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Philosophy of the Biotechnological Sciences: On Transhumanism, Posthumanism, and the Philosophy-Science Gap

Filosofía de las ciencias biotecnológicas: sobre el transhumanismo, el poshumanismo y la brecha entre filosofía y ciencia

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ABSTRACT

Transhumanism and posthumanism have become influential frameworks within the biotechnological sciences, grounded in the presupposition that the human body is inherently imperfect and therefore open to technical improvement. This essay develops a philosophical and bioethical critique of these positions, arguing that their central difficulties are not technical but normative, epistemic, and anthropological. Drawing on debates in philosophy of technology, bioethics, and science studies, the analysis examines how key notions such as enhancement, perfection, and necessity are reconfigured within transhumanist discourse. Particular attention is given to the way biotechnological rationality reframes contingent features of human existence—vulnerability, aging, dependence, and finitude—as deficits requiring intervention and control. This redefinition signals a shift from ontological conceptions of necessity toward instrumental logics

shaped by technological capability and governance practices. The essay further explores how scientific feasibility frequently advances without corresponding philosophical clarification, generating epistemic gaps concerning responsibility, consent, and the meaning of human flourishing. From this perspective, transhumanism and posthumanism are interpreted not as neutral scientific projects, but as normative frameworks that actively reshape anthropological self-understanding. The essay concludes by emphasizing the indispensability of sustained philosophical inquiry for assessing biotechnological innovation, warning that, in the absence of clear ethical and conceptual foundations, enhancement projects risk reinforcing inequality, dehumanization, and the reduction of human life to objects of technical management.

Keywords: Human finitude; Human enhancement; Normative indeterminacy; Instrumental rationality; Bioethical critique; Technical governance.

RESUMEN

El transhumanismo y el poshumanismo se han convertido en marcos influyentes dentro de las ciencias biotecnológicas, fundamentados en la presuposición de que el cuerpo humano es inherentemente imperfecto y, por tanto, susceptible de mejora técnica. Este ensayo desarrolla una crítica filosófica y bioética de estas posiciones, sosteniendo que sus dificultades centrales no son técnicas, sino normativas, epistémicas y antropológicas. A partir de debates en la filosofía de la tecnología, la bioética y los estudios de la ciencia, el análisis examina cómo nociones clave como mejora, perfección y necesidad son reconfiguradas dentro del discurso transhumanista. Se presta especial atención a la manera en que la racionalidad biotecnológica reencuadra rasgos contingentes de la existencia humana –vulnerabilidad, envejecimiento, dependencia y finitud– como déficits que requieren intervención y control. Esta redefinición señala un desplazamiento desde concepciones ontológicas de la necesidad hacia lógicas instrumentales moldeadas por la

capacidad tecnológica y las prácticas de gobernanza. El ensayo explora, además, cómo la factibilidad científica avanza con frecuencia sin una clarificación filosófica correspondiente, generando brechas epistémicas en torno a la responsabilidad, el consentimiento y el significado del florecimiento humano. Desde esta perspectiva, el transhumanismo y el poshumanismo son interpretados no como proyectos científicos neutrales, sino como marcos normativos que reconfiguran activamente la autocomprensión antropológica. El ensayo concluye enfatizando la indispensabilidad de una indagación filosófica sostenida para evaluar la innovación biotecnológica, y advierte que, en ausencia de fundamentos éticos y conceptuales claros, los proyectos de mejora corren el riesgo de reforzar la desigualdad, la deshumanización y la reducción de la vida humana a objetos de gestión técnica.

Palabras clave: Finitud humana; Mejoramiento humano; Indeterminación normativa; Racionalidad instrumental; Crítica bioética; Gobernanza técnica.

Introduction

The contemporary understanding of transhumanism and posthumanism rests on the widely shared assumption that the human body is inherently imperfect and therefore open to improvement. This assumption can be traced to Renaissance humanism and persists within contemporary biotechnological thought. Transhumanism typically frames technology as the primary means of overcoming human limitations, whereas posthumanism radicalizes this stance by challenging anthropocentrism and reexamining the position of the human within broader technological and biological networks (Brito Alvarado, 2025).

From this perspective, posthumanist transhumanism emerges less as a realistic redefinition of human nature than as a technological strategy, insofar as it presupposes that humanity can deliberately transcend its biological constraints and even act against natural

limits. Such a conception of progress contrasts with the persistence of unresolved social, ethical, and environmental challenges, thereby exposing a tension between technological optimism and the broader conditions of human existence (Méndez Reyes et al., 2025).

This tension becomes more apparent when the rational foundations of human enhancement are examined philosophically. Although transhumanism frequently presents biotechnological enhancement as both feasible and rational, this assumption entails significant limitations. As Lyreskog and McKeown (2022) argue, certain forms of enhancement involve transformative experiences that generate the epistemic gaps, thereby preventing individuals from fully understanding or anticipating their consequences in advance. Such gaps challenge the claim that technological enhancement necessarily produces a coherent form of human evolution and thus underscore the persistent gap between philosophy and science within contemporary biotechnological discourse.

From a bioethical standpoint, the gap between technological advancement and philosophical reflection reveals challenges that transhumanism, as a predominantly theoretical project, has yet to address. Meza Osorio (2022) argues that the pursuit of human enhancement through emerging biotechnologies raises serious concerns regarding human dignity, moral responsibility, ethics, and social justice, particularly in contexts shaped by structural inequality and unequal access to technological resources. Enhancements involving genetic engineering, artificial intelligence, or cybernetic integration not only intensify existing ethical dilemmas but also generate new risks of exclusion and dehumanization. Within this framework, bioethics operates as a necessary mediating domain between scientific innovation and human values, emphasizing the need for regulatory mechanisms capable of ensuring that biotechnological progress does not undermine the conditions of human coexistence (Meza Osorio, 2022).

Against this background, transhumanism and posthumanism cannot be reduced to transient intellectual trends or purely technological discourses. Rather, they articulate enduring philosophical, ethical, and political questions that shape contemporary bioethical debate. As Hottois (2015) maintains, trans/posthumanism functions as an implicit horizon within which many theoretical and practical discussions in bioethics unfold, extending its significance beyond strictly scientific concerns. These debates therefore gesture toward a broader philosophical framework capable of addressing both present conditions and future reflections on humanity. In turn, they call for a careful reconsideration of whether, and in what sense, a trans- or posthumanist form of humanism remains possible, thereby reaffirming the necessity of sustained philosophical inquiry into the relationship between scientific development and human values.

Critical Analysis of Transhumanism and Posthumanism

Philosophical, Epistemic, and Bioethical Limits of Human Enhancement

Within the biotechnological sciences, the gap between scientific development and philosophical reflection becomes especially visible in debates surrounding transhumanism and posthumanism. As Merzlyakov (2022) notes, these positions are frequently conflated despite their distinct implications for the understanding of the human. Posthumanism rejects ethical, biological, and ontological anthropocentrism by questioning the privileged status of the human, whereas transhumanism remains oriented toward the technological enhancement of human capacities. This distinction discloses an epistemic tension: posthumanist claims often extend agency and consciousness beyond the human, even though contemporary science still lacks a coherent account of consciousness itself. As a result, the posthumanist expansion of the anthropological horizon brings into relief the conceptual limits of current biotechnological discourse when philosophical clarification fails to keep pace with technological ambition.

From this perspective, recent bioethical analyses of human enhancement further illustrate how this conceptual gap operates at the practical level. Gerardi and Xinaris (2025) demonstrate that contemporary enhancement practices—particularly in the domains of cognitive and physical enhancement—systematically blur the distinction between therapy, prevention, and enhancement, thereby destabilizing the criteria by which health, disease, and normality are defined. This ambiguity is not merely regulatory but epistemic: when interventions aim to improve cognitive or moral capacities beyond therapeutic necessity, both individuals and institutions confront what the authors describe as potentially unbridgeable epistemic gaps, especially with regard to long-term consequences and informed consent. Accordingly, enhancement technologies advance within a framework in which scientific feasibility outpaces philosophical clarification, thereby reinforcing the disjunction between technological capability and conceptual understanding that characterizes contemporary biotechnological discourse.

In this sense, Gayozzo's analysis clarifies that the problem of human enhancement lies not in its technical feasibility but in its normative indeterminacy. Although transhumanism is commonly defined as the use of advanced technologies to modify the human body and the human condition (Gayozzo, 2021), the notion of improvement itself lacks scientific univocity, as it varies according to the theoretical framework that adopts it. This exposes a structural epistemological limit: while biotechnological science can intervene effectively in human biology, it cannot, by itself, determine what counts as "better," since technology is morally neutral and requires an external ethical framework to guide its application (Gayozzo, 2021). Accordingly, the fragmentation of transhumanism into multiple ideological approaches is not accidental but necessary, confirming that the gap between science and philosophy in contemporary enhancement debates is structural rather than contingent.

The debate on human enhancement is further characterized by a persistent conceptual ambiguity that weakens its normative clarity. The transhumanist use of terms such as “enhancement” or “augmentation” lacks conceptual precision, resulting in an unstable framework for evaluating what counts as human improvement. Definitions of enhancement remain fragmented and problematic, which prevents the formation of a unified or objective understanding of improvement. Within this context, enhancement is often reduced to biotechnological intervention, assuming that human betterment can only be achieved through technical means. This reductionist view is problematic because technological interventions cannot be separated from ethical consequences. For this reason, the core issue of human enhancement is not its technical feasibility, but the ethical, legal, and existential dimensions that shape human life. Consequently, enhancement should not be treated solely as a biomedical or bioethical matter, but as a broader anthropological, social, and historical problem that exceeds the explanatory capacity of science alone (García Echeverri et al., 2024).

Taken together, these analyses indicate that the principal limits of transhumanism and posthumanism are not primarily technical or empirical, but philosophical and epistemic. Persistent ambiguities surrounding concepts such as enhancement, improvement, and human flourishing suggest that biotechnological interventions operate within a normative framework that science alone cannot supply. While technological capacities continue to expand, the absence of a clear anthropological and ethical foundation renders enhancement projects conceptually unstable and normatively indeterminate. This condition exposes a structural disjunction between what the sciences are able to accomplish at the technical level and what philosophy can justify in terms of meaning and purpose. Accordingly, any rigorous discussion of human enhancement must acknowledge that its limits arise not from technological constraints, but from unresolved questions concerning human identity, moral responsibility, and the criteria by which “better” is defined. Addressing this disjunction requires reintegrating philosophical reflection into the development and assessment of

biotechnological advances, rather than allowing technological progress to proceed without adequate conceptual guidance (García Echeverri et al., 2024).

Philosophical Conceptions of Necessity: From Ontology to Instrumentality

A critical philosophical examination of transhumanism and posthumanism requires prior clarification of the concept of necessity, given that projects of human enhancement are systematically justified as responses to presumed human needs. In Aristotelian metaphysics, necessity is defined as that which "cannot be otherwise," a notion that operates across logical, physical, metaphysical, and ethical domains. Aristotle distinguishes between absolute necessity, proper to eternal and self-sufficient realities, and hypothetical necessity, which characterizes contingent beings whose existence depends on determinate conditions (Reader, 2005). Human life belongs to this latter domain: its necessities do not impose inevitability, but delineate the material and practical conditions without which life cannot be sustained. Needs, therefore, are not contingent desires or optional aspirations, but constitutive preconditions of human existence.

When this ontological understanding of necessity is contrasted with contemporary biotechnological discourse, a critical tension becomes evident. Transhumanism increasingly redefines necessity in instrumental terms, recasting contingent features of human existence –such as vulnerability, finitude, aging, and dependence– as technical problems to be optimized, deferred, or eliminated. Through this shift, necessity is displaced from its ontological grounding and transformed into a strategic justification for technological intervention. As a result, this instrumental reconfiguration marks a decisive rupture between philosophy and science: whereas philosophy conceives necessity as a constitutive dimension of human existence, transhumanist scientific discourse tends to reinterpret it as a deficit subject to technical

correction. From this perspective, the drive toward enhancement appears less as a response to unavoidable necessities than as a technologically mediated attempt to evade the conditions that define human life as contingent, embodied, and finite (Reader, 2005).

The transition from a general critique of transhumanism to a focused analysis of human finitude requires recognizing that biotechnological need is not neutral but conceptually constructed. As Fasoli (2023) argues, vulnerability is not a technical flaw or an accidental limitation, but a constitutive feature of embodied, finite, and mortal human beings. Transhumanist approaches reinterpret this ontological vulnerability as an imperfection to be corrected, framing the body as an internal obstacle and finitude as a technical problem to be eliminated; in doing so, experiences such as aging, dependence, and exposure to harm are no longer understood as structural dimensions of human existence, but as deficits that justify technological intervention. Consequently, biotechnological necessity emerges not from unavoidable ontological needs, but from a systematic denial of embodiment and vulnerability, transforming human finitude into an instrumental rationale for enhancement technologies (Fasoli, 2023).

The instrumental reinterpretation of necessity within contemporary biotechnological discourse can be further clarified through the shift identified by Habermas between the domains of necessity, contingency, and technical control. What was once understood as a natural basis beyond human disposal increasingly becomes subject to deliberate intervention, thereby altering the boundary between what is given and what can be designed (Habermas, 2003). This transformation does not merely expand the scope of human action but restructures the moral framework within which human life is understood, insofar as technical mastery over biological foundations modifies the background assumptions of ethical self-understanding. As the contingent processes that once belonged to the "kingdom of necessity" are reclassified as technically manageable, necessity itself is no longer experienced as an ontological condition but as a variable dependent on scientific

capability. In this sense, the philosophical conception of necessity grounded in contingency gives way to an instrumental logic in which what counts as necessary is increasingly determined by what can be controlled.

This reconfiguration of necessity has direct implications for how finitude and imperfection are perceived within biotechnological frameworks. As Habermas emphasizes, the increasing disposal over the biological foundations of human life transforms natural contingency into something that appears in need of correction, thereby destabilizing the taken-for-granted background of human self-understanding (Habermas, 2003). When individuals come to experience themselves not primarily as beings that have grown under conditions of uncontrollable contingency, but as beings that are, at least in part, made, finitude loses its status as a shared existential horizon. Instead, vulnerability, limitation, and dependence are reframed as deficits that legitimate intervention, thereby generating new normative expectations of optimization and control. Under these conditions, biotechnological "need" does not arise from the requirements of sustaining human life as such, but from a normative shift in which the mastery of contingency generates new expectations of correction and optimization. This conceptual transformation prepares the ground for understanding subsequent debates on how human finitude and imperfection are constituted as sources of biotechnological demand.

Human Finitude, Imperfection, and the Emergence of Biotechnological Need

Human finitude and imperfection play a central role in the emergence of what transhumanism presents as a biotechnological need. As Corby (2025) explains, the transhumanist project begins from the presumption that human beings are fundamentally "not good enough," a judgment that generates a perceived moral imperative to pursue enhancement through science and technology. Rather than understanding finitude as

a constitutive feature of human existence, transhumanism interprets it as a problem to be overcome, thereby grounding the necessity of enhancement in a negative anthropology; within this framework, the drive toward biotechnological modification does not arise from an objective account of human flourishing, but from frustration with the given condition of humanity. Consequently, what is framed as progress or hope is, in Corby's analysis, a deceptive response to human imperfection that masks a deeper despair regarding the value and meaning of embodied, finite human life (Corby, 2025).

In this sense, human finitude and imperfection are constituted as biotechnological "needs" not solely through scientific description, but through the normative structures embedded in technological systems. From this standpoint, technology cannot be understood as a neutral instrument, since modern technical arrangements materialize specific values and forms of social ordering (Winner, 1980). Biotechnological interventions aimed at correcting vulnerability, aging, or dependence therefore do not simply respond to pre-existing human necessities; instead, they institutionalize these dimensions as deficits requiring technical management. The framing of finitude as a problem to be solved is inseparable from the social and economic contexts in which such technologies are developed and deployed, insofar as these contexts shape what is perceived as necessary, desirable, or improvable. In this configuration, the emergence of biotechnological necessity reflects a broader transition in which scientific knowledge increasingly shifts from explanatory objectives toward practices of intervention and control, thereby transforming contingent features of human existence into objects of technical governance (Winner, 1980).

This transformation of finitude into an object of technical governance is further consolidated through the epistemic and institutional practices that structure policy-relevant and regulatory science. As Jasanoff (2003) shows, contemporary governance frameworks do not simply assess technological risks; they actively construct the categories, standards, and interpretive boundaries

through which vulnerability, exposure, safety, and effectiveness become intelligible. Within these regimes, uncertainty and human limitation are translated into variables to be managed, monitored, and optimized, displacing reflection on the normative meaning of finitude in favor of predictive and corrective logics. Regulatory science thereby participates in redefining imperfection as a condition requiring intervention, embedding judgments about acceptable risk, tolerable harm, and desirable outcomes within ostensibly technical procedures. Under these conditions, biotechnological necessity does not arise from an ontological account of human flourishing, but from governance practices that privilege control over humility and management over deliberation, thereby narrowing the space for ethical and political contestation (Jasanoff, 2003).

Scientific Necessity and the Transition from Explanation to Technical Control

Human finitude and imperfection become biotechnological problems only once the nature of human action is transformed by modern technology. As Hans Jonas argues, technological power has radically expanded the scope, scale, and temporal reach of human action, thereby dissolving the traditional ethical assumption that the human condition is fixed and not itself an object of technical reshaping. Features once accepted as constitutive of human existence are reinterpreted as deficiencies because technology now presents itself as capable of intervening in them. In this context, necessity no longer arises from the conditions required to sustain human life, but from the power to alter those conditions. Biotechnology thus emerges as a response to what technology itself makes appear problematic: the given limits of embodied existence. For Jonas, this shift does not merely introduce new technical possibilities but generates a new ethical situation, in which human finitude becomes a matter of deliberate choice and responsibility, rather than an unquestioned horizon of life (Jonas, 2014).

Technological Responses to Constructed Needs

Although Michael J. Sandel does not explicitly address transhumanism, his ethical analysis of biotechnological enhancement provides a normative framework for understanding how technological responses to human limitation are conceptually constructed. Sandel argues that the pursuit of enhancement expresses a "drive to mastery" aimed at replacing contingency with control and transforming human capacities from gifts into objects of deliberate design. When natural limits such as vulnerability, talent, or mortality are treated as outcomes to be managed rather than conditions to be accepted, necessity ceases to be grounded in what is required for human flourishing and is instead anchored in what technology renders possible. This shift reframes human imperfection as a failure demanding correction, thereby fostering a moral outlook in which success and ability are fully attributed to choice and design. For Sandel, the ethical concern lies not primarily in particular technologies, but in the disposition they cultivate: a diminished appreciation of the gifted and unchosen dimensions of human life, which undermines humility, solidarity, and responsibility toward others. Under these conditions, biotechnological "need" emerges not as an objective demand of human nature, but as a response generated by an increasing orientation toward technical control over the conditions of existence (Sandel, 2007).

Practice and Implementation: The Structural Divide Between Philosophy and Science

The structural distinction between philosophy and science is not primarily epistemic, but practical and institutional. As De Haro argues, scientific authority is grounded in experimental validation, technological effectiveness, and the capacity to generate results that can be operationalized within specific material, social, and institutional contexts (De Haro, 2019). Scientific inquiry is thus sustained not only by theoretical coherence, but also by its integration into practices of

application, production, and funding that respond to concrete demands and constraints. Philosophy, by contrast, does not aim to provide instructions for implementation or technological development; it engages instead in critical reflection on the meanings, presuppositions, conceptual frameworks, and normative orientations underlying scientific activity. Although philosophical analysis can motivate research, clarify conceptual foundations, and shape the formation of paradigms, the transition from theoretical insight to large-scale application entails practical considerations—such as feasibility, cost, and institutional support—that lie beyond the scope of philosophical deliberation as such. Under these conditions, the divergence between science and philosophy becomes most visible not at the level of inquiry itself, but at the stages of implementation and sustained practice, where material constraints and pragmatic goals direct the course of scientific work, even when philosophical reflection has played a formative role in its initial development (De Haro, 2020).

Conclusion

This study has argued that transhumanism and posthumanism cannot be adequately understood as purely scientific or technological projects, but must be approached as complex philosophical configurations in which epistemic, ethical, and anthropological assumptions are tightly interwoven. The analysis has shown that contemporary discourses of human enhancement rely on a redefinition of finitude, vulnerability, and imperfection, transforming them from constitutive conditions of human existence into biotechnological problems requiring intervention. This transformation is not neutral; it reflects a broader shift in which necessity is increasingly framed in instrumental and technical terms, displacing its ontological and philosophical grounding.

The examination of the philosophical limits of enhancement has revealed that the central difficulties of transhumanism and posthumanism do not arise from technical feasibility, but from

normative indeterminacy. Although the biotechnological sciences exhibit a growing capacity to intervene in human biology, they lack the conceptual resources required to determine what constitutes genuine improvement, flourishing, or progress. Concepts such as enhancement, optimization, and augmentation remain philosophically underdetermined, producing epistemic indeterminacies that cannot be resolved through scientific means alone. This confirms that the divide between philosophy and science is structural rather than accidental, rooted in the distinct aims, methods, and modes of justification that define each domain.

The analysis of necessity further clarified this structural distinction. Classical philosophical accounts understand necessity as grounded in the contingent conditions of embodied human existence, whereas contemporary biotechnological discourse increasingly treats necessity as a function of technical possibility. Within this framework, vulnerability, aging, dependence, and mortality are recast as deficits on the basis that they can, in principle, be modified or controlled. Biotechnological "needs" thus emerge not from the requirements of sustaining human life as such, but from governance practices, technological infrastructures, and normative expectations that redefine what is considered acceptable, improvable, or deficient. This instrumentalization of necessity illustrates how scientific rationality, when detached from philosophical reflection, risks converting contingent features of human existence into objects of continuous technical management.

By integrating philosophical, bioethical, and epistemic perspectives, this study has shown that transhumanism and posthumanism function as more than speculative projections of the future. They operate as conceptual frameworks that reorganize how humanity understands itself, its limits, and its responsibilities. The central issue is therefore not whether enhancement technologies can be developed, but whether the assumptions they advance about the human condition can be philosophically justified. In the absence of such

justification, technological power expands within a normative vacuum, guided primarily by feasibility, efficiency, and control rather than by reflective accounts of meaning, dignity, and shared vulnerability.

The persistent divide between philosophy and science within the biotechnological sciences cannot be resolved through the subordination of one domain to the other. It requires the reintegration of philosophical inquiry into the evaluation, governance, and conceptual framing of scientific innovation. Only by acknowledging the irreducibility of human finitude and the limits of technical rationality can debates on transhumanism and posthumanism move beyond instrumental optimism and toward a more responsible and reflective engagement with the future of human life.

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