Editorial

Human Element in Long-Duration Spaceflight Introduction

John M. Nicholas
Loyola University of Chicago, Chicago, Illinois 60611

FREQUENT followers of the *Journal of Spacecraft and Rockets* will recognize the theme of this section as a departure from the normal bill of fare. As the title "Human Element in Long-Duration Spaceflight" implies, the focus here is on one of the major elements of manned space missions, the crew, the purpose to give readers an appreciation of the behavioral issues of spaceflight, especially the long-duration missions of the future. Crews are just one element in space systems, but they are a crucial element; it is important that designers and engineers be aware of the salient issues that surround crew behavior and performance.

In the past, many space planners simply dismissed crew behavior as something not worth spending too much time worrying about. After all, the astronauts were highly trained and extremely capable people—the best and the brightest, most of whom were former test pilots accustomed to facing death on a regular basis; being an astronaut was simply an extension of this former role. It called for additional training and a zealous, singular devotion to the cause, but the ultimate experience of getting into orbit or to the moon was well worth the price. It did not matter who you flew with or even if you liked the person, as long as you flew. As Michael Collins wrote about being assigned to Gemini 10, "I would have flown by myself or with a Kangaroo . . . All that stuff about psychological compatibility is crap. Almost anyone can put up with almost anyone else for a clearly defined period of time in pursuit of a mutual objective important to each."[1] This largely reflected the attitude of most people during the Apollo era and up to the present. After all, high motivation and intensive training can get people through the greatest hardships, especially when the hardship is short-lived and the end is in close reach.

On all previous U.S. spaceflights, including the Shuttle, the end has always been in close reach. Aside from Skylab, every manned mission has lasted only a week or so; during such a short time almost anybody can work and get along with anybody else. There is little need to be concerned about thoughts, feelings, or emotions.

But with future missions—Space Station Freedom, lunar and Mars expeditions—we have to start questioning whether the same modus operandi will be effective over, say, periods of months or years, instead of just days. What will happen to motivation and coordination when there is no immediate sense of urgency? And what about people's social needs, or the effect of day-in, day-out interaction with people you can never get away from? These begin to look like matters worth serious pause. I find it interesting, and a little instructive, that the people who disregard crew "behavioral problems" as so much nonsense either have never flown in space, or have flown only a little, whereas the more experienced spacefarers—the "long-timers" like the Skylab astronauts and the Salyut and Mir cosmonauts—make frequent mention about the role of compatibility and interpersonal behavior. Nineteen years after Apollo 11, Michael Collins' reflections are a little different too. He suggests two cardinal rules for relieving tension in space: "Don't sweat the small stuff," and "It's all small stuff." Says he, "A trip to the moon, an 8-day round-trip, doesn't present much [of a problem]. But how about far out, where the planets and our solar system beckon? There things will get rough indeed, and a group of travelers are going to have to be selected and trained with the greatest of care. 'Group dynamics' will no longer be psycho-babble, but a *matter of life and death*"[2] (my emphasis).

The following articles cover the gamut of human behavioral issues in extended spaceflight. They include issues with ramifications for planning and design decisions such as crew size and composition, crew selection and training, work task design, crew leadership, vehicle habitat design, ground-crew relationships, and crew support. Though the primary goal in addressing these issues is to optimize crew effectiveness and productivity, there is also concern about the crew's mental and physical health, safety, and overall well-being.

The articles have been arranged in order of general coverage to specific coverage, beginning with overall issues, research findings, and implications, and finishing with more specific topics and plans for addressing the issues.

The first article, by Nicholas and Foushee, considers the current state of space-related research in behavioral science, focusing on factors that affect group performance. As it explains, a group's performance depends on more than just the skills of the people in it. The research indicates a variety of factors that influence performance, including crew status, crew leadership, group norms, and crew selection and training. Evidence is cited about disparate groups such as Polar expeditionary parties, submariners, combat units, and air transport crews.

The environment of spaceflight is rife with psychological, psychiatric, and interpersonal stressors. The article by Kanas reviews the research to-date on stressors relevant in long-duration spaceflight. Most evidence about stress and its behavioral effects in spaceflight is derived from research conducted in space-like environments called "space analogs"; Kanas reviews these environments, summarizes the issues, and presents the findings of the last 30 years' research.

The article by Penwell focuses on *intergroup* behavior, which is what happens when two or more groups interact. Spaceflight always involves at least two groups: at minimum, the crew at mission control and the crew in space. Their ability to get along and communicate can dramatically affect the mission outcomes, as demonstrated by Apollo 13 and by the astronaut "strike" on Skylab IV. On future missions, the evolution of subgroups within a crew and the rotation of relief crews (e.g., at space station and lunar bases) will increase the impact of intergroup dynamics on mission outcomes.

One of the best sources of scientific data about small groups in isolation and confinement (and a good place to learn what it might be like to be cooped up on a trip to Mars) is Antarctica. Palinkas has made several trips to Antarctica to study psychosocial effects and has drawn conclusions about planning for long-duration spaceflight. Based upon his findings he offers suggestions regarding crew selection, training, leadership, organization, and support infrastructure.

Crew behavior, productivity, and psychosocial well-being are largely influenced by the environment. The spacecraft itself is a major part of this environment; it is the inhabitants' whole world—where they work, rest, and recreate. Thus, it must not only be able to propel the crew to their destination and back, it must facilitate their work, be "livable," and be able to sustain the crew for the duration of the mission. Harrison and Connors review the myriad considerations of spacecraft design, emphasizing the human factors and habitability issues that affect crew performance and well-being on lengthy missions.

Some of the issues discussed in these articles are already being addressed by planners. The last article, by Santy, looks at matters from an operational perspective and describes a program for crew psychological health maintenance now under development at NASA-JSC. The program deals with the complete preflight-inflight-postflight mission cycle. Though aimed at crews for Space Station Freedom, elements of this program are being made ready for evaluation on STS and Extended-Duration Orbiter missions.

This Special Section makes no pretense about being comprehensive or exhaustive, but the articles as a group and their references do cover, reasonably well, what presently seem to be the most salient behavioral issues in long-duration spaceflight. We hope you find this section informative and thought provoking.

References

[1]Collins, M., *Carrying the Fire,* Farrar, Straus & Giroux, New York, 1974.

[2]Collins, M., *Liftoff,* Grove Press, New York, 1988.