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Necessity or Indulgence: Reconsidering Space Exploration

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Abstract. Taking the debate over whether space exploration constitutes a necessity or a mere indulgence as its starting point, this essay adopts a philosophical and interdisciplinary perspective to re-examine the value of human space activities inspired by the *Pale Blue Dot* photograph. The study breaks down the binary opposition between necessity and indulgence, arguing that this distinction is not purely economic but hinges on definitions of resource purposes and human civilisational goals. Three core dimensions are adopted for analysis: the failure of private markets to fund long-horizon innovative investment, unique planetary-scale challenges that can only be addressed via space infrastructure, and the intrinsic moral and philosophical meaning of exploration beyond utilitarian calculation. The analysis demonstrates that public investment in space programmes yields sustained economic spillover effects, delivers irreplaceable capabilities in climate monitoring, planetary defence and microgravity scientific research. Further, drawing on the concept of the overview effect, the paper distinguishes space exploration from historical colonial expansion, framing it as a secular pilgrimage oriented toward human self-transformation. This research concludes that dismissing space exploration as an indulgence relies on narrow short-term utilitarian standards; undertaking space exploration represents a civilisational choice concerning humanity's self-identity and shared responsibility for Earth.

Keywords: space exploration, pale blue dot, overview effect, long-term public investment, planetary defence

1. Introduction

On February 14, 1990, as Voyager 1 reached the outer edges of the solar system, NASA scientists turned the camera to look back at Earth one final time. The resulting picture shows that our planet is a small part of a single pixel, a faint blue spot in a sunbeam over 6 billion kilometres of empty space (see Figure 1). Shows us our responsibility to live together more peacefully and to protect and care for the pale blue dot, the only home we have ever known [1]. To refer to the work of art creation as an "indulgence" would be to fall into a category error. It was not consumption. It was self-manifestation.

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Figure 1. The Pale Blue Dot. Earth appears as a pale blue speck within a sunbeam in this photograph taken by NASA's Voyager 1 spacecraft on February 14, 1990. Credit: NASA/JPL-Caltech (1990/2020 reprocessed version)

The first reason this essay chooses to open with that photograph is that the question it poses - whether space exploration is a necessity or simply an indulgence - conceals another problem: what do we mean by "necessity", and who decides that it is a necessity? The division of necessity and indulgence is not an impartial economic category. It is a philosophical one that determines the purpose of the resources we have, the kind of entity we believe humanity to be, and over what time scale we measure the results of our choices. The launch of the first artificial satellite spurred in humanity not only scientific pride but also 'the desire to escape' the constraints of life on Earth [2].

Based on the above, the paper proposes that three reasons need to be satisfied for space exploration to occur: Firstly, there is an economic logic error with the long-term public investment of markets; Secondly, there are planetary-scale issues that cannot be solved without the space exploration; and finally, there is a philosophical goal of exploration itself, which is to enable self-improvement and this inherently carries moral implications that utilitarianism cannot address.

2. The economic logic of long-horizon investment

The main objection to space exploration so far has been cost. However, this charge often equates scale with wastefulness and thus fails to recognize the economic rationale for public investment. NASA's budget for the 2025 fiscal year will be about US$24.8 billion and account for 0.36 per cent of all US federal expenditures [3]. Table 1 shows the figure in the context of other national expenditure data.

Table 1. Comparison of NASA FY2025 budget with other major expenditure categories [3-5]

Category	Annual Spending	Ratio to NASA	Year
US Pet Industry	$158 billion	6:1	2025
Global Cosmetics Industry	$109.56 billion	4:1	2025
Global Gambling Revenue	$643 billion	26:1	2025
Social Security & Medicare	$2.6 trillion	105:1	2025
NASA Budget	$24.8 billion	0.36% of US spending	2025

However, the basic economic reason is not that of a larger size but rather a change in the structure of innovation. Markets do not provide sufficient investment for high-risk and long-payback-period technologies in a timely manner, which private capital is unwilling to undertake [6]. The

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semiconductor revolution, the Internet and GPS navigation all have a history of government-sponsored programmes, such as NASA. The Use of GPS satellites in the United States has saved approximately 52 billion gallons of fuel per year. By 2035, the larger commercial space economy will be as high as $1.8 trillion. A 2024 NASA economic impact report shows that the agency's work in 2023 contributed 75.6 billion US dollars to the economy and created more than 304,803 jobs [7]. Since 1976, NASA has released more than 2,000 cases of commercial technology transfer, including medical imaging equipment, water purification systems and environmental sensors [7]. Therefore, the correct question is not "can we afford space exploration?", but rather "can a society that has stopped investing in long-term public goods continue to create the innovations that support its welfare?" The evidence strongly suggests that it cannot.

3. What only space can do

People not persuaded by the return-on-investment argument have to confront a more difficult problem. Some classes of civilisation-threatening problems are unsolvable by shallow means on the Earth alone.

Satellites have been gathering climate change data over a large Area, however. While ground-based sensor nets are dense enough to be of use, they lack the universal, whole-Area coverage that is needed for the effective climate policy of monitoring effective changes to sea level rise, ice-sheet movement, or changes in atmosphere carbon concentration. Disaster management is about coordinating responses to hurricanes, wildfires and floods on the fly, some of that space based infrastructure has neither terrestrial analogue. Planetary Defence may be a particularly stark case, asteroid impacts threaten all of human civilisation at once, and they're a problem that can only be dealt with from space.

In September 2022, the DART mission of NASA successfully altered the orbit of the asteroid Dimorphos and demonstrated that kinetic deflection was feasible in practice for the first time [8]. The European Space Agency has found about 1,700 near-Earth asteroids with a relatively high impact risk [9]. The Chelyabinsk meteor event of 2013, which injured more than 1,500 people suddenly, originated from the direction of the sun and was thus invisible to current detection systems; only an expanded space-based observation network can monitor such events [10].

In addition to protecting the planet, there are tons of scientific experiments that can only be conducted in microgravity. NASA's Ring Shear Drop experiment on the ISS has directly observed the formation of amyloid fibrils (waxy plaques that develop in the brain of people who have Alzheimer's disease) in ways that cannot be duplicated in a lab here on Earth [11]. We can also process materials without containers and grow pharmaceutical crystals at high purity using microgravity rather than under gravity [11]. Those activities may take us to better solutions to treat the worst diseases that will affect an ageing world population.

Additionally, the argument that funding for space research is taking away money for helping people is built on a faulty assumption: that money spent for space is not being spent here; when NASA spends money on space projects, it is paying engineers, scientists, manufacturers and developers. Oftentimes, justification for the argument states that funding for weather research must be cut and diverted to assist victims of flooding. The progress of civilization is not limited at all by the restrictions placed on research; instead, it continues to grow in different ways every time researchers are allowed to continue their work uninterrupted [12]. Space exploration does not hurt people - it helps people.

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4. The ethics of the space exploration: a secular pilgrimage

The most severe objection to space exploration is not economic but moral; this will be stated in its strongest form before answering it. Past times of ground exploration were driven by considerable violence. In the 15th and 16th-century period, European powers of the sea engaged in mercantilism, sought to spread Christianity, and pursued imperial expansion. Therefore, many people were enslaved, natural resources were taken for free labour, and indigenous cultures were systematically destroyed [13]. Critics of current space exploration are reasonably concerned that the geopolitical dynamics of this era, such as the competition between the United States and China over orbital facilities and lunar resources, represent a structural repetition of the past [14]. The Outer Space Treaty of 1967 has designated outer space as "the province of all mankind" and offers some assurance [15]. In line with this treaty, the prohibition on national appropriation has gradually been bypassed by the development of commercial space law, and the history of international legal systems for territorial areas offers little hope for improvement [16].

This objection cannot be ruled out. But it is not the same. Colonialism serves as a model; thus, space exploration is regarded as a conquest that aims to take, use and control. However, this assumption merges the instrument with the reason, and the reason with a particular historical form it has taken. There is a different kind of system for people's relationships with space: the system of pilgrimage. The first goal of a pilgrimage is the spiritual reform of the pilgrim, not reaching the destination. The medieval pilgrim on her journey to Santiago de Compostela was not in her prime at that moment; she desired no possessions from the shrine nor desired to be superior to others along the path. The two types of "exploration", "discovery" and "discovery", are not the same. It has different structures, purposes and ethics in reality.

This character is exactly what shows that humanity's relationship with space exploration is morally justifiable, and it is also the character that has been reported most consistently by people who have been in space. The first to systematically document the Overview Effect, and most recently, Artemis II astronaut Christina Koch has described it; it is a profound and consistent change in those who look out at the Earth from space: a breakdown of national, ethnic and ideological divisions, along with a keen awareness of the fragility and unity of the biosphere [17, 18]. This would be feasible and questioned whether humanity was philosophically ready for it; indeed, the "conquest" of space need not reduce human dignity if it is achieved through true understanding rather than domination [19]. The Overview Effect is empirical evidence that, in some instances, it does.

The scientific goals of deep-space exploration are to learn about the birth of the solar system, to find whether there is life elsewhere in the universe, and to test how physical laws work far away from Earth; these are activities of learning, not of collecting samples. They want to know, not to have. The type of scientific knowledge that results from space exploration is inherently non-excusable, and therefore cannot be excluded. The problem is that the previous expeditions were not conducted out of the desire for a pilgrimage. Whether future exploration can actually be realized and whether its governance structure will enable the spirit of exploration to be implemented in practice rather than remaining an ideal.

5. Conclusion

Whether space exploration is a necessity or an indulgence cannot be known before we know what resources are for and what kind of beings we believe ourselves to be. If expenditure is only justified when meeting immediate, local and readily quantifiable needs, then all investment in long-term

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research, whether for theoretical physics, vaccine development or climate modelling, will appear unreasonable. However, such a uniform norm would not have allowed many of the advancements in modern life to take place.

Exploration for space will promote the development of humanity. It is one of the most demanding and telling expressions of it. It will bring about the generation of wealth for generations through the cycle of public investment, which private markets cannot achieve. It will build an infrastructure for satellite observation, planetary defence, and micro-gravity research that is impossible on Earth. And it offers us the hope of modifying our group's sense of self, changing our way of life with the Earth, and achieving this without relying on political talks.

Sagan's pale-blue dot is not about lack of initiative. It is a claim to responsibility and a recognition that, at the level of civilization, only the view of exploration can achieve such responsibility. The Earth is not the world. And the decision to go there is not about the stars and the other. It is a problem of what kind of people we wish to be.

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