

THE MOST PRECIOUS COMMODITY OF THE NEXT SPACE AGE

If extra-planetary travel ever becomes routine, power may revolve around who controls access to gravity, argues space archeologist Alice Gorman

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In the roughly six decades since humans began exploring the cosmos, there have been three periods of space activity, according to an influential 2007 paper by space-policy analysts Peter Hays and Charles Lutes. Each was driven by the need for a particular commodity. In the first period, from the launch of Sputnik 1 in 1957 to the end of the Cold War in 1991, the commodity was prestige. Following that, as the world's reliance on satellites for Earth observation and telecommunications grew, the commodity was information. They proposed that wealth would be the commodity driving space exploration in the next era. It looks like we've now arrived at this point.

Companies, nonprofits and space agencies, including the National Aeronautics and Space Administration, are planning lunar and orbital habitats. Startups are developing vehicles for space tourism, and financing research and technology to mine the moon and asteroids for rare earth elements and precious metals. Small, cheap satellites are making space accessible for a new generation of extra-planetary entrepreneurs. But what happens after that? I propose that the next phase of a space-based economy will revolve around gravity.

Humans evolved in the gravity environment of Earth's surface. The proper functioning of our bones and blood rely on it. Out in space, however, we meet with different gravity levels. The moon has one-sixth of Earth's gravity, and Mars is a bit over a third. Crew on the International Space Station live in microgravity: They are effectively weightless. To maintain their bone density and muscle mass, crew members must exercise for over two hours each day. Without this

discipline, the astronauts could end up with osteoporosis. Living in gravity so different from Earth's has consequences, including vision impairment and diminished organ function.

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It will be many years before technology exists to sustain human colonies in space. But if people want future settlements to succeed, there must be long-term solutions to living in these environments. This may involve reconceptualizing our relationship to gravity.

A few years ago, I tried a wordplay exercise with my students at the University of Applied Arts in Vienna, where I taught a course on space archaeology, or the study of the artifacts of human encounters with space. You take an existing word and add prefixes or suffixes, change letters, chop it up, make it into a verb or whatever you please.

Then you think about what the new word means and what kind of society needs this word to describe its values or practices. I was curious to see what happened when the class took “gravity” as the base word.

These are a few of the ideas we came up with. A “monograv” is a person who has only ever lived in one type of gravity, considered inferior to those who are adapted to multiple gravity regimes. “Antineogravitationists” are people who oppose living in artificial gravity, believing that the body should adapt to whatever gravity it finds itself in. One student proposed a “groovity club,” where dancers go to bust their moves to the DJ playing gravity levels along with the beats. Gravity might become as contested as diet is now—perhaps there are groups who believe in “palaeogravity,” replicating the gravity conditions of the pre-spacefaring age. A “gravault” is a prison where people adapted to low or microgravity are incarcerated in higher gravity, their ability to move freely taken away. Perhaps this is punishment for the future crime of “kleptogravity,” where a person steals another’s gravity ration.



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The
earliest
space
station

s, such as the rotating wheel conceived by the Viennese engineer Hermann Noordung in 1929, were designed to produce “artificial” gravity by spinning, like the centrifuge astronauts train in. Mr. Noordung thought that humans might be uncomfortable with the constant sensation of falling in Earth orbit, but he reasoned that pilots acclimate to a variety of such experiences, so it wasn’t impossible to adapt. In the 1960s, NASA considered spinning space stations, but decided that astronauts might not enjoy being spun like a sock in a washing machine. Having been in a gravity rotor in an amusement park, I can categorically say that I did not enjoy it.

None of the habitable space stations launched so far—the Salyut series, Skylab, Mir, Tiangong 1 and 2 and the International Space Station—has tried to create gravity by spinning. Part of their purpose is to conduct science in microgravity, after all. Higher gravity is just a luxury for the comfort of the crew.

The ISS crew’s exercise regime is critical to ensuring that their bodies can adapt when they return home. The treadmills, cycles and weights are a form of gravity surrogate, substituting for the work done by bodies going about their daily tasks on Earth. Everyone gets equal access to the exercise equipment. It doesn’t take much to imagine, though, that situations might change and one group might assert dominance by controlling access to exercise, knowing the consequences for those excluded.

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What if there is no return to Earth, whether that is for cultural, political or economic reasons? Research using rats on Space Shuttle flights indicates that a lack of gravity can cause abnormalities in embryo development. This is just one of the serious challenges in sustaining a human population in space. On the upside, one

study by Italian sports medicine researchers measured heart rates of pregnant women immersed in water. Their results suggested that microgravity might relieve some of the burden on muscles and bones experienced in late pregnancy.

Living in variable gravity environments makes gravity a commodity that it simply isn't on Earth; it becomes foreground rather than background. Power may be determined by whomever controls access to specially designed, high-gravity environments where people can maintain their strength. Gravity may indeed be rationed, and depriving people of access could have serious health (and even legal) consequences. If humans are to have any hope of maintaining permanent settlements off Earth, we'll have to consider not only the physiological effects of low gravity but the social adaptations as well.

Alice Gorman is a senior member of the American Institute of Aeronautics and Astronautics and senior lecturer at Flinders University, Adelaide. This article is adapted from her book, "Dr Space Junk vs The Universe: Archaeology and the Future," to be published Oct. 22 by the MIT Press.

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