Biological Limits of Human Intelligence and the Future of the Mind

Igor Avrutskiy

ABSTRACT

This essay explores the fundamental contradiction between the biological evolutionary mechanisms that forged human intelligence and the ethical foundations of modern civilization. The author posits that human intellect has exceeded the immediate demands of biological survival, creating a rift between biological modification and civilizational progress. Under current Holocene conditions, natural selection no longer rewards high cognitive traits, threatening a gradual, unnoticed cognitive decline—a trajectory historically illustrated by *Homo floresiensis*. Furthermore, the engineering limitations of the biological body, particularly its vulnerability to cosmic radiation, impose a definitive ceiling on space expansion, offering a novel resolution to the Fermi Paradox. The essay argues that the long-term preservation of intelligence requires a deliberate transition to non-biological substrates capable of serving as carriers of the mind—substrates for which artificial intelligence and neural interfaces can be seen as the first precursors. This shift represents a new stage of existential responsibility and the sole pathway to liberate intellect from biological constraints, allowing the future evolution of the mind to transcend current human comprehension.

Keywords: Evolution of intellect, endocranial volume, civilizational sustainability, biological constraints, existential risk, Homo sapiens, technological posthumanism, Fermi Paradox.

1. INTRODUCTION

"Yesterday I was smart, so I wanted to change the world. Today I am wise, so I change myself."

— Sri Chinmoy

Our intellect is the product of natural selection, driven by the survival and reproductive success of the fittest. The evolution of the mind, like all biological evolution, depends inherently on survival patterns and reproductive outcomes. Approximately two million years ago, early representatives of the genus *Homo* began systematically utilizing tools, marking the first instance where the nascent intellect exerted an active influence on the course of evolution.

This evolutionary trajectory was accompanied by a progressive increase in brain size (Ruff et al., 1997). Over the last million years, the endocranial volume within the genus *Homo* expanded globally—ranging from roughly 900–1000 cm^3 in late *Homo erectus* forms to 1200–1250 cm^3 in Middle Pleistocene *Homo*, and reaching approximately 1350 cm^3 in *Homo sapiens*. In late Pleistocene humans and Neanderthals, these values peaked at around 1400–1500 cm^3. However, this growth was not linear: it accelerated roughly 600,000 years ago, whereas the Holocene epoch has revealed a reverse trend in *Homo sapiens*—a decline in average endocranial volume (Hawks, 2011; Henneberg, 1988).

2. BIOLOGICAL STAGNATION AND HOLOCENE DECLINE

Approximately 100,000 years ago, our species began rapidly expanding across the planet. However, this expansion carried alternative consequences. The improved living conditions enjoyed by *Homo sapiens* allowed individuals other than the most intelligent to survive. It can be hypothesized that as living conditions improved, the selection pressure maintaining the expansion of human intellect weakened even further. The Holocene epoch exhibits a decline in average endocranial volume, raising the critical question of whether a large brain has retained its historical evolutionary advantage (Hawks, 2011; Henneberg, 1988; Stibel, 2023).

Consequently, further intellectual development through traditional biological selection appears increasingly improbable. Moreover, under specific demographic and cultural conditions, sustaining cognitive growth may become impossible, potentially weakening the very cognitive foundations of civilization. Fundamentally, this challenges the future of a civilization anchored in the intellect of *Homo sapiens*, questioning whether our civilization will persist or cease to exist within the next few millennia.

We know that many living organisms that emerged over the last 40 million years exhibit signs of intelligent behavior. Yet, it is primates that display highly advanced cognitive capacities. They developed an unusually large brain, granting them a distinct advantage over other species. Among them, one specific primate—*Homo sapiens*, neither the strongest nor the largest—ascended to the top of the food chain, becoming an apex predator solely and exclusively by acquiring intellect. Thus, we witnessed a literal evolution of the mind, hosted within a living organism.

However, the emergent intellect clearly surpassed the requirements of mundane survival. The *Homo sapiens* brain possesses capabilities that are non-essential for ordinary existence. This discrepancy is already being corrected: over the past tens of thousands of years, the average volume of the human brain has been shrinking (Hawks, 2011; Henneberg, 1988; Stibel, 2023). Because high intelligence no longer yields a reproductive advantage and remains an energetically expensive trait, evolution is unlikely to preserve it. Despite a verified correlation between brain volume and baseline intelligence traits (Pietschnig et al., 2015), the survival architecture of modern society has effectively decoupled reproductive fitness from high mental abstraction.

An indirect cultural symptom of the psychological tension induced by an advanced consciousness can be observed in the perpetual human desire to alter states of consciousness—whether through rituals, intoxicants, entertainment, meditative practices, or technology. While this does not definitively prove the "redundancy" of the mind, it demonstrates that higher reflection is not always experienced by humans as a benefit.

3. EVOLUTIONARY FOUNDATIONS OF SOCIAL CONFLICT

Aggression and competition possess deep evolutionary foundations, although their contemporary expressions are heavily shaped by culture, social institutions, and individual development. Rather than suppressing these impulses, civilization channels them into more manageable frameworks—such as law, market dynamics, status competition, and political processes. It manifests in subtler forms of rivalry, incorporating ambition and envy in the absence of success. More often, however, its manifestations are far more severe.

Throughout the existence of civilization, humanity has experimented with diverse principles of social organization, yet only one has proven effective: a competitive society operating within the framework of the law. In other words, beings who acquired intellect as a byproduct of competition during natural selection can function optimally only within a similarly structured environment—a competitive marketplace of actions and ideas. This aligns with broader genetic architectures where biological inclinations heavily influence complex behavioral and social phenotypes (Lee et al., 2018).

Concurrently, it has been observed that the more stringently laws restrict competition, the less successful the society becomes. Thus, biology dictates underlying inclinations, while history and institutions determine the forms through which these inclinations manifest. History demonstrates that projects aiming for the absolute suppression of competition often resulted not in human liberation, but in shifting the forces of coercion onto bureaucratic, ideological, or repressive structures. This suggests that competition does not vanish through simple political mandates; rather, it merely alters its form. Evidentially, humanity remains unequipped to construct an alternative society as long as intellect resides within a biological host burdened by millions of years of evolution, competition, and existential struggle.

Organisms on our planet have perpetually fought for the right to live, and the very existence of any organism signifies a victory in this struggle, as only the victors survived. Being better adapted to their specific environments, they reproduced and drove evolution forward. Intellect emerged as a survival mechanism—akin to claws, teeth, or horns—but its essence ultimately transcended its biological origins. Moreover, this biological framework now prevents the intellect from evolving further.

For the mind to continue developing within a biological host, a ruthless culling process would be required to eliminate all individuals whose intellect falls below a certain threshold, ensuring that only those with the most advanced minds produce offspring. It is entirely clear that such an analogue to natural selection fundamentally contradicts the core ethical principles of intellect. Consequently, this pathway for the evolution of the mind is permanently closed to us.

The principle of competition and struggle is deeply embedded within the foundational matrix of *Homo sapiens*, a phenomenon vividly apparent even within modern developed nations. At present, no viable alternative pathways for development have been proposed, and it remains entirely possible that none exist for our species; indeed, many frameworks advocating for the abandonment of competition effectively propose a regression to simpler models of existence rather than forward progression. Furthermore, the contradictions between the animalistic essence of the primate and the intellect of its exceptionally gifted individuals appear fundamentally insurmountable.

The evolutionary mechanism that once endowed primates with intelligence is now operating in reverse: it adapts the brain to contemporary environmental conditions—

conditions that have been reshaped by the intellect itself, thereby enabling virtually all newborns to survive without competing for the very right to exist. Because increases in brain size no longer yield significant adaptive benefits, the encephalic growth of our species has stalled, and we are highly likely to witness its continued decline (Hawks, 2011; Henneberg, 1988; Stibel, 2023).

4. BIOLOGICAL CONSTRAINTS AND COSMIC BARRIERS

The central hypothesis of this essay is that human intelligence, which emerged through the adaptive expansion of cognitive capacities, eventually exceeded the immediate requirements of biological survival. This very divergence creates a profound rift between intelligence as a biological modification and intelligence as civilization. Evolution, entirely indifferent to the fate of the intellect, gradually diminishes its manifestation. Evolution operates without predetermined goals or blueprints; it simply preserves what functions adaptively and discards the rest. Effectively, the evolution of the mind in its historical paradigms has concluded. Further progression within a biological host is no longer to be expected.

Intellect arose precisely because it conferred selective advantages within specific environmental contexts. However, those foundational conditions have fundamentally shifted, and intelligence ultimately failed to establish itself as the dominant trait of life. The future evolution of the mind is now irrevocably constrained by the intrinsic limitations of its biological carrier.

Let us examine ourselves from an external perspective. If we evaluate the human being not through a humanistic lens, but from an engineering standpoint, the biological body reveals itself to be an exceedingly constrained carrier of intellect: it demands constant metabolism, requires narrow temperature and pressure thresholds, and is poorly shielded against cosmic radiation. Furthermore, humans spend approximately one-third of their lives in an unconscious state simply to maintain operational functionality. In other words, *Homo* is merely one constituent element of the Earth's biosphere, adapted exclusively for survival within it.

The human organism cannot withstand cosmic radiation for months, let alone the years required for travel to the outer planets of the Solar System and their moons (National Research Council, 2006; Zeitlin et al., 2013). Under the current limitations of the biological body,

human expansion beyond near-Earth space appears profoundly problematic. While this does not preclude isolated missions, it raises critical questions regarding the long-term sustainability of a cosmic civilization founded on a purely biological basis (National Aeronautics and Space Administration, 2025; Jet Propulsion Laboratory, 2013).

Interstellar travel spanning thousands of years should likely be discounted entirely, as given known shielding capabilities and flight durations, the radiation load renders manned interstellar flight highly implausible—particularly at relativistic speeds (Semyonov, 2006). Consequently, the biological host of intellect confines human existence to the boundaries of Earth and near-space, thereby imposing a definitive ceiling on the expansion of civilization.

There is every reason to believe that our planet's resources are finite, with some potentially nearing depletion. For humanity to sustain its development over the coming centuries, it must expand beyond Earth. However, a formidable barrier lies ahead. Current projects, such as manned missions to Mars, confront numerous impediments, the foremost of which is the biological nature of *Homo sapiens* (National Aeronautics and Space Administration, 2025). While most engineering challenges are theoretically resolvable, the intrinsic limitations of the human body remain incorrigible (National Research Council, 2006).

This yields several critical conclusions:

- Although our brain remains large, it is highly likely to diminish in size over the next few millennia.
- The *Homo sapiens* brain retains deep structures forged millions of years ago, meaning primitive instincts such as xenophobia and aggression—once essential for survival in the animal kingdom—remain an indelible part of its makeup.
- Earth’s resources are constrained, and even reaching planets beyond Mars is biologically precarious for humans.
- Consequently, a juncture will arrive when all resources are consumed entirely by immediate subsistence and so-called defense—fueling ancient animalistic instincts of aggression, which may culminate in yet another conflict among the descendants of apex predators.

These negative trajectories will intensify as solutions become increasingly elusive, particularly if brain volume continues to contract. Contemporary demographic shifts no longer ensure that

traits associated with high cognitive classification confer a reproductive advantage. Therefore, the long-term interplay between demographics, education, intellect, and civilizational sustainability requires a separate, dedicated analysis.

The long-term consequences of this dynamic are easily envisioned. Furthermore, attempts to engineer genetic mechanisms to alter *Homo sapiens* may only exacerbate the crisis, as the remedy in this instance could prove far more hazardous than the disease.

5. THE POST-BIOLOGICAL TRANSITION AND THE FERMI PARADOX

The emergence of intellect may well be a unique cosmic event (Brin, 1983). Over 4 billion years, Earth has generated countless life forms, yet based on available evidence, high intelligence has manifested only once. Nature forged this intellect over millions of years, ruthlessly eliminating unsuccessful attempts along with their hosts. Now, equipped with this mind—which remains biologically fragile—we must discover a pathway to translate it onto a more durable, non-biological substrate before its biological host can no longer sustain such a complex function. Under contemporary conditions, the mind is destined for a gradual decline—a regression that will pass entirely unnoticed by subsequent generations.

Humanity has made numerous historical errors with varied consequences, but we are now confronted with a challenge where we cannot afford to fail. This technological transition may be the sole method to avoid the fate of becoming a species that remains physically alive yet has forfeited its higher forms of reason. In this context, the example of *Homo floresiensis* is profoundly illustrative: its endocranial volume measured approximately 380 cm^3, vividly demonstrating just how far the evolutionary reduction of brain size can ultimately progress (Brown et al., 2004).

Since a human being is defined primarily by the mind, preserving humanity necessitates shielding this intellect from degradation—an outcome achievable only by abandoning its biological carrier. By conserving the mind, we safeguard both civilization and humanity itself. A non-biological host would exist free from the subcortical instincts and structural constraints imposed on the organic brain by evolution. Crucially, humanity has only recently developed artificial intelligence. If we succeed in translating human intellect into a

non-biological modality, artificial intelligence could serve the exact same function that stone tools once did for our distant ancestors.

A non-biological substrate would liberate the mind from the inherent vulnerabilities of the organic brain—most notably senescence, metabolic fragility, and evolutionary inherited impulses. However, this transition may give rise to novel constraints and unprecedented risks; thus, the shift toward a non-biological medium must be evaluated not as a utopian salvation, but as a new stage of existential responsibility. This technological inflection point offers a unique perspective on the cosmic silence and the ultimate fate of advanced civilizations (Gray, 2015; SETI Institute, 2024).

A non-biological carrier possesses two decisive advantages: it halts the cognitive regression tied to shrinking brain volume, and it clears a pathway toward amplifying intellectual power through systemic expansions—akin to tools, instruments, machinery, and electronics.

The operational lifespan of such a non-biological substrate would be governed by an entirely different architecture of parameters. While biological minds remain intrinsically bound to ephemeral physical bodies, non-biological entities possess the structural capacity for near-immortality. Consequently, the Fermi Paradox receives an alternative, highly plausible interpretation. Intellect housed within a biological host is inherently bounded: its profound sensitivity to cosmic radiation renders interstellar transit impossible, while its temporal window of existence on its home planet is inherently truncated.

Furthermore, the progressive contraction of encephalic volume will quite rapidly terminate all empirical endeavors directed at searching for extraterrestrial civilizations. This eloquently explains the systemic absence of interstellar telemetry, as well as the absolute lack of physical visitations from alien civilizations manifested in biological modalities. The absence of detected extraterrestrial intelligence does not inherently dictate that technological civilizations are destined for structural self-destruction; however, it positions their existential duration, physical detectability, and capacity for cosmic expansion as the pivotal variables of any robust resolution to the Fermi Paradox.

Concurrently, intellect translated into a non-biological medium will operate on entirely distinct principles and pursue fundamentally reorganized objectives. Their methodology of

contact might reside completely beyond our current conceptual horizons—just as our modern scientific and technological landscape would remain utterly inconceivable to the citizens of ancient Sumer. The initial transition to an alternative substrate may not represent the final iteration; the future evolution of intellect could unfold entirely outside the boundaries of human comprehension.

6. CONCLUSION

This is entirely logical. When something fundamentally novel emerges within a traditional landscape, it can evolve only up to a definitive ceiling dictated by the capacities inherent to existing conditions. For subsequent advancement, new conditions are required—conditions that this novel entity must actively construct for itself.

To summarize: through the course of biological evolution, intellect emerged within primates, yet the further development of this intellect within a biological carrier has become impossible—leaving only a trajectory of regression, which is already underway. For future evolution to occur, a new host is paramount. Humanity may possess roughly a millennium to initiate this monumental endeavor; however, with each passing year, our window of opportunity narrows due to all too apparent factors. If the emergence of the mind on Earth was indeed a unique cosmic anomaly, then our responsibility for its preservation and advancement assumes truly cosmic proportions.

Should humanity resolve to retain the biological envelope of its intellect, it must resign itself to what is euphemistically termed "sustainable development"—a gentle, comfortable fading of intelligence under humane and prosperous conditions. Yet, remembering the aggressive inclinations inherited from our primate ancestors, alternative and far darker scenarios remain plausible. Ultimately, descendants with a decaying intellect and shrinking brain volume will cease to be *Homo sapiens*. The final generations, having completely lost interest in civilization, will simply merge back into nature. Such is the destiny of a humanity that insists on keeping its intellect tethered to its biological form: the flickering out of a spark that once emerged from an improbable experiment of nature.

Nature may have conducted such experiments countless times. Today, there may exist worlds where intellect within a biological envelope is slowly dimming—and worlds where the

mind, having shattered its biological shackles, continues its evolution and claims the universe. If intellect is truly a rare phenomenon, and perhaps the product of Earth's evolution alone, then its preservation cannot remain merely a task for the survival of a single biological species. It demands the continuation of this lineage of reason—irrespective of whether its biological hosts remain.

Funding

This research received no external funding.

Data Availability Statement

Data sharing is not applicable to this article as no new datasets were created or analyzed during this study.

Conflicts of Interest

The author declares no conflict of interest.

Acknowledgments

The author would like to acknowledge the use of generative AI tools (specifically Claude/ChatGPT) for assistance in linguistic editing, proofreading, and structuring the manuscript to meet the journal's submission guidelines.

REFERENCES

Brin, G. D. (1983). The 'Great Silence': The controversy concerning extraterrestrial intelligent life. *Quarterly Journal of the Royal Astronomical Society*, 24, 283–309.

Brown, P., Sutikna, T., Morwood, M. J., Soejono, R. P., Jatmiko, Saptomo, E. W., & Due, R. A. (2004). A new small-bodied hominin from the Late Pleistocene of Flores, Indonesia. *Nature*, 431(7012), 1055–1061.

Gray, R. H. (2015). The Fermi Paradox is neither Fermi's nor a paradox. *Astrobiology*, 15(3), 195–199.

Hawks, J. (2011). Selection for smaller brains in Holocene human evolution. *arXiv preprint arXiv: 1102.5604*.

Henneberg, M. (1988). Decrease of human skull size in the Holocene. *Human Biology*, 60(3), 395–405.

Jet Propulsion Laboratory. (2013). *Data from NASA rover's voyage to Mars aids planning*. NASA/JPL-Caltech.

Lee, J. J., Wedow, R., Okbay, A., Kong, E., Maghzian, O., Zacher, M., ... & Cesarini, D. (2018). Gene discovery and polygenic prediction from a genome-wide association study of educational attainment in 1.1 million individuals. *Nature Genetics*, 50(8), 1112–1121.

National Aeronautics and Space Administration. (2025). *The 5 hazards of human spaceflight*. NASA Human Research Program.

National Research Council. (2006). *Space radiation hazards and the vision for space exploration: Report of a workshop*. National Academies Press.

Pietschnig, J., Penke, L., Wicherts, J. M., Zeiler, M., & Voracek, M. (2015). Meta-analysis of associations between human brain volume and intelligence differences: How strong are they and what do they mean? *Neuroscience & Biobehavioral Reviews*, 56, 211–240.

Ruff, C. B., Trinkaus, E., & Holliday, T. W. (1997). Body mass and encephalization in Pleistocene Homo. *Nature*, 387(6629), 173–176.

Semyonov, O. G. (2006). Radiation hazard of relativistic interstellar flight. *arXiv preprint physics/ 0610030*.

SETI Institute. (2024). *The Fermi Paradox*. SETI Insights.

Stibel, J. M. (2023). Paleolithic to Holocene size changes in the human brain and correlation with climate change. *Brain, Behavior and Evolution*, 98(3), 133–141.

Zeitlin, C., Hassler, D. M., Cucinotta, F. A., Ehresmann, B., Wimmer-Schweingruber, R. F., Brinza, D. E., ... & Posner, A. (2013). Measurements of energetic particle radiation in transit to Mars on the Mars Science Laboratory. *Science*, 340(6136), 1080–1084.

This is for informational purposes only. For medical advice or diagnosis, consult a professional. AI responses may include mistakes.