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COGNITIVE LIBERTY AND INTELLECTUAL PROPERTY RIGHTS: WHO OWNS THE OUTPUT OF A NEURALINKED MIND?

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ABSTRACT

Brain-computer interfaces have transitioned from speculative neuroscience into tangible commercial products, with companies such as Neuralink demonstrating successful human implants since early 2024. These devices translate raw neural signals into digital commands, enabling paralysed individuals to operate computers, robotic arms, and communication software through thought alone. Yet this technological leap exposes a serious gap in intellectual property jurisprudence: when a human mind collaborates with a neural interface and its underlying algorithms to produce a creative work (a melody, a poem, a design), who holds authorship? This question is real and pressing, cutting across copyright doctrine, patent law, cognitive liberty, and the emerging field of neurorights.

The present study undertakes a doctrinal and comparative analysis of the authorship problem that brain-computer interfaces create for intellectual property law. It examines how existing frameworks in the United States, the United Kingdom, the European Union, and India grapple with the requirement of human authorship, tracing the trajectory from traditional copyright principles through landmark rulings such as Thaler v. Perlmutter and Naruto v. Slater. The paper then develops the concept of joint authorship between a human mind and a neural interface, arguing that neither the classical sole-author model nor the current artificial-intelligence exclusion adequately captures the hybrid creative process that brain-computer interfaces facilitate. Drawing on the emerging discourse around cognitive liberty and

neurorights, including Chile's pioneering 2021 constitutional amendment, the paper proposes a tiered authorship framework that allocates rights based on the degree of neural intentionality and algorithmic contribution. It concludes with specific legislative recommendations for national and international bodies, urging that intellectual property reform keep pace with the neurotechnological revolution before commercial interests outstrip legal protections for the human mind.

Keywords: Brain-Computer Interface, Intellectual Property Rights, Copyright, Authorship, Cognitive Liberty, Neurorights, Neuralink, Joint Authorship, Artificial Intelligence, Neural Data.

I. INTRODUCTION

In January 2024, Neuralink Corporation implanted its N1 brain chip into the first human participant, Noland Arbaugh, a young man paralysed from the shoulders down following a diving accident.[1] Within weeks, Arbaugh was playing video games and chess online, controlling a computer cursor using nothing but the electrical activity in his motor cortex. By mid-2025, the company had expanded its PRIME clinical trial to nine participants across four countries, and by January 2026, twenty-one patients carried the device.[2] This pace of development has turned what was once a distant scientific ambition into an imminent commercial reality. Elon Musk has publicly stated that Neuralink intends to begin high-volume production and move toward a streamlined, near-fully-automated surgical procedure within the year.

Yet for all the medical promise that brain-computer interfaces hold for individuals with paralysis, amyotrophic lateral sclerosis, and severe speech impairments, their intellectual property implications remain almost entirely unaddressed by legislatures and courts worldwide. The core difficulty is easy enough to put into words: when a person wearing a neural implant conceives of a musical phrase, and the brain-computer interface decodes the relevant neural signals, and the accompanying software renders that decoded signal into a digital audio file, who is the author of the resulting composition? Is it the human user, whose neural firing patterns initiated the creative impulse? Is it the software engineer who wrote the decoding

[1]Neuralink Corp., Neuralink Progress Update: First Human Implant, NEURALINK BLOG (Jan. 2024), https://neuralink.com/blog.

[2]Elon Musk (@elonmusk), X (formerly Twitter) (Dec. 31, 2025) (announcing high-volume BCI production in 2026).

algorithm that translated electrical noise into meaningful data? Is it the company that manufactured the device and trained the machine-learning model that maps brain activity to musical output? Or does the answer lie in some novel category that existing intellectual property law has not yet imagined?

These questions are not merely academic. The brain-computer interface sector is attracting massive investment, and multiple competitors (Synchron, Precision Neuroscience, Blackrock Neurotech, Paradromics) are advancing parallel clinical programmes alongside established research collaborations such as BrainGate.[3] As these devices move beyond restorative medical applications into augmentative territory, such as enhancing cognition, facilitating creative work, and enabling direct brain-to-brain communication, the volume of BCI-generated creative output will multiply. Without a workable legal framework for allocating authorship and ownership, the resulting uncertainty threatens to chill innovation, exploit vulnerable users, and concentrate intellectual property rights in the hands of device manufacturers rather than the minds that generate the underlying ideas.

The present work addresses that gap. It argues that the authorship question posed by brain-computer interfaces is different in kind from the broader debate over artificial-intelligence-generated works, because the BCI context always involves a human neural origin for the creative impulse, even when algorithms play a substantial role in shaping the final output. The discussion proceeds as follows. Part II sets out the research methodology. Part III provides a technical and conceptual overview of brain-computer interface technology to establish the factual foundation for legal analysis. Part IV surveys the existing intellectual property frameworks across major jurisdictions, examining how they handle authorship, originality, and the role of machines in creative production. Part V develops the core argument about joint authorship between a human mind and a neural interface, exploring both the doctrinal possibilities and the conceptual tensions. Part VI introduces the dimension of cognitive liberty and neurorights, arguing that any intellectual property framework for BCI output must be grounded in respect for mental autonomy. Part VII extends the analysis to patent law, examining how inventorship and trade-secret doctrines interact with BCI-generated innovations. Part VIII offers concrete proposals for legislative and regulatory reform, and a conclusion follows.

[3]BrainGate Collaboration, BrainGate: Turning Thought into Action, http://www.braingate.org (last visited May 10, 2026).

II. RESEARCH METHODOLOGY

This research paper employs a doctrinal and comparative legal methodology. The doctrinal component involves a systematic analysis of primary legal sources statutes, case law, administrative guidance, and international instruments across multiple jurisdictions, with particular attention to the United States, the United Kingdom, the European Union, and India. The comparative component examines how different legal systems approach the common problem of allocating authorship and ownership when creative production involves both human and non-human contributors, drawing analogies and contrasts that expose the strengths and weaknesses of each approach.

The research also incorporates an interdisciplinary dimension, drawing on technical literature from neuroscience and neuroengineering to ensure that the legal analysis is grounded in an accurate understanding of how brain-computer interfaces function. The policy recommendations in Part VII are informed by the emerging literature on neurorights and cognitive liberty, which spans legal scholarship, bioethics, and human-rights advocacy.

The scope of the research is limited in several respects. It focuses primarily on copyright and patent law, with only brief attention to trade secrets and other forms of intellectual property. It does not address the full range of ethical issues raised by brain-computer interfaces, such as the implications for personal identity, consciousness, or the potential for cognitive enhancement to exacerbate social inequality. And it does not attempt an empirical study of how BCI users themselves perceive the authorship question, though such a study would be a valuable complement to the doctrinal analysis presented here.

III. BRAIN-COMPUTER INTERFACES: TECHNOLOGY AND TAXONOMY

A. Defining Brain-Computer Interfaces

A brain-computer interface is, at its most elementary, a system that creates a direct link between the brain's electrical signals and an external computing device.[4] The concept emerged from electroencephalography research in the 1970s, but its practical realisation has accelerated dramatically in the twenty-first century. Unlike conventional human-computer interaction, which depends on peripheral muscular output like typing, moving a mouse, or speaking into a microphone, a BCI bypasses the body's motor pathways entirely. It reads neural signals at their

[4] Jonathan R. Wolpaw & Elizabeth Winter Wolpaw, BRAIN-COMPUTER INTERFACES: PRINCIPLES AND PRACTICE 3-4 (Oxford Univ. Press 2012).

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source and translates them into commands that a computer can execute.

The significance of this bypass for intellectual property law is enormous. When a person types a sentence on a keyboard, there is no serious question that the person is the author of the sentence. The keyboard is a passive tool; it does not contribute to the creative content. But when a BCI decodes a neural signal and renders it into a musical composition, the device performs an active interpretive function. The decoding algorithm must distinguish meaningful creative signals from background neural noise, must map those signals to specific musical parameters such as pitch, rhythm, and timbre, and must render the result in a format that constitutes a recognisable work. This active intermediation is what generates the authorship puzzle.

B. Categories of Brain-Computer Interfaces

Brain-computer interfaces can be categorised along several dimensions, each of which carries implications for the intellectual property analysis. The first and most significant distinction is between invasive and non-invasive systems. Invasive BCIs, such as Neuralink's N1 implant, involve surgically placing electrodes directly on or within the brain tissue. These devices offer high signal resolution because they record from individual neurons or small clusters of neurons, producing rich, detailed data about the user's neural activity.[5] Non-invasive BCIs, by contrast, sit on the scalp and record aggregated electrical activity through electroencephalography or similar techniques. Their signal quality is substantially lower, though recent advances in machine learning have improved their decoding accuracy.

The second important distinction concerns the directionality of information flow. Input BCIs read neural signals and translate them into external commands this is the category most relevant to intellectual property, as it covers the scenario in which a person's thoughts generate creative output. Output BCIs, sometimes called neurostimulation devices, send signals into the brain, such as Neuralink's Blindsight project that aims to restore limited vision by stimulating the visual cortex. Bidirectional BCIs combine both functions, creating a feedback loop between the brain and the device.

The third distinction concerns the degree of algorithmic processing involved in converting neural signals to output. At one end of the spectrum sits a simple motor-imagery BCI, where the user imagines moving a hand and the device translates that imagined movement into a cursor movement on screen. Here, the user's intention maps fairly directly onto the output, and

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[5]Gert Pfurtscheller et al., Current Trends in Graz Brain-Computer Interface (BCI) Research, 54 IEEE TRANSACTIONS ON REHABILITATION ENGINEERING 1, 1-4 (2006).

the algorithm functions more like a translator than a creator. At the other end sits a generative BCI, where the device decodes broad patterns of neural activity associated with emotional states, aesthetic preferences, or abstract conceptual intentions, and an artificial intelligence system uses those decoded patterns as seeds to generate a complex creative work. In this latter scenario, the algorithm contributes substantially to the final form and expression of the output, making the authorship question far more acute.[6]

C. The Current State of Development

As of early 2026, the brain-computer interface field is marked by rapid clinical progress and aggressive commercial ambitions. Neuralink's PRIME trial has expanded from a single patient to twenty-one, with the company achieving successful demonstrations of cursor control, robotic arm operation through its Convoy project, and the receipt of FDA Breakthrough Device Designations for both its Blindsight visual prosthesis and its speech restoration technology.[7] Competitors are equally active: Synchron's Stentrode, a minimally invasive device inserted through a blood vessel, has been tested in multiple patients; Precision Neuroscience has developed a flexible cortical electrode array called Layer 7 and Blackrock Neurotech has accumulated over two decades of data from its Utah Array implant.

For the purposes of intellectual property analysis, the most important development is the trajectory from restorative to augmentative applications. Today's clinical BCIs focus on restoring lost function enabling paralysed patients to move cursors or robotic limbs. Still, the underlying technology has no inherent limitation to restorative uses. Once a BCI can decode motor intentions with high accuracy, it is a comparatively short engineering step to decode creative intentions, emotional states, and conceptual thinking. When that step is taken and multiple research laboratories are actively pursuing it the intellectual property questions discussed here will shift from theoretical to urgent.

IV. EXISTING INTELLECTUAL PROPERTY FRAMEWORKS AND THE AUTHORSHIP REQUIREMENT

A. The Human Authorship Doctrine in the United States

The United States Copyright Act of 1976 protects original works of authorship fixed in a

[6]Favio Ramirez Caminatti, Copyrighting Brain Computer Interface: Where Neuroengineering Meets Intellectual Property Law, 14 CYBARIS 1, 2 (2023).
[7]U.S. Food & Drug Admin., FDA Breakthrough Device Designation for Neuralink Blindsight (2025).

tangible medium of expression, but the statute does not define the word "author."[8] Courts and the Copyright Office have consistently read this term to require a human creator. The foundational precedent is Burrow-Giles Lithographic Co. v. Sarony, decided by the Supreme Court in 1884, which described an author as one who gives the work its origin, and characterised the creative process in distinctly human terms involving intellectual invention and the mind of the creator.[9]

This human-centric reading has been reinforced by two recent developments. First, in Naruto v. Slater, the Ninth Circuit Court of Appeals held that a macaque monkey who had independently pressed the shutter button on a camera lacked standing to claim copyright in the resulting photographs, because the Copyright Act does not extend to non-human entities.[10] Second, and more directly relevant, the D.C. Circuit in Thaler v. Perlmutter unanimously affirmed in March 2025 that a work generated solely by an artificial intelligence system Stephen Thaler's Creativity Machine—could not be registered for copyright because only human beings can be authors under the Act.[11] The court emphasised that machines lack minds and do not possess intentions, and that the statutory text, legislative history, and policy rationale of copyright law all point toward exclusively human authorship.

The Copyright Office's 2023 guidance on works containing AI-generated material provides an important nuance. The guidance acknowledges that human authors may use artificial intelligence as a tool in the creative process, and states that the determinative factor is the extent to which the human had creative control over the work's expression.[12] Where AI determines the expressive elements of the output, the generated material falls outside copyright protection. But where a human selects, arranges, or modifies AI-generated material with sufficient creativity, the resulting work may be registered. This framework creates a spectrum rather than a binary, but it remains anchored in the premise that protectable expression must originate from a human mind.

For brain-computer interfaces, the American framework creates a paradox. The neural signal always originates from a human mind unlike a standalone AI system, a BCI cannot function without a living brain attached to it. Even so, the expression of that signal in the final creative work may be heavily shaped by the decoding algorithm and the generative software. The

[8] 17 U.S.C. § 102(a) (2018).

[9] *Burrow-Giles Lithographic Co. v. Sarony*, 111 U.S. 53, 58 (1884).

[10] *Naruto v. Slater*, 888 F.3d 418, 420 (9th Cir. 2018).

[11] *Thaler v. Perlmutter*, No. 22-1564, 2023 WL 5711898 (D.D.C. Aug. 18, 2023), aff'd, No. 23-5233 (D.C. Cir. Mar. 18, 2025).

[12] U.S. Copyright Office, Copyright Registration Guidance: Works Containing Material Generated by Artificial Intelligence, 88 FED. REG. 16,190 (Mar. 16, 2023).

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human authorship doctrine, as currently articulated, does not provide clear guidance on where to draw the line in this hybrid creative process.

B. The United Kingdom's Computer-Generated Works Provision

The United Kingdom stands apart in this comparative analysis because its Copyright, Designs and Patents Act 1988 expressly addresses computer-generated works. Section 178 defines a computer-generated work as one that is produced in circumstances such that there is no human author, and Section 9(3) assigns authorship of such works to the person who made the necessary arrangements for the work's creation.[13] This is the only major jurisdiction to provide a statutory mechanism for protecting works that lack a human author in the conventional sense.

As scholars have observed, this framework has the appeal of pragmatism: it ensures that someone holds the rights to commercially valuable creative output, regardless of how much human creative input was involved.[14] Applied to brain-computer interfaces, the UK model would likely assign authorship to whoever "made the necessary arrangements" for the BCI-generated work. The trouble is that this phrase is itself ambiguous in the BCI context. The user made the arrangement of thinking the creative thought. The neurosurgeon made the arrangement of implanting the device. The programmer made the arrangement of writing the decoding software. The manufacturer made the arrangement of assembling the hardware. Each claimant has a plausible argument, and the statute provides no hierarchy.

Besides, the UK provision was drafted in the late 1980s when "computer-generated" referred to relatively simple algorithmic outputs. It was not designed to handle the deeply intertwined human-machine process that characterises BCI-mediated creation, where the boundary between human thought and computational processing is not merely blurred but is, in a neurological sense, non-existent.

C. The European Union Approach

The European Union has historically taken a strict position on human authorship, rooted in the Continental tradition of droit d'auteur, which grounds copyright in the personality and creative expression of the individual author. The Court of Justice of the European Union has held in a line of cases that originality requires the work to reflect the author's own intellectual creation, a standard that quietly assumes human agency. The EU Artificial Intelligence Act, which entered into force in stages beginning in 2024, imposes transparency and risk-management

[13]Copyright, Designs and Patents Act 1988, c. 48, § 9(3) (UK).
[14]Andres Guadamuz, Artificial Intelligence and Copyright, WIPO MAG., Oct. 2017, at 15.

obligations on AI systems but does not directly address the copyright status of AI-generated or BCI-generated works.[15]

The General Data Protection Regulation is, however, highly relevant to the neural-data dimension of the problem. Brain-computer interfaces necessarily collect and process neural data which constitutes sensitive personal data under the GDPR's special categories, as it reveals information about health, cognitive states, and potentially about political opinions, religious beliefs, or sexual orientation.[16] Any framework for BCI intellectual property must therefore contend with the parallel GDPR requirements for lawful processing, informed consent, and data-subject rights, creating a complex regulatory intersection that no jurisdiction has yet resolved.

D. India's Position: Flexibility and Ambiguity

Indian copyright law occupies an interesting middle ground in this comparative analysis. The Copyright Act of 1957 defines joint authorship in Section 2(z) as a work produced by the collaboration of two or more authors in which the contribution of one author is not distinct from the contribution of the other author or authors.[17] More significantly, Section 2(d)(vi) defines the author of a computer-generated literary, dramatic, musical, or artistic work as the person who causes the work to be created.[18]

This provision was inserted by the 1994 amendment and mirrors the UK's approach, but its implications in the Indian legal context are distinctive. Unlike the US, where copyright is constitutionally anchored in the promotion of progress through the incentivisation of human authors, Indian copyright is a purely statutory right. Section 16 of the Act makes clear that no person is entitled to copyright except under or by virtue of the Act itself. This statutory foundation, combined with the explicit recognition of computer-generated works, potentially provides India with greater doctrinal flexibility to accommodate BCI-generated output than the American system.[19]

To be sure, this flexibility is tempered by ambiguity. The phrase "person who causes the work to be created" has never been judicially interpreted in the context of a brain-computer interface. In a BCI scenario, both the human user (who generates the neural signal) and the programmer

[15] European Commission, Proposal for a Regulation Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act), COM (2021) 206 final (Apr. 21, 2021).
[16] Reg. (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the Protection of Natural Persons with Regard to the Processing of Personal Data, 2016 O.J. (L 119) 1 (General Data Protection Regulation).
[17] The Copyright Act, 1957, No. 14, § 2(z), Acts of Parliament (India).
[18] *Id.* § 2(d)(vi).
[19] *Eastern Book Co. v. D.B. Modak*, (2008) 1 SCC 1 (India).

(who creates the software that processes that signal) could plausibly claim to be the person who caused the work to exist. The Supreme Court of India's decision in Eastern Book Co. v. D.B. Modak, which adopted a modicum-of-creativity standard for originality, provides some guidance but was decided long before BCI technology became a practical reality. The Indian Parliament has not signalled any intention to address this gap, leaving the question to future judicial development.

V. JOINT AUTHORSHIP BETWEEN A HUMAN MIND AND A NEURAL INTERFACE

A. The Doctrinal Framework for Joint Authorship

Joint authorship is a well-established concept in copyright law, but it was designed for collaboration between human beings, not between a human mind and a machine. Under United States law, a joint work is defined as a work prepared by two or more authors with the intention that their contributions be merged into inseparable or interdependent parts of a unitary whole.[20] Courts have developed additional requirements: each contributor must make an independently copyrightable contribution, and each must intend at the time of creation that their contribution be merged with those of others into a single work.[21]

The Second Circuit in Childress v. Taylor articulated an influential test requiring both copyrightable contributions and mutual intent to create a joint work. The same court in Thomson v. Larson held that mere contributions to a work, even substantial ones, do not establish joint authorship absent evidence of shared decision-making authority over the creative product.[22] The Ninth Circuit in Aalmuhammed v. Lee added a further gloss, holding that a joint author must exercise control over the work and be accepted as an author by all parties.[23]

Applying these doctrinal elements to the BCI context reveals both the attraction and the insufficiency of the joint-authorship model. The attraction lies in its capacity to recognise multiple creative contributions to a single work precisely the scenario that BCI-mediated creation presents. The insufficiency lies in the requirement, consistently emphasised by courts, that joint authorship presupposes collaboration between entities that have minds, intentions, and the capacity for mutual recognition. A brain-computer interface's decoding algorithm has none of these qualities.

[20] 17 U.S.C. § 101 (2018) (defining "joint work").
[21] *Childress v. Taylor*, 945 F.2d 500, 507 (2d Cir. 1991).
[22] *Thomson v. Larson*, 147 F.3d 195, 200 (2d Cir. 1998).
[23] *Aalmuhammed v. Lee*, 202 F.3d 1227, 1232-33 (9th Cir. 2000).

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B. The BCI Authorship Spectrum

Rather than treating all BCI-generated works identically, it is more analytically useful to recognise a spectrum of creative contribution that varies across different types of brain-computer interface interactions. At one extreme sits what might be called direct neural transcription, in which the BCI functions essentially as a high-fidelity translator of the user's fully formed creative intention. Consider a composer who has a complete melody in mind, and whose BCI decodes the relevant auditory-cortex activation patterns with sufficient accuracy to produce a digital recording that closely matches what the composer heard internally. In this scenario, the algorithm contributes technical translation but not creative expression, much like a stenographer transcribing dictation. The human user is clearly the sole author.

At the other extreme sits algorithmically augmented creation, in which the user provides a broad neural input perhaps an emotional state, a vague aesthetic preference, or a general conceptual direction and the BCI's generative AI system uses that input as a seed to produce a complex, detailed creative work that the user could not have independently conceived or articulated. Here, the algorithm contributes substantially to the expressive content of the final output, and the authorship question is genuinely difficult.

Between these extremes lies a continuum of cases in which the human mind and the algorithmic system share the creative labour in varying proportions. A BCI might decode a user's broad musical intentions the key, the tempo, the general melodic contour while the algorithm fills in harmonic details, orchestration, and structural development. Or a BCI might capture a user's visual-cortex activity in response to mental imagery and translate it into a visual artwork, with the algorithm interpolating between sparse neural signals to produce a coherent image.

This spectrum suggests that a one-size-fits-all approach to BCI authorship will end up casting the net either too wide or too narrow. Assigning sole authorship to the human user in all cases would ignore the substantial creative contribution that algorithms make at the augmented end of the spectrum. Assigning sole authorship to the programmer or the device manufacturer would strip the human mind of credit for its foundational role in initiating and guiding the creative process. And applying the current AI-exclusion doctrine which denies copyright to any expressive element determined by the AI would leave large categories of BCI-generated works in a legal vacuum, unprotected and un-owned.[24]

[24]Caminatti, *supra* note 1, at 27-30.

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C. The Problem of Intent

The requirement of authorial intent presents a difficult problem in the BCI context. Joint authorship under American law requires that each contributor intend to create a joint work at the time of making their contribution. But a BCI algorithm does not form intentions. It executes computational processes determined by its training data and its architecture. The D.C. Circuit in Thaler v. Perlmutter made exactly this point, saying that machines lack minds and do not intend anything.

That observation is technically accurate but conceptually incomplete when applied to brain-computer interfaces. The human user of a BCI does form an intention the intention to think a creative thought and to have the BCI translate that thought into a tangible work. The user knows, at the time of creative ideation, that the BCI will process the neural signal and that an algorithm will shape the final output. Put simply, the user intends the collaboration, even if the algorithm cannot reciprocate that intention.

This asymmetry of intent is not without precedent in creative collaboration. When a film director instructs an editor to cut a scene in a particular way, the director's creative intent encompasses both the director's own contribution and the anticipated contribution of the editor, even though the editor may exercise independent creative judgment in executing the instruction. The difference with a BCI is that the algorithm's contribution is not the product of independent creative judgment but of mathematical optimisation. Whether this difference is legally significant depends on whether copyright law treats the capacity for judgment as constitutive of authorship or merely as evidence of it.

D. A Proposed Tiered Framework

Drawing on the spectrum identified above and the comparative analysis of existing legal frameworks, this paper proposes a tiered approach to BCI authorship that allocates rights based on the degree of neural intentionality and algorithmic contribution. The framework has three tiers.[25]

The first tier covers direct neural transcription, where the BCI faithfully translates a fully formed creative intention into a tangible work with minimal algorithmic shaping of the expressive content. In this tier, the human user is the sole author, and the BCI functions as a tool analogous to a pen, a typewriter, or a voice-recording device. No modification of existing copyright doctrine is required.

[25] *See generally* Caminatti, *supra* note 1, at 26-31 (discussing four proposed approaches to BCI authorship).

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The second tier covers guided neural creation, where the human user provides substantial creative direction through neural input such as the key elements of a melody, the compositional structure of a visual work, or the narrative arc of a text and the algorithm fills in expressive details within the parameters set by the user's neural signals. In this tier, the human user should be recognised as the primary author, with the algorithmic contribution treated as an extension of the user's creative agency. This is analogous to the treatment of works made with the assistance of AI under the Copyright Office's 2023 guidance, where human creative control over the work's expression is the touchstone.

The third tier covers algorithmically augmented creation, where the user provides only a broad neural stimulus an emotional state, an abstract aesthetic preference and the algorithm generates a complex creative work that substantially exceeds what the user's neural input alone could specify. In this tier, authorship becomes genuinely contested. This paper proposes that such works should be treated as a new category of protected output, with ownership allocated to the human user by default but subject to contractual reassignment, and with a mandatory attribution right that acknowledges the role of the BCI system. This approach preserves the incentive structure of copyright for the human creator while accepting the plain fact that the algorithm's contribution is substantial.

VI. COGNITIVE LIBERTY AND NEURORIGHTS: THE MISSING DIMENSION

A. The Emergence of Cognitive Liberty as a Legal Concept

The intellectual property debate over BCI-generated works cannot be fully understood without engaging the parallel development of cognitive liberty as a legal and philosophical concept. Cognitive liberty, at its core, is about the right to think freely to keep one's mental processes under one's own control, to keep thoughts private, and to be free from outside meddling with how one's brain works.[26] The concept has roots in older philosophical traditions of mental freedom and freedom of conscience, but it has acquired new urgency in the age of neurotechnology because, for the first time in human history, devices exist that can read and decode the internal operations of the brain.

The formal articulation of cognitive liberty as a proposed human right is typically traced to the 2017 work of Marcello Ienca and Roberto Andorno, who proposed four core neurorights:

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[26]Nita A. Farahany, THE BATTLE FOR YOUR BRAIN: DEFENDING THE RIGHT TO THINK FREELY IN THE AGE OF NEUROTECHNOLOGY 45-47 (St. Martin's Press 2023).

"cognitive liberty," "mental privacy," "mental integrity," and "psychological continuity."[27] In the same year, Rafael Yuste and colleagues published an influential commentary in Nature setting out four ethical priorities for governing neurotechnology and AI, among them the protection of mental privacy and clear rules for who owns and may use neural data.[28]

These proposals have gained significant institutional traction. The Organisation for Economic Co-operation and Development adopted a Recommendation on Responsible Innovation in Neurotechnology in 2019, which includes provisions on mental privacy and cognitive liberty.[29] The United Nations Human Rights Council adopted a resolution on neurotechnology and human rights in October 2022.[30] The Council of Europe launched a five-year Strategic Action Plan on Human Rights and Technologies in Biomedicine with a dedicated module on neurotechnology governance.[31] And the NeuroRights Foundation, established by Yuste and colleagues, has engaged in active advocacy across multiple jurisdictions.[32]

B. Chile's Constitutional Precedent

The most consequential development in neurorights legislation to date is Chile's 2021 constitutional amendment. In October of that year, the Chilean legislature amended Article 19, number 1 of the Constitution through Law No. 21.383, adding a provision that requires science and technology to be placed at the service of people and to respect their physical and mental well-being.[33] Critically, the amendment requires that legislation give special protection to brain activity and to the data generated from it. This was the first time any country had elevated the protection of neural data and mental integrity to constitutional status.[34]

Chile's example has inspired legislative activity across Latin America and beyond. Mexico has two pending bills that would amend its Constitution along similar lines. Argentina has proposed the creation of a bicameral committee to develop a neurorights framework. Uruguay's Parliament has consulted with Chilean counterparts on the subject. And the Latin American

[27] Marcello Ienca & Roberto Andorno, Towards New Human Rights in the Age of Neuroscience and Neurotechnology, 13 LIFE SCI., SOC'Y & POL'Y 1, 5 (2017).
[28] Rafael Yuste et al., Four Ethical Priorities for Neurotechnologies and AI, 551 NATURE 159, 160 (2017).
[29] Org. for Econ. Coop. & Dev. [OECD], Recommendation of the Council on Responsible Innovation in Neurotechnology, OECD/LEGAL/0457 (Dec. 11, 2019).
[30] U.N. Human Rights Council Res. 51/L.3, Neurotechnology and Human Rights (Oct. 2022).
[31] Council of Europe, Strategic Action Plan on Human Rights and Technologies in Biomedicine (2020-2025) (2020).
[32] NeuroRights Foundation, The Neurorights Foundation: Human Rights for the Age of Neurotechnology, https://neurorightsfoundation.org (last visited May 10, 2026).
[33] Chile Const. art. 19, no. 1 (as amended by Law No. 21.383, Oct. 2021).
[34] Alejandra Zúñiga-Fajuri et al., Neurorights in Chile: Between Neuroscience and Legal Science, in REGULATING NEUROSCIENCE: TRANSNATIONAL LEGAL CHALLENGES 165 (Martín Hevia ed., 2021).

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Parliament, Parlatino, adopted a Model Law on Neurorights for Latin America and the Caribbean in 2023, providing a template for regional harmonisation.[35] As recently as April 2026, the Chilean Chamber of Deputies continued to refine its implementing legislation, hearing from experts including Rafael Yuste on the detailed rules needed to give the constitutional provision practical effect.[36]

The Chilean model is instructive but incomplete for the intellectual property dimension of the problem. The constitutional amendment and the proposed implementing legislation focus on protecting individuals from the harmful effects of neurotechnology surveillance, manipulation, unauthorised data collection. They do not directly address the question of who owns the creative output generated through brain-computer interfaces. Yet the principles they establish—that individuals retain sovereignty over their neural data, that brain activity merits special legal protection, and that technology must serve human dignity have serious implications for the authorship debate.

C. Cognitive Liberty as a Foundation for BCI Intellectual Property

Cognitive liberty should serve as a foundational principle for any intellectual property framework governing BCI-generated works. First, the creative output of a brain-computer interface originates in the neural activity of the human user. That neural activity is the most intimate form of personal expression it is, in the most direct sense, the content of a person's mind. To deny the user authorship over the creative products of their own mental activity is to permit a form of cognitive dispossession: the extraction of value from someone's thoughts for the benefit of others.[37]

Second, cognitive liberty entails the right to the fruits of one's own mental labour. This principle has deep roots in the Lockean labour theory of property, which holds that individuals acquire a natural right to the products of their work.[38] When a person engages in creative mental activity through a BCI, the neural labour involved the intentional generation of specific patterns of brain activity, the sustained cognitive effort required to guide the BCI's output constitutes a form of work that is at least as demanding as conventional creative labour. The personality theory of property, articulated by Margaret Jane Radin, provides additional support: creative

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[35]Latin American Parliament [Parlatino], Model Law on Neurorights for Latin America and the Caribbean (2023).
[36]Stanford Law School, Even Chile's Neurorights Leave Inferred Mental Data in a Gray Zone, LAW & BIOSCIENCES BLOG (Apr. 27, 2026).
[37]Farahany, *supra* note 26, at 112-15.
[38]John Locke, TWO TREATISES OF GOVERNMENT 287-88 (Peter Laslett ed., Cambridge Univ. Press 1988) (1690).

works generated through BCI are intimately connected to the user's personal identity and mental life in a way that demands legal recognition.[39]

Third, the asymmetry of bargaining power between individual BCI users and device manufacturers creates a risk that contractual arrangements will effectively strip users of their intellectual property rights. Companies like Neuralink will, sooner or later, present users with terms-of-service agreements that purport to allocate ownership of BCI-generated content. If the default legal rule does not recognise the user's authorship, users will have no baseline from which to negotiate, and in practice, corporations will own the creative output of their customers' minds. This outcome is squarely at odds with cognitive liberty, which requires that individuals retain meaningful control over the products of their mental processes.[40]

D. The Neural Data Paradox

Brain-computer interfaces create a paradox at the intersection of data protection and intellectual property law. The neural signals that a BCI records and processes constitute personal data indeed, sensitive personal data under frameworks such as the European Union's General Data Protection Regulation. The GDPR grants data subjects rights over their personal data, including the right to access, rectification, erasure, and data portability. At the same time, the creative works generated from that neural data may simultaneously be the subject of intellectual property rights that could belong to someone other than the data subject.

This creates a collision between two regulatory regimes. A BCI user might have a GDPR right to demand erasure of the neural data recorded during a creative session, but the resulting musical composition might be owned by the device manufacturer under the terms of service. Can the user exercise their data-protection rights without affecting the manufacturer's intellectual property rights? Can the manufacturer exploit the creative work without retaining the underlying neural data? The OECD's working paper on brain-computer interfaces and governance has identified this tension but has not proposed a resolution, noting only that the ownership of BCI data raises complex questions at the intersection of multiple regulatory domains.[41]

Resolving this paradox requires recognising that neural data and the creative works derived from it are conceptually distinct but practically inseparable. The neural signals are the raw

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[39] Margaret Jane Radin, Property and Personhood, 34 STAN. L. REV. 957, 959-60 (1982).

[40] Jan Christoph Bublitz & Reinhard Merkel, Crimes Against Minds: On Mental Manipulations, Harms and a Human Right to Mental Self-Determination, 8 CRIM. L. & PHIL. 51, 52-53 (2014).

[41] OECD, Brain-Computer Interfaces and the Governance System: Upstream Approaches, OECD SCI., TECH. & INDUS. WORKING PAPERS 2022/10, at 22-24 (2022).

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material; the creative work is the finished product. A workable legal framework must treat them in a coordinated manner, ensuring that data-protection rights and intellectual-property rights reinforce rather than undermine each other. The analysis below proposes that the principle of neural sovereignty the idea that individuals retain ultimate control over the outputs of their brain activity should serve as the unifying principle across both regulatory domains.

VII. PATENT LAW DIMENSIONS OF BCI-GENERATED INVENTIONS

A. Inventorship and the Human Requirement

The authorship question in copyright has a direct analogue in patent law: the question of inventorship. Just as copyright requires a human author, patent law in most jurisdictions requires a human inventor. The United States Patent and Trademark Office, the European Patent Office, and the UK Intellectual Property Office all rejected Stephen Thaler's attempt to list his AI system DABUS as the inventor on patent applications, holding that inventors must be natural persons. The Federal Circuit affirmed the USPTO's rejection in Thaler v. Vidal in 2022, and the D.C. Circuit reached the same conclusion in the parallel copyright context. The rationale closely mirrors the copyright reasoning: patent law's incentive structure is designed to motivate human beings, and machines do not respond to the economic incentives that patents provide.

In India, the Patents Act of 1970 requires that an inventor be a "person," and Section 3(k) excludes mathematical methods and computer programs per se from patentability.[42] However, the Act does not contain a provision analogous to Section 2(d)(vi) of the Copyright Act for computer-generated inventions, creating an additional gap in the Indian framework for BCI-generated innovations.[43]

Brain-computer interfaces complicate the inventorship question in the same way they complicate authorship. If a researcher uses a BCI to decode patterns of neural activity associated with an innovative technical concept a novel drug molecule, an improved engineering design, a new algorithm and the BCI's processing system contributes to refining or developing that concept, the question of who conceived the invention becomes blurred. The United States Supreme Court's decision in Alice Corp. v. CLS Bank International, which restricted the patentability of abstract ideas implemented through generic computer processing,

[42]The Patents Act, 1970, No. 39, § 3(k), Acts of Parliament (India).
[43]*Id.* § 2(1)(j).

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adds a further layer of complexity: BCI-generated inventions may face challenges under the abstractness doctrine even if the inventorship question is resolved.[44]

B. Trade Secrets and Neural Algorithms

A dimension of the BCI intellectual property picture that has received too little attention is trade-secret protection. The neural decoding algorithms and signal-processing methods used by BCI companies are often protected as trade secrets rather than through patents, because trade-secret protection avoids the disclosure requirement of the patent system and provides indefinite duration. These algorithms are the bridge between the user's neural activity and the final creative or inventive output, and whoever controls them wields enormous power over the allocation of intellectual property rights.

If the decoding algorithm is a trade secret owned by the BCI manufacturer, the user cannot fully understand how their neural signals were processed, what algorithmic choices shaped the final output, and therefore how much of the creative expression in the work originated from the user's mind as opposed to the algorithm's processing. This information asymmetry undermines the user's ability to assert authorship or inventorship claims and tilts the practical balance of power heavily toward the manufacturer. A regulatory framework for BCI intellectual property should therefore include transparency requirements that compel manufacturers to disclose, at minimum, the general nature and extent of their algorithm's creative contribution to any BCI-generated output.

VIII. TOWARD A COMPREHENSIVE FRAMEWORK: LEGISLATIVE AND REGULATORY PROPOSALS

A. National Legislative Reforms

Based on the analysis in the preceding sections, a series of legislative reforms at the national level is warranted. For the United States, Congress should amend the Copyright Act to include a provision modelled on, but more detailed than, the UK's computer-generated works section. The amendment should explicitly recognise brain-computer interface-generated works as a distinct category, adopt the tiered authorship framework proposed in Part IV, and establish a default rule that the human user of a BCI holds authorship rights in any work generated through the interface, subject to the user's voluntary contractual reassignment. The constitutional purpose of copyright to promote the progress of science and useful arts by securing exclusive

[44] *Alice Corp. v. CLS Bank Int'l*, 573 U.S. 208, 217 (2014).

rights to authors[45] is best served by recognising the human neural contributor as the author, because this allocation preserves the incentive for individuals to engage in creative mental activity through BCIs.

For India, the Copyright Act of 1957 already contains the doctrinal building blocks for accommodating BCI-generated works through Section 2(d)(vi), but the provision needs clarification. The Indian Parliament should amend the Act to define "person who causes the work to be created" in the BCI context as the individual whose neural activity initiated and guided the creative process. The amendment should also address the interaction between the Copyright Act and the Information Technology Act to ensure that neural data receives appropriate protection as sensitive personal information.[46]

For the European Union, the challenge is to reconcile the strong Continental tradition of human authorship with the practical reality that BCI-mediated works involve a degree of algorithmic contribution. The EU should develop sector-specific guidance within the framework of the AI Act that addresses BCI-generated creative works, establishing transparency requirements for BCI manufacturers regarding the algorithmic contribution to creative output and ensuring that the GDPR's data-protection principles are harmonised with any new intellectual property rules.

B. International Harmonisation

Brain-computer interfaces operate across national boundaries, and the creative works they generate circulate in a global digital marketplace. National legislative reforms will therefore be insufficient without international harmonisation. The World Intellectual Property Organization should convene a dedicated working group on neurotechnology and intellectual property, building on its existing Conversation on Intellectual Property and Artificial Intelligence.[47] This working group should develop a model provision for national adoption that establishes minimum standards for BCI authorship, neural-data protection, and transparency requirements for BCI manufacturers.

The Berne Convention for the Protection of Literary and Artistic Works and the TRIPS Agreement both presuppose human authorship without explicitly excluding BCI-mediated

[45]U.S. Const. art. I, § 8, cl. 8.
[46]The Copyright Act, 1957, No. 14, § 2(d)(vi), Acts of Parliament (India); Information Technology Act, 2000, No. 21, § 43A, Acts of Parliament (India); Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011, r. 3 (India).
[47]World Intellectual Property Organization [WIPO], WIPO Conversation on Intellectual Property and Artificial Intelligence (2020).

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works.[48][49] A protocol or interpretive declaration could clarify the application of these instruments to BCI-generated content without requiring a full renegotiation of the treaties, which would be politically impractical. The OECD's existing work on responsible innovation in neurotechnology provides a useful platform for developing soft-law norms that could eventually harden into binding international obligations.

C. Regulatory Safeguards

Beyond legislative reform, regulatory safeguards are needed to protect BCI users from exploitation in the intellectual property domain. Three specific measures deserve attention.

First, BCI manufacturers should be required to provide users with clear, accessible information about how the device's algorithms contribute to any creative or inventive output. This transparency requirement is a precondition for informed consent and for the user's ability to make meaningful decisions about the allocation of intellectual property rights. The requirement should be enforceable by the relevant national regulatory authority the FDA in the United States, the CDSCO in India, the EMA in the European Union.[50]

Second, terms-of-service agreements between BCI manufacturers and users should be subject to heightened scrutiny for unconscionability, particularly with respect to intellectual property provisions. Given the medical dependency that many BCI users will have on their devices a paralysed patient who relies on a BCI for communication cannot simply switch to a competitor if they dislike the terms standard form contracts that purport to assign all BCI-generated IP to the manufacturer should be presumptively unenforceable. This approach draws on the consumer-protection principles that many jurisdictions already apply to essential services.[51]

Third, national intellectual property offices should develop specialised examination guidelines for BCI-related applications. Copyright registration for BCI-generated works should require disclosure of the type of BCI used, the general nature of the neural input, and the degree of algorithmic processing involved. Patent applications for BCI-generated inventions should require a similar disclosure. These requirements would build a body of administrative practice that courts and legislators could draw on as the technology develops and the legal questions become more concrete.[52]

[48]Berne Convention for the Protection of Literary and Artistic Works art. 2(1), Sept. 9, 1886, S. Treaty Doc. No. 99-27.
[49]Agreement on Trade-Related Aspects of Intellectual Property Rights art. 27, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299.
[50]Farahany, *supra* note 26, at 200-05.
[51]Yuste et al., *supra* note 26, at 161.
[52]Jonathan Baker, Copyrighting Brain-Computer Interface-Encoded Brain Signals: Establishing a Threshold of

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IX. CONCLUSION

Brain-computer interfaces are no longer speculative technology; they are clinical reality. With twenty-one patients carrying Neuralink implants as of early 2026, multiple competing devices in clinical trials, and a market trajectory measured in hundreds of billions of dollars, the question of who owns the creative output of a neurally interfaced mind is no longer a thought experiment. It is a pressing legal problem that demands a considered response from legislatures, courts, and international institutions.

The foregoing analysis has shown that existing intellectual property frameworks across major jurisdictions are poorly equipped to handle the authorship question that brain-computer interfaces raise. The American insistence on exclusively human authorship, while doctrinally coherent for standalone AI systems, produces uncertain results when applied to the hybrid human-machine creative process that BCIs facilitate. The UK's computer-generated works provision offers pragmatism but insufficient precision. The European Union's strong personality-based theory of authorship sits uneasily with algorithmic contribution. And India's flexible statutory framework has doctrinal potential but lacks the judicial and legislative development needed to translate that potential into clear rules.

The paper has proposed a tiered authorship framework that calibrates the allocation of rights to the degree of neural intentionality and algorithmic contribution in the creative process. It has argued that cognitive liberty the right of individuals to exercise autonomous control over their mental processes and to benefit from the products of their own cognitive labour must serve as the foundational principle for any BCI intellectual property regime. And it has offered specific legislative, regulatory, and international proposals designed to ensure that the neurotechnological revolution enriches rather than dispossesses the human minds at its centre.

The danger of doing nothing is real. If intellectual property law fails to keep pace with brain-computer interface technology, the default outcome will be determined by contractual arrangements drafted by device manufacturers and presented to users on a take-it-or-leave-it basis. Those arrangements will, almost certainly, favour the manufacturer, concentrating ownership of BCI-generated creative works in corporate hands and reducing the human minds that generate the underlying neural activity to the status of biological input devices. This goes beyond unfair economics; it strikes at the heart of cognitive liberty and the principle that the law should protect the sovereignty of the human mind.

But a better outcome is within reach. The doctrinal building blocks are present in existing

Exceptional Effort, 27 RICH. J.L. & TECH. 1, 22-24 (2021).

copyright and patent law. The normative framework of cognitive liberty and neurorights provides a principled foundation. The international institutional infrastructure WIPO, the OECD, the Council of Europe, the United Nations Human Rights Council is already engaged with neurotechnology governance. What remains missing is the political will to bring these elements together into a functioning framework before the technology outpaces the law. The history of intellectual property teaches that regulatory delay in the face of technological change produces inequities that persist for generations. The stakes in the neurotechnology context where what hangs in the balance is the creative output of the human mind are too high to let that pattern repeat.

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