Neurotechnology, Cognitive Liberty, and the Law: Building a New Legal Architecture for Mental Autonomy in the Digital Age

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Abstract

The rapid expansion of neurotechnology is transforming the foundational relationship between law, technology, and the human person. Unlike earlier technological developments that primarily affected external behavior or information flows, contemporary neurotechnologies directly intervene in the neural mechanisms of thought, emotion, memory, and decision-making. This shift generates unprecedented risks to mental autonomy, personal identity, and moral agency, exposing the structural inadequacy of existing legal doctrines centered on bodily integrity and informational privacy. Using a narrative review with descriptive analytical methodology, this study examines the technological landscape of neurotechnology, the emerging concept of cognitive liberty in contemporary legal thought, and the growing gap between technological capability and legal protection. The analysis demonstrates that current regulatory frameworks, including human rights law, constitutional law, criminal law, and data protection regimes, fail to address the unique ontological status of neural data and the profound vulnerabilities introduced by direct cognitive intervention. In response, the study develops a comprehensive legal architecture for mental autonomy grounded in the principles of mental inviolability, cognitive self-determination, neural due process, and the categorical prohibition of non-consensual cognitive interference. It further conceptualizes a system of fundamental neuro-rights, including mental privacy, psychological continuity, identity integrity, and freedom from algorithmic mental manipulation, and proposes institutional and regulatory mechanisms for their implementation at domestic and international levels. The findings underscore that the protection of mental autonomy constitutes the next frontier of human rights and represents a decisive challenge for legal systems in the digital age. Without proactive legal reconstruction, neurotechnology risks institutionalizing new forms of domination over the human mind.

Keywords: Neurotechnology; Cognitive Liberty; Mental Autonomy; Neuro-Rights; Human Dignity; Legal Architecture

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1. Introduction

The digital age has ushered humanity into a technological epoch in which the boundaries between mind, machine, and social order are being fundamentally reconfigured. Neurotechnology, once confined to experimental neuroscience laboratories and

highly specialized medical environments, has rapidly migrated into the core of contemporary technological development and public life. Brain–computer interfaces, advanced neurostimulation techniques, large-scale neural data extraction, and consumer-oriented cognitive enhancement systems now constitute a rapidly expanding technological ecosystem that directly engages the most intimate domain of the human person: the mind. This transformation is not merely technical but juridical and civilizational. Neurotechnological innovation increasingly challenges the legal architecture of human rights and compels a rethinking of the conceptual foundations upon which legal systems protect individual autonomy and human dignity. Scholars of law and technology emphasize that artificial intelligence and human-centered technological design must now integrate normative commitments that preserve the integrity of human agency in digital environments (Rezaev & Трегубова, 2023). The emergence of neurotechnology therefore marks not only a new frontier of scientific possibility but also the onset of a profound legal crisis concerning mental autonomy, identity, and freedom.

The contemporary landscape of neurotechnology is characterized by a convergence of neuroscience, digital engineering, artificial intelligence, and big data analytics. Brain–computer interfaces enable direct communication between neural activity and external devices, allowing users to control machines through cognitive signals, while neurostimulation technologies modulate neural circuits to treat neurological disorders or enhance cognitive performance. Developments in neural data extraction allow the collection, storage, and algorithmic processing of neural signals at unprecedented scale, creating new categories of information that reveal mental states, emotional responses, and behavioral tendencies (Ienca & Vayena, 2022). These technologies are no longer limited to therapeutic contexts. Cognitive enhancement devices are increasingly marketed to consumers seeking improved memory, attention, and emotional regulation, while military institutions invest heavily in neurotechnological research to optimize soldier performance, resilience, and decision-making under combat conditions. The transition from clinical therapy to consumer neurotech and military deployment illustrates how neurotechnology has become structurally embedded in economic, political, and security systems, thereby magnifying its legal and ethical implications (Mostajo-Radji, 2023).

This technological expansion redefines the locus of vulnerability within the human person. Traditional legal frameworks evolved to protect bodily integrity, physical privacy, and external forms of coercion, but neurotechnology penetrates beyond these boundaries into the cognitive and psychological dimensions of existence. Digital environments already shape attention, perception, and behavior, as empirical studies on voluntary attention among adult internet users demonstrate how technological interfaces influence cognitive functioning (Medvedskaya, 2022). When such influence becomes technologically internalized through neural interfaces, the legal assumption that the mind remains an inviolable private sphere collapses. Digital nudging mechanisms, which subtly shape user behavior through algorithmic design, illustrate how cognitive influence is already being exercised within contemporary digital ecosystems (Ienca & Malgieri, 2022). Neurotechnology intensifies this phenomenon by enabling direct neural intervention, thereby rendering existing privacy doctrines structurally inadequate.

The historical evolution of rights protecting the human person reflects successive expansions of legal concern from property and physical security toward dignity, autonomy, and privacy. The recognition of bodily integrity and personal liberty formed the foundation of modern human rights, later supplemented by privacy protections as technological surveillance expanded. Yet these doctrines presuppose a separation between external observation and internal cognition. Neurotechnology dissolves this separation by transforming mental processes into quantifiable and manipulable data. International human rights discourse increasingly acknowledges that digital and bio-convergence technologies are giving rise to new categories of rights that extend beyond classical frameworks (Eom, 2022). However, existing constitutional and data protection regimes remain grounded in models of informational privacy and physical autonomy that fail to capture the ontological status of neural data and cognitive processes. Mental integrity, unlike bodily integrity, concerns the continuity of identity, agency, and psychological selfhood, dimensions that are not adequately protected by prevailing legal concepts.

The insufficiency of current doctrines becomes particularly evident when examining data protection law. While legal instruments such as the General Data Protection Regulation recognize sensitive personal data, they conceptualize information as an external attribute of the individual rather than as constitutive of personal identity. Neural data, by contrast, encodes elements of thought, intention, emotion, and decision-making, rendering it qualitatively distinct from ordinary personal information (Ienca & Vayena, 2022). The commodification of such data by technology companies and research institutions creates unprecedented risks of cognitive surveillance, manipulation, and discrimination. These risks are amplified in

geopolitical contexts where technological competition accelerates the deployment of neurotechnologies without adequate normative safeguards (Mostajo-Radji, 2023). The legal order thus confronts a new category of vulnerability that existing rights frameworks were never designed to address.

In response to these developments, scholars have begun conceptualizing cognitive liberty and mental autonomy as foundational normative principles for the neurotechnological era. Cognitive liberty refers to the right of individuals to control their own mental processes, to determine how their brains are used, and to remain free from coercive or non-consensual interference. Mental privacy extends traditional privacy rights to the domain of neural activity, protecting individuals from unauthorized access to their thoughts and cognitive states. Psychological continuity safeguards the stability of personal identity over time, while mental self-determination affirms the capacity of individuals to shape their own cognitive development and experiential life. These concepts draw on philosophical traditions concerning freedom of thought and moral agency, while being reinforced by neuroscientific evidence demonstrating the centrality of neural processes to identity and decision-making. The emergence of neurorights discourse reflects growing recognition that these interests must be legally protected in their own right (Rainey, 2023).

Philosophical inquiry into the nature of personhood underscores that autonomy is not merely the absence of physical constraint but the capacity for reflective self-governance. When technologies alter the conditions under which cognition occurs, they reshape the very foundations of moral agency. Contemporary discussions of human-centered artificial intelligence emphasize that technological systems must preserve meaningful human control and prevent the erosion of psychological coherence (Rezaev & Треруб̆ова, 2023). Neuroscientific research further reveals the plasticity of neural structures and the susceptibility of cognitive processes to external modulation, demonstrating that technological interventions can produce durable changes in personality, memory, and emotional regulation. These insights converge on the conclusion that mental autonomy requires distinct legal recognition and robust protection.

Despite this conceptual progress, the regulatory landscape remains fragmented and underdeveloped. No comprehensive global framework governs neurotechnological development or enshrines cognitive liberty as a fundamental right. International human rights instruments provide partial coverage through freedom of thought and privacy provisions, yet they lack the specificity required to address neurotechnological risks (Eom, 2022). Domestic legal systems exhibit uneven approaches, with some jurisdictions exploring constitutional recognition of neurorights while others rely on existing data protection or biomedical regulations that fail to capture the full scope of neurotechnological impact (Bejar, 2023). This regulatory vacuum creates a dangerous mismatch between the pace of technological innovation and the capacity of legal institutions to respond.

The consequences of this mismatch are already visible. Neurotechnologies are being integrated into digital health platforms, educational systems, workplace environments, and national security infrastructures, often without transparent governance mechanisms or meaningful public oversight. Ethical reviews and soft-law guidelines provide limited constraints, while commercial incentives drive rapid deployment. The experience of digital mental health technologies for young people illustrates how ethical promises often coexist with serious governance challenges and accountability gaps (Wies et al., 2021). As neurotechnologies converge with artificial intelligence and data analytics, the absence of coherent legal architecture threatens to normalize forms of cognitive surveillance and manipulation that undermine democratic values and personal freedom (Vale, 2022).

The crisis of mental autonomy therefore constitutes not merely a technological problem but a structural failure of law to evolve in response to changing conditions of human vulnerability. Legal systems historically expand their protective reach when new forms of power emerge that threaten fundamental interests. The digital age has already forced reconsideration of privacy, data protection, and informational self-determination. Neurotechnology now demands an even deeper transformation, requiring the recognition of the mind itself as a protected legal domain. Without such recognition, technological power will continue to outpace normative control, exposing individuals to unprecedented forms of domination and exploitation.

Against this backdrop, the present study undertakes a comprehensive narrative review of neurotechnology, cognitive liberty, and the emerging legal challenges associated with mental autonomy. Employing a descriptive analytical method, the study systematically examines interdisciplinary scholarship spanning law, neuroscience, ethics, political theory, and technology studies. Primary sources include peer-reviewed academic literature, international legal instruments, policy reports, and doctrinal analyses. The analytical logic of the study proceeds from conceptual clarification to normative evaluation and

institutional design. The first section situates neurotechnology within the broader crisis of mental autonomy and outlines the conceptual foundations of cognitive liberty. The subsequent sections analyze existing legal approaches, identify structural deficiencies, and develop a framework for a new legal architecture capable of protecting mental autonomy in the digital age. The objective of this research is to articulate a coherent theoretical and legal model for safeguarding cognitive liberty and mental integrity in the face of accelerating neurotechnological transformation.

2. Neurotechnology as a Legal Disruptor: New Risks and New Rights

Neurotechnology has rapidly evolved into a heterogeneous and technically complex field whose legal consequences cannot be understood without a careful taxonomy of its principal modalities. Contemporary neurotechnological systems may be broadly distinguished between invasive and non-invasive brain–computer interfaces. Invasive BCIs involve the surgical implantation of electrodes or microchips into neural tissue, enabling high-resolution recording and stimulation of brain activity and offering unprecedented therapeutic potential for paralysis, epilepsy, and neurodegenerative disorders, while simultaneously introducing profound legal questions concerning bodily integrity and long-term neural integrity (Bejar, 2023). Non-invasive BCIs, including electroencephalography-based interfaces, transcranial magnetic stimulation, and functional near-infrared spectroscopy, allow neural signals to be monitored or modulated without physical penetration of the skull, significantly lowering barriers to widespread adoption in consumer, educational, and occupational contexts (Villamil & Wolbring, 2022). Alongside BCIs, advanced neuroimaging technologies now permit increasingly precise mapping of cognitive and emotional processes, while neuromodulation techniques manipulate neural circuits to alter mood, attention, memory, and behavior. Neurodata analytics, powered by artificial intelligence, transform raw neural signals into actionable cognitive profiles, and consumer-grade cognitive enhancement devices promise to improve learning, concentration, and emotional resilience. These interconnected technologies form an integrated ecosystem that dissolves traditional distinctions between therapy, enhancement, and optimization, a transformation that intensifies the urgency of legal reform (Mostajo-Radji, 2023).

The legal disruption generated by this technological taxonomy lies in the fact that neurotechnologies operate directly upon the mechanisms of cognition and identity formation. Where earlier medical devices acted upon organs or physiological systems, neurotechnologies intervene in the neural substrates of thought, emotion, and volition, raising unprecedented risks to mental autonomy. Scholars of digital and bio-convergence have already observed that such technological convergence is reshaping the very concept of human rights, necessitating the recognition of new normative categories that correspond to emerging forms of vulnerability (Eom, 2022). The scale and speed of neurotechnological development further complicate legal oversight, as commercial platforms increasingly integrate neural sensing and stimulation into wearable technologies, gaming systems, productivity tools, and digital health services, thereby embedding cognitive intervention into everyday life (Wies et al., 2021). This normalization of neuro-intervention fundamentally alters the relationship between individuals and the technological environment in which their mental lives unfold.

One of the most alarming risk domains involves neural surveillance and so-called mind-reading technologies. Although contemporary systems do not literally decode subjective thoughts, neuroimaging combined with machine learning algorithms can increasingly infer intentions, emotional states, attention levels, and decision-making tendencies from neural data (Ienca & Vayena, 2022). In contexts such as employment screening, education, marketing, and law enforcement, such capabilities enable unprecedented forms of cognitive monitoring that surpass traditional surveillance models. The extraction and interpretation of neural signals for behavioral prediction or compliance assessment transforms mental processes into governable objects of institutional power, undermining the presumption that thoughts remain inherently private. The use of neurotechnological assessment tools within digital platforms risks producing a society in which cognitive states become continuously measurable and economically exploitable, thereby collapsing the boundary between inner life and external governance (Vale, 2022).

Beyond surveillance, neurotechnology facilitates novel forms of manipulation and coercion. Neuromodulation systems can alter mood, suppress fear, enhance focus, or induce compliance, enabling subtle behavioral modification that operates beneath the threshold of conscious awareness. Algorithmic cognitive nudging, already prevalent in digital platforms, acquires far greater potency when integrated with direct neural feedback loops, allowing systems to optimize persuasive strategies based on real-

time cognitive responses (Ienca & Malgieri, 2022). This technological configuration enables unprecedented forms of influence over human decision-making, raising profound concerns regarding free will, consent, and moral responsibility. When behavioral modification becomes technologically embedded within neural processes themselves, the traditional legal distinction between persuasion and coercion becomes increasingly unstable, threatening the normative foundations of contract law, criminal responsibility, and democratic participation (Rainey, 2023).

A further risk arises in the form of neuro-discrimination and mental profiling. Neurodata analytics permit the construction of cognitive profiles that predict intelligence, emotional stability, attention capacity, risk tolerance, and susceptibility to persuasion. Such profiles may be used to allocate opportunities, determine insurance coverage, assess employability, or target individuals for political messaging. In this context, cognitive characteristics become new axes of social stratification, producing forms of discrimination that operate at the level of neurological traits rather than observable behavior (Villamil & Wolbring, 2022). The experience of digital governance in political systems already demonstrates how algorithmic profiling undermines democratic equality and distorts public discourse (Vale, 2022). When such profiling is grounded in neural data, the resulting power asymmetries become even more entrenched, as individuals lose control over the cognitive attributes through which they are socially evaluated.

Understanding these risks requires a deeper engagement with the ontology of mental data. Neural data differs qualitatively from conventional personal data because it encodes aspects of the self that are constitutive rather than descriptive. Whereas ordinary data records external attributes or past actions, neural data captures the ongoing processes through which identity, intention, and experience are generated (Ienca & Vayena, 2022). This continuity between thought, identity, and autonomy means that interference with neural data is not merely informational intrusion but direct intervention in the formation of the self. Psychological research on attention and cognitive processing demonstrates the sensitivity of mental states to environmental and technological stimuli (Medvedskaya, 2022). When such stimuli are mediated through neurotechnological systems that operate within neural circuits, the potential for durable modification of personality and behavior becomes both scientifically plausible and legally consequential.

The continuity between cognition and identity also explains why neural interference threatens psychological continuity. Identity is not static but emerges through the temporal integration of memory, emotion, and intention. Neurotechnologies that alter these processes risk disrupting the coherence of personal narrative and self-understanding. Digital mental health interventions already illustrate how technological mediation can reshape psychological development, particularly among young users (Wies et al., 2021). As neurotechnologies become more precise and pervasive, their capacity to influence identity formation expands accordingly. Legal systems that continue to conceptualize autonomy solely in terms of external choice fail to recognize this deeper dimension of personal integrity.

Traditional privacy frameworks prove inadequate in addressing these challenges. Data protection regimes treat information as detachable from the person, subject to consent-based transactions and regulatory oversight. Such models cannot accommodate the ontological uniqueness of neural data, which is inseparable from the cognitive processes that constitute agency itself (Ienca & Vayena, 2022). Consent loses much of its protective function when individuals cannot fully comprehend the long-term cognitive consequences of neural data extraction or modulation. Moreover, asymmetries of power between individuals and neurotechnology providers undermine the voluntariness of such consent, particularly in contexts of employment, education, or healthcare where participation in neurotechnological systems may become de facto mandatory (Bejar, 2023).

These limitations necessitate a conceptual shift from privacy toward cognitive sovereignty. Cognitive sovereignty recognizes the mind as a domain of fundamental rights that cannot be reduced to property or data. It affirms the principle that individuals possess ultimate authority over their own mental processes and neural architecture, regardless of technological capability. Emerging human rights scholarship increasingly emphasizes that new technological environments demand corresponding expansions of normative protection (Eom, 2022). The recognition of cognitive sovereignty therefore represents not a radical departure from existing rights traditions but their logical extension into the neural domain.

From this foundation arises the need for new categories of rights, including neuro-privacy, neuro-integrity, and cognitive freedom. Neuro-privacy protects individuals from unauthorized access to neural data and cognitive states. Neuro-integrity

safeguards the physical and functional integrity of neural structures against harmful or non-consensual intervention. Cognitive freedom secures the right to mental self-determination, protecting individuals from coercive manipulation of their beliefs, emotions, or decision-making processes (Rainey, 2023). These rights respond directly to the structural vulnerabilities created by neurotechnological systems and provide the normative architecture necessary to preserve mental autonomy in the digital age.

The development of such rights also aligns with broader movements toward human-centered technological governance. Legal theorists emphasize that technological systems must be designed and regulated to enhance, rather than undermine, human agency and dignity (Rezaev & Трегубова, 2023). Without explicit recognition of mental autonomy as a protected legal interest, neurotechnological innovation risks institutionalizing new forms of domination that operate within the most intimate dimensions of human life. The law therefore confronts a critical juncture: either it evolves to protect cognitive sovereignty, or it becomes complicit in the erosion of the very autonomy upon which legal order itself depends.

In sum, neurotechnology functions as a profound legal disruptor by exposing the insufficiency of existing doctrines and compelling the articulation of new rights suited to the realities of cognitive intervention. Its diverse technological taxonomy generates novel risks of surveillance, manipulation, discrimination, and identity disruption, all of which converge upon the core of mental autonomy. The ontological uniqueness of mental data undermines traditional privacy models and necessitates the recognition of cognitive sovereignty as a foundational legal principle. Only through the construction of new normative categories—neuro-privacy, neuro-integrity, and cognitive freedom—can law restore equilibrium between technological power and human dignity in the emerging neuro-digital order.

3. Cognitive Liberty in Contemporary Legal Thought

The concept of cognitive liberty has emerged from a long philosophical and legal tradition concerned with the protection of the inner life of the individual against coercion, domination, and unwarranted interference. Its philosophical roots may be traced to classical theories of autonomy and moral agency that define personhood through the capacity for reflective self-governance. Enlightenment thinkers located freedom in the realm of reason and conscience, emphasizing the inviolability of the mental sphere as the foundation of ethical responsibility and political legitimacy. This intellectual lineage is reflected in modern legal doctrines that enshrine freedom of thought, conscience, and expression as core human rights. Yet contemporary technological conditions have fundamentally altered the context in which these freedoms operate. Digital environments already exert pervasive influence over attention, perception, and decision-making, as studies of voluntary attention among internet users illustrate (Medvedskaya, 2022). Neurotechnological systems intensify this transformation by directly intervening in the neural mechanisms that sustain cognition, thereby exposing the inadequacy of traditional legal formulations of mental freedom.

Freedom of thought, long recognized as an absolute and non-derogable right in international human rights law, presupposes that the mind remains beyond the reach of external power. However, as digital and bio-convergence technologies penetrate the neural domain, this assumption becomes increasingly untenable. Scholars analyzing the formation of new human rights in digital environments argue that the classical understanding of mental freedom must evolve to address the technological capacity to access, influence, and manipulate cognitive processes (Eom, 2022). Cognitive liberty thus emerges as a contemporary articulation of these enduring principles, reframing freedom of thought not merely as protection from ideological coercion but as protection from technological interference with neural processes themselves. This expanded conception links cognitive liberty directly to the preservation of personal identity, agency, and dignity in technologically mediated societies.

The neuro-rights movement represents a concrete attempt to translate these philosophical insights into legal norms. Legal scholars and ethicists increasingly advocate for the explicit recognition of rights protecting mental privacy, psychological continuity, and cognitive self-determination in response to accelerating neurotechnological innovation (Rainey, 2023). These proposals reflect growing awareness that existing rights frameworks fail to capture the unique vulnerabilities introduced by neurotechnology. International discussions surrounding neuro-rights emphasize the need to establish clear legal boundaries governing neural data extraction, neuromodulation, and cognitive enhancement, particularly as such technologies become commercially available and politically consequential (Mostajo-Radji, 2023). The recognition that neurotechnology operates

simultaneously within medical, economic, military, and political domains underscores the urgency of coordinated global governance.

Several jurisdictions have begun exploring constitutional recognition of neuro-rights, seeking to enshrine protections for mental integrity and cognitive liberty at the highest level of legal authority. These efforts reflect a broader trend toward constitutional adaptation in response to digital transformation. Comparative constitutional scholarship demonstrates that legal systems increasingly incorporate technological realities into rights interpretation, extending existing freedoms to new domains of vulnerability (Bošković, 2023). Constitutional recognition of cognitive liberty would provide a normative anchor for regulating neurotechnological development and resolving conflicts between technological innovation and fundamental rights. However, such efforts remain fragmented and uneven, reflecting the absence of a coherent global consensus on the legal status of mental autonomy.

Alongside constitutional initiatives, a growing body of soft-law instruments and ethical frameworks addresses neurotechnological governance. International organizations, professional associations, and academic consortia have issued guidelines emphasizing informed consent, risk minimization, and respect for mental integrity in neurotechnology research and deployment (Wies et al., 2021). These instruments play an important role in shaping professional norms and public discourse, yet they lack binding force and enforcement mechanisms. The gap between ethical aspiration and legal obligation persists, allowing neurotechnological systems to proliferate within regulatory environments that remain structurally underprepared for their societal impact.

Comparative legal analysis reveals divergent approaches to cognitive liberty across legal domains. In human rights law, freedom of thought and privacy provide partial protection, yet neither was crafted with neurotechnological interference in mind. Human rights jurisprudence traditionally focuses on external constraints on belief and expression, leaving unaddressed the possibility of technological intrusion into neural processes (Eom, 2022). Constitutional law offers more flexible interpretive tools, enabling courts to extend existing rights to new technological contexts, yet constitutional adjudication often lags behind technological change, producing regulatory uncertainty. Criminal law presents further challenges, as its doctrines of culpability and responsibility presuppose autonomous agency and voluntary action. When neurotechnological interventions influence impulse control, risk assessment, or emotional regulation, traditional notions of mens rea and moral blameworthiness become increasingly unstable (Rainey, 2023). The criminal justice system thus confronts foundational questions concerning the compatibility of cognitive liberty with technologically mediated behavior.

Data protection regimes represent another critical arena of legal tension. While modern data protection law recognizes sensitive personal data and imposes obligations on data controllers, it conceptualizes information as an external attribute of the individual, subject to transactional consent and regulatory oversight. This framework fails to account for the ontological uniqueness of neural data, which is inseparable from the cognitive processes that constitute identity and agency (Ienca & Vayena, 2022). The commodification of neural data by technology companies further exacerbates these shortcomings, as economic incentives drive the extraction and monetization of cognitive information without adequate safeguards for mental autonomy. The experience of digital governance in political contexts demonstrates how data-driven systems can distort democratic processes and amplify power asymmetries (Vale, 2022). When such systems incorporate neural data, the resulting legal vulnerabilities intensify.

Doctrinal gaps and conceptual conflicts become particularly evident when examining the distinction between voluntary and involuntary neural interference. Traditional legal frameworks assume a clear boundary between voluntary action and external coercion. Neurotechnologies destabilize this boundary by enabling subtle forms of influence that operate within neural circuits and bypass conscious awareness. Neuromodulation and algorithmic cognitive nudging already demonstrate how behavior can be shaped without overt compulsion (Ienca & Malgieri, 2022). As these techniques become integrated into neurotechnological systems, determining whether an individual's actions remain genuinely voluntary becomes increasingly complex. This uncertainty undermines the coherence of legal doctrines governing consent, responsibility, and liability.

Consent in neuro-interventions represents another major doctrinal challenge. Informed consent presupposes that individuals can understand the nature and consequences of the interventions to which they agree. Yet neurotechnological systems operate on cognitive mechanisms that are not fully transparent even to experts, let alone to lay participants. Moreover, structural pressures in employment, education, and healthcare contexts may render consent effectively compulsory, as individuals are

forced to accept neurotechnological monitoring or enhancement to remain competitive (Bejar, 2023). The erosion of meaningful consent threatens to normalize cognitive intrusion under the guise of contractual agreement.

State security and criminal justice further complicate the landscape of cognitive liberty. Governments increasingly view neurotechnology as a tool for enhancing interrogation, lie detection, behavioral prediction, and risk assessment. Such applications promise greater efficiency and security but risk eroding fundamental rights. The use of cognitive surveillance in law enforcement contexts mirrors broader trends in digital governance, where technological power often outpaces legal accountability (Rezaev & Трегубова, 2023). Balancing public security with the preservation of mental autonomy thus emerges as one of the central normative dilemmas of the neuro-digital age.

The cumulative effect of these developments reveals a profound transformation in contemporary legal thought. Cognitive liberty is no longer a peripheral ethical concern but a central legal imperative. As neurotechnology reshapes the conditions of human agency, law must evolve to preserve the autonomy, dignity, and identity upon which legal order itself depends. The emergence of cognitive liberty within contemporary jurisprudence therefore marks a decisive moment in the historical evolution of human rights, one that demands new legal architectures capable of governing the age of the mind.

4. Toward a New Legal Architecture for Mental Autonomy

The accelerating penetration of neurotechnology into social, economic, and political life necessitates a fundamental reconfiguration of legal architecture. Existing legal systems, shaped around the protection of bodily integrity and informational privacy, lack the conceptual tools required to govern direct technological intervention in cognitive processes. A new neuro-legal framework must therefore be grounded in principles that recognize the mind as a distinct and inviolable domain of human rights. Central to this framework is the principle of mental inviolability, which affirms that the cognitive and neurological structures of the individual are beyond the legitimate reach of external power. This principle extends classical notions of bodily integrity into the neural domain, acknowledging that interference with neural processes constitutes a unique category of harm. Legal scholars increasingly emphasize that human-centered technological governance must preserve the coherence of agency and dignity in the face of digital transformation (Rezaev & Трегубова, 2023). Mental inviolability thus becomes the cornerstone of legal protection in the neuro-digital age.

Closely linked to mental inviolability is the principle of cognitive self-determination, which affirms the right of individuals to control the development, use, and modification of their own cognitive capacities. Cognitive self-determination reflects the insight that autonomy is not merely freedom from external constraint but the capacity to shape one's own mental life. Neuroscientific research demonstrates that cognitive processes are deeply sensitive to technological environments (Medvedskaya, 2022), making it imperative that individuals retain authority over the conditions under which their cognition is influenced. The law must therefore protect not only the outcomes of decision-making but the cognitive processes that generate decisions. This principle directly challenges regulatory models that treat neural intervention as a matter of consumer choice or professional discretion, demanding instead robust legal safeguards that preserve personal sovereignty over the mind.

A further foundational principle is neural due process, which adapts procedural justice to the context of neurotechnological intervention. Neural due process requires that any interference with cognitive processes be subject to strict legal scrutiny, transparent justification, and effective remedies. This includes clear standards governing the development, deployment, and use of neurotechnological systems, as well as meaningful avenues for redress when violations occur. The emergence of digital governance models demonstrates how technological systems often escape effective oversight when regulatory structures fail to evolve in tandem (Vale, 2022). Neural due process seeks to prevent similar failures in the neurotechnological domain by embedding accountability, proportionality, and legality into every stage of cognitive intervention.

Integral to this framework is the categorical prohibition of non-consensual cognitive interference. Unlike traditional forms of coercion, which operate through physical force or overt constraint, neurotechnological interference can subtly alter cognition without conscious awareness. Neuromodulation and algorithmic nudging already illustrate how behavior can be shaped beneath the threshold of volition (Ienca & Malgieri, 2022). The law must therefore recognize that non-consensual interference with neural processes constitutes a profound violation of human dignity, irrespective of whether physical harm occurs. This

prohibition establishes a bright normative line, signaling that the mind is not a legitimate object of manipulation by states, corporations, or other actors.

Building upon these principles, neuro-rights must be designed as fundamental rights embedded within constitutional and human rights frameworks. Mental privacy emerges as the first pillar of this rights architecture. While traditional privacy law protects personal information, mental privacy safeguards the confidentiality of cognitive states and neural data. Neural data, unlike ordinary personal data, encodes the processes through which identity and agency are continuously produced (Ienca & Vayena, 2022). Protecting mental privacy therefore means preventing unauthorized access to the inner workings of the mind, whether through surveillance, data extraction, or algorithmic inference. This right is indispensable for preserving the autonomy and dignity of individuals in neurotechnological societies.

Closely related is the right to psychological continuity, which protects the coherence of personal identity over time. Psychological continuity reflects the integration of memory, emotion, and agency that allows individuals to maintain a stable sense of self. Digital mental health research already demonstrates how technological mediation reshapes psychological development, particularly among young users (Wies et al., 2021). Neurotechnologies capable of altering memory consolidation, emotional regulation, or attentional processes threaten this continuity, creating risks of identity fragmentation and cognitive dependency. Legal recognition of psychological continuity as a protected interest ensures that neurotechnological innovation does not undermine the fundamental narrative structure of personhood.

Identity integrity constitutes a further dimension of neuro-rights. Identity integrity protects individuals from external interventions that distort or override their core cognitive and emotional characteristics. Neuro-discrimination and mental profiling already reveal how cognitive traits can become new axes of social stratification (Villamil & Wolbring, 2022). When such profiling is grounded in neural data, individuals lose meaningful control over the characteristics by which they are judged. Identity integrity thus serves as a bulwark against the instrumentalization of the mind, ensuring that technological systems respect the uniqueness and inviolability of personal identity.

Freedom from algorithmic mental manipulation represents another essential neuro-right. Algorithmic systems increasingly shape cognitive environments by structuring information flows, influencing attention, and guiding decision-making. The integration of these systems with neurotechnological interfaces magnifies their capacity to manipulate mental states. Studies of digital nudging illustrate how algorithmic design can subtly steer behavior (Ienca & Malgieri, 2022). When such mechanisms operate within neural circuits, they threaten the very conditions of free will. Legal protection against algorithmic mental manipulation ensures that individuals retain genuine authorship over their beliefs, preferences, and actions.

The realization of this neuro-rights architecture requires robust institutional and regulatory mechanisms. Licensing and oversight of neurotechnology companies must become central components of governance. Just as pharmaceutical and medical device industries are subject to rigorous approval processes, neurotechnology enterprises must be regulated according to standards that reflect the gravity of cognitive risk. Regulatory bodies should evaluate not only physical safety but also psychological and cognitive impact, recognizing that harm to mental autonomy is as consequential as bodily injury (Bejar, 2023). Without such oversight, market incentives will continue to prioritize innovation and profit over the protection of fundamental rights.

International governance models are equally essential. Neurotechnology transcends national boundaries, and its risks cannot be effectively managed through fragmented domestic regulation. Comparative scholarship on emerging human rights emphasizes the need for coordinated global responses to digital and bio-convergence technologies (Eom, 2022). International agreements establishing baseline neuro-rights standards would provide normative coherence and prevent regulatory arbitrage, whereby companies exploit jurisdictions with weaker protections. Soft-law initiatives and ethical frameworks, while valuable, must ultimately be complemented by binding legal instruments that ensure universal respect for mental autonomy.

Courts and constitutional adjudication play a critical role in shaping this new legal architecture. Judicial interpretation has historically driven the expansion of rights in response to social and technological change. Constitutional courts are uniquely positioned to articulate the normative foundations of cognitive liberty and to resolve conflicts between technological innovation and fundamental rights (Bošković, 2023). Through principled adjudication, courts can establish precedent recognizing mental autonomy as a core constitutional value, thereby guiding legislative and regulatory development.

The implications of this new legal architecture become particularly acute in the domains of criminal justice and national security. Neurotechnologies offer tools for lie detection, memory extraction, and cognitive monitoring that promise enhanced investigative efficiency. Yet these applications pose existential threats to mental autonomy and the presumption of innocence. Neural surveillance techniques capable of inferring intent or truthfulness from brain activity undermine the foundational principle that individuals cannot be compelled to incriminate themselves. The experience of data-driven governance already illustrates how technological power often expands beyond effective legal constraint (Rezaev & Трегубова, 2023). When such power operates at the level of neural processes, the risk to civil liberties intensifies dramatically.

Legal limits on admissibility and coercion must therefore be rigorously enforced in the neuro-age. Evidence obtained through non-consensual neural intervention should be categorically excluded from judicial proceedings, as it violates both mental inviolability and the integrity of the adjudicative process. The prohibition of compelled neural interrogation extends the logic of existing protections against torture and self-incrimination into the cognitive domain. Redefining evidence and self-incrimination in the neuro-age requires recognizing that the extraction of mental content is not merely a new investigative technique but a transformation of the relationship between the individual and the state.

Ultimately, the construction of a new legal architecture for mental autonomy represents one of the most profound challenges facing contemporary law. Neurotechnology compels legal systems to confront the limits of existing doctrines and to articulate new normative foundations capable of preserving human dignity in the age of the mind. The principles, rights, institutions, and safeguards outlined in this section provide the structural framework for such a transformation, ensuring that technological progress remains aligned with the fundamental values upon which just societies depend.

5. Conclusion

The emergence of neurotechnology marks a decisive turning point in the historical relationship between law, technology, and the human person. Unlike previous technological revolutions that transformed physical labor, communication, or information exchange, neurotechnology intervenes directly in the neurological foundations of identity, agency, and autonomy. It alters not merely what humans do, but how they think, feel, decide, and remember. This unprecedented capacity forces law to confront a new category of vulnerability: the vulnerability of the mind itself. The traditional legal architecture, constructed around the protection of bodily integrity and external freedom, is no longer sufficient. The crisis of mental autonomy explored throughout this study reveals that without fundamental legal reconstruction, neurotechnology risks institutionalizing forms of power that penetrate the most intimate domain of human existence.

This article has demonstrated that neurotechnology is not simply a new regulatory subject but a structural disruptor of legal concepts. The taxonomy of neurotechnologies—from brain–computer interfaces and neuromodulation to neurodata analytics and cognitive enhancement devices—reveals a technological ecosystem that dissolves the boundary between medical treatment, enhancement, and behavioral governance. These systems generate new risks of neural surveillance, cognitive manipulation, behavioral modification, mental profiling, and neuro-discrimination. Such risks cannot be meaningfully addressed by existing privacy or data-protection regimes because neural data is not ordinary information; it is constitutive of the self. Interference with neural processes therefore constitutes a distinct category of harm that threatens personal identity, psychological continuity, and moral agency.

The analysis of contemporary legal thought shows that cognitive liberty is emerging as a necessary extension of freedom of thought and personal autonomy in the digital age. While traditional rights protect belief, expression, and conscience from external coercion, they were never designed to govern technologies capable of accessing and shaping cognition from within. The growing neuro-rights movement reflects a recognition that the mind itself must become an explicit object of legal protection. Yet global legal systems remain fragmented and underdeveloped, with constitutional initiatives, soft-law instruments, and ethical guidelines offering only partial and uneven responses. This fragmentation creates a widening gap between technological capability and legal protection, leaving individuals exposed to profound forms of cognitive vulnerability.

In response, this study has proposed a new legal architecture for mental autonomy grounded in foundational principles: mental inviolability, cognitive self-determination, neural due process, and the categorical prohibition of non-consensual cognitive interference. From these principles flows a coherent system of fundamental neuro-rights, including mental privacy, psychological continuity, identity integrity, and freedom from algorithmic mental manipulation. Together, these rights establish

cognitive sovereignty as the normative foundation of neuro-governance, recognizing that individuals possess ultimate authority over their own mental life regardless of technological capability or institutional interest.

The practical realization of this architecture requires robust institutional design. Regulatory systems must impose strict licensing, oversight, and accountability on neurotechnology developers and operators, evaluating not only physical safety but cognitive and psychological impact. International governance frameworks must establish shared standards to prevent regulatory fragmentation and technological exploitation. Courts and constitutional adjudication must articulate the normative core of cognitive liberty, resolving conflicts between innovation and fundamental rights and guiding legislative development. Nowhere are these safeguards more urgent than in criminal justice and national security, where neurotechnologies threaten to undermine the presumption of innocence, the right against self-incrimination, and the very conditions of fair trial by transforming thought itself into evidence.

At its deepest level, the challenge posed by neurotechnology is not merely regulatory but civilizational. The concept of human dignity that underpins modern law presupposes that individuals are autonomous moral agents capable of governing their own mental lives. When technology acquires the power to access, modify, and manipulate cognition, that presupposition collapses unless law intervenes to restore it. The protection of mental autonomy is therefore not a marginal concern of technological governance but the central legal question of the coming era. How societies answer this question will determine whether neurotechnology becomes a tool of human flourishing or a mechanism of unprecedented domination.

The future of legal responsibility, political freedom, and human identity now depends on the recognition that the mind itself is the final frontier of rights. Law must evolve accordingly, not reactively but proactively, constructing legal institutions capable of governing the age of the mind before its most destructive possibilities become entrenched. The architecture outlined in this study offers a blueprint for such evolution. By placing mental autonomy at the heart of legal order, societies can ensure that neurotechnology remains a servant of human dignity rather than its undoing.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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