Chapter 1

Space Travels and Empathy: A New Area of Educational Intervention

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Additional information is available at the end of the chapter

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Abstract

Empathy is a relevant factor which the astronauts must own to face with long missions. In fact, the absence of this can be a cause of a fail mission. Due to the fact space projects involve a great invest, the way of developing empathy on crew and the teaching of strategies is a priority. For all this, the main goal of this paper was to analyze the current situation of the research on empathy concerning space travels. The specific objectives were (a) to find out how this issue and other psychological variables were related to astronauts and space travels and (b) to propose aspects for the design of an educational program to encourage people to solve social problems and develop social skills. For that, a review was made by using diferent databases and diferent resources by studying several variables related to empathy and long-duration space missions. Findings show that the psychological variables will be specially relevant in future missions and space colonization, as for instance, on Mars or the Moon. Conclusions can be useful to design educational programs to train crew members and control mission personnel on empathy and problem solving.

Keywords: empathy, astronaut selection, space travel, coexistence, space psychology

1. Introduction

Empathy can be defined as the ability to understand other people, both their feelings and their points of view [1]. This multidimensional view of social capabilities is also involved in space flight. While technology plays a key role in a mission, how to solve and prevent problems by human beings is also relevant. Therefore, it is necessary to consider other variables such as expectations, prior knowledge, the intrinsic and extrinsic motivations, learning styles,

coping strategy problems, algorithms for problem solving, how to resolve conflicts, as well as the ability to put yourself in the perspective of another person, among others. Space travel is going to become very important today. The world became interested in space watching other planets and stars as an escape route to perpetuate the human condition and spread their deoxyribonucleic acid (DNA), new economic opportunities, or tourism for the simple desire to excel. So, space psychology is becoming more popular nowadays [2].

Although the concept of empathy has been widely developed on educational field, it has not happened the same on special contexts. There has been an approach to study how people behave under extreme stress and special contexts such as on captivity, an expedition to the Arctic, experiments on artificial biospheres on small places on small spaces with other people, or even on space stations. However, the number of studies is smaller than on education, for example. Obviously, neither the conditions nor the cost is the same. Coming back to the issue, empathy is crucial to carry out long space missions, and in this chapter, these aspects will be developed. Besides, a series of limitations on studies about space travels have been found: the lack of subjects to study, no control groups, and difficulty to compare tasks within different studies [3].

In this line, psychological and cultural factors should be studied in the same way as physicists do, particularly for long-duration missions (e.g., Mars) [4]. There are different studies which shed light on how psychological aspects are involved on space travels. Due to that, it will be interesting and necessary to unify all of them to create a "corpus" of knowledge. This could be described as a branch of knowledge called "space psychology." Several psychological variables must be considered to understand the adaptation of the astronaut in a mission such as affiliation motive, satisfaction, occupational success, aggressiveness, cooperation, conformity, and so on. It can depend on sociodemographic variables such as nationality or culture [5], as it will be shown during the chapter.

Psychological variables associated to personal on Earth must be considered as well. Historically speaking, the figure of Von Braun, a leather in his field, must be reminded. Ernst Stuhlinger (as cited in Ref. [6]) describes him as a person with superior intelligence, a person with the ability to make the team proud of themselves and participate in debates, and a person who is talkative and good at designing machines. To understand the social moment which caused the arrival of human being to the Moon, the same authors refer to the concept of astrosociological study. It involves the existence of determined social factors which contribute to the space race: social motivation, money, competition between countries, and so on.

Having said that, the main aim of this chapter was to analyze the current situation of the study of empathy and other psychological variables concerning space travels. The specific objectives were (a) to find out the current situation of the issue concerning social skills, coexistence, empathy, and other psychological variables related to astronauts and space travels and (b) to propose key aspects for the design of an educational program to encourage people to solve social problems and develop social skills. For that, a review was made by using different databases and resources to get as many studies as possible (e.g., Web of Science, ScienceDirect, and Google Academic, mainly), by using descriptors such as "space psychology," "empathy," and "social skills."

In this chapter, it will begin by describing the concept of empathy and extreme environments. Next, the characteristics of a long-term mission and what is meant by "safe days" will be

developed. After this, the effects of prolonged exposure to outer space as well as various psychological variables such as gender, culture, or type of work will be explored. Then, various countermeasures that can be carried out to improve the psychological aspects of workers will be discussed. Lastly, basic aspects, which should be considered to improve empathy, coexistence, and social relations before, during, and after the mission in a global and multidimensional program, will be exposed. For all this, this paper pretends to be a reflection on what kind of psychological variables can explain the reality of space race and how to improve the coexistence on space throughout the design of educational programs.

2. Empathy and coexistence in extreme environments

2.1. Empathy and coexistence

A first approach to the concept of empathy in English was studied by Edward Titchener, by using the German term "einfühlung" in order to mean "feeling into" [1]. The same author describes the concept as the social and cognitive ability to understand the feelings of the rest [1]. Empathy is a key piece for coexistence, and it is difficult to define it due to the complex relationship which may keep with other abstract concepts such as morality. Empathy and morality may be related to each other. Due to the fact which seems to be that empathy can address or influence morality, it has been proposed to use other determined terms such as "emotional sharing" or "affective perspective taking" [7]. It is of paramount importance because it involves cultural issues that can influence on the expression of more or less empathy.

Social skills on twenty-first century require a series of aspects as Hesse, Care, Buder, Sassenberg, and Griffin (2015) claim (as cited in Ref. [8]). Concretely, the task is seen like a process in which action, interaction, and task completion are involved. Within social regulation aspects, negotiation, self-evaluation, and memory are found. The authors also expose some task regulations including resource management, tolerance for both ambiguity and tension, organization to be able to make the problem analysis, and setting goals. With this model, it is possible to create knowledge throughout knowledge acquisition, setting relationships, rules, hypothesis, and solutions. All these ideas involve both social and cognitive aspects [8]. Regarding the development of certain abilities, those people with "poor behavioral regulation skills," "poor language skills," and other characteristics are more likely to be less adapt and with less social outcomes [9]. Thus, the researchers emphasize the need for intervening both on language development and social skills since an early moment.

Finally, concerning crew members, Suedfeld, Brcic, and Legkaia (2009) (as cited in Ref. [10]) claim that the main coping strategy among astronauts is social support. So, it is possible to highlight the group living, coexistence, and harmony as variables closely related to the success of the mission.

2.2. Extreme and unusual environments

Harrison, Clearwater, and McKay (1991) (as cited in Ref. [10]) describe how the ICEs (Isolated and Confined Environments) are a way to study extreme conditions of living. These communities

must share privacy and space in EUEs (Extreme and Unusual Environments). These environments can be lethal, as for instance, undersea habitats, nuclear submarines, Antarctic stations, and so on. In this line, the environment in which the astronauts operate has a certain similarity with other tiny spaces such as nuclear submarines [11]. Psychological adaptation to confinement situation throughout a study on isolation chambers highlights the need for taking into account which coping strategies that are put in place to deal with this situation, since, by definition, people will be subjected to high levels of stress [12].

Before going to explore Mars with humans, the own planet has been used for analyzing how the stress will influence on them. For this reason, different places have been chosen to recreate the conditions of a mission to another planet and, more concretely, how to stay on it once they have arrived. On Earth, there are weird and difficult regions to live—and survive—and thanks to that, it is possible to simulate an exploration [13]. The 105-day study represents a pilot study before a higher experiment. It was a previous research before the Mars-500 Project—the duration was eventually 520 days in that case. Having said that, its results interestingly add a little description about the habitat where crew members were confined: the place contained both living and laboratory areas. To make the experiment more real, there was a communication delay of 40 min as in a real mission on Mars. It included even a mock-up of the Mars surface for recreating geological tasks of astronaut. The crew was composed of a commander, a sports physiologist, a mechanical engineer, a medical doctor, and a pilot [14].

Recently, the psychosocial variables of space flight associated to aging have also been studied. According to this review, extreme conditions such as those associated with space flight can, to a greater or lesser degree, affect to health. The researchers raised several questions such as whether it was possible to learn to enjoy the confinement situation or extract positive experiences. However, the questions are beyond a simple analysis of the ability of adaptation [10].

Obviously, it is not the same study on Earth than on space. Real situations in outer space lead to different results in some psychological variables compared to results obtained in simulated confinement situations or on planet Earth. In this line, changes in mood or perceived social climate in space crews in comparison with other simulation environments such as isolation chambers or bases in Antarctic have not been found. Scientists describe a possible explanation of the fact that in a real situation in space, the crew must be constantly attentive to aspects related to their survival, and there is a real danger. The same researchers claim it is not possible to ensure that astronauts will not have psychosocial problems in a long-term mission (e.g., Mars) when boredom, monotony, and greater autonomy conditions are present [4], being the ISS as a great habitat to study them [4]. There is no doubt that real environments can result more useful, though previous studies in "unreal conditions" are absolutely necessary to be prepared to face with conflicts and unpredictable situations. Actually, the "big" question is how confined people will be able to create a common culture and fix morale problems [10]. In this line, the way to manage social problems and conflicts is closely related to empathy which is the core of this chapter.

3. Astronaut psychology in long-duration missions

"Astronaut" is one of the main and more famous words used around the world, but it is not the one. The own name of the concept of "astronaut" depends on the culture and the country (e.g., astronaut in USA, cosmonaut in Russia, taikonaut in China, and so on). In the future, the name may be modified depending on the functions which are involved (for instance, commercial or exploration ending) and on social, legal, and ethical implications [15]. In this chapter, the concept of "astronaut" will be used to embrace different names, meanings and nationalities in general terms, to make the development of content easier. Having made this reflection, it is time to describe long-duration space missions.

3.1. Long-term missions

First, it must be considered that there is a substantial difference between orbit missions and deep space ones: the feeling of support. Astronauts have got visual contact with the Earth, and it is possible to send help in a determined case. However, long-duration exploratory missions such as on Mars will not have these attractive conditions. Crew members will be physically alone [16]. Due to the fact that it is very difficult to set up real missions of long-term space trips, most of the studies analyze several factors involve in simulations or short-term missions and treat to extrapolate to the situation of the long-duration space travel. Therefore, analogy is the key to understand this field of study and predict what could happen [17].

Accurately, the relevance of psychosocial issues in a long-duration expedition to Mars will be even higher than now. On this trip, psychological, cultural, personal, and psychiatric effects on the astronauts are expected to be obvious and present. The need for fostering this kind of reviews is logical due to the fact that there are a small number of studies related to long and far expeditions, while there is more information on near-Earth missions. There is paucity knowledge about how long-duration space missions might affect psychological issues among astronauts [3]. Unknown stressors are supposed to appear during long missions. Curiously, some scientists suggest that the effects will be both negative and positive [18].

3.1.1. Autonomy in space travels

Now, it is time to study how the rise of autonomy can influence on long-duration space missions in real situations. The concept of autonomy applied for space travel has also been studied carefully. So, there are several and evident differences between short and long missions. In the first case, crew has got rigid schedules and an individualized support by mission control. However, in the second case, free time takes on a greater role. Therefore, longer missions will lead to greater autonomy for the astronaut, without so many short deadlines [19].

Coming back to the mock mission in Mars for 105 days, during the first 10 weeks, the level of autonomy of the six men was low, while during the last 5 weeks, the level was higher. In the last situation, crews could plan their own work. Weekly, both mission control and crew members completed a battery of questionnaires about psychological issues. The results shed light on how

the autonomy conditions affect the mood and performance at both groups. During the period of high autonomy, the objectives of the mission were achieved, there were no negative effects, and mood was better. Nonetheless, the personnel of mission control lived the situations with more anxiety due to the uncertainty derived from unknowing exactly what crew members were going to do [14]. Obviously, the autonomy of future astronauts in long-duration missions is expected to be higher [19]. Meanwhile, social experiments in real situation like in ISS will be useful [14].

3.1.2. Monotony: the enemy at home

There is a serious problem in outer space: boredom [10]. Traditional space missions, due to the duration, have been very workload with little monotony. In contrast, long-duration space missions involve long period of time for spare time, leisure, and monotony [16].

The lack of meaningful activities evokes monotony which is harmful to psychological health. The way to avoid it is to modify the environment, leave time to practice meaningful activities, and invest time on cultivating an artificial garden to connect with the nature [10]. In conclusion, monotony and habitability must be studied, and the information derived from it must be used for designing better conditions and introducing countermeasures [16].

3.2. "Safe days"

Astronauts may suffer from uncertainty from space radiation exposure. During space missions, crew members are exposed to particles charged of energy which can penetrate inside the cells and modify DNA. This is related to an increased risk of cancer. For this reason, the knowledge of this fact is relevant not only for designing new protections against radiation (such as a double shield) but also for keeping a psychological balance during the mission. In this line, there is a concept used to express the period when levels of uncertainty and risk are considered acceptable: "safe days." It involves several difficult situations, not only those produced by radiation [20].

Initially, the estimation of safe days was up to 900–1200 days (by studying the solar activities which is the main source of radiation). However, the number of safe days seems to depend on the type of statistical analysis. Specifically, when up to 95% confidence levels are applied, the account of days is reduced until 300–400 days [20]. To get an idea of the time that astronauts are in space, it is necessary to resort to a review, according to which, already in 2014, there had been more than 300 space missions. If all the days that the astronauts have been in maneuvers were added, the number would ascend to more than 32,000 days. In addition, two thirds were by astronauts who were in the space more than 21 days [3]. So, the time of exposure to radiation was considerable. For all these facts, it is necessary to carry on with research on safe days to get a better and safe space flight [20].

4. Psychological variables associated to space travel

Psychological aspects must be taken into account in long-term missions to avoid negative effects [21]. Variables involve in a mission depend on the duration. So, short missions require

high physics and technical demanding, while long missions need people with a balanced mood since conflicts are more likely to occur [10].

Personality is one of the variables which is studied in the process of selection to become an astronaut [22]. The figure of the leader has also been analyzed. It seems that the way to manage and describe the role of the leader depends on the size of the crew. In consequence, in groups of two or three astronauts, each one is specialized in a field and assumes the leadership in their field. There is no exactly a typical leader. Besides, the relationships must be care because the cohesion is essential, overall by considering that the rest of humans are far. However, when the group is bigger, the social structure changes, and the traditional figure of leadership emerges [4].

Regarding the process of selection, social desirability has covered a great relevance due to the fact that the candidates may give a better image of themselves, and this affects the results of the tests [22]. On the other side, but within the recruitment, there is a meaning difference between a past negative psychology and a modern positive psychology about selection of astronaut. Specifically, people were selected for going out in space by prioritizing those skills aimed at achieving the mission though the astronaut could be less sociable. In this situation, it was important to select personnel with the ability to stay alone for a long time, with "excessive interpersonal intimacy." However, according to this author, a positive psychology orientation pays attention to other characteristics such as familiarity, ability to improvisation, how aspirant faces with social problems, camaraderie, and the sense of belonging to the group [23].

Once the relevance of considering the psychological variables in the astronaut selection process has been introduced, the main physical and psychological effects of space on the subject will be studied.

4.1. Physical and psychological effects of space

To understand the psychological variables is necessary to have a global vision of the situation. For this reason, not only the working time and activity of the crew have been studied but also their breaks [13]. So, astronauts suffer from some symptoms like the elderly. In addition, many symptoms are eventually mediated by stress, and reactions can appear such as depression, anxiety, or social withdrawal [10]. In another vein, there is no evidence of changing on visual space perception. Contrary to the previous ideas of the researchers, a long period of confinement (e.g., Mars-500 Project) does not cause significant changes in three-dimensional perception [24]. In another vein, as was stated in defining the concept of "safe days"[20], traveling to Mars requires to go out from the magnetic field of the Earth and make a long-duration trip in which crew will be expose to radiation [20]. Thus, it is primordial to reduce the risks to the brain during the missions [3].

Stress is another factor to consider. This cannot be considered wrong if it helps people develop new strategies and behaviors to adapt to the environment. Sometimes, living under extraordinary circumstances evokes the development of resilience and the establishment of a real and consistent social support network [10]. The own process of training can be stressful. Military has studied how to adapt to stressors in centrifuge training. The results show that there are

elements such as the lightproof cockpit which can be a source of stress. The power of the pedal design as a stressor was studied too. There is no doubt that ergonomics play a relevant role in order to generate stress [25]. Other psychological variables have been studied to know how stress affects performance. So, it is known that anxiety levels evoked by the exposition to G forces throughout a centrifuge acceleration which can interfere with the ability to finish the training. However, anxiousness response can be taught and learned by coaching [26]. Anyway, it is possible to teach coping strategies to face with personal and work problems by considering that they are depending on sociodemographic variables such as gender and the kind of job [27].

Sleep problems such as insomnia or a lack of sleep quality are also common among space travelers. They are caused by bad conditions and the own body: from interruptions, lack of privacy, noise, and social conflicts to circadian rhythms. The given solution is related to make an arrangement or try to foster the environmental conditions [10].

Concerning gravity, transitioning from a low-to-high state, can cause syncope due to the fact that the blood goes from the head to the feet. To combat this situation, it seems that a good idea is to stimulate the cardiovascular system through simple mental stressors. Thus, loss of consciousness or even syncope may be delayed giving margin to be able to ask for help and receive assistance. To analyze deeply the effect of mental stressors on cardiovascular system, an Aerobatic Single-Engine Cap-10B plane was used. It is a plane capable to replicate hyper- and hypogravity conditions throughout parabolic flights. The results showed that cardiovascular activity can be increased during the performance of stressful tasks that require a cognitive activation of the subject (e.g., mental calculation). Thanks to this, it is possible to rise and stimulate the cardiovascular activity and prevent blood from flowing out of the head sharply. This last study shows the importance of training astronauts to develop cognitive skills to use in space [28].

Radiation, less gravity, and the lack of feelings of risk are some limitations of the mock missions. However, there will be a common aspect between simulations and real conditions: the huge number of variables to measure. In consequence, the interference between different studies running simultaneously will be inevitable. In some occasions, there have been at least 90 protocols working at the same time [13].

Eventually, it is also possible to find positive effects from the space flight experience such as more self-confidence, better quality of relationships, spirituality, and a higher respect of nature and Earth [10]. In fact, the analysis of the oral histories of 97 astronauts showed more positive than negative results across flight phases (before, during, and after) [29].

4.2. Sex and gender

To succeed on space travels throughout human missions, sex and gender must be considered in the equation. There are different risks and effects of the space depending on the sex and gender. So, more cases of visual impairment on males after a space flight in comparison with female astronauts have been found. However, it is also true that the number of female astronauts in long-duration missions is rather minor. In another vein, orthostatic intolerance is

more common in females [30]. Moreover, differences regarding sex and safe days are found. So, the number of safe days for females was 300 and 400 days for males [20]. In the future, sex and gender variables will play an important role on personalized space medicine [30]. Researchers have made a resume of the main differences by sex and gender in several aspects (e.g., cardiovascular, immunologic, or behavioral adaptation to space flight) by finding the following data collected in **Table 1**.

4.3. Nationality and culture

Astronauts are considered different due to their nationality when they are in outer space. They feel that they are treated in a different way by depending on the nation instead of focusing on their abilities or personal factors. It is more usual when they are sharing a multicultural space in a mission, according to Suedfeld, Wilk, and Cassel (2011) (as cited in Ref. [10]). Differences can be observed even in the language used to refer the rest of coworkers. For example, when people are grouped by nationality, they create an in-group feeling and tell "us" for talking about themselves and "them" for the rest. Besides, relationships and contacts between ones and others are distant [31].

Cultural differences were also observed by comparing Europeans and Russians when the level of autonomy was increased. An interesting effect was that the Russians felt more work pressure in high-autonomy situation than the Europeans. So, the Russians reported a rise in work pressure regarding the European. On the contrary, the Europeans increased their negative dysphoric mood [14, 19]. It has also been found that differences between the motivations of astronauts belong to the National Aeronautics and Space Administration (NASA) and the Russian Federal Space Agency (FKA), being the first ones more motivated for the need for power [5].

Heterogeneity of the group can be a negative aspect for crew cohesion. In this line, a research in isolated situation was realized by analyzing variables such as culture and gender. The studied simulation was developed in hermetic chambers. The different groups in the study were composed of people (both male and female) from several places: Russia, Germany, Canada, Austria, and Japan. A conflict with physical force and some social incidents must be highlighted. The tensions between the groups caused the closure of the hatch so certain experiment had to be postponed at least for a month [31].

	Male astronauts	**Female astronauts**
They are more likely to	Suffer from hearing loss Suffer from calcium oxalate kidney stones Have visual impairment Have a worse immune response	Have a better immune response Suffer from struvite kidney stone Suffer from orthostatic intolerance Suffer from urinary tract infections
They are less likely to	Suffer from urinary tract infections	Suffer from hearing loss

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Table 1. Main differences between male and female astronauts (adapted from Ref. [30]).

From these results, it is derived that the cultural variables influence in some way in the perception of the subjects. Even the way to cope with problems and face with stress may be different depending on national characteristics. This may reflect different trainings and ways to operate between astronauts and cosmonauts [4]. Thanks to this kind of studies, it is possible to understand with more detail intergroup dynamics [31].

4.4. Workstation

Not only are there studies about astronauts. The mission control personnel is also an object of investigation. In this regard, less negative emotions and more vigor and innovation among crew members of the ISS than among ground control personnel have been found. The results may relate to different personalities depending on the job. Moreover, the own fact of staying at outer space may be a source of excitation [4]. In Mars 2013 study, a high motivation and less health problems were found in comparison with control mission [17]. Besides, during "Mars-500 Project," it was found that the conflicts between crew members and ground control personnel were five times more frequent than among people in confinement [13]. Taking up the issue of autonomy, when these levels increased for crew members and they could set goals and organize their timetable, it was lived positively by them. In fact, results showed a greater mood, creativity, and the achievement of the aims. However, ground control personnel lived the rise of the autonomy of the crew members with uncertainty and confusion [19].

The knowledge exposed is relevant for the selection, training, and teaching of countermeasures for future long-duration space exploration missions [13]. For all these reasons, it is necessary to enhance prosocial attitudes. In fact, empathy is strongly related to prosocial behavior [32]. The following will discuss what measures can be implemented.

5. Countermeasures to improve psychological balance among astronauts

A series of psychosocial countermeasures can be carried out to avoid or reduce the negative effects of ICEs such as spare time; hobbies, to modify the environment (light, temperature, etc…); sleep hygiene; autonomy over clothing or schedules, to encourage a culture of group; and funny activities [10]. These practical tips can be structured and used in different fields as it is set forth in **Table 2** [4].

The design of "bull sessions" to manage psychosocial problems in group to make up decisions and propose collective solutions is also recommended. Besides, it is strongly recommended to teach these social strategies since the beginning, before starting the trip. This kind of activities should be taught to all the members implied in the mission what involves both crew members and mission control personnel [4]. In another vein, it must be highlighted that there are an unbalanced number of male and female astronauts. In the face of future long-term missions, it will be paramount to introduce mixed crews to ensure multi-diversity. Other recommendations given by the same experts are to foster those studies with a perspective of gender, to take into account individual issues, and so on [30].

Aspect	Advices or countermeasures depending on different variables	
Selection	Crew members	Count on people with ability to solve social problems in a fast way, personal maturity, and psychological balance
	Commander	Leadership, ability to support the crew, and capacity to consider the psychological aspects of the crew (overall if they are from different nations and cultures)
Training	What to teach	How to manage social conflicts throughout "prelaunch psychosocial educational training"
	How to teach	Addressing the training for the crew and ground control personnel, where appropriate, all together
	Specific topics to train	Time effects, leadership, cultural issues, and crew members-mission control personnel relationship
	Goals	Detecting problems and fixing them (e.g., throughout the learning of problem-solving strategies)
Monitoring and support	What must both professions learn	To understand the problem of the other To know what stressors can be influencing on their coworkers to be able to see the other points of view (the knowledge about other tasks and jobs is required)
	How to do it	Giving the group time to interact each other and discuss and communicate ideas Throughout group dynamics Using a computer-based training during the mission
	When to do it	During prelaunch and mission
	Family	To encourage families to play an active role To help astronauts adapt the routine

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Table 2. Countermeasures to improve psychological issues among astronauts and increase mission probability of success (adapted from Ref. [4]).

Furthermore, having analyzed psychosocial variables in the Shuttle-Mir program, researchers expose a series of measures to consider. Concretely, they claim that a common language is essential, and it should be a requirement to be selected. Of course, the compatibility between the members of the crew should be looked for. All people should be trained in interpersonal conflicts, ways to support the rest, individual strategies and joint activities, how to manage spare time, how to discuss the play rolled by the family, and how to get the readaptation of the crew once they have come back home [21].

Recommendations will be useful for astronauts and future candidates for long missions in order to establish a Moon base or on Mars [33]. Disagreements and social problems are a reality in outer space. Fortunately, as it will be exposed in the next section, it is possible to prevent from conflicts throughout the training of social skills [34].

6. Aspects to include in an educational program on space travels

Once the main psychological issues related to space psychology and isolated situations have been treated, it is time to make a proposal of aspects to include in an educational program to develop social skills, emphasizing empathy, and to enhance the coexistence within crew members and between them and mission control personnel (see **Table 3**). The development of empathy is a way to improve social and functional behaviors [32]. The program has been designed under an educational perspective. Social abilities can be taught, and, for this reason, it is possible to train them.

To design educational programs, individual differences must be considered. For example, different levels of self-esteem have been found between men and women [35]. There are also differences in coping strategies [27]. As it can be seen in **Table 3**, there are two main goals. Concerning specific goals (by receiver) are to understand other viewpoints (all), to respect other cultures (all), to know a protocol to act in case of conflict (crew and control), to use a minimum of social skills to ensure coexistence (crew and control), and to support relatives and help them solve social problems (families).

Regarding aspects to train, a key concept to develop is creativity since this ability is involved in the process of solving problems [36]. Another relevant content is life satisfaction. It seems to exist a relationship between social problem solving and life satisfaction. Concretely, it has been found that life satisfaction is an antecedent of social problem solving. So, it is logical to conclude that if one is improved, the other will get better. For this reason, both concepts must be considered to include it within future prevention and intervention of educational programs [37]. In another vein, topics such as decision making and awareness are also relevant to future Mars travels [2]. Besides, it must be highlighted that the group dynamics are involved in all the phases and practically among the different collective professionals (see **Table 4**). Depending on the moment, it is possible to propose a series of activities to get the goals of the program.

Concerning the activities, online discussion can be used for encouraging people to interact with each other [38]. This aspect is more important during the mission. Regarding technological resources, digital storytelling (DST) is a method which can be useful for fostering relationships and assimilation of norms and culture [39]. Mobile technology has been successfully used for teaching behavioral skills [40]. Besides, in the educational field, discussion activities by using images have been very useful for developing leadership, confidence, self-control, problem-solving skills, and emotional intelligence [41]. It would not be difficult to extrapolate this methodology to space psychology. In addition, the application of a language protocol for using very specific conflicts could avoid misunderstanding.

Programs should set up not only before the mission but also during the travel to resolve social problems and avoid conflicts [13]. It has been showed on research that the motivation of the astronaut can change at three stages of their expedition, finding differences from preflight to in-flight stages [5]. For this reason, the application of different group dynamics depending on the phase (including the post-flight and readaptation) is essential [33]. The other aspect to

Main points	Development	
Need analysis	Social conflicts can cause the failure of the mission or hinder the correct relationships among coworkers	
Receiver	Crew members, mission control personnel, and families of astronauts	
Goal and specific goals	• To prevent from conflicts between all the agents involved • To intervene when the problem takes place	
Content or topics	Empathy, coexistence, creativity, prosocial behavior, problem-solving, leadership, viewpoints, relaxing techniques, proactive and retroactive strategies, social skills, self-esteem, self-concept, assertiveness, coping strategies, spare time, life satisfaction, decision-making, awareness emotion, and performance	
Activities	Personal interviews, monitoring, peer tutoring, working in small groups (e.g., size like the crew), working in big groups, and so on (see **Table 4**)	
Methodology	Human resources	Expert in space and educational issues
	Material and technological resources	Tests completed either on paper or digitally. The second type is essentially important during the mission to save space to carry out
	Temporalization	Prelaunch, during the mission and post-mission
	Physical space	Prelaunch and post-mission on Earth
	Grouping	Initial group explanation
Evaluation	Initial	Pretest to draw a baseline
	Continuous assessment	During all the program by adjusting, especially in the mission situation, during the trip itself, where unforeseen conflicts may arise
	Final	Posttest, tracing and monitoring

Table 3. Structure of a proposal of program for developing empathy and coexistence on space travels.

consider is the arousal. The ability to feel relaxed is critical to face with social problems and conflicts [34]. Astronauts must learn how to increase their activity and when to decrease it by looking for the optimum operating point.

It is important to create a feeling of group. Astronauts can develop a feeling of "intragroup" and "out-group" during the mission and feel displacement as a defensive mechanism to face with dysphoria. Concretely, they can consider that they do not have enough support from people outside of the group [4]. These feelings must be detected and worked. Finally, regarding the abilities of the trainer, the development of empathy of the expert with people who will be taught is essential to make the relationship work. So, it will be easier to teach them healthy strategies and skills [42].

Phase	Activities
Prelaunch	Role playing, discussion groups, brainstorming, change of roles (crew members-control mission personnel), emotional recognition dynamics, digital storytelling, case study, social problem-solving games, and discussion of dilemmas
During the mission	Monitoring, peer tutoring, discussion groups, online discussions, change of roles (within crew members), rotational leadership, boredom prevention, setting an ephemeris—to create a common culture, mediation, and protocol of interaction and to create the figure of justice of peace
Post-mission	Strategies for readaptation, new routines, and feedback activities

Table 4. Activities depending on the phase of the mission.

7. Conclusion

In this chapter, the implications of the concept of empathy on isolated situations and the main psychological variables involve in the space travel have been analyzed. Besides, countermeasures have also been proposed. Finally, a proposal has been made to design educational programs for training empathy and other psychological aspects. It has been seen that empathy is a key aspect of the human space flight, and due to the negative consequences that can cause its absence, it is necessary to improve it. Common goals and culture should also be fostered [31].

The space race must be seen as a whole, including both technical and psychosocial aspects [2]. It is about a gear where everything must be embedded, a synergetic system where its elements are interconnected: crew members, control mission personnel, families, government, space agencies, economy of the country, political issues, etc. Social aspects are also involved. Society must want to go further. So, when the Apollo program was developed, there was a determined social context [6]. Maybe, a new space age is beginning. The humanity seems to want to go to Mars, the number of documentaries and research increases, private enterprise is also interested, and there are various projects for the next years.

Regarding the new challenges in the near future, the longer the mission lasts, the more problems arise [11]. And, there is no doubt that space agencies (e.g., NASA, European Space Agency (ESA), FKA, Japan Aerospace Exploration Agency (JAXA), and Chinese National Space Administration (CNSA), among others) are worried about the astronauts' health, and they keep them as healthy as possible. The solution to improve security will go through a multiaxial approach [2]. Maybe, when establishing the first permanent colonies on the Moon or on Mars, strong feelings of inbreeding may arise. The way to manage these feelings and the relationship that are maintained, within the *extraterrestrial* groups and between them and the Earth, will be key to maintain the commercial and peace relations. All this must be worked from the beginning, laying the foundations of appropriate social relations. The larger the

crew, the more complex the relationships will be, becoming a microcosm, that is, a reduced scale society where coexistence is equal to survival. This reflection can be useful for both future public (e.g., NASA or ESA) and private (SpaceX) initiatives. Certainly, this will be a new area of educational intervention. Moreover, the inclusion in the educational system of concepts such as space travel and coexistence in isolated situations may be a reality in the future. For that, the design of a curriculum for students or a concrete subject would help the youngest assimilate space concepts, as a previous training, from early ages.

Concerning limitations, this article is a literature review. Therefore, the conclusions are based on the theoretical level. In another vein, one implicit goal of this chapter is to foster the collaboration with practitioner and researcher of aeronautics and space fields. A multidisciplinary approach is the key to the advancement of science. My specialty's education (including social skills, the field of behavior, and coping strategies) is contributed to develop in this new academic area, and this article is sprout and pathbreaking review in such area. It must be assumed that there are principles in learning that are common so that each area of knowledge can and should contribute its grain of sand.

To conclude, further research is needed to understand how empathy works [32]. Aerospace psychology can benefit from information from other branches of psychology such as education to train the crew. A mission can be affected by the lack of social skills. Human error may lead to a cancelation of the mission, loss of human lives, high economic costs, etc. For this, future mission should consider these factors in the selection. In another vein, the number of articles based on the chosen issue is low so that it is necessary to encourage scientific community to depth on this point. Therefore, educational programs to encourage candidates to improve their competences, by considering both gender and nationality, will be required. These programs will be able to set up not only before the mission but also during the travel to resolve social problems and avoid conflicts.

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