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On Orbit and Beyond: Psychological Perspectives on Human Spaceflight. Douglas A. Vakoch (Editor). New York: Springer. 2013, 317 pages, $129.00 hardcover.

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Well into its sixth decade, people still wonder what achievements await the Space Age. The popular next choice would be a manned mission to Mars. According to a recent poll, 75 percent of those Americans surveyed agreed that the National Aeronautics and Space Administration's (NASA) budget should be substantially increased in order to fund this endeavor (Koebler, 2013). A mission to Mars, though, will test the physical and mental endurance of astronauts. Accordingly, the psychological aspects of space travel will loom larger as astronauts spend more time with one another with greater autonomy from Mission Control. In an edited volume — *On Orbit and Beyond: Psychological Perspectives on Human Spaceflight* — Douglas A. Vakoch, Professor of Clinical Psychology at the California Institute of Integral Studies and also the Director of Interstellar Message Composition at the SETI Institute, assembles a collection of essays written by a number of leading experts in the field of space psychology.

From its inception, psychological screening played an important role in the American space program. In the chapter "Behavioral Health," Albert A. Harrison and Edna R. Fiedler provide an overview of the history of psychological screening in the space program. As they explain, early astronauts were chosen for their "right stuff." Initially, NASA intended to recruit astronauts from a wide variety of backgrounds including military and commercial aviators, mountain climbers, polar explorers, and deep sea submersible operators, but with strong pressure from the White House, the candidate pool was limited to military test pilots who had already demonstrated their skills and temerity (p. 13). Intelligence, motivation, fitness, good decision-making skills, high tolerance for stress, emotional maturity, and the ability to work with others were the necessary traits for the demanding job of an astronaut.

But as the American space program progressed, interest in psychology waned. After five Mercury flights without serious performance deficits, NASA officials decided that there was no pressing need to continue exhaustive psychological testing procedures. Inasmuch as NASA managers were preoccupied with the scientific and engineering facets of spaceflight, behavioral health received short shrift. Therefore, psychiatrists and psychologists played only a minimal role in the selection process of astronauts

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from Gemini until well into the early Shuttle missions (pp. 13–14). The faintest possibility that a space mission would be compromised by psychological factors could be a public relations disaster for NASA (p. 7). The stereotype of the right stuff deterred snooping and prying that might suggest a real or imagined blemish that could lead to mission disqualification — a most dreaded result for an astronaut. Even the American press was loath to report negatively on any aspects of the lives of astronauts. Rather, the media sought confirmation that the astronauts embodied America's deepest virtues.

By the start of the twenty-first century, however, cracks began to appear in this image. Research suggested that astronauts suffered from a number of maladies as a result of their missions. Harrison and Fiedler found some astronauts reported depression, substance abuse problems, marital discord, and jealousy after completion of their missions (pp. 8–9). Psychological issues could no longer be ignored. Not only could unresolved mental problems jeopardize space missions, they could result in a public relations disaster. Inasmuch as NASA funding depends in large part on public perceptions, the space agency could not risk such an eventuality. Several developments rekindled interest in space psychology. The first missions into space were of short duration, lasting only hours or days, and the crews were small. But since the end of the Apollo program, the trend has been in the direction of larger crew sizes, greater crew diversity, and longer mission duration. Concern over psycho-social adaptation was heightened in the mid-1990s when astronauts joined cosmonauts on the Russian space station *Mir*. For that reason, cross-cultural issues have become more salient (p. xxviii). Current estimates suggest that a round trip mission to Mars along with a scientific expedition would take roughly two and a half years. To date, astronauts have not experienced missions of such long duration. Two particular factors that will compound an astronaut's stress are the deprivations of living in a confined environment and the inability to escape it.

Due to the infrequency of space flights, researchers have looked for alternative ways to study the psychological implications of long duration missions. Although there have been only limited opportunities to study astronauts in space, as Sheryl L. Bishop notes in her chapter "From Earth Analogues to Space: Learning How to Boldly Go," there are ample opportunities to study people in environments that resemble that of space. By studying these analog substitutes, researchers found good examples of exploration that exposed human frailties and group failures (pp. 25–50). Examples included long-duration missions to severe, remote areas, such as Antarctica. Though these settings were quite different than the near zero gravity environment of space, people who worked in them had to deal with stressful situations that might give insights that could be applicable to space crews. Historical exploratory expeditions were typically of long duration and involved many unknown risks. Because of the uncertainty, there was often a high degree of situational decision-making. Studying individuals in analog environments has taken two basic approaches. One involves constructing an environment within a laboratory setting with maximum control over exogenous variables and utilizing research subjects. To that end, several space-analogous settings have been created including the NEEMO underwater habitat located new Key Largo, Florida, the Haughton–Mars project on Devon Island in Canada, and the Mars500 simulation at the Institute for Biomedical Problems in Moscow (p. 27). The second approach examines in situ groups in real environments. For example, studies of submarine crews were thought to be applicable to spacefarers insofar as submariners operated in tightly-confined environments for missions of long duration (p. 40).

For long-term missions, temporality may affect an astronaut's psychological well-being. Some reports suggest that crewmembers in space and analogue environments

experience psychological and interpersonal difficulties at the start of the third quarter of a mission. According to this view, the relief that the mission is half over is overcome by the realization that the second half is yet to come. To test this hypothesis, Nick Kanas and his colleagues conducted two large international on-orbit studies involving crew and Mission Control personnel during a series of missions to the Russian *Mir* Space Station and the International Space Station; however, as they explain in their chapter "Psychology and Culture During Long-Duration Space Missions," they found no evidence to support the "third quarter" thesis. Actually, there was significantly greater mood disturbance and more tension during the first half of the mission than during the second. One explanation for this is the fact that crewmembers were supported by space psychologists and flight surgeons in Mission Control that employed a number of countermeasures to help the astronauts deal with stress and monotony as the mission progressed. Cohesion scores, however, dropped significantly during the last third of seclusion (pp. 153–184).

As the composition of space crews become more heterogeneous, more opportunities for interpersonal issues arise. Interpersonal difficulties can lead to increased depression, irritability, and homesickness. The problems can in turn foster territorial behavior and a reduction in group cohesion. Kanas and his colleagues identified a number of issues that might interfere with crew cohesion: (1) crew tension resulting from environmental stress and factors related to crew heterogeneity, (2) temporal-related drops in cohesion, most notably during the second half of the mission, (3) poor leadership skills, and (4) stress due to cultural and language differences (p. 174).

Despite all of the associated pitfalls, living in isolated and confined environments can also have growth-enhancing effects. For instance, the experience of people working in polar environments suggests that prolonged space travel could actually increase fortitude, perseverance, self-reliance, ingenuity, camaraderie and even decreased tension and depression (p. 162). Paradoxically, Palinkas (2003) found that a depressed mood was inversely associated with the severity of station environments — that is, the better the environment, the worse the depression. For example, in Antarctica, the winter-over experience was associated with reduced rates of hospital admissions (p. 42). Palinkas speculated that the experience of adapting to isolation and confinement may actually improve an individual's self-efficacy and self-reliance thus engendering coping skills that could be applied to other areas of life to counteract stress.

According to the research of Jason P. Kring and Megan A. Kaminski, evidence from space flights, and also from analogous settings such as Antarctica and submarines, suggests that the size of the crew has a major impact on its members. Large crews possess several advantages over smaller ones, for instance, a greater range of skills and abilities, as well as presenting opportunities for forming friendships and creating a more interesting social experience. Moreover, members of larger crews appear to get along better, exhibit less hostility, are more stable, and make better and more efficient decisions (p. 125).

In her research on astronauts aboard space stations, Phyllis J. Johnson notes that over time, crewmembers began to identify the space station as their home; nevertheless, they also wanted reminders of their home on Earth. For her chapter "The Roles of NASA, U.S. Astronauts, and Their Families in Long-Duration Missions," she reviewed autobiographical documents and discovered ways in which astronauts maintained some semblance of their lives on Earth. Engaging in a variety of activities, including reading, watching videos, and exercise, made the experience on the space station more bearable. Birthdays of the crew and their friends on Earth were celebrated along with various holidays and important landmarks in the history of space exploration. The opportunity to talk with their families was very important for crewmem-

bers. In recent years, astronauts have used platforms such as Facebook and Twitter to stay in contact with family, friends, and the public (p. 18). Exercise was important to maintain both mental and physical wellbeing. According to Johnson, looking out the window of the spacecraft was mentioned as the most favorite leisure activity for astronauts. Crewmembers enjoyed noting the locations of their homes and other personally relevant places on Earth. Likewise, in the chapter "Patterns in Crew-Initiated Photography of Earth from the ISS: Is Earth Observation a Salutogenic Experience?," Julie A. Robinson and her colleagues describe how observing the Earth from space can help support the health and wellbeing of the crewmembers (pp. 51–68). Because viewing Earth is a positive experience for space crews, the "Earth-out-of-view" problem could arise with astronauts on long-distance missions, such as a trip to Mars, in which the home planet will be reduced to an insignificant-looking dot in space (p. 156).

Initially, the astronaut corps was comprised almost exclusively of male military pilots; however, over the years, there has been increasing representation of different professions and a greater number of women and ethnic and racial minorities. Even before *Apollo* astronauts stepped foot on the Moon there was political pressure to increase the diversity of the astronaut corps by including women as well as representatives of different racial and ethnic groups. Nonetheless, President John F. Kennedy's admonition to place a man on the Moon before the end of the decade was interpreted by NASA to mean that the agency could not divert resources to sending women into orbit (p. 16). In their chapter "Gender Composition and Crew Cohesion During Long-Duration Space Missions," Jason P. Kring and Megan A. Kaminski examine the effect of gender on social interaction and interpersonal cohesion of crewmembers. Their research suggests that men and women carry out work in slightly different ways. In some contexts, all-male teams make less accurate and more overly aggressive decisions than mixed-gender teams. Unique contributions from each gender often improve team performance in settings such as health care, manufacturing, and extreme environments. These findings support the use of mixed-gender teams (pp. 123–124).

The Space Age commenced as a rivalry between the two superpowers, but since the end of the cold war, crewed flights have transitioned from fiercely competitive national space programs to collaborative efforts with international crews. Despite national rivalries, the quest for knowledge at times motivated the cold war enemies to work together in space exploration. Over time, space exploration took on a more multinational character, as both the United States and the Soviet Union included crewmembers from their respective allies, and eventually, from each other, in their missions. As Peter Suedfeld, Kasia E. Wilk, and Lindi Cassel point out in their chapter "Flying with Strangers: Postmission Reflections of Multinational Space Crews," at first, the inclusion of international crewmembers was primarily a propaganda move. Both superpowers offered room and board in the space capsules to citizens of their respective blocs. The foreign spacefarers were granted only limited access to their host's spacecraft. In 1984, President Ronald Reagan approved the development of another U.S. space station to replace the *Skylab*, but its construction was delayed for almost fifteen years, when in 1998 President Bill Clinton finally decided to cast the project as a truly worldwide venture which became the International Space Station. This change in orientation has led to more inclusive crews representing a greater number of nations. International crewmembers bring with them different cultures that can impact interpersonal relations. For example, studies suggest that whereas Russian culture values collectivism, hierarchy, and paternalism, American cultural values favor individualism, egalitarianism, and autonomy. In order to minimize misunderstanding that could arise from the interaction of different cultures, Suedfeld

and her colleagues recommend that both crew members and ground staff take in situ language training and familiarization in each other's countries (pp. 185–209).

In their chapter, "Cross-Cultural and Spaceflight Psychology: Arenas for Synergistic Research," Juris G. Draguns and Albert A. Harrison make the case that international flights make good sense for a variety of reasons. First, drawing from an international pool allows space managers to select astronauts from a broad range of interests and skills. Second, inasmuch as space missions are overarching and superordinate endeavors that encourage nations to work together, they could serve as a prototype for other collaborative ventures. Third, the more nations that participate in a mission, the greater the number of people that can identify (if only vicariously) with the challenge and triumphs of spaceflight. Finally, international missions can reduce duplication of effort, thus defraying the enormous costs of spaceflight (pp. 211–228).

As more nations work collaboratively in space, it is imperative that their astronauts overcome cultural differences. Although subjective culture is implicitly known to its members, its knowledge is rarely overtly articulated. Draguns and Harrison advocate using a culture assimilator to build cross-cultural awareness and sensitivity. Developed by F.E. Fiedler, T. Mitchell, and H.C. Triandis, this program consists of 100 to 200 scenarios in which people from two cultures interact. Each scenario is followed by four or five explanations of why the member of the culture acted in a specific way. The trainee then selects one of the explanations and is asked to turn a page (or go to the next computer screen), where feedback is provided concerning the chosen explanation. Over time, the trainees tend to become more specific and complex and less ethnocentric in their attributions in the exercise. Furthermore, they become better at predicting what members of the target culture will do. As a result, a great deal of anticipatory cultural learning takes place in a short time. As the composition of space crews becomes more diverse, Draguns and Harrison argue that this training could be useful to instill a greater awareness of sensitivity to different cultures. Moreover, they argue that cultural assimilators could be applied not only in international situations, but also to different levels within organizations. For instance, the training could help bridge the gap between different occupations within NASA.

The experiences of astronauts on both the *Mir* Space Station and the International Space Station have demonstrated that crews from a variety of national and ethnic groups can work effectively together. But as Harvey Wichman notes in his chapter "Near-Term Extended Solar System Exploration," to date, these missions have taken place in quasi-military structures. However, we are now on the cusp of a new age of space flight that will allow tourists to visit space. In fact, Bigelow Aerospace in Las Vegas has successfully launched two inflatable habitats that orbit the Earth. The firm intends to someday lease the station for research, industrial testing, and space tourism. Along with the high purchase prices for their space vacations, tourists will expect commensurate services. Space tourism will vastly broaden the spectrum of participants in the space program. This historic shift in space exploration will occasion a reconsideration in the way engineers, designers, and flight managers approach their tasks. Drawing upon the results of a simulation designed to mimic a single-stage orbit rocket, Wichman found that not only could minimally trained civilians tolerate the extreme environment of a space simulator, they could also find the experience very pleasing. As a result, Wichman is sanguine about the prospects of the fledging space tourism industry (pp. 267–280). Rather than emphasizing selection criteria that would restrict the number of prospective tourists, Wichman argues in his other chapter "Managing Negative Interactions in Space Crews: The Role of Simulator Research," that the space program should focus on environmental design and training so that the

prospective pool of spacefarers could be broadened. The primary tool for this effort, he proposes, is the spaceflight simulator (pp. 107–122).

For better or for worse, as spacefarers travel farther and farther from Earth, they will work under conditions of greater autonomy from Mission Control. Communications between the crew and ground control will become increasingly delayed. Depending upon where the planets are in their respective orbits, the time required for round-trip electronic transmissions between Earth and Mars would range from six to forty-four minutes (p. 246). Astronauts en route to Mars will not be able to rely upon automated life-support systems or short-term rescue possibilities in the case of emergencies. Consequently, autonomy will increase.

Greater autonomy could lead to possible breakdowns in interpersonal interactions both within the crew and with Mission Control. There is a danger that crewmembers may increasingly view ground personnel as an out-group, thus leading to mutual tension and misunderstanding. On occasion, conflicts have emerged between the flight crew and the ground control, leading to displacement. Displacement occurs when people cannot express emotion to those who are the source of the anger, for example, a boss for fear of retaliation. Instead, the aggrieved person takes his frustration out on safer targets — for example, his spouse or children — who are innocent victims of the anger (p. 94). Typically, anger wants an outlet — and a target — and the astronaut has three from which to choose. First, astronauts can vent their anger at another crewmate, but usually try not to do so because it would make a bad situation even worse. They are stuck with each other and they obviously cannot walk out of the mission. Second, a crewmember can direct his frustration inward, resulting in possible depression (Roach, 2010). Finally, crewmembers can displace their frustration at Mission Control. To mitigate displacement effects, in his chapter "Human Interactions On-orbit," Nick Kanas recommends periodic "bull sessions" whereby crewmembers and Mission Control can address issues before they begin to fester (pp. 93–106). He counsels that it is important to deal effectively with tensions that are sure to arise in the stressful environment of space. Group sensitivity training involving both crew and ground personnel could reduce the influence of personal, cultural, national, and other peculiarities during the mission.

Increased autonomy can also have some positive effects. Nick Kanas and his research team examine this issue in the chapter "High Versus Low Crewmember Autonomy in Space Simulation Environments." Exploring pilot studies from numerous space-analogous settings, they found that greater autonomy was associated with increased creativity, improved performance, and higher mood and morale (pp. 231–244). Likewise, in their chapter "Effects of Autonomous Mission Management on Crew Performance, Behavior, and Physiology: Insights from Ground-Based Experiments," Peter G. Roma and his colleagues concluded that greater autonomy was associated with enhanced performance and fewer negative emotional states (pp. 245–266).

Some space psychologists, however, fear that the more autonomous structure of extended missions could lead to groupthink, that is, a situation of greater conformity and reluctance to express concerns or disagreements about decisions. This could have serious implications for a manned mission to Mars insofar as the crew will experience high autonomy and interdependence. To be sure, a consensus of values can enhance team performance and make for harmonious personal interactions during space missions; however, the complete removal of interpersonal tensions may not be desirable. In their chapter "The Risk for Groupthink During Long-Duration Space Missions: Results from a 105-Day Confinement Study," Gro Mjeldheim Sandal, Hege H. Bye, and Fons J.R. van de Vijver examined how personal values change over the course of mission

simulations. For their analysis, they examined the Mars 105-day confinement study, which was conducted at the Institute of Biomedical Problems in Moscow in 2009. Counter-intuitively, they concluded that rather than converging, differences in values among crew members actually increased over time. Furthermore, there were greater tensions arising from value conflict at the end, rather than the beginning, of the mission. These findings suggest that rather than converging toward conformity, crewmembers actually began to drift apart in their thinking (pp. 135–149).

New breakthroughs in nanotechnology and computers could someday enable long-range space missions including a round trip to Saturn and its moon Titan. But several perils will face those astronauts who embark on long-duration missions. For instance, astronauts would encounter increased levels of cosmic radiation. They could not rely on the Earth's Van Allen Radiation Belts for protection. Inasmuch as humans have evolved for life on Earth, living in space is very difficult. Initially, weightlessness can be an exhilarating experience; however, the novelty quickly wears off. Furthermore, living in a zero gravity environment can have serious health consequences including the deterioration in muscle and body mass. The lack of the usual gravitational force in space can also affect brain mechanisms (p. 169). Currently, the practical limit on weightlessness has been six months. One method to facilitate long-duration space travel would be to produce centrifuge gravity in the space vessel. This method was used in the rotating spaceship that was featured in the film *2001: A Space Odyssey*. According to Robert Zubrin (2008), a 1,500-meter-long tether could be used to connect a space vessel with a small rocket. Once in space, firing the rocket would cause the system to rotate. He estimates that even a slow rotation rate of 2.6 RPM (rotations per minute) would produce artificial gravity about equal to that on Earth (p. 274).

In his chapter "Near-Term Extended Solar System Exploration," Harvey Wichman argues that there are advantages to returning to the Moon, as that could serve as an important step toward exploratory missions to Mars and future missions to asteroids. Returning to the Moon would be a suitable way to test equipment that will be used for a mission to Mars. Using the analogy of the settlement of the American West, Wichman notes that the frontier was initially opened up by intrepid explorers. They were followed by trappers and hunters who found ways to exploit the resources of the new land. Next, settlements were established, which ultimately turned into permanent communities (pp. 267–283).

In the chapter "From Earth's Orbit to the Outer Planets and Beyond: Psychological Issues in Space," Nick Kanas discusses the mental health implications for extended and multigenerational missions. The first mission to Mars will likely involve a crew of six or seven astronauts. Using current technology, a roundtrip to Mars would require twenty-four months. With six months on station, the journey would take thirty months. A roundtrip to Saturn without any time on a station would take fourteen years. This will create a situation in which crewmembers experience an acute sense of isolation and separation from Earth. The crew will have only infrequent supplies and it will be impossible to evacuate to Earth for emergencies (p. 286). For such long trips, individuals might be reluctant to apply because of the terrestrial opportunities they would have to forgo. For example, a forty-year old astronaut on a mission to the planet Saturn would be well into her fifties when she returned. Children would have grown up with family members and friends, perhaps dying in the interval. For interstellar travel, an astronaut might be kept in some form of suspended animation. But if she would ever return to Earth, all of her family and friends would be dead. How could the person be reintegrated after such a long time away from Earth (p. 291)?

One way out of this conundrum would be for whole communities to travel together in space. Several scientists including Gerard Kitchen O'Neill, Freeman Dyson, and

Isaac Asimov have speculated that giant self-contained generation ships might be used someday to travel across the galaxy (Asimov, 1979). As Kanas points out, the psychological impact of a permanent divorce from the home planet is unclear. To be sure, the effects on the first generation of colonists would be profound, as the crew would vividly remember life on Earth. For subsequent generations, though, their total existence and reference point would be the generation ship. Images and stories of Earth would be preserved, perhaps forming the subject of future lore as the colony evolved over time (p. 293).

Inasmuch as space missions will continue to change, there will always be a need for more research and new operational procedures. With new advances in technology, astronauts will be able to monitor their own behavior, thus reducing the threat that performance lapses could lead to flight disqualification. Such self-monitoring has been achieved by means of computers and personal digital assistants that are designed to measure several dimensions of cognitive functioning (e.g., attention, processing, and recall) [p. 20]. New technology will surely lead to new human–machine partnerships. In fact, with advances in artificial intelligence, it might soon be possible to send androids into space. In his 2005 book, *The Singularity Is Near: When Humans Transcend Biology*, the noted futurist Ray Kurzweil predicted that by the year 2042 computers will become self-aware and greatly exceed humans in intelligence. From the perspective of space engineers, sending robots might seem more feasible than sending humans as the former require no water, oxygen, or food supply. Moreover, there is no need to worry about interpersonal issues that might arise with a human crew. With their physical limitations and short life spans, assigning human astronauts to deep space missions might seem increasingly quixotic when more able androids are up to the task. If Kurzweil's singularity does indeed lie ahead in the near future, then it might be more practical to send intelligent machines on the first long-range space missions to Mars and beyond. Be that as it may, nothing excites the human mind more than to know that flesh and blood people are exploring the cosmos.

References

Asimov, I. (1979). *Extraterrestrial civilizations*. New York: Crown Publishers.

Koebler, J. (2013, February 11). Poll: Americans overwhelmingly support manned mars mission. *U.S. News and World Report*, February 11, 2013, http://www.usnews.com/news/articles/2013/02/11/poll-americans-overwhelmingly-support-manned-mars-mission.

Kurzweil, R. (2005). *The singularity is near: When humans transcend biology*. New York: Penguin Books.

Palinkas, L.A. (2003). On the ICE: Individual and group adaptation in Antarctica. http://www.ssc-net.ucla.edu/anthro/bec/papers/Palinkas_On_The_Ice.pdf.

Roach, M. (2010). *Packing for Mars: The curious science of life in the void.* New York: W.W. Norton.

Zubrin, R. (2008). How to live on Mars: A trusty guidebook to surviving and thriving on the red planet. New York: Three Rivers Press.