



Prioritizing scientific exploration: A comparison of the ethical justifications for space development and for space science[☆]



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ABSTRACT

I argue that the moral justification for space science is more compelling than the moral justification for space development. Thus, we ought to reemphasize the status of science as a major stakeholder in space, especially when entertaining policies which might encourage the kinds of space development activities (e.g. resource exploitation) that are liable to conflict with the scientific uses of space.

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1. Introduction

In order to reach its space objectives the United States Government is increasingly partnering with and depending on the private sector.¹ However, many from the private sector retain the perception that the current regulatory environment is not especially conducive to widespread private investment in space development. It is commonly argued that dramatic increases in private investment in space development will occur only alongside the implementation of new policies designed to encourage such investment—by relaxing insurance requirements, reducing range fees, establishing a basis for property rights in space, etc.²

This paper investigates whether and to what extent we can *morally* justify such regulatory shifts—primarily those intended to encourage activities like space settlement and space resource exploitation. I argue that the moral force behind these space development activities is relatively weak, and thus provides little impetus for moving to a regulatory environment that would mitigate the perceived obstacles to space development. Meanwhile, space science activities are subject to a relatively strong moral justification. And so, to the extent that space

development and space science activities are likely to conflict, policies should prioritize space science activities. Conflicts are most likely to occur over competition for terrain, wherein development activities compromise sites of scientific interest (e.g. on the Moon, Mars, the asteroids, etc.). Although such conflicts are unlikely to arise in the immediate future, that does not eliminate their relevance to contemporary policies and funding priorities, since our actions today will affect the viability of space science in the future. I submit this as evidence that we ought to reemphasize the status of science as a major stakeholder in discussions about space settlement and space resource exploitation.

I begin in Section 2 by assessing the usual justifications given in support of space development, *viz.*, that space development is needed to satisfy our obligations to ensure species survival and to improve overall human welfare.³ I argue that we must distinguish between a variety of forms of space development, and that our survival and

³ Another common sort of argument, which I find thoroughly unconvincing, appeals to our alleged destiny as humans or to our purported “nature” as explorers, frontiers-people, etc. The idea that we as humans have a destiny, if not intended metaphorically, is unscientific, and should be dismissed for that reason. But most likely it is intended as a metaphor for our purported nature as explorers, etc. While it may be true that certain individuals experience a “natural” desire to explore, etc., one commits the fallacy of composition when imputing this quality to humanity in general ([8] p. 570). Moreover, one commits the naturalistic fallacy when using such a claim to *justify* exploratory and frontier-settlement activities. Just as the “natural” or innate tendencies of certain individuals to commit acts of violence fails to justify those acts, so too do the natural or innate tendencies of explorers and frontiers-people fail to justify their actions *qua* explorers and frontiers-people. It is true that there are further reasons for judging violent acts to be wrong, just as there are further reasons for judging exploration and space frontier settlement to be good, but my point is simply that such further reasons are required—the mere presence of a desire, natural or otherwise, is no justification at all.

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¹ See, e.g. the FY 2015 White House NASA Fact Sheet: http://www.nasa.gov/sites/default/files/files/FY15_White_House_NASA_Fact_Sheet.pdf.

² See, e.g. Refs. [1–7].

welfare duties only justify a small subset of space development activities. This support, though extant, is weak. No form of space development is, except over the very long term, actually likely to ensure human survival or to improve human welfare. In Section 3 I argue that the duty to scientifically examine the universe provides strong support for space science activities, as these activities involve important research that can only be conducted in concert with space science missions. Section 4 discusses possible sources of conflict between development and science, leading to my recommendation in the concluding section that we must reserve a substantial role for science as we envision forward-looking space development policies.

The substratal value of this discussion is to serve as a clarification of some of my previous work, in which I have argued that we have a moral obligation to support “space exploration” [9]. With the benefit of hindsight I realize how vague and unhelpful such a claim is—‘space exploration’ is often used as a blanket term covering many varieties of space activities, and it is highly doubtful that we have a duty to support all forms of space operations. Thus I hope to show that our obligation to support “space exploration” primarily covers the *scientific* examination of the Solar System, and covers space development only secondarily (if at all).

Throughout I shall take it for granted that we have obligations (a) to ensure our survival as a species; and (b) to improve overall human welfare. I shall also provide a provisional justification for a further obligation (c) to scientifically examine the universe. Although the wider public largely accepts (a) and (b), it does not appear to as enthusiastically endorse (c), and this is pragmatically relevant for space advocates. I suspect that one reason why it is difficult to justify space research to the wider public is that the wider public only dimly understands the value of science, scientific research, and scientific exploration. In this sense, space science is only one kind of scientific exploration. We can discuss the comparative value of this kind of science *ad nauseum*, but that will be, at best, only half of the battle. We also need to convince the public, governments, etc., of the value of science more generally—a task that will surely require more than the provisional discussion provided here (and which falls beyond the purview of this paper).

2. Space development

Before considering justifications for space development (and for policy changes designed to encourage space development) it is first necessary to clarify what is meant by the term ‘space development’. Usage varies widely, and covers (but is not limited to) the following types of activities⁴:

- Developing space real estate
- Exploiting space resources
- Space tourism
- Space settlement
- Continuing and expanding satellite services
- Satellite *servicing*
- Space-based energy solutions
- Materials research/space manufacturing
- Space vehicle and other technology design/construction
- Technology transfer⁵

⁴ For a useful sectoring of the political and economic impact of operations in space, see Ref. [10].

⁵ The usual connotation here is the idea of “spin-off” technologies, i.e., the repurposing of space technologies for use on Earth. However, as Ref. [11] discusses, the oft-neglected reverse idea also applies—much of “space development” involves the repurposing of non-space technologies for use in space.

Thus, ‘space development’ refers not to any one activity but instead to a cluster of economically-minded activities. This point will remain relevant throughout—as we consider the strength of the moral justifications available to space development (and to policies designed to promote space development), we must accept the very real possibility that not all forms of space development warrant our moral approbation.

2.1. Justifying space development

The two questions I shall entertain in this section are: what moral justifications are available to space development? and should such justifications underwrite using space policy to promote space development? I would like to begin this discussion by focusing on policy concerns—in particular, on why many view a policy shift as necessary for encouraging space development.

The simple fact is that many would-be investors view space development as an unlikely source of revenue. Even if a would-be investor is comfortable dealing with the large up-front costs and long time-horizons involved, the regulatory environment severely constrains many of the more grandiose development projects, e.g. lunar and asteroid mining. The current regulatory environment is based on the Outer Space Treaty (OST). Relevant provisions include Article I, which states that “[t]he exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries,” as well as Article II, which states that “[o]uter space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means” [12]. These provisions are generally understood to preclude any kind of ownership of space resources.⁶

Several commentators identify a more liberal regulatory environment as a means for encouraging space development. For instance, Ricky Lee claims that “one of the major inhibiting factors to the commercial exploitation of mineral resources from celestial bodies is the absence of an appropriate legal framework to govern such activities” [[6] p. 315], and that “[f]or such a venture to be *profitable* or at least financially feasible, there must be legal and regulatory certainty for the conduct of such activities” [ibid. p. 317; emphasis added]. Such certainty does not obtain under the OST, according to Lee [ibid.]. John Jurist et al. mention *lobbying* in particular when it comes to reducing the costs (and hence, increasing the profitability) of engaging in space operations:

The critical factors in making orbital access cheaper than \$1000 per lb are lobbying, negotiating, or exiting to lower range fees, lobbying to lower liability insurance standards, auctioning payload and liability insurance, and self-insuring the vehicle. Even the best engineering will not help, if \$1000 to \$1300 per lb is consumed by range fees and insurance. [[5] p. 329]

These sentiments form part of what Ozgur Gurtuna describes as the “Destination Problem”:

... there is very little need for serving destinations in space on a regular basis. Currently, the only destination served regularly is the International Space Station ... with the exception of the ISS, all space products and services are destined to serve end users

⁶ Many view the prohibition on national appropriation as indirectly precluding a legal means for *defending* ownership claims, but it has been argued that the Outer Space Treaty’s prohibition on national appropriation directly implies a prohibition on private appropriation; see Ref. [4]. Of course, given the right catalysts, a spacefaring nation might simply decide to withdraw from the treaty, clearing the way for it to assert sovereignty over space resources—see Ref. [13] for discussion.

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