Probing Question: Can a human survive a trip to Mars?

March 3 2005

President Bush's recent proposal to focus NASA's efforts on manned space exploration has rekindled efforts to define the human limits on long voyages in deep space. According to Jim Pawelczyk, associate professor of kinesiology at Penn State and a payload specialist on the 1998 Columbia mission, there are three major "showstoppers" that need to be addressed.

The first problem is not unique to space, but a magnified version of an issue in daily life: People forced to live at close quarters have to be able to get along. "If you think about it," Pawelczyk said, "less than half of all Americans can stay married -- and that's living in a rich social environment, not cooped up in a can." The history of polar exploration, he noted, includes both poorly equipped teams that persevered beyond the seeming limits of human endurance, and others who, with more supplies and preparation, failed.

One thing that helps build camaraderie, he said, is being forced to be resourceful. In NASA's plans, therefore, Mars explorers will use their ingenuity to tap Martian resources whenever possible. This includes finding and collecting most of their own water. "It keeps people busy with useful, purposeful work, and that's a good way to form a team."

Another problem is the presence of high-energy radiation in outer space. Gamma rays and hot neutrons streaming from the Sun, with no Earth atmosphere to block them, pass through a spacecraft's metal and ceramic shell like rain goes through chicken wire. During his Challenger flight,

Pawelczyk remembered, “It never seemed to get completely dark, because when we were lying there trying to go to sleep, radiation would hit the rods and cones in our retinas, and make bright little flashes. We would say, ‘Wow! There goes a colored one!’”

The radiation bombardment in deep space, farther away from the protection of Earth, likely will be much more intense. To keep the risk of radiation-induced cancer as low as possible, Pawelczyk said, effective shielding will be crucial. On the Russian space station Mir, he said, some astronauts took to sleeping with their heads beside large lead batteries, which afforded better protection from cosmic rays. Because it is rich in hydrogen, water actually makes an excellent shield, so sleeping quarters and workstations in future spacecraft may be positioned between water tanks.

Perhaps the biggest obstacle to long-distance space travel, Pawelczyk said, may be osteoporosis. Outside gravity, he noted, astronauts lose one percent to two percent of their bone mass per month: That’s 10 percent to 25 percent of the skeleton in a one-year trip to Mars and back. Most of this loss is irreversible and it occurs even in astronauts who diligently do physical exercises designed to increase impact load, Pawelczyk said. “This is like being bedridden and immobile for 10 to 15 years.” Now, NASA is looking beyond exercise to bone-building drugs and spaceships with giant rotating arms designed to mimic the effect of gravity.

In the end, all three “showstoppers” get worse the longer astronauts spend in deep space. An indirect solution to all three, therefore, is to design faster spaceships. Such vehicles would require either using nuclear fuels -- still a somewhat controversial technology, but one that could cut travel time to Mars in half -- or waiting for a superior propulsion system to be invented.

Source: Penn State