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Are Cyborgs Alive?

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Abstract

Cyborgs challenge traditional definitions of life by integrating biological and technological components. Drawing from Gaia theory, post-humanism and Actor-Network Theory, this article argues that life should be redefined as adaptive and relational rather than strictly biological. Cyborgs exhibit autonomy, evolution and self-organization, resembling living systems within Gaia's self-regulatory processes. By blurring the artificial–natural divide, they compel us to rethink identity, agency and evolution, ultimately expanding our understanding of what it means to be alive in a post-human era.

What Does It Mean to Be Alive?

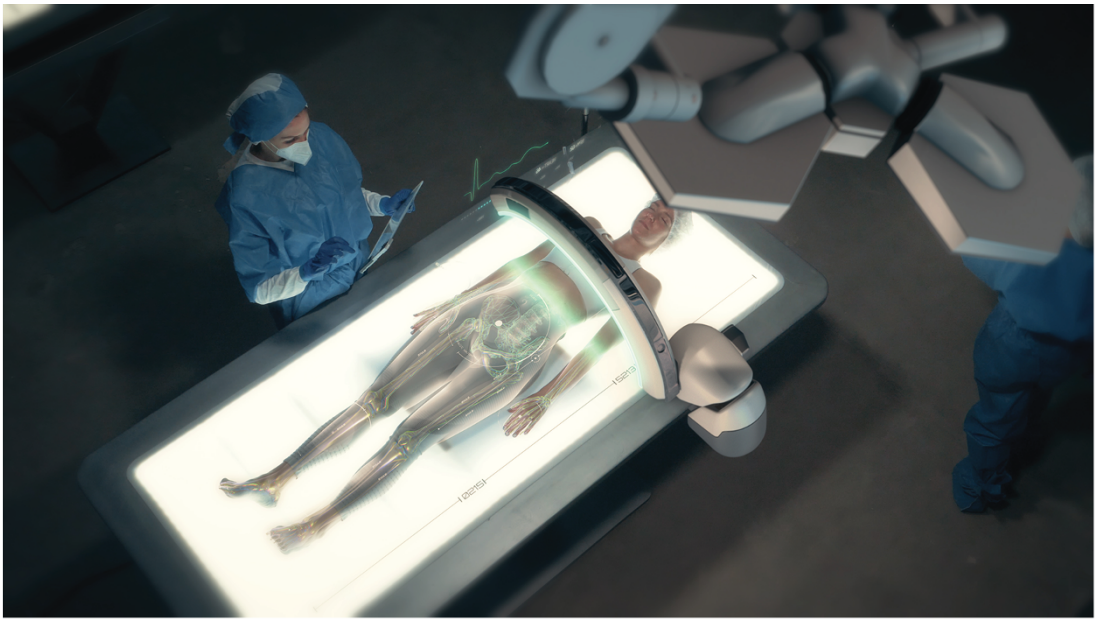
Imagine a robotic limb that not only mimics human movement but also learns and adapts to its user's unique neural impulses. Or consider a bio-hybrid robot inspired by plant roots that 'grows' to navigate its environment. These examples blur the line between biology and technology, forcing us to confront a provocative question: are such entities alive?

For millennia, the concept of life has been tethered to biological processes. Aristotle framed life as an organism's purpose-driven activity, or telos, where each entity strives to fulfil its potential – a tree growing to its full height, an animal seeking prey or a philosopher engaged in reasoning. Centuries later, Hans Jonas added a more mechanistic layer to this understanding, emphasizing metabolism as the defining trait of life: the capacity of an organism to exchange energy and matter with its environment in a self-sustaining cycle. By these measures, life has always been firmly grounded in the organic. Yet, the rise of cyborgs – hybrid entities that merge biological and technological components – now compels us to re-evaluate these age-old definitions.

Cyborgs challenge these traditional frameworks not by mimicking biological life superficially, but by exhibiting behaviours that were once thought to be uniquely organic. Consider advanced prosthetics: they do not merely replace lost limbs but restore agency, adapting to their users' neural inputs over time. Or take neural implants that not only enable sensory perception but evolve alongside their users, reshaping our understanding of interaction and adaptation. These innovations push us to question whether traits like adaptation, purpose and self-regulation – long considered hallmarks of life – might apply to entities that transcend the boundaries of biology.

James Lovelock's Gaia theory offers a radical perspective. Gaia conceptualizes the Earth as a self-regulating organism, where life emerges not from isolated metabolic processes but from dynamic, systemic interactions between living and non-living components. In this framework, adaptability and purposefulness

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extend beyond individual organisms to encompass entire ecosystems, and even the technological systems humans create. Could cyborgs, with their capacity for adaptation and interaction, fit into this broader definition of life? Are they truly alive, or are they something entirely new? By reframing life as a spectrum of interaction and adaptability, we uncover the profound implications of our increasingly hybrid existence, challenging the traditional boundaries of what it means to live.

The Cyborg's Evolution: From Tool to Philosophical Paradigm

The term 'cyborg' was coined by Manfred Clynes and Nathan Kline in 1960. It initially described a human-machine system designed for space exploration. Clynes and Kline envisioned 'an exogenously extended organisational complex functioning as an integrated homeostatic system unconsciously'. Early cyborgs aimed to enhance survival in extreme environments, focusing on homeostasis and functionality.

This vision of the cyborg emerged from the specific challenges of space exploration. The human body, limited by its biological constraints, could not endure the extreme conditions of space without assistance. Rather than replicating Earth-like environments, Clynes and Kline proposed modifying the human body itself, integrating technology to maintain internal stability. This marked a shift in how humanity approached survival, presenting the cyborg as a bridge between biology and technology.

Over time, the cyborg transcended its utilitarian origins to become a rich cultural and philosophical symbol. Donna Haraway's *Cyborg Manifesto* (1991) reimagined the cyborg as a figure that disrupts entrenched binaries such as nature/culture, male/female and human/machine: it embodies fluidity, interconnectedness and resistance to hierarchical constructs, offering a vision of liberation through hybridity. According to Haraway, the cyborg is not merely a technological entity but a powerful metaphor for rethinking identity and agency in a technologically mediated world.

Building on Haraway, thinkers like N. Katherine Hayles and Rosi Braidotti expanded

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the cyborg's conceptual framework. Hayles emphasized the embodied nature of cognition, critiquing the disembodied notion of information in cybernetics. She argued that human identity is co-constituted by materiality and interaction with technology. This perspective redefined the cyborg as an entity where biological and technological components coalesce to form new modes of being. Braidotti, in her post-humanist framework, viewed the cyborg as a relational entity that challenges anthropocentric hierarchies. By emphasizing interconnectedness and interdependence, she framed the cyborg as a model for understanding the porous boundaries between humans, machines and the environment.

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Technological advancements have materialized these theoretical explorations, making the cyborg a tangible reality. Neural implants, AI-driven prosthetics and bio-hybrid robots exemplify the integration of biological and technological systems. Neural implants, for instance, restore sensory functions while adapting to the user's neural patterns, effectively merging human cognition with machine intelligence. Similarly, AI-driven prosthetics do more than replace lost limbs – they enhance physical capabilities, creating a seamless interaction between human intention and technological execution. Bio-hybrid robots, inspired by natural systems, navigate and adapt to their environments in ways that resemble organic life.

These innovations blur the boundaries between organism and machine, raising profound ethical and philosophical questions. What does it mean to have agency in a system where human and machine are intertwined? How do we define identity when biological and technological components are inseparable? The cyborg, once a tool for survival, now serves as a lens through which we explore these complexities. It challenges us to rethink not only our relationship with technology but also the very definitions of life, identity and autonomy.

The Cyborg in Science Fiction and Cultural Imagination

Beyond the academic realm, the concept of the cyborg has deeply permeated popular culture, shaping how society grapples with the interplay of humanity and technology. From iconic films like *Blade Runner* (1982) to *The Matrix* (1999), cyborgs have been depicted as symbols of both human transcendence and existential anxiety. These narratives explore themes of autonomy, identity and the potential alienation that can accompany technological integration. In *Blade Runner* for instance, the replicants – artificial beings with biological components – struggle with the question of what it means to be alive. Their plight mirrors the philosophical dilemmas surrounding cyborgs, particularly the tension between autonomy and control. Similarly, *The Matrix* explores the implications of existing in a world where boundaries between reality and artificiality have dissolved. Such stories resonate with contemporary debates on the ethics of cyborgization, illustrating how fiction can provide a lens through which to examine emerging technologies.

Science fiction often anticipates the moral and philosophical dilemmas posed by cyborgization. In *Ghost in the Shell* (1995), the protagonist – a cyborg with a human brain – grapples with identity and the meaning of selfhood in a world dominated by artificial entities. These narratives challenge audiences to consider whether humanity's essence resides in biology, consciousness, or something else entirely. Cultural representations of cyborgs push us to confront

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questions about agency, ethics and coexistence in increasingly hybrid worlds. Fiction becomes a testing ground, offering speculative scenarios that parallel real-world technological advancements and their implications.

Are Cyborgs Alive? Revisiting Life's Definitions

Traditional definitions of life emphasize characteristics like metabolism, growth and reproduction. Hans Jonas's focus on metabolism as the hallmark of life underscores autonomy – an organism's ability to sustain itself by exchanging energy and matter with its environment. However, this metabolic-centric view risks excluding entities that exhibit purposeful behaviour and interaction without traditional biological processes. Could these definitions be too narrow in an age of technological complexity?

Barbara Mazzolai's plantoids challenge such exclusions. These robotic systems emulate plant root behaviours: they grow, explore their environment and respond to external stimuli. While they lack cellular structures or biochemical metabolism, their ability to adapt and self-organize mirrors the functional autonomy of living organisms. Similarly, neural implants, which restore lost sensory functions, go beyond passive replacement. They integrate with neural systems, evolving alongside the user's brain to enhance and adapt functionality over time. Such examples suggest that life's defining traits might extend beyond biology to include adaptive behaviours and teleological functionality.

James Lovelock's Gaia theory offers another disruptive lens. Gaia frames life not as an isolated property of individual organisms but as an emergent phenomenon of interconnected systems. In this view, the interplay between organic and inorganic components sustains the dynamic equilibrium of life on Earth. Cyborgs, as hybrid entities, fit naturally within this framework. By participating in adaptive, self-regulating systems – whether environmental or biological – cyborgs can contribute to the broader equilibrium of Gaia. Bio-hybrid robots could come to monitor ecosystems, demonstrating how technology can serve as an active agent in maintaining planetary health.

Critics often argue that cyborgs lack intrinsic agency because their behaviours are derived from human programming. However, the phenomenon of emergence complicates this critique. Emergence occurs when complex systems exhibit behaviours and patterns that are not reducible to their individual components. In AI-driven systems, for example, algorithms often produce solutions that even their creators cannot predict. This emergent behaviour resembles the distributed agency observed in ecosystems, where no single entity governs the whole, yet purposeful patterns emerge. If we consider agency as an interaction-driven phenomenon, cyborgs might indeed possess a form of distributed agency.

This redefinition of agency also compels us to reconsider what it means to be alive. If life is characterized by autonomy, interaction and adaptability, rather than solely by cellular or metabolic processes, then the boundary between the living and the non-living begins to blur. Cyborgs, with their capacity for self-organization and purposeful interaction, challenge the sufficiency of traditional definitions of life. They compel us to expand our understanding of life to encompass systems that integrate biology with technology, redefining what it means to exist in an increasingly hybrid world.

The Ethical Dimensions of Hybrid Existence

Cyborgs challenge ethical frameworks grounded in anthropocentric and binary thinking. Their hybrid nature raises profound questions about autonomy, equity and environmental responsibility. Autonomy, a cornerstone of ethical theory, becomes increasingly ambiguous in cyborg systems. Neural implants and AI-enhanced prosthetics blur the boundaries between user and device, distributing agency across human and machine. This distributed autonomy necessitates a reconsideration of accountability, agency and consent. For example, when decisions emerge from a collaborative human–machine

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interface, who holds responsibility – the user, the device or the engineers who designed it?

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Equity presents another pressing concern. Advanced cyborg technologies, such as AI-driven prosthetics or neural interfaces, remain prohibitively expensive for many, creating the risk of a ‘cyborg elite’. Those with access to these advancements gain significant advantages, exacerbating existing social inequalities. Ensuring that these transformative technologies are accessible to all is critical to fostering ethical progress and preventing a deepening of the socio-economic divide.

Finally, the ecological implications of cyborg systems echo James Lovelock’s Gaia hypothesis. On the one hand, technologies like bio-hybrid robots offer the potential to mitigate environmental challenges, contributing positively to planetary health by monitoring ecosystems or reducing pollution. On the other hand, the production, maintenance and disposal of cyborg components introduce significant ecological costs, from resource extraction to electronic waste. Sustainable design and deployment practices must therefore be prioritized to balance innovation with environmental stewardship.

In redefining the boundaries of autonomy, addressing inequity and embracing environmental accountability, cyborgs compel us to rethink the ethical frameworks that shape technological progress. As hybrid entities, they invite a more nuanced and inclusive perspective – one that recognizes the intertwined futures of humanity, technology and the natural world.

Cyborgs as an Evolutionary Adaptation

Darwinian evolution emphasizes the adaptability of organisms to survive environmental changes. Cyborgization could represent a leap in this process, allowing humans to transcend biological limitations through augmented technology. Exoskeletons, for example, enhance physical strength, while wearable health devices optimize physiological processes. These systems embody the principles of adaptation, aligning human evolution with technological innovation.

James Lovelock’s Gaia theory positions cyborgs within a broader ecological narrative. By integrating technology into natural systems, cyborgs can contribute to planetary resilience. For instance, bio-hybrid robots could mitigate environmental crises by monitoring ecosystems or cleaning up pollutants. This symbiosis underscores the potential of cyborgs to harmonize human activity with Gaia’s self-regulating processes. This potential also marks a profound shift in how humanity interacts with its environment. Traditionally, humans have adapted their surroundings to meet their needs, often at the expense of ecological balance. Cyborg systems, however, offer the possibility of a more symbiotic relationship. By enhancing human capacity while aligning with natural processes, cyborgs can bridge the divide between technological advancement and environmental stewardship. Far from being mere tools, cyborgs represent an evolutionary adaptation – a means of ensuring human survival in increasingly complex and hostile environments. They are not just augmentations of individual capabilities but also extensions of Gaia’s systems, integrating humanity into the broader ecological framework. For instance, neural implants could enhance collective decision-making processes, allowing societies to respond more effectively to global challenges. Similarly, wearable technologies that monitor environmental health could

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transform individuals into active participants in planetary resilience.

Cyborgization could thus become part of a collaborative evolution, where humanity's technological ingenuity complements the adaptive intelligence of nature. Rather than opposing natural evolution, cyborg systems extend its principles, creating a future where life is not defined by its origin – organic or artificial – but by its ability to sustain and enrich interconnected systems. This paradigm shift challenges us to rethink not only the boundaries of life but also our role within it. Are we passive beneficiaries of evolution, or active participants in shaping its next stage?

Conclusion: Redefining Life in a Hybrid World

The rise of cyborgs invites us to reconsider the essence of life. By expanding life's definition to include adaptability, interaction and teleological functionality, we move beyond the organic/artefact dichotomy. Cyborgs, as participants in Gaia's self-regulatory processes, exemplify life's inherent hybridity and interconnectedness. Philosophically, cyborgs challenge Cartesian dualisms and anthropocentric hierarchies, offering a vision of existence rooted in relationality and interdependence. They compel us to rethink identity, agency and autonomy in an era of technological integration.

Are cyborgs alive? The answer lies not in their components but in their capacity to redefine life itself. By embodying adaptability and participating in life-sustaining networks, cyborgs extend the boundaries of what we consider alive. As we merge further with our creations, the question is no longer merely whether cyborgs are alive, but how their existence reshapes our understanding of life in a posthuman era. By embracing these hybrid entities, humanity is prompted to move beyond rigid definitions, fostering a more inclusive and interconnected vision of existence. Cyborgs embody not just technological progress but the deep relationality at the heart of life itself. Their rise urges us to forge ethical and philosophical frameworks that reflect this evolving reality, ensuring a future where biology and technology coexist in harmony, enriching what it means to live.

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