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The Human Factor in a Mission to Mars

An Interdisciplinary Approach

 Springer

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Preface

Future human missions to Mars will by definition be undertaken by voyagers who are representatives of humanity. The evolved composition of our psychological modules and our cultural histories will constitute the lens through which we experience and interpret these momentous events. Our unique human needs and frailties, and how we plan to satisfy them, will influence both how far we travel and how long we stay away from our terrestrial tethers. Thus, the “human factor” will undoubtedly be the leading consideration for expert and layperson alike as the first Mars missions approach. Several issues are worthy of explanation in regard to “the human factor.”

First, the human factor in space missions should be clearly distinguished from uncrewed spaceflights. Humanity has a relatively long history of successful exploration of space by robotically controlled spacecraft. While space exploration by robots has been relatively routine (yet, not so comparable to human-centered exploration when the current robotic capabilities are compared with human dexterity and intelligence), human spaceflights from the past several decades include only routine missions at Earth orbit. Human missions to the Moon realized in 1969–1972 at first glance may look more like irrational extravagancy motivated only by the political competition of the Cold War. But the fact that the human lunar missions were canceled and then never reactivated again is meaningful also in the context of the missions to Mars. It may suggest that no one is able to find a sufficiently strong rationale to once again send human astronauts to the Moon. The canceled human lunar program is not a challenging undertaking in terms of technological challenges with our current state of the art in-flight technology when compared to the challenges of the Mars mission. This lack of a technological challenge undoubtedly casts a shadow upon our collective motivations which are usually spurred by new challenges and difficult enterprises.

Second, the human factor demands a rationale which is much stronger than that for robotic space missions. For many reasons—from financial to medical—human presence in space requires rationale. The lack of technological challenge, political expediency, and other motivators to send humans to the Moon are at least partially responsible for the lack of the human lunar program. There is no doubt that

humanity is able to realize large, expensive, risky, and long-term projects on Earth (see: chapter of Jacob Haqq-Misra). For this reason, the question of “go to Mars or not to go” is not purely a financial issue because humanity spends more money for countless terrestrial undertakings (see: chapter of Konrad Szocik). This question becomes an ethical (also in the context of the allocation of financial resources) issue due to the need for a rationale. In some sense, the study of human factor in space is, at least to some extent, identical with the search for a rationale. The readers of this volume may find that almost in every chapter of this book, rationale is discussed to some extent. The last chapter is totally focused on the consideration of this topic. When particular contributors discuss such issues like psychological challenges in space, the impact of space weather, and also ethical issues toward uninhabited Mars, they discuss in fact the rationale for this mission. They show what kind of problems and areas of risks may appear and therefore contribute to the calculus of rationale.

After rationale, the concept of risk is the next key concept connected with the human factor in a mission to Mars. As with the case of rationale, almost every chapter in this volume mentions some risks which should be expected at various stages of the mission. One of the first steps for a successful human mission in space is detection and analysis of all possible and probable areas of risks. This broad set of risks requires an interdisciplinary approach.

Interdisciplinarity is hence the next essential concept. The main idea of this book assumes that the human factor in a mission to Mars will be, in fact, repetition of all problems and challenges which are a domain of human evolution and life on Earth. The extra challenge will be living in a hazardous space environment. This environmental challenge will cause technological and medical problems including unexpected deleterious effects. This environmental factor is expected to affect in a peculiar way the future evolution and development of humans in space.

Interdisciplinarity expresses complexity of the human factor, both on Earth and in space. This case is expressed by areas of expertise of contributors to this volume, and by selected topics. Contributors to this book represent such diverse fields as biomedical engineering, astronomy, astrophysics, physics, meteorology, astrobiology, biology, anthropology, theology, and philosophy. Each of these disciplines expresses a particular facet of being a human being. One could ask if whether it is possible and justified to make some order and hierarchy of priorities and values in these mentioned factors. Another could skeptically reply that technological, medical, and environmental factors should be considered first, or even, that only they matter. Without a life support system and medical protection—which require not only aerospace engineering and medicine, but also many associated disciplines—no one is able to send humans to Mars. But the question arises if skepticism to nonmedical and non-technological considerations may be justified. In our opinion, the answer is no. Human beings include not only physiology and biology, but also culture. Culture mostly in recent years is broadly discussed as a strong selective power comparable to natural selection. Culture is connected with human social and political life. All of them connect with ethical issues. It is hard to imagine and to assume that humans in space will live without culture, and that they will not feel

and experience the same needs, feelings, and purposes like they experience on Earth.

For these reasons, the human factor in a mission to Mars as discussed in this book refers to all possible challenges, risks, but also human needs and desires—all contexts of human life as it is known on Earth—which are supposed to appear wherever human factor occurs. It means that humans will take all their specificity and complexity wherever they travel in space. This assumption explains the diverse collection of topics in this volume. However, this list is far from being complete. This book does not discuss such important issues like legal concerns connected with the broad field of space law, or possible future political challenges. This book also does not discuss in detail all the medical challenges which may appear in space (however, a couple of chapters in the first part discuss this issue). One aim of this book is to show how complex and complicated the human factor in a mission to Mars truly is.

This volume is divided into two parts. The first part is focused mostly on medical, psychological, and biological challenges which may appear during human mission to Mars and may be challenging for the success of this mission. This part includes the five following contributions.

Steven Abood discusses the importance of environmental psychology—how our physical environments affect our psychologies, on the Mars mission. Living on Mars will cause numerous psychological challenges. Abood suggests that humanity must attempt to cope with these challenges by the careful design of the choice architecture of environments which make people more or less likely to choose different behaviors. The fulfillment of fundamental existential, relationship, safety, and fitness needs on the Mars mission largely depends on designing environments so that certain choices and behaviors are more favored than others.

Margaret Boone Rappaport and Christopher Corbally study the complexity of challenges caused by the space environment. They focus mostly on the impact of space on human psychology, social life, and culture. Then, they consider a broad set of possible countermeasures to cope with more and less serious threats. These latter ones include, among others, ubiquitous Martian dust, limited access to sunlight, and the monotony of the Martian red color.

Mark Shelhamer is focused on the danger of spaceflights. He shows that even relatively easy and routine tasks conducted in Earth orbit may lead to disaster. Shelhamer underlines the complexity of hazardous and deleterious factors in human spaceflights. He argues that the crew—which should be aware of the fact that the long distance from Earth excludes some rescue and recovery strategies—might be supported by some new tools including, among others, automated systems. However, as the author argues, such solutions may be challenging for our human sense of freedom and autonomy.

The chapter of Mike Hapgood presents the challenges concomitant with space weather. Two the most important factors are here galactic cosmic rays and solar radiation storms. Hapgood reviews their physical specificity and their impact on the health and performance of astronauts. Required countermeasures should include

mixed strategies containing both shelter and detecting systems on the board, supported by experts on Earth.

The last contribution in this first part is Chris Impey's chapter. This contribution is a good transition and connection between two parts. Impey connects issues appropriate for the first part—like a broad set of various challenges including even the possibility of new speciation among Martian population, with topics discussed in the second part. These latter ones include such issues like human fascination with Mars, human plans of terraforming Mars, or current, more or less reliable plans of colonizing Mars.

The second part is the collection of nine chapters which explore aspects of the human factors in space other than those comprising technological, psychological, biological, and environmental concerns. The first contribution to this part authored by Klara Anna Capova portrays the idea of Mars colonization from the point of view of sociocultural anthropology. Capova shows how Mars became the planetary pop star which infected human brains in recent centuries.

Jacques Arnould's contribution opens a series of six chapters focused on various ethical questions. Arnould discusses, among others, the politics and policy of space agencies and governments interested in the exploration of Mars. But he also shows why a Mars settlement might constitute the birth of a new ethical horizon for humanity.

Jacob Haqq-Misra focuses his attention on ethical issues on Earth. He notices that the long-term human space program, including a Mars settlement, will require a multi-generational responsible effort aimed at development and maintenance of this mission. Because this effort at least at the beginning will not be profitable for benefactors and sponsors, the author introduces his theory of deep altruism.

Andreas Losch discusses the idea of a human mission to Mars in the broader framework of the concept of sustainability. He argues that it is worth it to include an opportunity to use the outer space both as the part of human heritage, but also as a chance for human survival.

Tony Milligan and Martin Elvis consider one of the possible rationales for a human settlement on Mars: human base for asteroid mining. They point out that it is desirable to apply the 1/8 principle for protection—the final barrier for human exploitation of resources in space which should not extend 1/8 of the available resources to avoid super-exploitation. Their chapter corresponds with Haqq-Misra's care for the long-term responsible maintenance of human space settlement, and with Losch's idea of interplanetary sustainability.

The contribution of Gonzalo Munévar presents the importance of Mars for progress in science. As the author shows, studying Mars matters both for scientific progress in space geology and astrobiology, and also for making progress in science applicable on Earth. He adds that human settlement on Mars should follow purely scientific analysis focused mostly on the study of tracks of life on Mars.

Erik Persson considers possible ethical attitudes toward uninhabited Mars. As he shows in his chapter, the basic—but definitely not obvious and not easy!—task is the necessity to consider the possible intrinsic value of a given object (in this case, Mars). An uninhabited planet does not possess moral status. Persson argues that the

main criterion for the application of ethical considerations is existing as a sentient being.

The chapter written by Lluís Oviedo focuses our attention on the issue of religion in space. Oviedo analyzes possible scenarios in the future human Mars settlement in which religious beliefs could play any role. This mental experiment shows how broadly encompassing a human factor is in a mission to Mars. Religion is discussed here mostly due to its enormous role played during human cultural evolution on Earth. Oviedo shows that it is important to consider its possible role in space colony in the context of its psychological and social functions.

The last chapter by Konrad Szocik offers skeptical remarks on the idea of a human mission to Mars. The author enumerates and discusses challenges including the (in his opinion) poor rationale for this mission, the challenge of sustainable development, and the risk for human health and life. While this chapter is without doubts the most skeptical contribution to this volume, it is not aimed at questioning the justification for the human interplanetary mission. Its main idea lies in the assumption that mission planners should take into account many, sometimes not obvious and unexpected, issues. These issues include long-term consequences like the ethical challenge of human enhancement, mentioned in this chapter.

The book shows that the study of the idea and plans for a human mission to Mars is a promising topic of future study through the lens of diverse fields including the social and political sciences. This is a field which is still open for new ideas, especially those which appreciate interdisciplinary, combined efforts. Contributions to this volume show that it is possible and worthwhile to extrapolate facts, processes, and mechanisms known in human history and evolution on Earth to the human future in space.

Rzeszów, Poland

Konrad Szocik

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