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Viewpoint

Is space an environment?

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Abstract

Expanding the human sphere of influence beyond Earth presents philosophical questions that also have important practical applications. Do we need to worry about the moral implications of our actions in the vastness of space? What kind of explorers will we be - and what kind of explorers should we be? The answers to these basic questions depend greatly on what moral status is assigned to space; how it is conceptualized. This article sets forth arguments both for and against considering space as an environment, that is, as a place deserving of ethical treatment in the same way that terrestrial environments are valued and respected in environmental ethics. It sketches some answers to how space exploration could meet high ethical standards and puts forward the notion of environmental 'virtue ethics'.

1. Introduction

Expanding the human sphere of influence beyond Earth presents philosophical questions that also have important practical implications. In order to begin studying these questions, one must first choose how to conceptualize the target area, in this case space. Conceptualization means commitment to certain values - to a fixed conception of how one should understand the world. In recent discussion, space is assumed to be an environment. However, the concept of environment is a term loaded with implications and background assumptions. The question of whether or not space is in fact an environment, should be decided consciously, based on something more than just intuition or convention. If we choose to understand space as an environment – as opposed to a mere phenomenon for us to exploit – we lay the foundations for an ethics of space exploration that is very different from an ethics that treats space exclusively from the point of view of human interests. Do we need to worry about the moral implications of our actions in the vastness of space? What kind of explorers will we be - and what kind of explorers should we be? The answers to these questions depend greatly on what answer is given to the deceptively simple question 'is space an environment?'. No matter which option we end up choosing (and it should become clear later that the decision is not simple), the conceptual framework should be chosen after studying the available options analytically. In Sections 2 and 3 I therefore examine arguments both for and against considering space as an environment.

These turn on whether discussion of the ethics of space exploration would benefit from applying the conceptual tools found in environmental ethics. Is environmental ethics a suitable model for guiding our actions in space or is it an impractical viewpoint that has no real value in treating the universe outside Earth? Most importantly, what is the general moral status of space? Should it have equal value with environments on Earth, no moral value at all, or perhaps something in between? The answers to questions like these contain not only the building blocks for a larger theory of ethics of space exploration, but also contain normative power. If, as a result of analytical study, we conclude that space should be considered an environment, then we must accept that at least some concerns and norms of environmental ethics are also relevant when discussing the exploration of space. On the other hand, if our analysis indicates that some concerns are not relevant, that also affects our conceptions of how we can explore and exploit space. In a short article it is not possible to provide final answers to all these questions but, during the course of the analysis, they will at least be addressed.

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2. Arguments against considering space as an environment

2.1. Earth is practically a closed system, space is infinite

One good reason to think that environmental ethics is important and that we ought to regulate our actions towards other beings is that, on Earth, all things are connected and the harm we inflict upon our environment may well become harm done to ourselves. Earth is practically a closed system,[1] and we do not yet fully understand its complexity [1]. Even if we agree that there are good reasons to limit the exploitation of Earth and preserve it, do we have to agree that we should adopt similar attitudes regarding outer space? Most people think intuitively that it should make no moral difference whether we travel some thousands of kilometres westwards or upwards. But is this intuition correct?

Considering space as something that does not enjoy a moral status equal to that of Earth's environments does not imply that it would be wise for us to exploit it short-sightedly. Certainly, it would still be wise to keep our own long-term interests in mind while planning new projects. However, it is a very different thing to recognize that it is in our own best interest, e.g. to reduce the amount of debris in important orbits (see [2]) or to preserve areas that have important historical or aesthetic value, than it is to say that space, for the most part, has inherent value in the same way that Earth environments are thought to have.

On Earth, the term 'environment' is loaded in so many ways that 'space' is not. Our own well-being is closely connected with the well-being of our planet. If there is excessive pollution we will become ill or may even have to move away from areas that have become unsafe. Space, on the other hand, is extremely hostile to humans to begin with. While it can be argued that some phenomena taking place in space are significant from the perspective of human well-being, our actions in general do not have the power to affect those phenomena in nearly the same way that we can affect the flourishing or extinction of life on Earth. Second, on Earth we have an abundance of life forms. In space we have interesting phenomena but it is lifeless, and in environmental ethics life is of special importance; many central environmental ethical concepts and ideas make sense only when we are talking about places where there is life. It is still under dispute how far we should go to protect and cherish life here on Earth. Another complication is that the theory of environmental ethics is often quite different from the practices in place in various levels of society: even when we know that polluting our environment is harmful, we often choose to do it anyway for one reason or another. Keeping this in mind, it may be difficult to argue that we should prohibit all exploitation of space on the grounds that pollution in the process is inevitable.

For instance, if we think about the idea of terraforming Mars, the 'ethics of life' makes a great deal of sense. If there is indigenous life on Mars, the question is: would it thrive more if the atmosphere were denser, if there were steady supplies of water on the surface, etc. Or would such life suffer and perhaps even become extinct? In the latter case, terraforming would not be ethically acceptable because doing so would diminish the diversity of life in the universe, even if we could later bring Earth life to Mars. Spreading life from Earth to other planets would just increase its quantity (and consequently the chances of survival were a disaster to make Earth hostile to such life). But Martian life would be qualitatively different and, therefore, losing it would be a loss that could not be compensated by introducing Terran life to a terraformed Mars, even if it were possible to introduce more species than originally existed on that planet. The danger, as pointed out by Williamson, is that an attempt to terraform Mars - the most likely candidate - could destroy existing but undiscovered life forms, as well as changing existing landforms and other physical features [1]. Strictly speaking, it is unlikely that, at the time when a decision to terraform another planet was made, we could completely exclude from consideration the possibility of the existence of life not yet discovered. A good question is thus when is the likelihood of discovering hidden life low enough to justify terraforming?

On the other hand, if we can assert with great certainty that Mars is a dead planet, then terraforming it would be a good deed, as it would make Mars more diverse, a more special place than it is as a lifeless place, as well as increasing the chances of long-term survival for species that could be introduced to a new planet. Interesting geological features of Mars would still probably exist and possibly even provide a base for forming new kinds of ecosystems capable of supporting the evolution of species that could not evolve on Earth.

Our connection with minor planets, comets and stars is very thin, however. How could building polluting mines on Ceres affect human welfare at all (except that it might reduce pollution on Earth)? And since Ceres is – as far as we know - a lifeless place, what good would be gained by investing in expensive systems that reduce pollution? The concept of pollution is a negative one, something that is undesirable and produces adverse effects. It may, however, be misleading to talk about pollution in places where there is nothing that could be affected adversely. Not every effect that is caused by human action, nor every alteration to a natural state, may be adverse. Not every piece of discarded material may be pollution - the presence of that material has to produce bad consequences in some way. In many cases, humans will be the ones to suffer from a build-up of debris. In the case of congested major orbits this is already true [1]. This fact can be acknowledged without talking about 'harm to the environment' in cases where the existence of an 'environment' is questionable.

Besides, most of what we can perceive in outer space is not nearly as complex as any one square metre of Earth, a planet soaked in life.[2] Rocks and snowballs, clouds of dust and stars

[1] Earth is not a completely closed system. Meteors and comets hitting Earth bring new matter to Earth, solar storms affect in electronic equipment and especially the upper atmosphere, and so on. Furthermore, in relation to energy, Earth is an open system. See [1].

[2] Ref. [3].

are fascinating, but often lack complexity compared to the smallest eucaryotes found on Earth. While some space environments display phenomena that are not known on Earth, others do not.

It is perfectly coherent to think that we ought to protect life on Earth and at the same time believe that, apart from a few special places – such as the Apollo landing site and the geostationary orbit - exploitation of space has few ethical issues unrelated to the protection of mankind's long-term interests. Therefore, we might as well talk about protection of humanity's long-term interests when appropriate, without assigning any special moral status to space.

2.2. Worrying about environmental problems on lifeless worlds may make finding solutions to Earth's problems unnecessarily difficult

One of the important motivators behind the space exploration effort is the hope that we may find the energy, resources, colonization opportunities and other things that are in short supply here on Earth in space. It would be easy to build mines in space so that their effect on human well-being would be minimal compared with mining operations of similar size on Earth. Hazardous chemical plants could be situated in distant places like Mars and Earth's precious atmosphere and delicate ecosystems could be preserved. If we start worrying about environmental protection of space, are we not seriously out of focus? Do we not squarely miss the important point, namely that our own planet will not tolerate our current way of living in the long run but that exploiting space would at least provide us extra time for solving our problems? It is true that the resources of space will probably not improve things in the long run unless we learn to treat environments with greater respect [4]. But it is probable that the path to a sustainable high technology civilization would be far less rocky if we had access to the resources of near space.

Is it not absurd to worry about lifeless environments if the flourishing of Earth is at stake? Our own survival may well depend on being able to take the ecological pressure off Earth and, when survival is at stake, starting to speak seriously about aesthetic values, the rights of micro-organisms and the inherent value of lifeless environments would seem not only foolish but dangerous.

A related argument is one I call 'Earth first' (not to be confused with the militant eco-group of the same name). According to the Earth first argument, in order to protect the environment as much and as effectively as possible, we should concentrate our efforts in selected key areas and only after these have been taken care of, expand our sphere of concern further. At the moment, we are not protecting the environment on Earth nearly as effectively as we could, because of a lack of motivation and resources. Despite the expansion of our influence to the universe outside Earth, Earth will still remain the centre of human activity for a very long time, if not forever. Therefore it makes sense to concentrate our environmental protection efforts here. This is where our work will have the most impact and this is where our environmental choices affect the lives of the vast majority of people directly. This kind of attitude is moderate in the sense that adopting it does not mean that we deny the value of alien environments altogether. It is beneficial and praiseworthy to protect alien environments too when there are cost-efficient means of doing so.[3] It is simply that our resources are limited and therefore it is wise to prioritize. If we scatter our environmental concern randomly, we may end up being less efficient in all our environmental protection efforts than we would be if we acted in a more organized manner.

2.3. Space is largely lifeless, so the only beings with interests in it are humans

We now have good reasons to think that life could be discovered elsewhere in the universe but, for the time being, we do not have conclusive proof. Space, as far as we have explored it, is devoid of life except here on Earth. Even if we did find life in a few other places in our Solar System, it still remains true that space is largely lifeless. Our Solar System can still be properly labelled as 'mostly lifeless' and the only species having space exploration-related interests in it is humanity. Therefore we can argue that we can regard at least most of the natural resources in space as our own to use as we see fit. Again, it will be in our own best interest to make sure that we exploit space while keeping the long-term consequences of our actions in mind. But since no other beings than us have interests in the Solar System, it is acceptable to take a human interest-centred approach towards space exploration and exploitation.

The questions that Sadeh et al. ask about the ethics of lunar commercial development can be addressed from the point of view of human interests. All we need to do is to agree that, for humans, commercial and scientific values are not the only values that need to be taken into account when asking what kind of human activity is ethically acceptable on the Moon [5]. We might conclude that the cultural and historical significance of Moon and our interest in keeping it looking perfect for backyard astronomers are greater than the benefits from strip mining would be [6]. Or we might conclude that economic interests should override other concerns. The point is, we can perform quite an extensive analysis from the perspective of human interests. Moon-like planetary bodies, which have no atmosphere, weather or significant tectonic activity have no facility for environmental renewal, as Williamson has pointed out [7]. But it can be argued that even this is only a major problem if 'the Moon as wilderness' has great value to us, as beings with diverse Moon-related interests.

When it comes to the protection of extraterrestrial life forms, we may benevolently choose to protect microscopic life on Mars or ice shrimps on Europa; these exceptions can be made out of generosity in conditions of abundance. Even if we feel less generous, we may choose to protect them because extraterrestrial life has great scientific and cultural value. On

[3] Here, the term 'costs' is used broadly, to mean not only financial costs but also human effort, harm to people or restrictions on pursuing human interests.

Earth we do not seriously question our right to live and pursue knowledge and modest material welfare even if it means that other life forms will suffer from our actions. How could we reasonably take a stricter moral stand in relation to lifeless places?

3. Arguments for considering space as an environment

3.1. Considering space as an environment is both logical and practical

Some writers believe that space ethics should arise from practical issues and consist of solutions to these issues. However, such an approach is in danger of becoming casuistic and contradictory - highly impractical once we move beyond covering the most obvious problems. It might be better to try to form some basic ethical principles first and then attempt to apply them to a range of practical issues. This approach would safeguard the integrity of the ethical system and, second, it could also be adapted to treat completely new questions.

Philosophically it may be beneficial to employ the tools of environmental ethics in discussions about space ethics. If we act in space, the ethical questions we encounter often have as much in common with environmental ethics as with the philosophy of science or sociology. There already exist ethical questions that have a distinctly environmental ethical undertone (for example: if we discover life, how should we treat it?). This strongly suggests that we should consider space as an environment for practical reasons. Studying space as an environment allows us to have another perspective besides that of human interests. While it is true that studying the ethical questions of space exploration from the perspective of human interests can answer many ethical questions (for instance, cluttering an important orbit with debris is unwise mainly because doing so is against our own best interests in the long term, and this provides a good reason to avoid it[4]), other questions benefit from combining different perspectives. Questions such as whether or not it is ethically acceptable to mine the rings of Saturn until they are destroyed or to blow the moons of Mars out of existence as part of a nuclear weapons test programme, are questions where applying only a human perspective seems insufficient. An account of ethics that does not grant these places some inherent value seems to be lacking something important - the perspective of the object of human actions. If we choose to ignore that perspective, we may fail to realize the full consequences of our actions. When making moral decisions humans have a tendency to count only certain features of the objects of their actions as significant. For example, when discussing the ethics of animal testing, laboratory animals are often portrayed as 'models' or biological machines with no subjecthood or interests of their own. In the same way, some space explorers might see the objects of their interest – like the rings of Saturn – only as mineral deposits. Adopting the attitude that the rings of Saturn are an environment in the sense that they can be considered things that have inherent value beyond their value to humans is a way to avoid this kind of blindness. According to Rolston, it is very human but also quite short-sighted to value a system only for its production of life. As he puts it, while life is special in many ways, it is a mistake to believe that this means that lifeless places, 'mere things', are beyond appropriate and inappropriate consideration [8].

[4] Naturally, it is a long way from recognizing this to actually taking action to reduce debris.

3.2. Limited sphere of influence instead of a closed system

While it is true that the universe is so huge a closed system that for all purposes it could as well be open, it can be argued that we ought to expand environmental ethics to concern space because the human sphere of influence is limited. It does not matter how far we travel, how many small outposts we build - we cannot escape from ourselves. As long as these remote outposts interact with the rest of the human population, there remains a possibility that actions out there will affect more people than seems likely at first.

It does not matter whether Earth is a closed system or whether we find ourselves living in a limited system. Nothing can remove us from the centre of our own sphere of influence. Therefore we can conclude that, although the link between human well-being and the well-being of the space environment in which we act is different and perhaps weaker than the link between human well-being and the well-being of Earth, it does exist. We can discuss space as environment in the sense that our actions in those parts of space that lie in our sphere of influence can affect our own well-being, also in ways that are not easily foreseeable.

3.3. Diversity of human interests

Thus far most discussion of space exploration has been carried out by those with the most obvious interests in it and these interests have become dominant: scientific interests, economic interests, Earth-centred environmental interests, political interests. But humans have diverse interests and which ones are pursued often depends on political conditions and resources.

One of the reasons for exploring space is that Earth is not enough for us. We need more living room and resources than our home planet can offer. But who is this 'we?' Is spreading out into space a good thing if the human presence there consists of large commercial enterprises, scientists and members of a rich elite? Should we not mark from early on another interest: that of equal freedom. Equal freedom means that the goal of space exploration is to make space accessible to ordinary people who are not particularly rich or influential or particularly professionally involved in it. Satellite services are a good example of how the exploitation of space has also improved the lives of ordinary people. If space is explored in part for the purpose of making human life better, it should mean the life of the ordinary human. Otherwise there is a risk that the gap between the privileged and the poor will expand

into something never seen before, with equally unpredictable consequences. The space environment is like the Earth's environment in the sense that we have diverse interests towards it but physical and social realities set certain limits on the manner and the extent to which we may pursue these interests. Treating space as an environment highlights the need to discern and evaluate our various interests, as well as the need to ask, who 'we' includes in a given situation.

3.4. Objects in space have inherent value

It was suggested above that, in order to obtain useful answers to the ethical questions of space exploration, it would be wise sometimes to grant space the status of a moral subject (environment). Can we make this case stronger and say that, at least sometimes, moral subjecthood is more than a philosophical tool? Can we assert that objects in space really have inherent value?

According to Rolston, we can. He points out that asking what alien worlds are good for prevents us asking whether those worlds are good in a deeper sense. In his opinion the class of habitable places is only a subset of the class of valuable places and a failure to be functional for Earth-based life is a different thing from failing on form, beauty or eventfulness. Therefore, just as there is (in)appropriate behaviour in places on Earth, regardless of how hospitable they are to human life, so it is also meaningful to speak of (in)appropriate behaviour in space environments [8]. Williamson agrees with this when he says that, whereas life forms and ecology are considered sacrosanct, the inherent beauty of geology and geomorphology is not always accorded the recognition it deserves [1]. Recognizing that space environments have inherent value is a simple way of keeping in mind that, even when lifeless, space environments can have many valuable qualities that deserve to be protected and cherished. Space is not just a new area for the application of environmental ethics but can also teach an ethics lesson of its own: that environmental ethics at its best is more than an ethics of life. If lifeless environments can be valuable and unique in many ways, what does this tell us about our moral responsibilities towards all environments?

4. From dreams to history books

4.1. How to avoid becoming a galactic plague

A staple of science fiction imagery are tales of Earth being attacked by a ruthless spacefaring conqueror species. Noble humans then rise to fight and finally beat the invaders. These latter, technically advanced species trample through the galaxy leaving destruction and death behind. Everyone agrees that it is only good and right to stop such a galactic plague by any means necessary. But if we abandon the idea of space as an environment that we must explore responsibly and view the ethics of space exploration only as a subspecies of the ethics of science, are we not well on our way to becoming a galactic plague ourselves? Our track record on Earth shows that we certainly have a capability to destroy our environment - and to an increasing degree, also the capacity to regret it later. On the other hand, if we regard space as wilderness, in the spirit of astro-environmentalism, we might avoid repeating some of the mistakes we have made on Earth. Conceiving of space as a wilderness to explore and protect rather than as a frontier to exploit could help to keep nuclear technology, debris and other environmental hazards out of the heavens [9].

If space exploration as a science treats ethical questions only in terms of human interests, can we really expect a future in which the exploration of space is capable of fulfilling the hopes humanity has placed on it? It is important to ask how our actions will shape us as a civilization and perhaps even as a species. This can be done by employing a framework of 'virtue ethics'.

4.2. On virtue ethics and space exploration

According to Bill Shaw, virtues are stable propensities to excel or character habits that are instilled into us from youth and for as long as we are capable of growing morally. True virtues also find a mean between excess virtue and a deficit thereof.[5] For example, a person who is honest does not reveal everything s/he thinks at every opportunity, but is forthcoming enough to share information that is relevant and not privileged in a discussion. Finally, virtues are not the same as rules. A virtuous person does not follow a rule blindly and live in blind obedience to a fixed position. Instead, s/he is a person of character and good judgment. Shaw explains that virtues cannot be formulated with the precision of rules because they require decisions to be made under unique and changing circumstances. When a virtuous person makes these decisions, s/he harnesses both the emotional (affective) and the cognitive (rational) aspects of his or her psyche. Shaw notes, however, that it would be wrong to characterize virtue ethics as hostile to rules. While virtues are basically contextual, Shaw thinks that rules still have their uses, for example in educating children and keeping them from harm, even when they may be too rigid or alternatively too abstract to properly guide an adult [11].[6]

From the point of view of environmental virtue ethics it does not make any difference whether we act on Earth or in space - if we act anywhere at all, we can evaluate our actions using the conceptual framework of virtue ethics. If we wish to explore space, the big question is: what kind of explorers will we be? Will our actions be those of a species that is greedy, destructive and short-sighted? Or will they speak of people who are considerate, benevolent and peaceful?

The fact that virtue ethics considers rules as rules of thumb that may work in most situations but are not the final word on the issue is not a sign of impracticality. On the contrary, it provides flexibility that is essential for the ethics of an

[5] According to Aristotle, besides excess and deficit of virtue there are things that are inherently evil, like stealing. Such things are outside the general framework presented here. See [10].

[6] See also: [12].

exploratory science. In doing exploratory science it is certain that, sooner or later, something unforeseen will happen. I argue that any account of the ethics of space exploration should be capable of answering this uncertainty at the core of exploratory science. Otherwise, the theory of ethics does not correspond well with the practice of exploration - its intended area of application. In fact, principle-based ethics has already been used in the context of space exploration. Margaret Race and Richard O. Randolph have suggested a set of ethical principles as guidelines in the event of discovery of non-intelligent extraterrestrial life [13].

A rule-based ethics relies heavily on predictability: when someone makes a rule, s/he must have a picture of its intended area of application in mind. If something totally unexpected happens, following the rule strictly may not lead to its intended result. Where law is concerned, it is sometimes said that, in tricky cases, the judge should observe the spirit rather than the letter of the law. The 'spirit of the law' refers to the principles and virtues that have inspired the law rather than the form in which the law has been explicitly expressed, and a good judge is also aware of what these principles are. Estimating how one's intended actions realize virtues - for example, evaluating if doing x is courageous or cowardly - can be done more reliably even in unexpected situations because conducting such an estimation does not require detailed knowledge about one's environment. The properties of the moral agent, not the properties of his/her environment are the key to doing the right thing, and no matter how strange the circumstances an explorer may find himself in, she always has access to knowledge about her own state of mind. Further knowledge can be useful, but it is not crucial to moral decision making in the way it is in consequentialist approaches. An explorer who has a grasp of virtue ethics may find that s/he should learn more about the situation s/he is in, but the capability to make moral decisions is never crippled to a level where making a moral choice is little more than a guess.

It is easy to see that not all virtues are compatible with each other. Sometimes a courageous act is not a fair one, sometimes what is careful is not effective. When virtues conflict, a virtue ethicist considers the whole. Then it is possible to reason that human benefit cannot be maximised by submitting to a single virtue but rather by mediating virtues so that excesses and other harm are avoided. In a short article space constraints prevent further description of the virtue approach, but this sketch will suffice for our purposes of evaluating the previously presented arguments.

4.3. Towards a sustainable ethics

A virtue ethics viewpoint enables one to see that there are reasons both for and against considering space as an environment in the traditional sense. There are good reasons to place a high priority on the needs of Earth, and it also seems reasonable to recognize that most of the human space-related interests currently discussed are important and worth pursuing. However, we should pay attention to the manner in which we pursue these interests. We should also keep in mind that human interests are varied. Not everything that can be done may be worth doing. Instead, we should evaluate what is necessary for fulfilling our real needs and important goals. We should try to discern which wants may stem from greed and carelessness and avoid short-sighted exploitation of space, especially when it can lead to the destruction of inherently valuable things or things that could be valuable for future generations. Virtue ethics also suggests that we should not pursue even worthy goals by means that require us to act in immoral ways, because actions, not noble goals (which exist somewhere in the world of speculation at the time of action) are the key to ethical excellence. Ethical excellence, in turn, should not be seen as a restriction on our creativity and productivity but as a means to ensure that our actions are truly beneficial from a wider perspective.

Furthermore, goals often change with changing policies and trends, while our basic conceptions of right and wrong change more slowly.[7] Directing one's actions according to stable guidelines such as virtues will produce moral decisions that are more sustainable over time and also better justified in historical perspective. For research aiming at excellence and sustainability, observing high ethical standards is therefore something that improves the impact of the research. Norton's reading of Thoreau suggests that virtue ethics is also compatible with weak anthropocentrism, in which certain uses of things are capable of transforming and ennobling human nature. According to this view, some human experiences are better than others because they expand and enlarge human consciousness and help us become better human beings [14]. Virtue discourse is a way to discuss such actions and formulate them into habits and guidelines for action.

5. Conclusions

In many ways Earth, with its unique, abundant life, is special. There is nothing quite like it in the Solar System - as William Hartmann has put it, Earth is a Hawaii in a Solar System full of Siberias [15]. Therefore, I suggest that space at large should not enjoy a moral status equal to Earth. However, some environmental ethical viewpoints are still important: for example, the idea that humans' actions towards their surroundings will continue to affect people whether we live on Earth or in space.

Space environments are diverse and therefore we should treat ethical questions of space exploration with sensitivity. Some space environments are just as special as terrestrial environments, others have historical value, and some are economically valuable. It would be difficult to formulate an ethics based on listing all the characteristics that can make some areas of space special and then evaluate places based on such a list[8]; since space has still many surprises in store for us, such a list would probably lack something important. Since

[7] I do not mean to suggest that our conceptions of right and wrong do not change over time, sometimes over a short period of time. For example, loyalty to one's family has traditionally been considered as a virtue, while in modern society individualism and 'loyalty to oneself' have become increasingly important in less than 100 years. It is hard to say which view will ultimately serve humanity better.

[8] This approach has also been suggested, however. See [16].

humans are moral agents, we can take ourselves as a starting point in the sense that we are already experienced in evaluating whether proposed actions are short-sighted, careful or effective – in light of virtue ethics.

Virtue ethics principles are practical and applicable to space exploration. In particular, sustainability deserves special emphasis in the context of space exploration where the costs of research are extremely high and discoveries made can change our world-view forever. The environmental ethics of space will necessarily be different from the environmental ethics of Earth, but can still provide valuable views and philosophical tools for assessing questions related to the exploration and exploitation of space. The ethics of space exploration should be scientific, philosophical ethics.

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