

# From Neurocolonization to Cognitive Emancipation: The Critical Turn of Neurocapitalism

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## Abstract

The deep development of digital capitalism has given rise to a new form of domination of neurocapitalism, which transforms human cognitive activities such as perception and memory into exploitable data resources through brain-computer interfaces and neural sensing technologies, forming an algorithmic hegemony to colonize cognitive systems. The traditional Frankfurt School critical theory encounters difficulties in explaining the operation of power in the age of neurotechnology, and the study reveals the multidimensional colonization mechanism of neurocapitalism with the help of the technological reconstruction of Habermas's theory of interactional rationality and the dual critical framework of the phenomenology of technology-neuropolitical economy. Facing the systemic crisis of cognitive freedom, the cognitive alienation of neurocapitalism requires critical theory to shift from labor alienation to neuroalienation paradigm, to reconstruct the integrity of human subjectivity in the digital age by defending the autonomy of embodied cognition and the ethical limits of technological applications, and ultimately to guard the existential dignity of free will in the civilizational choices.

**Keywords:** neurocapitalism, cognitive colonization, embodiment, interactional rationality, algorithmic hegemony

## 1. Introduction

In the present era where digital capitalism continues to reconfigure the human condition, a more insidious form of colonization is breaking through the explanatory boundaries of traditional critical theory. When Neuralink's brain-computer interface chips are able to decode neuroelectric signals from the motor cortex in real time, and Kernel's hippocampal memory reading and writing technology transforms Proustian spontaneous memories into tradable NFT assets, the power tentacles of capitalism have already penetrated the curtain of cultural symbols and directly invaded the last frontier of human freedom — the neurocognitive system. This new form of "neurocapitalism" marks the urgent need for the Frankfurt School's critical theory to realize a paradigm shift from "cultural criticism" to "neurocriticism".

Adorno and Horkheimer, the first generation of Frankfurt School scholars, used the concept of "culture industry" to expose how mass media dissolve subjectivity through standardized production, while Habermas diagnosed the crisis of instrumental rationality's colonization of the lifeworld through the theory of interactional rationality. However, these classic critical paradigms have encountered interpretive difficulties in the age of neurotechnology, where capital power is no longer satisfied with manipulating the cultural symbol system, but rather transforms human perception, memory, and even subconsciousness into exploitable, programmable, and tradable data resources through brain-computer interfaces, neural sensing, and other bio-digital technologies. Neurocapitalism thus establishes a triple logic of domination, and in the context of Habermas's theory of interactional rationality, it constructs a dual analytical framework of technophenomenology and neuropolitical economy to rebuild cognitive freedom eroded by the hegemony of algorithms, which is not only the

contemporary activation of the Frankfurt School's critical tradition, but also the provision of a theoretical weapon and program of action for the defense of subjectivity in the digital era.

## 2. Triple Deconstruction of the Critical Paradigm of Neurocapitalism

In the age of intelligence, the dominant form of neurocapitalism poses a great epistemological challenge to the traditional critical theory. When the power of capital penetrates the cultural symbolic system and directly intervenes in the bio-digital interface of neural activities, the critical paradigm of the Frankfurt School is in urgent need of realizing a paradigm revolution from epistemology to methodology. The epistemological rupture from the critique of cultural industry to the critique of neural colonization is revealed in the historical context, the neurological reinterpretation of Habermas's doctrine of interactional rationality is accomplished within the theoretical framework, and the neural-phenomenological synthesis of the phenomenological analysis of experience and the critique of political economy is reached at the methodological level. Only through this three-dimensional deconstruction and reshaping can we penetrate the technological barriers of neurocapitalism, and anchor the contemporary coordinates of critical theory in the paradigm shift from symbolic manipulation to neuro-involvement of capital power.

### 2.1 *The Cognitive Turn: The Paradigm Break from Cultural Industry to Neurocolonization*

Adorno's critique of the culture industry reveals the hidden mechanism of domesticating the consciousness of the subject through standardized symbolic production in late capitalism. The culture industry occupies people's superego in practice, and it achieves total domination by catering to the needs of the ego effectively weakening the resistance of the self<sup>1</sup>. The cultural products it produces mask their industrialized nature with false individuality, and collect the subject's aesthetic experience and reflective ability as an appendage of capital value-added. However, this critical paradigm suffers a fundamental failure in the age of neurocapitalism. Quadriplegic patient Nolan Albo has achieved real-time communication between his brain and external computer equipment through brain-computer interface technology from Musk's brain-computer interface company Neuralink, and has been able to play video games and chess online through his mind<sup>2</sup>; Theo Berg, a biomedical engineer at the University of Southern California, has developed a memory prosthesis that can convert short-term memories into slightly longer-term memories, which doesn't guarantee a complete recovery of memories, although it might improve them. The device mimics the function of the hippocampus, which is surgically grafted into the brain and electrically stimulates the brain in a specific way, and finally form memories<sup>3</sup>. When Neuralink's brain-computer interface technology is able to decode the neuroelectric signals of the motor cortex in real time, and Kernel's hippocampal memory reading and writing device cuts "stretches" in Bergson's sense of the word into storable and discrete units of data, the power of capitalism has broken through the mediated manipulation of cultural symbols and intervened in the ontological realm of neural activity. The power of capitalism has broken through the mediated manipulation of cultural symbols and directly intervened in the ontological field of neural activity. Neurocapitalism is no longer satisfied with shaping the subject's structure of consciousness, but rather reconfigures the material basis of subjectivity through bio-digital technology.

In Merleau-Ponty's phenomenological vision, human pattern-recognition ability is revealed as a constitutive dimension of embodiment, which is neither an a priori function of pure consciousness nor a passive product of mechanical response, but is rooted in the dynamic coupling system between the body subject and its dynamic organs. Through the intentional projection of bodily schemas, our perceptual system transforms the kinetic potential of the organs into a mechanism for generating meaning in environmental interactions in an embodied continuum of presence, making pattern recognition an ontological manifestation of "being-in-the-world"<sup>4</sup>. Human subjectivity also does not originate from a priori consciousness, but is constructed through the dynamic interaction between the body and the world. Neurocapitalism's domination technique precisely targets this existential root. Brain-computer interfaces transform bodily intentionality into programmable sets of algorithmic instructions, so that the phenomenological content of grasping movements, such as strength and direction, which are originally rooted in contextualized bodily experience, are downscaled into parameters optimized by deep learning models.

On the one hand, this technological intervention has led to the reduction of the subject's "earthly existence" in the world to an engineering problem of signal transmission, and the essence of technology criticized by Heidegger, "set placement," has reached the most relevant interpretation in the neural domain<sup>5</sup>. On the other hand, Marx had mentioned in the 1844 Economic and Philosophical Manuscripts that "the more power the laborer expends in his labor, the stronger the power he creates with his own hands against the world of his own, alien objects, and the more impoverished he is in himself, in his internal world, and the less is attributed to him"<sup>6</sup>. Neuroplasticity itself becomes a new field for capital accumulation, and the data generated by each adaptive adjustment of the motor cortex becomes a means of production for the training of algorithms, and it is the short-circuiting of knowledge that results from the alienation of such algorithms that creates the whole of what Stiegler identifies as the "Proletarianization of Consciousness" in Capitalist Social Existence<sup>7</sup>. Only through a

cognitive revolution can critical theory gain access to the reigning codes of neurocapitalism, which is neither a simple denial of technological progress nor a fall into technological determinism, but a reconstruction of the dialectical tension between technological mediativity and subjective freedom.

## *2.2 Neuralization of Interactional Rationality: A Critical Approach to the Threshold of Technological Colonization*

Habermas's theory of the colonization of the lifeworld points out that society is a lifeworld on the one hand and a system on the other, and that social evolution is a dual development process in which the system and the lifeworld are interdependent and complementary. The "lifeworld" is a storehouse of interpretive paradigms organized by cultural transmission and language; the "system" is material, purposeful and rational, the bearer of content, a technological thing in which only purposive behaviors are performed. The basic characteristic of modern Western society is the disconnection between "system" and "lifeworld", i.e., the "colonization of the lifeworld"<sup>8</sup>. In the framework of neurocapitalism, the erosion of instrumental rationality in the field of interaction leads to the distortion of intersubjective understanding, and this colonization takes on a more radical form. Examining the paradigm shift of contemporary neural interface technologies under the Habermasian perspective of interactional rationality reveals that it is accelerating the process of colonization of the lifeworld by instrumental rationality in a dual path. Since 1924, when human beings first extracted EEG signals from the surface of the scalp, scientists have been devoted to exploring and revealing the mysteries of brain science through the study of EEG signals<sup>9</sup>. Carnegie Mellon University's electroencephalogram-mechanical arm control system decodes EEG signals to directly map the subject's thoughts into mechanical movement parameters, a closed-loop construction of a "neural-digital interface" that essentially replaces inter-subjective verbal negotiation with technological mediation. This closed-loop construction of "neural-digital interface" is essentially a process of replacing inter-subjective verbal negotiation with technical mediation<sup>10</sup>. Habermas's emphasis on "communicative action" is downscaled to a neurological extension of instrumental action when the strength and trajectory of grasping actions, which would otherwise require body-language coordination, are reduced to unidirectional control commands of neural signals. In MIT's neural control experiments, the precise modulation of the macaque motor cortex by artificial neural networks not only achieves technological domination of the organism's behavior, but also exposes the ultimate ambition of neurocapitalism, which is to transform the material foundations of intersubjectivity into algorithmically optimized engineering parameters by reconfiguring the mechanisms of neural plasticity<sup>11</sup>. This technological practice breaks out of the Habermasian critique of "systemic colonization of the lifeworld" and points directly to the technological deconstruction of the existential premise of interactional rationality, whereby the innate ability of the subject to construct consensus through language, as neural interfaces encode brain activity as a sequence of computable signals, is being replaced by the principle of the efficiency of neural signal transmission<sup>12</sup>.

At this point, the principle of "intelligibility" of interactional rationality must be extended to the algorithmic transparency of neural data. When the decision logic of a brain-computer interface is encapsulated in a commercial black box, the semantic clarity required for intersubjective understanding is dissolved by technological agnosticism. This calls for the establishment of the right to algorithmic interpretation as a fundamental human right in the neural age, ensuring traceability of neural data processing through mandatory open source protocols. The radical nature of this neuralized reconfiguration is that it transforms interactional rationality from an abstract philosophical category into a material technological device. When the algorithmic logic of brain-computer interfaces must be determined through intersubjective negotiation rather than the will of capital, technology itself becomes the vehicle for the materialization of interactional rationality. This not only breaks through the techno-pessimism of traditional critical theory, but also opens up practical paths of resistance to cognitive colonization. The ethical roots of intersubjective understanding are guarded in algorithmic hegemony through the reconstruction of neural negotiation space. Techno-democratization is no longer limited to the modification of pre-existing devices, but directly intervenes in the design process of neurocognitive architecture.

## *2.3 Neurophenomenological Methodology: Embodiment and Political Economy Dialectics*

The theoretical synthesis between Merleau-Ponty's phenomenology of the body and Marx's critique of political economy is neither a simple theoretical grafting nor an eclectic collage, but a holistic analytical framework based on new forms of alienation in the age of neurotechnology. Merleau-Ponty's phenomenology reveals the mechanism of brain-computer interface's reconfiguration of the "body-world" relationship, whereby the neuroplasticity of the motor cortex of a paraplegic patient is algorithmically rewired when he manipulates a robotic arm through a Neuralink chip. This technological intervention leads to a "double demystification" of embodied cognition, where the ambiguity and openness of bodily intentionality is replaced by the certainty of algorithmic commands on the phenomenological level; and the authenticity of "being-in-the-world" is reduced to the reliability of signal transmission on the existential level. The question of the reliability of signaling. This

phenomenological analysis must be combined with Marx's critique of political economy.

In his theory of labor value, Marx argues that "labor has become not only a means of earning a living, but also the first necessity of life"<sup>13</sup>. The theory of "cognitive division of labor" developed by Kircher provides a new dimension for the interpretation of this viewpoint. Unlike the traditional view of labor as "decomposing repetitive labor to be done by different workers" discussed by Adam Smith and Marx, cooperation in scientific research is essentially a way of integrating the differences of researchers. The essence of cooperation in scientific research is to create new epistemological value through the integration of differentiated cognitive resources, research strategies and technical means of researchers, and its breakthrough is not the mechanical superposition of simple labor<sup>14</sup>. In the new form of cognitive labor driven by intelligent technology, laborers produce intelligent products in the process of human-computer collaboration by strategically invoking, coordinating and transforming various types of cognitive abilities. The core feature of this form of labor is that the creative use of cognitive ability has surpassed physical labor and become the dominant element of value creation<sup>15</sup>. The process of collection, processing and circulation of neural data is essentially an exploitation of the cognitive labor of science and technology workers and data source providers in the age of intelligence. When the subject interacts with the environment through brain-computer interfaces, the  $\delta$ -wave oscillations, synaptic connection patterns, and other biological data generated by his neuroplasticity adjustments are no longer merely by-products of physiological processes, but are constructed by capital power as new types of means of production. Capital accomplishes the deepest level of exploitation of the subject's consciousness through the enclosure of memory data. The fundamental innovation of this exploitation mechanism is that it breaks through the "labor time-surplus value" paradigm of Marx's time, advances the "colonization of the lifeworld" described by Habermas into the neurobiological realm, and the ontological dimension of cognitive activity (Merleau-Ponty's "schema of the body") is transformed into a new form of production. The ontological dimension of cognitive activity (Merleau-Ponty's "body schema") and the economic dimension (Marx's "form of value") are forcibly coupled at the level of technological mediation. As the raw material for the production of "cognitive surplus value", the value increase of  $\delta$ -wave data follows the formula of "money-commodity-money" revealed by Marx<sup>16</sup>, but in neurocapitalism it is upgraded to the recursive accumulation mode of "data-algorithm-data".

This neurophenomenological synthesis overcomes the limitation of traditional phenomenology that ignores social and material conditions, and embeds the analysis of bodily experience into the techno-political and economic structure of capitalism. This synthesis not only continues the dialectical tradition of Frankfurt School's critical theory, but also provides a theoretical weapon for emancipatory politics in the digital age through methodological innovation.

### 3. Theoretical Remodeling of Neural Power

In Foucault's theoretical system of power, disciplinary power is constructed as the "anatomical politics of the body," a microscopic mechanism of power that realizes social control through the precise manipulation of the individual's physical body. With the evolution of modern power forms, Foucault further puts forward the concept of "the vital politics of the population," marking the expansion of power operations from the individual body to the biological life sphere of the whole population. This transformation of power forms reveals that contemporary capitalist politics has evolved into a "politics of life" that systematically manipulates life processes. Although the process of capitalist modernization takes on the appearance of technological rationality and institutional perfection, it is in fact a capitalized reconstruction of "life force" that incorporates biological existence into the system of surplus-value production. The logic of capital, through the dual operation of disciplining technology and regulating mechanism, not only shapes the tamed production subject, but also regulates the biological characteristics of the population, ultimately making life itself the carrier of capital proliferation. Foucault's critical insight lies in the fact that this seemingly civilized technique of governance essentially constitutes a new form of domination, whereby the politics of life transforms biological existence into an object of political economy, realizing capital's colonized domination over the dimension of life<sup>17</sup>. Foucault decodes the structural mapping of capitalist life-governance techniques through the dual ordering of anatomical politics and life politics; the historical generation of capitalism not only constitutes its ontological premise, but also lays the epistemological foundation for the reconstruction of the life-political paradigm of contemporary critical theory<sup>18</sup>, while neurocapitalism is writing a new chapter in the history of power, which is no longer satisfied with disciplining the flesh or regulating the population, but extends the power tentacles to the microcosmic realm of neural activities through brain-computer interfaces, and a new form of power — neural power — is born here.

#### 3.1 The Neural Interface of Free Discipline: The Cognitive Upgrading of Foucault's Life Politics

Foucault's training power is controlled through spatial and temporal segmentation and physical training, while Amazon's neurosensing headband Halo pushes this mechanism to the neural level. Morpheus-1 realizes neuromodulation through the ultrasonic hologram generating technology, and its core mechanism lies in the targeted stimulation of the prefrontal cortex, a brain region responsible for higher-order cognitive functions, to

achieve lucid dreaming induction and stabilizing control<sup>19</sup>. This paradigm of fusing deep neural network computation with neuromodulation techniques marks a key breakthrough in the translation of brain-computer fusion technology from proof-of-concept to commercialization in the era of neurocapitalism. This neuromodulation technology bypasses behavioral observation to directly monitor cognitive processes, upgrading the panoramic open-mindedness described by Foucault to neural open-mindedness<sup>20</sup>; at the same time, it transforms Marx's labor time exploitation into neural resource extraction<sup>21</sup>, the attention fluctuation curve is no longer just a physiological phenomenon, but has become the metadata for calculating pay and promotion.

This neural power reconfiguration completely subverts the traditional notion of subjectivity, and its deeper crisis lies in the dissolution of cognitive freedom. For Kant, human freedom is a necessary precondition for the question of "how moral action is possible". Freedom, which in discursive reason is relegated to the unknowable "thing-in-itself," is in practical reason the beginning of human moral behavior<sup>22</sup>. Kant's concept of freedom takes rational self-discipline as its kernel, and regards freedom from the domination of other-directed desires as a prerequisite for the realization of the moral subject. Contemporary neurosensing technology reconfigures the subject's cognitive paradigm through real-time neurofeedback mechanisms, radically alienating the paradigm of self-technology revealed by Foucault's politics of life, whereby biopower has penetrated to the level of neuroplasticity, forming a new type of cognitive programming mechanism. This shift from external control that regulates the physical body to the operation of micro-power that shapes neural circuits marks the completion of a paradigmatic revolution in the biopolitics from macro-social apparatuses to synapse-level self-colonization.

### *3.2 Framework Construction of Subconscious Data: $\delta$ -wave Harvesting and the Movement of Spiritual Privatization*

The theory of the bourgeois public sphere established by Habermas in "The Structural Transformation" of the Public Sphere faces a deconstructive crisis in the age of neurotechnology. Habermas emphasizes that the formation of the bourgeois public sphere must be based on the binary separation of the private and public spheres, in which the private sphere, as a pre-political space for the generation of subjectivity, assumes the core functions of individual identity, ethical reflection, and the construction of intersubjectivity. The sanctity of the private sphere is not only reflected in the law's protection of physical boundaries such as housing and communication, but also points to the inviolability of the human spiritual world at a deeper level. This inviolability constitutes the prerequisite for the subject to conduct rational communication, and requires that individuals, both as the public and in the private sphere, must possess this rational critical spirit. So that individuals are not restricted by others or public power, and maintain personality independence<sup>23</sup>. The current techno-capitalism is constructing a neural public sphere through neural interface devices, incorporating mental activities that originally belonged to the private sphere into the circulatory system of capital appreciation. At the same time, the system-life world dichotomy presupposed by Habermas appears to overlap in scope in the age of neurotechnology, and when the technological system directly intervenes in the biochemical process of the neural synapses, the colonization of the life world has broken through the level of social interaction and penetrated deeper into the material basis of neurobiology.

However, with the breakthrough development of neurotechnology, the material basis of this binary structure is also increasingly dissolving.  $\delta$ -wave acquisition technology decodes 0.5-4Hz low-frequency brain waves, and transforms the non-symbolizable substrate of the "realm of the real" in Lacanian psychoanalytic theory, including traumatic memories and instinctive impulses in the pre-linguistic stage, into algorithms that can be analyzed by algorithms and analyzers. The Lacanian psychoanalytic theory of the "real world" of the unsignifiable substrate, including the traumatic memories and instinctive impulses of the pre-verbal stage, is transformed into a stream of data that can be parsed by the algorithm. The technological system constructs a new cognitive type through the manipulation of data, turning the ineffable, which was the foundation of the subject's existential theory, into a cognitive surplus that can be manipulated by capital. In Lacanian psychoanalysis, the realm of the real is a hard core of impossibility that resists symbolization and reproduction, an impossible thing that is difficult to be described, imagined, and comprehended by the subject<sup>24</sup>, while the intervention of  $\delta$ -wave technology precisely creates an ontological rupture between technical rationality and psychoanalysis, which evolves into a self-propagating technological drive in the continuous capture of data streams, and ultimately opens up a new cybernetic frontier between the rift between the symbolic realm and the realm of the real.

### *3.3 The Ontological Usurpation of Algorithmic Hegemony: From the Public Sphere to the Cognitive Corridor*

The public sphere as conceived by Habermas is a space for rational subjects to form consensus through discursive negotiation, and inter-subjective discursive interaction based on interactional rationality is a core experience of reaching consensus without coercion<sup>25</sup>. This idealized public space requires participants to have free access to pluralistic information and to achieve truth generation through critical debate. However, the technological paradigm of neurocapitalism is dissolving this theoretical foundation, as exemplified by Neuralink, a neural interface device developed by Meta, which dynamically optimizes information pushing algorithms to

continually reinforce individual cognitive inertia through real-time monitoring of neuroelectrical signals in users' auditory cortex. This closed-loop system based on neurobiological data feedback essentially reconfigures the public sphere into a neurocognitive corridor, where the criterion of truth is shifted from inter-subjective rational debates to the algorithm's adaptive modulation of neural arousal patterns, resulting in the metamorphosis of public negotiation into a unidirectional tuning process between the neurobiological signals and the artificial intelligence system. This shift at the ontological level signifies that technological power has broken through the traditional path of colonization of social systems to directly intervene in the neurobiological basis of human cognitive structure.

This algorithmic hegemonic reconfiguration involves two kinds of usurpation, where algorithmic systems replace humans as arbiters of meaning, and neuroplasticity is hijacked by algorithms as a hegemonic tool. The ultimate danger of this neural gyrus lies in its self-legitimizing mechanism. As algorithms continuously optimize neurostimulation strategies through reinforcement learning, users lose not only their cognitive autonomy, but also their ability to perceive heterogeneous ideas, and their brains are reshaped to be the best vehicle for algorithmic hegemony. The "rationality of interaction" that Habermas had pinned so much hope on has been reduced to an outdated protocol that cannot be decoded under the framework of neurocapitalism, and a new type of power is completing the ultimate reorganization of the human spirit in the name of neurocompatibility.

#### **4. The Neuralized Path to Redemption of Interactional Rationality**

In the crisis of neurocapitalism's full-scale colonization of the cognitive field, Habermas's theory of interactional rationality not only needs to be reconstructed at the theoretical level, but also urgently requires the practical transformation of technologization and institutionalization. When the power of capital reduces the brain to a data-producing organ through the hegemony of algorithms, the resistance movement must simultaneously open up a battlefield in the three dimensions of neural interface, legal framework, and technological substrate. This trinity of redemptive paths is not only a neuralized continuation of Habermas's "unfinished program of modernity," but also a strategic outline for the defense of subjectivity in the digital age.

##### *4.1 Conditions for the Possibility of a Neural Public Sphere: Reconstructing the Cognitive Foundation of Consultative Democracy*

The ideal discursive situation proposed by Habermas constructs three core elements for consultative democracy: equality of discourse between subjects, transparency of information exchange, and free will from power control<sup>26</sup>. In the era of neurocapitalism, however, algorithmic hegemony is systematically dismantling these preconditions for democratic consultation through the transformation of cognitive infrastructure. Algorithmic recommender systems create cognitive closure. The platform's personalized push mechanism locks users into a cognitive cocoon constructed from behavioral data through neuroprofiling techniques. This neural plasticity-based information feeding not only dissolves the necessary heterogeneous information exchange in the public sphere, but also creates cognitive dependence through the dopamine reward mechanism.

And to rebuild the cognitive foundation of consultative democracy, the practice of neuropolitics needs to be developed from three dimensions. First, to establish a mechanism for democratizing neurotechnology, breaking the technological monopoly through open-source brain-computer interfaces and public neural databases; second, to build a framework for algorithmic transparency, requiring platforms to disclose the generative logic and value parameters of neural portraits; and third, to develop neural civic literacy, fostering the public's ability to critically reflect on cognitive manipulation technologies. Interdisciplinary dialogues between neuroscientists and democratic theorists have shown that through the democratized use of neuroplasticity, humans can reshape more inclusive cognitive architectures. When technological democratization interacts benignly with cognitive autonomy, interactional rationality, weakened by algorithms, will regain its material roots in the neural public sphere. This practice of cognitive democratization is essentially a neuroscientific recontextualization of Habermas' theory of interactional behavior in the digital age.

##### *4.2 The Legal Philosophy of Neurocitizenship: The Dialectic of Sacredness of Consciousness and Data Sovereignty*

Against the backdrop of digital capitalism's reconfiguration of human existence, the binary framework of the traditional human rights theory between the right to body and the right to property is being fundamentally deconstructed. Neurocapitalism, on the other hand, has reduced the realm of consciousness, originally considered sacrosanct, to a new type of means of production by transforming bioelectrical signals, cognitive patterns, and even subconscious activities into tradable data streams. Although the Charter on Data Ethics issued by the Institute of International Finance (IIF) attempts to establish a governance framework, its internal logic still regards neurodata as the "petroleum treasure trove" in the age of intelligence, which reflects the deep dilemma of the commoditization of consciousness<sup>27</sup>. Herein lies the value paradox of the Data Ethics Charter, which advocates an informed consent framework that faces fundamental failure in the neurodata scenario. As

neurocapture devices become deeply embedded in everyday life (e.g., mood-monitoring head rings, attention-tracking eyeglasses), the unconsciousness and continuity of data production has rendered the rational subject presupposed by traditional contractual theory non-existent. This requires the philosophy of law to go beyond the individualistic paradigm and reconstruct neurocitizenship in the dimensions of group rights and ecosystems, both recognizing the public product attributes of neurodata and establishing a collective protection mechanism against conscious alienation.

The ultimate point of neurocitizenship is to rebuild the integrity of human beings in the era of digital civilization, which requires the legal system to develop a new normative framework that can both resist neuroexploitation and promote the democratization of cognition in the dialectical movement between the sanctity of consciousness and data sovereignty. Like the projection of Habermas' theory of interactional rationality in neural space, this philosophical foundation of law is essentially a re-questioning of what it means to be a human being.

#### *4.3 Reverse Engineering of Technological Resistance: OpenBCI's Political Decoding of Algorithmic Black Boxes*

In the data empire constructed by neurocapitalism, commercial brain-computer interface systems create double alienation by encoding neural signals as encrypted commodities through closed architecture. Users are both unable to understand the algorithmic transformation process of their own neural data and lose the ability to dispose of their conscious data. It is no longer an engineering challenge to create components that mimic or even realize the ability to think with the added benefit of technological evolution. If the OpenBCI (Open Source Brain-Computer Interface) movement uses the democratization of technology as a weapon to combine these thinking devices based on the way the human brain thinks, together with the transcendence of biological finiteness by electronic, mechanical, and informational components<sup>28</sup>, dismantling the algorithmic black box through reverse engineering can open up novel paths of resistance in the neuropolitical arena. The power asymmetry of the traditional brain-computer interface system is rooted in the technical black box where the data capture mechanism at the sensor layer, the feature extraction model at the algorithm layer, and the value distribution rules at the application layer are all encapsulated as commercial secrets. OpenBCI breaks this technological fiefdom through the full-stack open-source strategy by making public not only the design drawings of the hardware, but also the core algorithms of the signal filtering and time-frequency analysis in the GitHub community. Its Ultracortex headset not only makes the hardware design drawings public, but also puts the core algorithms, such as signal filtering and time-frequency analysis, under the supervision of GitHub community. This transparent architecture allows ordinary users to trace the complete chain of neuroelectric signals from bioelectrical impulses to digital symbols.

However, technological resistance always faces recursive cannibalization by power structures. The ethical potential of open-source protocols may be coopted as a compliance frill for the commercial system, and barriers to entry for hardware costs continue to reproduce the technological elite. True reverse engineering must move beyond instrumental rationality critique to construct systemic alternatives at the level of cognitive political economy. This requires the uplifting of code open source into an institutionalized practice of cognitive justice — both through algorithmic transparency that dismantles the commodity fetishism of neural data, and a knowledge community model that rebuilds the social contract of consciousness production. Technological decoding thus becomes the new emancipatory narrative of the digital age, igniting a rational spark of resistance to alienation at the abyss of brain-computer fusion.

### **5. The Neuralized Extension of Critical Theory and the Defense of Anthropology**

When neurocapitalism advances the logic of exploitation from the realm of labor to the realm of cognition, the task of critical theory is not only to explain the world, but also to defend the existential foundation of human beings as human beings. The “alienation of labor” revealed by Marx in the 19th century is being upgraded to “cognitive alienation” in the age of neurotechnology, where the power of capital not only appropriates the surplus value of laborers, but also colonizes the mechanisms of their perception, memory, and desire through brain-computer interfaces. Only by breaking the complicity between neural circuits and the logic of capital can the integrity of the embodied subject be reconstructed and the irreducibility of human consciousness be defended in technological mediation.

#### *5.1 Diagnosis of the New Forms of Alienation: Paradigm Shift from Labor Alienation to Cognitive Alienation*

The theory of labor alienation constructed by Marx in the 1844 Economic and Philosophical Manuscripts reveals the fourfold alienation of the essential power of the laborer under the capitalist relations of production: the alienation of the laborer from the product of labor manifests itself in the hostile existence of objectified labor; the alienation of the process of labor reduces productive activity to the antithesis of vital activity; the alienation of the essence of the class cuts off the free and self-conscious character of the human being; and the alienation of interpersonal relations reduces social relations to objectified relations. social relations down to materialized relations<sup>29</sup>. This theoretical system has suffered an epistemological rupture under the framework of

contemporary neurocapitalism, where the violence of alienation has penetrated from the realm of material production to the neurocognitive dimension, completing a paradigm revolution from the exploitation of human labor to the reconstruction of the human being itself.

Neurocapitalism has implanted the logic of capital proliferation into the human neuroplasticity system through technological devices such as brain-computer interfaces and neural augmentation, and so the quadruple nature of alienation revealed by Marx has gained a new elaboration in the cognitive dimension: the alienation of cognitive products (neural data) reduces mental activity to a means of production; the alienation of cognitive processes downgrades the movement of thought to algorithmic training; the alienation of the cognitive class of essences dissolves the subjectivity of the reflective dimension; and the alienation of cognitive relations constructs the hierarchical domination of neural networks. Neurocapitalism achieves a qualitative shift from the exploitation of surplus value to the production of the cognitive subject by advancing the objectified domination of labor alienation theory to a neuralized reconfiguration. The deep violence of this cognitive alienation lies in the fact that it is no longer satisfied with appropriating the product of labor, but rather, through the technological intervention of the nervous system, it transforms the cognitive potential of the human being into an organ of capital's self-multiplication. The alienation of man from his own kind of essence, as Marx puts it, is corroborated at the neurobiological level in the age of neurocapitalism. This revolutionary leap in the paradigm of alienation requires us to reinterpret the contemporary value of Marxist theory and, moreover, to develop a cognitive critical paradigm against neurocapitalism to guard the essence of human freedom amidst the wave of technological accelerationism.

### *5.2 The Neuropsychological Path of Subjectivity Reconstruction: Confrontation Between Embodied Cognition and Algorithmic Hegemony*

At a time when intelligent technology is deeply involved in human cognition, the reconstruction of subjectivity has become an important proposition in the field of neuropsychology. The confrontation between the theory of embodied cognition and the hegemony of algorithms is essentially a philosophical reconstruction of the way of human existence, the core of which is to break the domination of subjective consciousness by technological alienation, and to reshape the bodily experience and autonomy in cognitive activities. Algorithmic systems are systematically reconfiguring the human cognitive framework through dataization, standardization, and predictive manipulation. Their efficiency-first logic reduces cognitive processes to computable input-output models, leading to the abstraction of embodied experiences into data streams and the displacement of fuzzy decisions into probabilistic calculations. This cognitive colonization not only dissolves the body's function as a carrier of meaning generation, but also reshapes the operation mode of brain circuits through the mechanism of neuroplasticity, so that subjectivity gradually becomes dependent on the algorithmic interpretation system. At the same time, the rapid development of big data technology has laid the potential foundational conditions for the widespread expansion of surveillance capitalism, where massive amounts of user-generated data have become the object of influence exerted by corporations and other actors using predictive algorithms, a process that profoundly reveals the dynamics of power in the data economy. However, this model in practice often lacks sufficient ethical consideration and accountability. Surveillance capitalism tends to disregard established legal frameworks and ethical boundaries, and only reluctantly acknowledges the existence of its violations when faced with an unstoppable wave of public criticism<sup>30</sup>. Platforms such as Facebook/Meta exist to precedent of manipulating users' behavior without their consent in an attempt to quantify and influence our emotional responses, mental states and even behavioral tendencies. This phenomenon shows that in the pursuit of maximizing commercial interests, ethical norms are often marginalized or even ignored, and as long as there is the possibility of circumventing regulation and accountability, ethical boundaries are easily blurred or even crossed.

In order to fight against the hegemony of algorithms, we should emphasize the dynamic coupling mechanism between body schema and the environment at the perceptual level, and resist the fragmented cognition of algorithms by restoring the wholeness of sensory experience; advocate the non-calculability of pre-reflective consciousness at the level of cognitive generation, and reveal the constitutive role of bodily movement in concept formation; and build a shared meaning space of embodied interaction at the level of intersubjectivity, so as to break the cognitive silo constructed by algorithms. The cognitive defense against technological alienation jointly constituted by these three dimensions is to introduce Merleau-Ponty's philosophy of incarnation into the field of technological criticism, and to re-anchor the ontological status of the body in digital civilization through the theoretical structure of neuropsychology. It not only requires technological systems to respect the biological constraints of embodied cognition, but also to reconstruct the limits of technological intervention at the phenomenological level.

### *5.3 Ultimate Guardianship of the Frontier of Freedom: Neurodemocratization and the Choice of a New Form of Human Civilization*



The development of neurotechnology is reconfiguring the existential foundation of human civilization, and introducing the evolutionary history of species into an unprecedented field of ethical decision-making. This technological revolution not only implies a paradigm shift in cognitive science, but also opens up the ultimate proposition of subjectivity reconstruction in the philosophical dimension. When the neural interface breaks through the physical barrier of the biological brain, and when the neural data stream becomes a programmable algorithmic object, human beings must face the structural reshaping of free will and the paradigmatic choice of civilization. The expansion of neurocapitalism is essentially the ultimate colonization of the field of life by instrumental rationality. Its cognitive paradigm of downgrading the brain to a “wetware” implicitly perpetuates the modernity of Cartesian mind-body dualism, reducing conscious activity to a set of neural signals that can be computed and traded. This cognitive colonization process realizes the algorithmic deconstruction of the subject’s decision-making mechanism through neuroeconomics, implanting consumerist value presuppositions in the neural feedback loop, and reducing free will to a neuroplastic market variable.

The new form of human civilization is essentially an existential turn at the level of techno-philosophy. Heidegger’s theory of technological demystification shows the value of early warning here. When neurotechnology transforms conscious activities into quantifiable information flows, the truth of existence may be obscured by computational rationality<sup>31</sup>. The risk inherent in cutting-edge neurotechnology is that it may tend to obscure or even dissolve the essential existence of human beings, focusing too much on the technology itself and ignoring the subjective position of the individual. Neurotechnology should be positioned as an aid to solving practical problems, and its application must ensure that it does not diminish or jeopardize the rights and dignity of the individuals who are the subjects of the research<sup>32</sup>. Moreover, the ultimate goal of neural democratization lies in the establishment of a hermeneutic framework for the application of technology, so that neural augmentation always serves the expansion of existential possibilities rather than the dismantling of essence. This calls for a reconfiguration of the ontological foundations of the concept of posthumanity, not through neural modification to achieve the self-transcendence of the human species, but rather to sustain the integrity of dignity in an existential sense in the process of technological embodiment. As the technological singularity of the neural interface breaking through the physical limitations of the biological brain approaches, the choice of civilization has gone beyond the scope of traditional ethical discussions and has risen to the level of existential collective decision-making. Only by maintaining the necessary tension in the dialectical movement between technical rationality and value rationality can human beings maintain the ethical baseline for the continuation of civilization in the neurotechnological revolution.

## 6. Conclusion

The domination techniques of neurocapitalism have pushed humanity to a tipping point in the history of the species: when  $\delta$ -wave data becomes the new raw material for capital accumulation, when fluctuations in attention are quantified as indicators of productivity, and when the algorithmic gyratory replaces rational negotiation in the public sphere, the existential roots of human beings as human beings are experiencing an unprecedented erosion. This crisis not only exposes the limitations of the explanatory power of traditional critical theory, but also forces philosophy to re-examine the symbiotic relationship between technology, capital and subjectivity. The construction of a neurodemocratic governance paradigm is not only a neuralized continuation of Habermas’s “unfinished program of modernity”, but also an expansion of the cognitive dimension of Marx’s alienation theory. At the crossroads of civilization, only by liberating brain-computer interface technology from the logic of capital and making it the material carrier for rebuilding the rationality of interaction can we guard the ultimate dignity of human beings as the subject of meaning generation, which is not only the contemporary mission of critical theory, but also the ethical bottom line for the survival of digital civilization.

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## Author Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Zisi Yang and Ying Yang. The first draft of the manuscript was written by Zisi Yang and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

### Data Availability Statement

The datasets used and analysed during the current study available from the corresponding author on reasonable request.

### Ethics Declaration

Not Applicable.

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