially important.

A review of publicly available privacy information for consumer-neurotechnology services, including Muse, Neuralink, neurofeedback systems, and cognitive-tracking technologies, shows differing levels of detail. Providers may identify the controller, data categories, and processing purposes, but information about the processing and reuse of neural data is not always specific or readily intelligible.

Muse's publicly available materials describe the collection and analysis of EEG-related information associated with sleep, focus, mood, and meditation.<sup>36</sup> Although the service provides some transparency mechanisms, questions remain about profiling, secondary uses of neural information, and future repurposing of cognitive data.

Neuralink publishes a privacy policy describing its collection and processing of personal information in connection with its services.<sup>37</sup> Brain-computer interfaces nevertheless create risks that exceed conventional personal-data processing because neural information may reveal intimate cognitive and neurological patterns. These risks reinforce the importance of informed consent, security, protection against unauthorized access, and safeguards for autonomy, identity, and mental integrity.

Privacy policies associated with neurofeedback systems and cognitive tracking technologies also reveal broader structural limitations concerning transparency and informed consent. Although certain providers identify categories of collected information and commercial purposes, privacy notices frequently remain vague regarding predictive analytics, algorithmic inference, profiling practices, and the commercialization of cognitive information. In many situations, us-

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<sup>35</sup> Regulation (EU) 2016/679, General Data Protection Regulation, arts. 13–14, OJ L 119 (May 4, 2016): 1–88, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016R0679>.

<sup>36</sup> Muse, “Your Privacy Choices,” accessed August 27, 2026, <https://choosemuse.com/pages/data-sharing-opt-out>.

<sup>37</sup> Neuralink, “Privacy Policy,” March 12, 2025, <https://neuralink.com/privacy-policy/>.

ers may not fully understand the extent to which their neural activity can be analysed, interpreted, aggregated, or reused beyond the immediate functionality of the technology.

These practices generate risks from both privacy and data protection perspectives. Unlike ordinary personal data, neural data possess a uniquely intimate character because they provide direct insights into mental activity and cognitive processes. The risks associated with neurotechnology therefore extend beyond informational privacy and increasingly affect mental privacy, cognitive autonomy, and psychological integrity. Continuous cognitive monitoring may facilitate behavioural influence, emotional profiling, or forms of neuro-surveillance capable of interfering with individual self-determination and freedom of thought.

From a GDPR perspective, a principal concern is the adequacy and intelligibility of information provided to users about neural-data processing.<sup>38</sup> Privacy notices may fail to distinguish raw neural data from cognitive inferences generated by AI and may provide limited information about automated profiling, secondary use, international transfers, commercialization, or long-term retention.

These developments suggest that existing transparency obligations may require reinterpretation and adaptation in the context of neurotechnology. Traditional data protection frameworks were primarily designed to regulate informational privacy rather than direct forms of cognitive monitoring and neural inference. Consequently, privacy notices relating to neurotechnology should include detailed explanations regarding the nature of neural data, the cognitive objectives of processing activities, the use of predictive analytics, profiling mechanisms, and the potential impact of data processing on mental privacy and cognitive autonomy.

### **3.2. Cognitive Profiling, Psychometric Assessment, and Neurotechnological Governance**

The growing integration of artificial intelligence into psychometric assessment systems demonstrates that cognitive monitoring is no longer limited to invasive neurotechnologies or brain-computer interfaces. Contemporary recruitment platforms and AI-assisted psychometric systems increasingly process behavioural, cognitive, and inferential forms of data. These systems generate highly detailed profiles regarding intellectual abilities, psychological characteristics, emotional reactions, and decision-making patterns. These developments illustrate the broader transformation of digital governance from traditional informational surveillance toward cognitive and behavioural governance.

AI-assisted psychometric platforms, including systems offered by SHL<sup>39</sup>

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<sup>38</sup> Regulation (EU) 2016/679, arts. 13–14.

<sup>39</sup> SHL, “Practice Tests and Assessments,” accessed August 27, 2026, <https://www.shl.com/shldirect/en/practice-tests/>.

and Criteria's CCAT assessment,<sup>40</sup> use predictive analytics, behavioural science, algorithmic scoring, and inferential profiling in recruitment. Although marketed as efficient decision-support tools, they raise concerns about transparency, fairness, privacy, and cognitive autonomy. Such systems interpret behavioural signals and probabilistic inferences to predict conduct, suitability, or psychological traits.

From a data protection perspective, these systems raise questions concerning the scope of information obligations established under GDPR.<sup>41</sup> Existing privacy notices frequently provide general information regarding categories of processed data and assessment purposes. However, they often remain insufficiently transparent concerning the logic of automated scoring systems, predictive analytics mechanisms, benchmarking practices, or the broader implications of inferential profiling. Consequently, individuals subjected to AI-assisted assessments may not fully understand how cognitive information is interpreted, combined, or used within algorithmic evaluation processes.

The risks associated with psychometric AI systems extend beyond ordinary employment-related privacy concerns. Algorithmic assessment technologies may facilitate forms of behavioural classification and cognitive ranking capable of affecting professional opportunities, access to employment, and socio-economic inclusion. These systems also reinforce structural asymmetries between employers, platform providers, and candidates, particularly when algorithmic scoring mechanisms remain opaque or difficult to contest. Furthermore, predictive profiling practices may reproduce discriminatory patterns or generate unfair outcomes through biased datasets, flawed behavioural assumptions, or insufficiently explainable AI models.<sup>42</sup>

The convergence between neurotechnology and psychometric artificial intelligence demonstrates that cognitive data governance increasingly operates across interconnected technological ecosystems. While consumer neurodevices collect neural activity directly through cognitive monitoring systems, psychometric AI platforms generate cognitive inferences indirectly through behavioural analysis and predictive modelling. Despite these technical differences, both categories of systems rely on the extraction, interpretation, and commercialization of sensitive information concerning mental activity and cognitive functioning.

These developments suggest that existing legal frameworks remain predominantly focused on informational privacy rather than cognitive integrity and inferential protection. Traditional data protection approaches primarily regulate identifiable personal data. Meanwhile, AI-driven cognitive systems increasingly

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<sup>40</sup> Criteria, "Criteria Cognitive Aptitude Test (CCAT)," accessed August 27, 2026, <https://www.criteriacorp.com/assess/cognitive-aptitude/criteria-cognitive-aptitude-test-ccat>.

<sup>41</sup> Regulation (EU) 2016/679, arts. 13–14.

<sup>42</sup> Regulation (EU) 2024/1689, Artificial Intelligence Act, OJ L 2024/1689 (July 12, 2024), <https://eur-lex.europa.eu/eli/reg/2024/1689/oj/eng>.

derive behavioural predictions, psychological assessments, and probabilistic conclusions capable of influencing individuals without requiring direct access to neural activity itself. Consequently, the distinction between neural data and inferred cognitive data becomes more difficult to sustain within technologically mediated environments.

The expansion of AI-driven psychometric governance therefore strengthens arguments supporting the recognition of neuroprivacy and mental integrity as autonomous dimensions of fundamental rights protection. The risks generated by cognitive profiling systems cannot be reduced solely to ordinary data protection concerns because they increasingly affect autonomy, freedom of thought, behavioural self-determination, and psychological integrity. In this context, the emergence of neurorights reflects broader concerns regarding the governance of human cognition in technologically mediated societies.

The societal implications of cognitive monitoring are particularly visible in employment. Workplace stress, depression, and burnout can be intensified by organizational pressures that reward constant performance.<sup>43</sup> These conditions make the legal protection of mental life and cognitive autonomy increasingly important.<sup>44</sup>

This article argues that predictive AI in forensic psychiatry should not rely on neurobiology alone but should also account for social and environmental factors.<sup>45</sup>

The increasing use of cognitive-monitoring technologies shows that AI governance must also protect mental autonomy and cognitive freedom. Emerging governance models should address cognitive surveillance and establish safeguards against intrusive behavioural prediction, inferential profiling, and neuro-technological influence.

#### 4. Legal Challenges and the Limits of Current Frameworks

Neurotechnology has generated international concern about its implications for fundamental rights and freedoms. In Resolution 51/3, the United Nations Human Rights Council recognized that neurotechnology may enable access to, monitoring of, and manipulation of the neural system while raising complex ethical, legal, and societal questions requiring human-rights analysis.<sup>46</sup>

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<sup>43</sup> Christoph Bublitz, "My Mind Is Mine? Cognitive Liberty as a Legal Concept," in *Cognitive Enhancement: An Interdisciplinary Perspective*, ed. Elisabeth Hildt and Andreas G. Franke (Dordrecht: Springer, 2013), 233–64, [https://doi.org/10.1007/978-94-007-6253-4\\_19](https://doi.org/10.1007/978-94-007-6253-4_19).

<sup>44</sup> Bublitz, "My Mind Is Mine?"

<sup>45</sup> Georg Starke, Ambra D'Imperio, and Marcello Ienca, "Out of Their Minds? Externalist Challenges for Using AI in Forensic Psychiatry," *Frontiers in Psychiatry* 14 (2023): 1209862, <https://doi.org/10.3389/fpsy.2023.1209862>.

<sup>46</sup> United Nations Human Rights Council, *Neurotechnology and Human Rights*, A/HRC/ RES/51/ 3, October 6, 2022, <https://digitallibrary.un.org/record/3991860>.

The Council of Europe's Strategic Action Plan on Human Rights and Technologies in Biomedicine (2020–2025) historically sought to embed human rights in the development of biomedical technologies. Within that framework, the Council of Europe and the OECD convened a 2021 round table and published a report on the human-rights challenges raised by neurotechnologies.<sup>47</sup>

The existing human-rights framework may be interpreted dynamically in light of new knowledge about the brain and new technological capacities to influence it. From a positivist perspective, however, the line between substantially reconceptualizing an existing right and introducing a new right can be difficult to draw.<sup>48</sup> Expanding mental integrity to include an entirely new dimension may produce an outcome similar to recognizing a distinct right.<sup>49</sup>

The rapid development of neurotechnology exposes significant limitations in legal frameworks governing privacy and data protection. Traditional regulatory models were not designed for the depth and sensitivity of neural data. A central issue is whether existing human-rights law adequately protects mental privacy or whether neuro-specific safeguards must be established.<sup>50</sup>

Existing legal instruments protect against some forms of personal-data misuse, but their application to information derived directly from brain activity remains contested. On April 17, 2024, Colorado enacted House Bill 24-1058, which amended the Colorado Privacy Act by treating biological data, including neural data, as sensitive data. The law took effect on August 7, 2024.<sup>51</sup>

This distinction challenges the adequacy of existing legal categories, including data protection, privacy, and bodily integrity. These frameworks do not fully capture the intrusive potential of technologies capable of accessing or influencing mental processes.

Moreover, the principle of consent, central to many legal systems, becomes increasingly problematic in the context of neurotechnology. Individuals may lack full awareness of how their neural data is collected, interpreted, or used, which undermines the validity of informed consent.

The difficulty of distinguishing between therapeutic and non-therapeutic uses further complicates regulatory responses. Technologies initially developed

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<sup>47</sup> Council of Europe, *Common Human Rights Challenges Raised by Different Applications of Neurotechnologies in the Biomedical Field* (2021), <https://www.coe.int/en/web/human-rights-and-biomedicine/round-table-on-the-human-rights-issues-raised-by-the-applications-of-neurotechnologies>.

<sup>48</sup> Nora Hertz, "Neurorights—Do We Need New Human Rights? A Reconsideration of the Right to Freedom of Thought," *Neuroethics* 16 (2023): article 5, <https://doi.org/10.1007/s12152-022-09511-0>.

<sup>49</sup> Istace, "Human Rights Law," 309–40.

<sup>50</sup> Vidal, "Neurotechnologies under the Eye of Bioethics."

<sup>51</sup> Colorado General Assembly, House Bill 24-1058, "Protect Privacy of Biological Data," approved April 17, 2024, effective August 7, 2024, <https://leg.colorado.gov/bills/hb24-1058>.

for medical purposes may be repurposed for commercial or behavioural manipulation.

As a result, legal systems face structural challenges in adapting to these developments. The evolving nature of neurotechnology requires more flexible and anticipatory regulatory approaches capable of addressing emerging risks.

Neurorights are generally understood as rights or safeguards aimed at protecting mental privacy, cognitive liberty, mental integrity, and psychological continuity from neurotechnological interference.

## 5. The Neurorights Debate

Concerns about brain manipulation and the collection and disclosure of neural data have led to calls for “neurorights.” These proposals seek safeguards tailored to brain data and neurological intervention and commonly address mental privacy, agency, identity, cognitive liberty, psychological continuity, and freedom from harmful manipulation.

Several provisions of the European Convention on Human Rights may protect the mind: the prohibition of ill-treatment in Article 3; the right to respect for private life, including privacy, integrity, autonomy, and identity, in Article 8; and freedom of thought in Article 9. Other provisions may also be relevant in particular contexts. Article 5 has been discussed in relation to access to neurotechnological treatment for some detainees,<sup>52</sup> while Articles 6 and 10 may apply to the use and disclosure of mental information in criminal proceedings.<sup>53</sup> Articles 2 and 14 may also be engaged in limited circumstances. The ECHR therefore provides a central, though not necessarily exhaustive, framework for examining the protection of the mind.<sup>54</sup>

The convergence of AI and neurotechnology raises issues of data privacy, autonomy, fairness, transparency, identity, bias, and accountability. Neurotechnology also introduces distinctive risks because it may intervene directly in neural processes and threaten mental integrity.<sup>55</sup>

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<sup>52</sup> Johannes Bijlsma et al., *Kansen en Risico's van de Toepassing van Neurotechnologie in het Strafrecht* (The Hague: WODC, 2022), 7, 106, <https://repository.wodc.nl/handle/20.500.12832/3174>.

<sup>53</sup> Sjors Ligthart, *Coercive Brain-Reading in Criminal Justice: An Analysis of European Human Rights Law* (Cambridge: Cambridge University Press, 2022), chaps. 5–6, <https://doi.org/10.1017/9781009252447>; Sjors Ligthart et al., “Forensic Brain-Reading and Mental Privacy in European Human Rights Law: Foundations and Challenges,” *Neuroethics* 14 (2021): 195, 198–99, <https://doi.org/10.1007/s12152-020-09438-4>.

<sup>54</sup> Naomi Anna Willemijntje van de Pol, *Protection of the Mind under the ECHR: An Analysis in Light of Emerging Neurointerventions in Criminal Justice* (PhD diss., Utrecht University, 2026), <https://doi.org/10.33540/3323>.

<sup>55</sup> Liam J. Robertson et al., “Ethical Governance Strategies for the Responsible Innovation of Neurotechnologies: A Scoping Review,” *Journal of Bioethical Inquiry* 22, no. 4 (2025): 931–48, <https://doi.org/10.1007/s11673-025-10440-9>.

Recommended responses include anticipatory regulation, interdisciplinary collaboration, and the prioritization of human dignity.<sup>56</sup> UNESCO's governance work emphasizes cognitive liberty, justice, mental privacy, psychological continuity, and personal identity.<sup>57</sup> Rather than embracing technological determinism or bioconservative alarmism, it supports a rights-based framework in which individuals are not treated merely as means in technoscientific projects.<sup>58</sup> The OECD Recommendation on Responsible Innovation in Neurotechnology similarly stresses safeguards for autonomy, human rights, and personal brain data throughout development and deployment.<sup>59</sup>

The emergence of neurotechnology has generated an intense debate regarding the necessity of recognizing new rights specifically designed to protect the human mind. This discussion revolves around the concept of neurorights.

In this context, the Neurorights Foundation advocates a leading role for the United Nations in building international consensus on the protection of neurorights.<sup>60</sup>

Proponents of neurorights argue that existing legal protections are insufficient to address the unique risks posed by neurotechnological interventions. They emphasize the need for explicit recognition of rights such as protection of personal identity, mental privacy and integrity, cognitive liberty and psychological continuity.<sup>61</sup>

These proposals seek to protect individuals against unauthorized access to neural data and external interference with cognitive processes. Critics respond that the priority should be to reinterpret and strengthen existing rights rather than fragment the human-rights framework. The debate remains unresolved and reflects a wider tension between legal innovation and doctrinal continuity.

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<sup>56</sup> Alexander V. Shenderyuk-Zhidkov, Vladimir A. Maximenko, and Alexander E. Hramov, "Ethical Challenges at the Intersection of Artificial Intelligence and Neurotechnology," in 2025 9th Scientific School Dynamics of Complex Networks and Their Applications (DCNA) (IEEE, 2025), <https://doi.org/10.1109/DCNA67486.2025.11199934>.

<sup>57</sup> UNESCO, *The Risks and Challenges of Neurotechnologies for Human Rights* (Paris: UNESCO, 2023), <https://doi.org/10.54678/POGS7778>.

<sup>58</sup> Luiz Fernando Ridolfi and Silanides Saraiva Santos, "Neurotechnology and Philosophy of Neuroscience: Ethical and Ontological Challenges in the Era of Brain-Computer Interfaces," *Revista Ibero-Americana de Humanidades, Ciências e Educação* 11, no. 9 (2025): 2880–92, <https://doi.org/10.51891/rease.v11i9.21134>.

<sup>59</sup> OECD, *Recommendation of the Council on Responsible Innovation in Neurotechnology*, OECD/LEGAL/0457 (December 11, 2019), <https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0457>.

<sup>60</sup> Neurorights Foundation, "Mission," accessed August 27, 2026, <https://neurorightsfoundation.org/>.

<sup>61</sup> Marcello Ienca and Roberto Andorno, "Towards New Human Rights in the Age of Neuroscience and Neurotechnology," *Life Sciences, Society and Policy* 13 (2017): article 5, <https://doi.org/10.1186/s40504-017-0050-1>.

## **6. Governance and Regulatory Perspectives: Ethical and Societal Implications**

The current human rights framework can shield people from many of the risks associated with neurotechnological applications.<sup>62</sup>

A central governance question is whether conceptual difficulties in defining new, standalone rights justify relying instead on the interpretation of existing rights. Achieving transnational consensus on a new treaty may be more difficult than developing existing rights through courts and competent treaty bodies, such as the United Nations Human Rights Committee.<sup>63</sup>

As the limitations of existing legal frameworks become more apparent, attention has increasingly shifted toward the development of governance models for neurotechnology. These approaches emphasize coordination between legal, ethical, and technological perspectives.

Regulatory responses are emerging at both national and international levels, often taking the form of guidelines, recommendations, and soft law instruments. These mechanisms allow for flexibility and adaptability in a rapidly evolving field.

Interdisciplinary collaboration plays a central role in shaping these governance frameworks.

At the same time, the convergence between neurotechnology and artificial intelligence introduces additional regulatory complexity. The interaction between these fields amplifies existing risks and creates new challenges for governance.

If human decision-making is not meaningfully integrated with AI systems, people risk being left merely “on the loop” rather than “in the loop.”<sup>64</sup>

Effective regulation requires anticipatory approaches capable of addressing future developments rather than reacting to them retrospectively. This involves balancing innovation with the protection of fundamental rights.<sup>65</sup>

In this context, governance is not limited to formal legal rules but includes broader mechanisms of accountability, transparency, and ethical oversight.<sup>66</sup> These elements are essential for ensuring responsible technological development.

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<sup>62</sup> Abel Wajnerman-Paz et al., “A Healthcare Approach to Mental Integrity,” *Journal of Medical Ethics* 50, no. 10 (2024): 664–69, <https://doi.org/10.1136/jme-2023-109682>.

<sup>63</sup> Istace, “Human Rights Law,” 309–40.

<sup>64</sup> Prashant Desai, John R. Shook, and James Giordano, “Assessing Systemic Benefit and Risk in the Development of BCI Neurotechnology,” in *Brain–Computer Interfaces*, ed. Mikhail A. Lebedev (Academic Press, 2025), 431–43, <https://doi.org/10.1016/B978-0-323-95439-6.00018-1>.

<sup>65</sup> Daniela Duță, “Responsible Innovation: Confidentiality, Privacy and Data Protection,” *L’Europe Unie* 20 (2023): 27–35, <https://doi.org/10.5281/zenodo.15194440>.

<sup>66</sup> Leda Tortora et al., “Neuroprediction and A.I. in Forensic Psychiatry and Criminal Justice: A Neurolaw Perspective,” *Frontiers in Psychology* 11 (2020): 220, <https://doi.org/10.3389/fpsyg.20>

The special status of the brain lies at the heart of neuroethical inquiry. Neuroethics is an interdisciplinary field at the intersection of the human sciences and neuroscience. It examines how neuroscience and neurotechnology may affect individuals, relationships, everyday life, work, and society.<sup>67</sup>

International human-rights law already provides broad protection against harmful intrusions into the body, brain, mind, thoughts, identity, opinions, and privacy. Institutions such as UNESCO, the Human Rights Council, treaty bodies, and national courts can interpret and apply that framework to modern technology. Because many risks arise from private companies, states must also ensure that domestic law addresses non-consensual measurement and processing of brain activity through effective regulation, civil liability, or criminal law where appropriate.<sup>68</sup>

No single method for measuring psychological influence in digital interfaces has yet achieved general acceptance. Interdisciplinary research is needed to develop reliable tools for assessing digital manipulation.<sup>69</sup> Freedom of thought may already provide strong protection for the mental domain, while data-protection rules should enable meaningful control over the processing and withdrawal of neural data.<sup>70</sup>

Beyond legal considerations, neurotechnology raises profound ethical and societal questions. Its capacity to access and influence mental processes directly affects core aspects of human identity and autonomy.

The potential for behavioural manipulation represents one of the most significant ethical concerns. Technologies capable of influencing decision-making processes may undermine individual agency and freedom.

Issues of inequality and access further complicate the ethical landscape. Unequal distribution of neurotechnological benefits may reinforce existing social disparities and create new forms of exclusion.

Commercial uses of neurotechnology, particularly in areas such as neuromarketing, raise additional concerns regarding exploitation and data misuse. The commodification of mental activity challenges traditional understandings of personal autonomy.

Public perception and awareness also play a critical role in shaping the

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<sup>67</sup> Laure Tabouy, “Neuroethical Issues in Times of Health Crisis: What Roles for Neurosciences, AI, and Neurotechnologies?,” preprint, 2026, <https://univ-reims.hal.science/ETHIQUE/hal-05486222v1>.

<sup>68</sup> Sjors Ligthart, Christoph Bublitz, and Susie Alegre, “Neurotechnology: We Need New Laws, Not New Rights,” *Nature* 620, no. 7976 (2023): 950, <https://doi.org/10.1038/d41586-023-02698-z>.

<sup>69</sup> Elena Cristina Popa Tache and Cătălin-Silviu Sararu, “Law, Neuroscience, and Authenticity by Design: Protecting Users’ Minds in the Digital Sphere,” *Frontiers in Psychology* 17 (2026): 1815392, <https://doi.org/10.3389/fpsyg.2026.1815392>.

<sup>70</sup> Popa Tache and Sararu, “Law, Neuroscience, and Authenticity by Design.”

societal impact of neurotechnology. Misunderstandings or exaggerated expectations may influence both regulatory responses and technological development.

Addressing these challenges requires not only legal solutions but also broader societal engagement. Ethical reflection must remain an integral component of technological governance.

## 7. Conclusions

Recent neurotechnologies can visualize or alter aspects of brain function and mental life.<sup>71</sup> They offer new medical possibilities while also posing ethical and societal challenges. The capacity to access and influence mental states raises questions about privacy and autonomy and underscores the need for responsible-innovation frameworks that promote well-being without infringing individual rights.<sup>72</sup>

Brain–computer interfaces capable of altering perception, supporting memory, or modulating neural activity are moving from speculation toward practice. The mental domain, long regarded as an exceptionally private sphere, is therefore increasingly exposed to technological access. Existing safeguards address part of the risk, but their application remains uncertain. Carefully defined neuro-specific protections may be needed to secure mental privacy, identity, and integrity while avoiding unnecessary fragmentation of the human-rights system.<sup>73</sup>

The ethical implications are profound. Technologies capable of influencing behaviour raise concerns about autonomy and free will.<sup>74</sup>

Protecting cognitive autonomy in digital environments is indispensable to human dignity and social cohesion. Despite difficulties of legal definition, regulatory coordination, and scientific impact assessment, policymakers can build on existing human-rights and data-protection principles. Effective implementation will require interdisciplinary, multidisciplinary, and transdisciplinary collaboration among legal scholars, neuroscientists, ethicists, technologists, regulators, and affected communities.<sup>75</sup>

The analysis demonstrates that existing legal frameworks, particularly

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<sup>71</sup> Sjors Ligthart, Emma Dore-Horgan, and Gerben Meynen, “The Various Faces of Vulnerability: Offering Neurointerventions to Criminal Offenders,” *Journal of Law and the Biosciences* 10, no. 1 (2023): lsad009, <https://doi.org/10.1093/jlb/lsad009>.

<sup>72</sup> Ari Rotenberg et al., “The Neurotechnology Patent Landscape in a Time of Neuroethics,” *Humanities and Social Sciences Communications* 12 (2025): article 633, <https://doi.org/10.1057/s41599-025-04757-4>.

<sup>73</sup> Giampaolo Collecchia, “Neurotechnologies and Neurorights: Mental Privacy,” *Recenti Progressi in Medicina* 112, no. 5 (2021): 343–46, <https://doi.org/10.1701/3608.35871>.

<sup>74</sup> Gerben Meynen and Guy Widdershoven, “The Impact of Closed-Loop DBS on Agency: An Open Question,” *AJOB Neuroscience* 8, no. 2 (2017): 79–80, <https://doi.org/10.1080/21507740.2017.1320325>.

<sup>75</sup> Popa Tache and Sararu, “Law, Neuroscience, and Authenticity by Design.”

those centred on privacy and data protection, remain insufficient to address the unique nature of neural data and the risks associated with neurotechnological applications. Neural data differs fundamentally from ordinary personal data because it may reveal thoughts, emotions, intentions, and subconscious cognitive patterns. Consequently, neurotechnology raises challenges that directly affect mental integrity, cognitive autonomy, and human dignity.

In this context, the debate surrounding neurorights reflects the growing need to protect the human mind against intrusive technological interference. While existing human rights frameworks provide an important foundation for protection, they are no longer sufficient on their own to respond to the increasing capacity of neurotechnology to monitor, predict, and influence cognitive processes. Therefore, new specific rights and safeguards are needed to protect mental privacy, cognitive liberty, psychological continuity, and freedom against harmful manipulation of mental activity. At the same time, reinterpretation of existing rights, particularly the rights to privacy, freedom of thought, and mental integrity, remains essential for ensuring immediate legal protection within current human rights systems.

The convergence between neurotechnology and artificial intelligence further intensifies these concerns by enabling predictive profiling, cognitive inference, and increasingly sophisticated forms of behavioural influence. Effective governance therefore requires interdisciplinary and anticipatory regulatory approaches combining law, ethics, neuroscience, and technological oversight. Ultimately, neurotechnology forces contemporary legal systems to reconsider the boundaries of autonomy, identity, and mental freedom in technologically mediated societies. Protecting the human mind can no longer remain solely a philosophical or ethical aspiration. It has become a legal necessity.

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