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Contextualizing Neuroprotection: Latin American Perspectives on the Impact of Neurotechnological Development in Life and Society

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AI and Neurotechnology Regulation in Chile: A Comparative Case Analysis



Gabriela Arriagada-Bruneau, Abel Wajnermann, and Pablo López-Silva

Abstract In 2021, Chile became the first country to discuss two initiatives addressing the potential misuse of neurotechnologies: a constitutional amendment (Bill 13827-19) and a bill to create neurorights (Bill 13828-19). While the constitutional reform was swiftly approved, the bill for the creation of specific neurorights remains under discussion in the Chamber of Deputies. Despite initial support, both initiatives currently face criticism. Meanwhile, Chile has advanced in regulating AI systems through legislative proposals (Bills 16821-19/15869-19). A study by (Humeres et al. in *Big Data Society*, 12(1), 2025) identifies three key controversies in Chile's AI regulation process: deflection of technology liability, instrumentalization of policy, and moralization of technology use. This chapter explores how this analysis focused on sources of controversy could inform the neurorights debate currently in need of a systematic socio-political analysis. Applying this framework could help categorize the diverse positions within the discussion, providing a more comprehensive understanding of its development.

Keywords Artificial intelligence · Neurotechnology · Neurorights · Regulation

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1 Introduction

In 2021, Chile became the first country in the world to discuss two initiatives aimed at protecting citizens from the potential misuse of medical and commercial neurotechnologies, namely, a bill to amend the first section of Article 19 of the national constitution (Bill 13827-19), and a bill to create specific neurorights with legal force (Bill 13828-19). Following ethical concerns raised in the context of multiple international scientific research projects focused on neurotechnological development, these two initiatives were aimed to show the government's explicit concern about how neurotechnologies could negatively impact society at different levels if not properly regulated. However, despite its initial popularity, both initiatives have received a number of criticisms over the last years (Borbón & Borbón, 2021; Bublitz, 2022; Hertz, 2023; Lighthart et al., 2023; Susser & Cabrera, 2023; Zuñiga-Fajuri et al., 2021; López-Silva & Madrid, 2021, 2022, 2024). Indeed, while the constitutional reform was promptly approved, the bill for the creation of specific neurorights is still under discussion in the Chilean's Chamber of Deputies. In parallel, and contrasting with the tone of the neurorights discussion, over the last two years Chile has been moving forward in the implementation of legal changes aiming at regulating the use and application of Artificial Intelligence (AI) technology systems (Bill proposal 16821-19/15869-19). A detailed examination of the socio-political dynamics of AI regulation in Chile offered by Humeres et al. (2025) identifies three main sources of controversy during the legislative process, namely, the deflection of technology liability, the instrumentalization of technology policy, and the moralization of technology use. In this chapter, we examine how the identification of these sources of controversy could inform the examination of how the discussion about neurorights in Chile has developed. In contrast to the AI case, the analysis of the socio-political dynamics of the neurorights debate in Chile has not been systematized so the application of this analytic framework could allow the elaboration of a comprehensive characterization of different positions that have been defended in this context.

2 AI Regulation in Chile

Traditional technology governance models face significant challenges when applied to the analysis of the ethical issues associated with the use of AI technologies. While such models are often thought to regulate predictable component-based systems, AI technologies are inherently opacity systems characterized by emerging behaviors. As Judge et al. (2024) argue, the unpredictability of AI systems, particularly those developed through machine learning (ML), undermines the conventional assumption that design and operational compliance can ensure safety and reliability. As a consequence, there seems to be an urgent need to develop adaptive and robust regulatory models tailored to AI's complexities and the ecosystem in which they operate.

One major debate in this context centers on whether AI should be governed through sector-specific regulations or horizontal approaches encompassing all applications in society (Finocchiaro, 2024). While the European Union's AI Act exemplifies the latter (offering a framework with risk-based classifications and harmonized rules), other approaches emphasize the tailoring of regulations to specific domains such as healthcare, data protection, and justice (Kane, 2021; Laptev & Feyzrakhmanova, 2024; Palaniappan et al., 2024; Tschider et al., 2024). This dichotomy seems to reflect broader tensions between fostering innovation and ensuring ethical compliance, a balance that is particularly challenging given the rapid pace of technological advancement and global competition (de Bruin, 2024; Staszczyk, 2024). Furthermore, the international nature of AI development underscores the need for transnational regulatory coordination. Zaidan and Ibrahim (2024) highlight the limitations of fragmented national approaches, emphasizing the risks of uneven development and the potential for regulatory arbitrage. The authors advocate for the establishment of a global regulatory authority to harmonize standards and ensure equitable distribution of AI's benefits while mitigating its risks. This perspective aligns with calls for a precautionary yet enabling framework that addresses both innovation and responsibility.

As aforementioned, Humeres et al. (2025)'s study explored how legislative debates regarding AI regulation in Chile are shaped through specific processes that temper potentially contentious discussions. This case study not only highlights the specific processes employed in Chile but, as we will argue, it also offers insights applicable to broader global regulatory efforts that can apply to the field of neurotechnologies, as similar challenges apply to both discussions. In their analysis, the authors analyze the discussions in the Chilean Chamber of Deputies regarding AI regulation, which occurred within the "Future, Science, Technology, Knowledge, and Innovation" Commission, which initiated the deliberation of a draft bill in mid-2023. Participants in these debates included a mix of parliamentarians from various political parties, state bureaucrats, and invited experts primarily from academia. These experts represented fields such as engineering, law, and social sciences. The discussions, spanning 11 sessions, were held in person and were accessible to the public through broadcasts on the National Congress's website. Citizen participation was limited to a brief consultation period to gauge public approval of legislating AI. This diverse yet focused assembly sought to explore the implications of regulating AI systems, robotics, and related technologies across various applications, reflecting a wide range of perspectives on the opportunities and challenges posed by AI. In the remainder of this chapter, we examine how the three main sources of controversy identified by the authors in the AI regulation process in Chile can inform our understating of three main domains in the case of neurorights: (1) the distinction between regulating neurotechnology and regulating its use, (2) the tension between developing situated regulations tailored to the local context and harmonizing local and international regulations and (3) the relationship between legal and ethical norms.

3 AI and Neurotechnology Regulation: Towards a Comparative Analysis

3.1 *Deflection of Technology Liability*

The deflection of technology liability highlights a pivotal aspect of legislative debates: the evolution from defining AI as a technology to questioning whether AI itself should be subject to regulation. While there was no universal consensus, a significant number of participants framed AI as a neutral tool—a mere object devoid of intentions. This perspective argued that responsibility should rest with human users rather than the technology itself, suggesting that existing legislation already governs human actions sufficiently.

The authors notice that in its initial draft, the Chilean Chamber of Deputies (CD) incorporated a definition of AI based on the European AI Act, conceptualizing it as a collection of computational techniques. However, this broad definition faced persistent criticism. Critics argued that it was so encompassing that even simple tools, like calculators, could fall under its scope. From a computer science perspective, this vagueness was problematic, conflating all computational systems with AI, thereby diluting the focus on tools exhibiting human-like intelligence. Key objections revolved around the portrayal of AI as functionally neutral, with its effects determined entirely by human agency. Analogies like “a hammer can build a house or attack a person” were used to argue that AI itself is neither inherently harmful nor beneficial—it depends on how individuals wield it. This perspective, prominent among industry representatives, emphasized regulating human misuse rather than the technology itself.

Conversely, legal scholars in Senate working groups advocated for broader, flexible definitions capable of adapting to the evolving nature of technology. Drawing from legal principles, they argued that rigid definitions risk excluding future phenomena that could require regulation. This perspective aligned with global trends, including Europe’s adjustments to generative AI and anticipatory regulation for potential scenarios like general AI. The debates often revealed a tension between the technical precision demanded by computer scientists and the broader societal concerns raised by social scientists and legal experts. For example, efforts to highlight risks like misinformation and algorithmic bias were frequently reframed into technical language, leading to a disconnect. Computer scientists often dismissed these concerns as impractical or overly simplistic, stalling meaningful discussions on AI’s social impacts.

The debate between technology as neutral or value-laden has also been raised during the drafting of the neurotechnology bill. In this case, there was a consensus between scholars and policymakers involved in the debate that the bill’s aim should not be to regulate the technologies themselves, but their research, medical and commercial applications (Amunátegui Perelló, 2022). However, a key aspect of the bill may suggest otherwise. From an application-focused approach, one would expect

to find distinct sets of rules oriented to the particularities of each domain. Nevertheless, a key article seems to establish regulations for medical technologies as the standard for the regulation of *all uses* of neurotechnology.

Article 7 of Bill 13828-19 states that all neurotechnologies should be registered by the Instituto de Salud Pública (ISP, *Institute of Public Health*)—the Chilean equivalent to the US's Food and Drug Administration (FDA). This registration requires that independently of whether the technology is intended for medical use or not, its effectiveness and safety would be tested in the same way as medical technologies. Medical testing studies must be performed to provide evidence regarding potential adverse effects. Depending on this evidence, The ISP may assign a qualification to each registered neurotechnology “according to their impact on people's health” (Article 8). In this sense, the law takes a medical standpoint and demands that non-clinical devices comply with the rules of therapeutic instruments. Crucially, no other consumer-oriented kind of device currently requires such a standard in Chile (Fuentes et al., 2025).

The nature of the assessment of the ISP seems to be aligned with the application-focused approach. The developers are required to state the intended uses of the technology, and the bill declares certain uses as explicitly prohibited. This includes influencing human conduct or extracting data without the user's consent, exploiting weaknesses, or affecting the neuroplasticity of vulnerable groups, children, and young adults. Some of these prohibitions were inspired by the European Proposal of Harmonized Rules on Artificial Intelligence, while others, such as the one regarding neuroplasticity, refer to a specific problem of neurotechnologies (Amunátegui Perelló, 2022).

Despite this apparent focus on the device applications, treating all neurotechnologies as medical seems to contradict their intrinsic neutrality. ISP registration process is aimed at preventing specific risks that may be unique to technologies intended for medical uses. However, Article 7 seems to presuppose that in the case of neurotechnologies, these risks are independent of the intended use. Is this a reasonable assumption? It may be in the case of ‘stimulation’ or ‘modulation’ neurotechnologies, technologies that influence neural activity through electrical or magnetical stimulation. Neural processes underlying psychological function are highly complex and, in most cases, still poorly understood. Therefore, potential harms to mental health may be much more difficult to predict than in the case of devices that influence the mind through the usual sensory pathways (e.g., digital technologies). Additionally, the physical interaction between the device and the brain exposes users to potential physical harm, a risk that is absent in other mind-related technologies. These risks may ground the idea that a high degree of protection is due to technology users independently of the intended use of the device.

However, this assumption may not be reasonable in the case of ‘mind-reading’ and non-invasive or non-implanted neurotechnologies. For instance, consider EEG devices. While being in contact with the scalp, EEG electrodes pick up neural signals by interacting with the waves of ions produced by neural activity (Yeh, 2012). *Prima facie*, all the physical and mental health risks mentioned above are not present in this kind of device-brain interaction. Furthermore, this is one of the technologies most

widely used for non-medical uses, including education and labor-related applications (Muhl & Andorno, 2023; Privitera & Du, 2022). In this case, the reason to regard these technologies as intrinsically medical could be related to the specially sensitive nature of the neural data they collect (Wajnerman-Paz, 2022). Perhaps all neural data can be classified as medical data because of the medical information it can be inferred from it. This would justify treating all the ‘reading’ neurotechnologies as medical regardless of intended applications.

We agree that this is a plausible line of reasoning. However, it implies that many other technologies, including those targeted by the AI bill, should also be classified (and regulated) as medical (Wajnerman-Paz & López-Silva 2022). Behavioral data generated in digital platforms is processed by increasingly complex and powerful algorithmic techniques that have been proven to be successful in obtaining medical information. For instance, digital footprints of social media users may be used to identify a wide variety of medical conditions, such as postpartum depression disorder, PTSD, Anxiety, OCD, bipolar disorder, eating disorder, attention deficit, hyperactivity disorder, anxiety, and schizophrenia (Wongkoblapp et al., 2017).

3.2 The Instrumentalization of Technology Policy

The instrumentalization of technology policy is the second source of controversy noted by the authors and it represents a core source of controversy in AI regulation, rooted in competing geopolitical and economic aspirations. In the Chilean legislative debates, stakeholders often framed regulatory approaches in terms of alignment with global paradigms, such as those established by the European Union (EU) or North America. Proponents of rapid regulation emphasized the symbolic importance of Chile being the first Latin American country to enact comprehensive AI laws, asserting this would position the nation as a regional leader in technology policy. For example, a legislator highlighted the need for Chile to navigate between regulatory models to align with global expectations, framing this ambition as indispensable given the rising ubiquity of AI across sectors.

Conversely, critics cautioned against the regulatory pressure stemming from such aspirations, arguing that premature legislation could inadvertently suppress innovation. One tech industry representative described the situation as a “regulatory burden” noting that strict adherence to international frameworks, such as the EU’s AI Act, could impose excessive compliance costs, particularly for local enterprises. This view reflects broader concerns about the region’s economic role as a consumer rather than a producer of AI technologies, with some stakeholders emphasizing the necessity of adopting pragmatic policies that foster infrastructural and developmental growth. The resulting tension highlights the dichotomy between the aspirations for “technological sovereignty”—as described by advocates for local innovation—and the perceived need to conform to external regulatory models that may not align with

Chile's socio-economic realities. These competing perspectives exemplify how political agendas and global positioning efforts shape and often constrain the discourse on AI governance.

The worry about overly restrictive regulation and the need to adapt to international regulation to avoid a negative impact on local marketing opportunities has also been discussed regarding neurotechnology (Rodríguez et al., 2021; Wajnerman-Paz, 2021). However, in this case, the international context is significantly different because a neurotechnology equivalent of AI regulations in the EU or the US did not exist when the discussion in Chile started. On the contrary, the Chilean bill was a pioneer attempt to implement a neurotechnology-centered framework that was intended to trigger a snowball effect in the rest of the world (Ruiz et al., 2024). Indeed, this seems to be what happened, as several Latin-American countries, including Mexico, Brazil, Argentina, and Colombia followed Chile in developing their regulatory proposals, often aligned with neurorights frameworks (Borbón & Ramírez Gómez, 2024). *Prima facie*, this context seems to provide a solution to the tension between technological sovereignty and the need to conform to external regulations, as Latin American countries would be protagonists in the development of international frameworks.

However, it is unlikely that this solution to the problem will work in the long term. The reason is that the neurorights frameworks on which most Latin American proposals are based have received significant criticism from academia (e.g. Borbón & Borbón, 2021; Bublitz, 2022; Hertz, 2023; Lighthart et al., 2023; Susser & Cabrera, 2023; Zuñiga-Fajuri et al., 2021). Symptomatic of these voices being heard are the more conservative proposals developed by leading organizations. For instance, current recommendations from the United Nations Human Rights Council (2024), OHCHR; OECD (2019), Council of Europe (2023), and the Inter-American Juridical Committee—OAS (2023), do not advocate for new rights, but rather make soft law and principle-based recommendations (Borbón, 2025).

This forces Latin America to face again the risk of losing technological sovereignty to fit into international regulation. Nevertheless, unlike what can be seen in the AI debate, the motivation to drop or reformulate their proposals could be grounded on much more than pragmatic or instrumental reasons. Criticism against some formulations of neurorights proposals is very widespread and well-founded and, to the best of our knowledge, has not received an appropriate response from their main advocates.

3.3 The Moralization of Technology Use

Lastly, the third source of controversy is called the moralization of technology use, which centers on the substitution of ethical frameworks for enforceable regulatory measures in AI governance. In Chile's legislative discourse, corporate actors and tech sector representatives frequently invoked ethical principles as an alternative to formal regulation, arguing that adherence to voluntary ethical guidelines could ensure socially responsible AI without imposing burdensome legal restrictions. This stance

was exemplified by industry claims that companies already follow best practices in areas such as transparency, privacy, and non-discrimination, rendering additional legislative oversight unnecessary. For instance, representatives from multinational corporations like Google and Microsoft proposed self-regulation mechanisms as sufficient safeguards, emphasizing that ethical standards would promote innovation without stifling entrepreneurship.

Critics, however, identified this reliance on ethical discourse as a form of “ethics washing”, where corporations use the language of ethics to resist legally binding accountability. Social scientists participating in the debates expressed concerns that deferring regulation in favor of ethical principles risks privileging industry interests over the protection of fundamental rights. One academic described this dynamic as a “remedy worse than the disease”, suggesting that self-regulation fails to address systemic risks such as algorithmic bias or data misuse. The co-occurrence network in the discussions illustrated the separation between “ethics” and “regulation”, signaling that ethics was often framed as a substitute rather than a complement to lawmaking. Ultimately, this controversy underscores how the invocation of ethics can serve as a strategic tool for delaying or diluting meaningful regulatory efforts, raising critical questions about the efficacy and accountability of self-regulation in the rapidly evolving AI landscape.

Unlike what can be seen in the AI debate, the voice of neurotechnology developers and companies has not been integrated into the local neurotechnology debate. Furthermore, neurotechnology companies have appeared in local media as adversaries rather than collaborators in the regulation and application of ethical standards to neurotechnologies (see Perello 2023; Muñoz et al., 2024). Moreover, the main neurorights frameworks developed in the US and the EU have had initially a strong focus on the legal protection of neurotechnology users (Ienca, 2021).

In the case of the neurotechnology debate, it seems that an opposing trend can be observed. Instead of minimizing the legal protection of users by relying more on ethical guidelines for developers and companies, it seems that the legal protection has been extended to domains that may belong to purely moral considerations. Just to mention a paradigmatic example, one of the most discussed neurorights was the right to equal access to neurotechnologies for mental enhancement or augmentation. As Borbón et al. (2021) argue, “this new right could pose the problem of a new burden for the State, for which it would be forced to finance, with public funds, the introduction of all the neurotechnologies that are developed.” Alternatively, if this becomes a duty for companies, their financial interests would be undermined and therefore they would lose any incentive for technological innovation. The problem, as we see it, is that guaranteeing access to technologies is morally desirable but may belong to the realm of the supererogatory rather than to the mandatory, and therefore is not a norm that should be transformed into legislation.

Similarly, the neuroright to ‘free will’ grounds the mentioned prohibitions to technologically influencing behavior. Besides neurotechnology, digital technologies used for ‘algorithmic nudging’ have also been the focus of this concern. However, many scholars have noticed that it is very difficult to draw a clear line between technological persuasion and coercion, a line that can be turned into precise policy (Zohny et al.,

2023). Although it is morally desirable that people do not use technology to bypass the decision-making capacity of others to serve their purposes, it may be excessive to prohibit all forms of influence, many of which are a constitutive part of most of our daily social interactions.

4 Concluding Remarks

The regulatory challenges surrounding AI and neurotechnology in Chile reflect broader global tensions between innovation, ethical accountability, and legal oversight. While AI governance has sparked contentious debates on liability, policy instrumentalization, and ethical discourse, neurotechnology regulation presents distinct yet overlapping concerns, particularly regarding the classification of these technologies and their potential risks. This comparative analysis highlights how Chile's approach to regulating these emerging fields has been shaped by both international influences and local political dynamics, revealing key areas where regulatory frameworks must evolve to address their unique complexities.

A central issue in both AI and neurotechnology regulation is the deflection of technology liability. In the AI debate, the tendency to frame AI as a neutral tool has led to arguments that human users, rather than the technology itself, should bear responsibility for its harm. This perspective, largely driven by industry stakeholders, risks overlooking the systemic biases and emergent behaviors inherent in AI systems. Conversely, in the case of neurotechnology, the Chilean legislative framework appears to take a more interventionist stance by mandating the classification of all neurotechnologies under medical regulations, regardless of their intended use. This assumption contradicts the intrinsic neutrality of neurotechnologies and raises questions about whether the risks associated with specific applications warrant blanket regulatory measures that may hinder innovation and non-medical applications.

The instrumentalization of technology policy also plays a crucial role in shaping AI and neurotechnology regulation. In AI governance, debates have been influenced by the desire to align with global regulatory trends, particularly those set by the European Union, while also ensuring that Chile does not impose undue restrictions that could stifle local innovation. In contrast, Chile has positioned itself as a pioneer in neurotechnology regulation, with its neurorights framework inspiring legislative efforts across Latin America. However, this leadership role comes with its own challenges, as emerging criticisms of neurorights frameworks may force Chile to reconsider its regulatory approach. The evolving international stance—shifting from rights-based frameworks to softer regulatory guidelines—suggests that Chilean policymakers will need to navigate the tension between maintaining technological sovereignty and ensuring compatibility with global governance standards.

A further distinction between AI and neurotechnology regulation lies in the moralization of technology use. In AI governance, ethical principles are often invoked as an alternative to formal regulation, a trend that critics argue serves to delay meaningful

oversight while allowing corporate interests to dominate the discourse. In contrast, the neurotechnology debate appears to exhibit the opposite tendency, where legal protections have been extended into areas that may be better suited to moral deliberation rather than strict legal enforcement. By critically assessing the interplay between local regulatory debates and international developments, this analysis highlights the importance of avoiding both regulatory overreach and laissez-faire approaches. As Chile continues to shape its AI and neurotechnology policies, it must navigate the fine line between fostering technological innovation and safeguarding fundamental rights. The insights gained from this comparative perspective offer valuable lessons for the broader global discourse on emerging technology governance, emphasizing the need for regulatory models that are flexible, equitable, and attuned to the sociotechnical realities of AI and neurotechnology across different social contexts.

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