

The following issue of Perspectives, no 68, is the first in an initial series of two, in which ESPI explores the pros and cons of the one-way ticket to Mars. Perspective 68 sets out the arguments in favour of the one-way ticket. Perspective 69, which describes the cons, will be issued in three weeks' time. Perspective 68 is the result of deliberations by a group within ESPI which favours the one-way ticket idea. These deliberations were undertaken separately from those of the ESPI 'con consortium', the authors of Perspective 69, in order to ensure that arguments for and against would be brought out as clearly as possible against their own premises. Both groups hope that readers will find lots of food for thought relative to a topic which exposes many of the value-judgments of our society and how we make these judgments. Going to Mars on a one-way ticket would be a deadly serious issue if it would be realistic at this time, but it is clearly not. Therefore the authors of both exposés can, with good conscience, express the wish that readers will have also fun reflecting on where the future may take us in this domain!

Can 'One-Way Tickets' Serve as a Basis for Planetary Exploration in our Solar System?*

Why Not?

Arne LAHCEN, Resident Fellow, ESPI
Cenan AL-EKABI, Resident Fellow, ESPI
Nathalie ARMELLIN, Management Assistant and Social Media, ESPI

This Perspective attempts to capture the views and arguments that favour the concept of one-way tickets in a balanced way by using acknowledged practices, rights and terrestrial comparisons that exist today. The first step in this respect was to outline the context in which advocating for this venture is relevant and defensible. Subsequently, the boundary conditions that need to be met before such venture should be considered are assessed. This is necessary because the implications of sending people on a one-way trip are profound and irreversible, and thus they entail a great deal of responsibility for humanity. Finally, this Perspective explores the routes that point towards the ethical justification of such an undertaking. This includes several arguments that directly support the idea, and several additional arguments against the outright prohibition or restriction of one-way voyages to other celestial bodies in our solar system.

1. The Context

The idea of sending people on a one-way journey to Mars is something that leaves few people untouched – whether positive or negative – and for a number of reasons. Aside from being a milestone in human achievement, such an interplanetary voyage/mission would dramatically increase the amount and diversity of scientific data that can be gathered. After all, our current rovers, even Curiosity with its sophisticated set of scientific instruments, are limited in terms of mobility and flexibility when compared to human capabilities. People against the idea tend to emphasise the risks associated with a one-way trip and the fact

that the decision to leave Earth would, for instance, deprive individuals of their future freedom if they were to change their mind sometime after departure.

A first glimpse at what is at the centre of the arguments, pro and against, immediately reveals the relentless dynamic feeding this discussion: a difficult trade-off between huge opportunities and the risk of ultimate personal sacrifice, that of one's life. In this sense, this discussion should only be considered to be a relevant one as long as the debate takes place in a context where both positions remain defensible. It would indeed be somewhat pointless to send people on a one-way

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voyage if we would have a prospect of establishing a return mission to Mars within the next upcoming decades. To date, however, we do not have this perspective and because of this the discussion is more alive than ever before; especially now that the commercialisation of space activities, and even commercial-driven space exploration are becoming ever more relevant. If commercial or other non-governmental players step into the field, there is no guarantee that one or more national governments will be able to stop them from fulfilling their aspirations.

2. The Boundary Conditions

Arguing in favour of considering one-way voyages throughout our solar system is somewhat tricky, because when doing so one might easily be labelled as 'short-sighted', 'unethical' or 'naive'. This raises a first important 'but' on the pro side: the boundary conditions. If such an undertaking would be considered, it is critical that certain conditions are fulfilled in terms of technical requirements, the guarantee of physical safety and psychological well-being.

First of all, this includes the effort to protect human life on this journey to the extent possible from all associated risks such as radiation, technical failures, lack of oxygen, food and perhaps the most underestimated one – lack of purpose. If we were to send a human crew to Mars, we ought to guarantee their physical safety and psychological well-being as much as possible. To this effect, the minimal conditions for habitability on Mars should be defined in a holistic manner. This will include the size of the habitat module, redundancy in its life support systems and supply chains, mobility on the surface, the availability of self-sustaining activities such as greenhouse farming, entertainment, the ideal crew size and composition etc. Current state-of-the-art technologies are not yet sufficiently developed to allow these basic needs to be met but there are promising technologies being developed and studied that, when successfully combined, might lead to game-changing capabilities. Think for instance what concepts like inflatable modules or progress in nanotechnology, biotechnology, and advanced materials might bring for a permanently inhabited base on another planet. If these would materialise on the mid-term, many of the severe risks – including radiation – could be mitigated by several orders of magnitude.

History has shown us, however, that complete risk mitigation is impossible, especially in human space flight. This brings us to the essential criteria of assessment, communication and awareness of all the risks that cannot be mitigated. The to-be astronauts and future inhabitants of another planet should be selected very carefully and they should be aware of all the risks and implications associated with the lifelong challenge they subscribe to. In this respect, it is very likely that the profile of the ideal candidates differs profoundly from the classic profile of astronauts that typically reside in the ISS for a couple of months, because they leave with the prospect of coming back. This will be an extremely difficult exercise and there is still a lot of work for space psychology in this field, indicating the need for research that addresses the long term impacts of human isolation beyond what has been done in return mission simulations such as Mars-500. Nevertheless, there are terrestrial parallels here as well. The majority of people are not born to have an eremitic lifestyle but there are always people who have, such as monks or people that prefer to retreat from society and live in remote solitude. Clearly this in itself is anything but sufficient, but it indicates that it will come down to finding the right combination of characteristics within the right person. In other words: the ideal candidates are most likely out there and some of them will probably sign up, they just need to be identified.

3. The Ethical Arguments Pro

If the above conditions are met – and for the sake of clarity: currently they are not! – the idea of allowing people to take up this challenge could be considered, and there are several arguments that support this notion. It is important to note that the different arguments discussed below are often somehow related and as such, they often reinforce each other, rather than being completely parallel, independent motivations.

The first argument relates to the intrinsic human rights of freedom of choice and self-determination. People against the idea of a one-way trip often tend to dismiss candidates for such a mission as 'crazy' or they say that they don't know what they are up for once embarking on the project. Granted, the majority of people showing interest in a one-way journey to Mars would not pass the difficult selection processes, among other reasons because their motivation is not solid enough. This

would be the case, for instance, when their candidacy turns out to be no more than a short-lived snapshot decision driven by curiosity or the aspiration to become famous. In these cases it is society's responsibility to protect these people from themselves! In other words, distinguishing suitable candidates from those who believe they are suitable is key. Nevertheless, in our global society of seven billion people, there is a very select, small group of intelligent and matter-of-fact people out there that are very aware of the risks and that would immediately sign up for this first attempt to turn humankind into a multi-planetary species. Yes, they will probably not live to become 90, but they will be the first humans to settle on another planet! Despite appearances, however, a one-way trip to Mars is not exactly comparable to a suicide mission. The volunteers would be more than just martyrs going there to fulfil a couple of tasks and then slowly die; they would be choosing to spend the rest of their life there, as if they were migrating to another continent. Going to Mars is not something we are obliged to do by an imminent danger; even though it can be considered a desirable achievement, at present nothing forces us to do it. The volunteers would be choosing to go on this mission with considerably more freedom of will than, for example, the Chernobyl liquidators. One could say that ethically, it is much more acceptable to send well-informed volunteers to Mars with the hope of great discoveries for mankind, than to send a group of sometimes unsuspecting workers to clean up a nuclear accident site to save others from disaster. Of course, selecting the suitable miniscule percentage from the list of applicants will probably be one of the biggest challenges and will require multiannual assessments by different teams of people. But perhaps the nature of a mission to Mars creates the conditions for selecting a very special type of individual to do it. The mere fact that going to Mars is such a perilous and challenging endeavour means that we might need to select the kind of people who would be ready for anything and would go there bearing in mind the possibility of no return in any case. As a matter of fact, some astronauts have already expressed the desire to be chosen for a one-way mission to Mars, and astronauts are not the kind of people who say this on the spur of the moment only to regret it later. So if a selection process succeeds in finding suitable candidates and if we have the technical possibility to ensure acceptable risks, what grounds do people against the idea of a one-way mission have to deny these

people the right to go there? We ought to be careful not to project our personal choices and visions upon other people, just because we believe we know what's best for them. If we are sure their intentions, wishes and aspirations are genuine and resolute and they are aware of the risks; respecting their choice is ultimately our choice of respecting their freedom and right of self-determination.

The second argument is somewhat in line with the first, but slightly more related to an intrinsic human feature. Everyone wants to grow old, but nobody wants to be old, an expression goes. Intuitively this sounds sane because it is in line with our evolutionary instinct for self-preservation, but in reality – when the whole society is considered, there seems to be something flawed about it. It fundamentally contradicts the fact that some people very consciously prefer to live by the “live fast, die young” paradigm. Not everybody considers the prospect of a long and risk-averse life his or her '*summum bonum*' when there are other – in their eyes much more valuable and interesting – lifestyles to be lived. This diversity is actually already tolerated here on Earth, think for instance about the wide variety of high-risk activities people engage in for their own leisure or well-being, regardless of economic gain or fame. We allow people to take part in the world's most dangerous sports such as base jumping, heli skiing or cave diving although we know that, accumulated over time, these activities intrinsically entail deadly casualties. We might comfort ourselves by the idea of control and argue that sporadic accidents are unfortunate side-effects and not central to the activity concerned. This however is a fallacy, caused by a false sense of control and a phoney sense of non-responsibility. Fatalities even overcome the very best and we could easily avoid dozens of these accidents through their prohibition. Still we choose not to, because we give people the freedom to decide, assume the risk, and do what they consider is in their own interest.

4. The Nature of Human Progress

Creating awareness is not only good, it is a fundamental requirement. Pampering people, on the other hand, is neither a requirement, nor good! In fact, on a longer time perspective, the human disposition to take risks is the main reason why we are currently such a successful species; occupying nearly every setting in our planet's ecosystem. Society and our habitat as it exists today was only

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made possible by the people that have continuously taken these endeavours throughout human history, from 'Out of Africa' some 100,000 years ago, over the population of the scattered Pacific Islands by the Polynesians risking their life on their timber rafts, to the first colonists moving from Europe to the New World and beyond. In a world that boasts so few undiscovered places and where our technology enables us to go beyond, this seems to be just the next logical step in our development, undertaken by those who feel it is their calling. By allowing them to do so, we would allow them to give their life meaning and a sense of purpose and existence that would be unprecedented compared to historical analogies.

Besides, our manned space programmes have been sold to the public with the underlying idea that space is the next step to humankind's natural expansion and with the ultimate though distant goal of colonising other worlds. We have sent the Voyager missions partially to send information and human culture into the universe, in the hope of finding another presence or any clue that could further help us explain the ultimate mystery of our existence. From ancient times, humankind has tried to solve the mystery of life and to find answers in the universe. If we take the assumption that humanity is the consciousness of the world, and perhaps even of the universe, in the absence of any known form of life outside of our planet, then it would be the duty of humankind to continue to explore the universe and search for answers and while doing so, to take every possible measure to protect itself from extinction. In the long run, colonising another planet could be seen as a way to have a back-up plan in case of a major disaster on planet Earth.

Next, the question should be raised whether the status-quo – i.e. avoiding one-way missions even when they would be possible under the conditions previously discussed – serves our general interests in the best way possible. This argument fits in the perspective of maturing risks and how to deal with them. Human space exploration, even in Low-Earth-Orbit (LEO) or cislunar ranges, by itself is unsafe in relativistic terms to other Earth-centric journeys. The idea of a safe journey and existence on a one-way ticket in the perpetual harsh environment envisioned is untenable, much like it was in the days of Yuri's first flight and the Apollo missions to the Moon. These conditions can be mitigated to a stage of tolerance, but like with

commercial suborbital space flight, space exploration will make its gambit amid a totality of unknown risks. If our long term objective remains to transform our space-capable society into a truly space-faring one, we will have to overcome our fear of unknown risk, and step out of our comfort zone.

Moreover, to delay such an endeavour by decades and even centuries will not per se automatically decrease the inherent risk. On the contrary, it might even create an illusion as though we are better equipped to handle unknown problems as they arise. Future advancements in technology might result in unrelated developments, leaving the idea of space exploration a stale taste for yet another generation as in the case of the lost momentum in landing on the Moon. Progress in certain areas of interplanetary habitability will only be made if we actually start doing it; there is only a certain amount of progress that can be made by improving computer models and developing the required technologies. Engineers and pilots are not one hundred percent sure whether a new type aircraft flies safely until someone has actually flown it, ideally under a wide array of circumstances, including challenging ones. At a certain point we will have to go out there and start doing the job. Again, this does not mean that the risks should be ignored, minimised, let alone not mitigated to the fullest extent possible. It does mean that at a certain point in the future, when the moment is right, we should not avoid it just because there is a certain risk involved. When that point has come we will be able to start fine-tuning our approaches and human spaceflight will start becoming part of normal human activities, expanding the human realm significantly beyond the borders that have cradled us for so long. Until that point, however, the discussion remains on the table and one definitely worth having, preferably in a spirit of openness and frankness.

Finally, in a very long-term perspective, under the currently envisioned state of technological advancement, further space exploration beyond our solar system will have to be done on a one-way ticket anyway. Though centuries or even millennia away, if humankind is to explore solar systems that have Earth-like planets in the 'goldilocks' zone of their stars, then manned expeditions can one day be envisioned as well. Based on the sheer distance between stars (the nearest stars are still over 4 light years away), such a void cannot be surmounted

within the estimated lifetime of a single generation of human beings. Undoubtedly, this debate on a one-way ticket will arise again, yet if we are to go beyond our own solar system, society must accept that the choice an individual makes by their commitment outweighs the burden of hardship and loss of convenience from never returning to the place they once called home.

5. Is there a Basis for Restrictions?

The final question to consider is whether non-stakeholders have the right to intervene if an individual willingly chooses a course of action that is not prohibited by national or international laws. Though argued strictly on ethical grounds, a one-way ticket in space exploration has never been addressed in national or international legislation. Though international space treaties such as the Outer Space Treaty and Moon Treaty allude to space being free for exploration without discrimination, with free access to all areas of celestial bodies, and manned stations on the Moon respectively. Nevertheless, where no applicable law exists, the contingency to that potential 'non-liquet' is the general international norm that everything which is not expressly prohibited is allowed. Unlike in most instances of 'what is not prohibited is allowed', often criticised as flawed when one's freedom is granted above the freedom of another on a first-to-claim first-served basis, an explorer's right to the one-way exploration ticket does not impinge on the rights of any other individual. As non-stakeholders are unaffected by the one-way ticket, they should not be able to impose or intervene on the right of an individual to pursue such a lifestyle.

6. Conclusions

Although most concerns regarding the possibility of one-way tickets as a means for solar system exploration are genuine and should be considered with due regard, this Perspective revealed that concept itself is defensible when it is framed in the right perspective. To this effect some essential boundary conditions were put forward and described that facilitate a proper judgement.

With these boundary conditions in mind, various arguments that support the notion of one-way tickets were presented. Some arguments relate to the intrinsic right of human freedom of choice and the right to self-determination. In this group of

arguments, there are many, less exotic, terrestrial examples with parallel characteristics. Other arguments are rather linked to the nature of human progress. As technology advances further into the domain of science fiction, society must decide how it will use this enabler in the following century. In space exploration, we can now reach and almost inhabit other celestial bodies and we can explore deeper into our solar system and universe; but as with all new technologies, the cost is at a premium. The need to explore is inherent in the nature of humanity, and it should be accepted as fact that in the coming future, humanity will extend beyond LEO permanently. The issue is how to make this inevitable striving a reality. This issue raises some practical questions. Should humanity wait for governments to fully develop space exploration and market it to its citizens with the promise of a return-ticket, or should citizens take the lead in space exploration on an already existing one-way ticket, creating a catalyst that will push governments in developing that same return technology at an accelerated rate? There are some that want to become that catalyst, and are willing to leave Earth behind in order to become pioneers by expanding the human realm to another planet for the very first time in our history.



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Email: office@espi.or.at

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