Off-world colony simulation reveals changes in human communication over time with Earth

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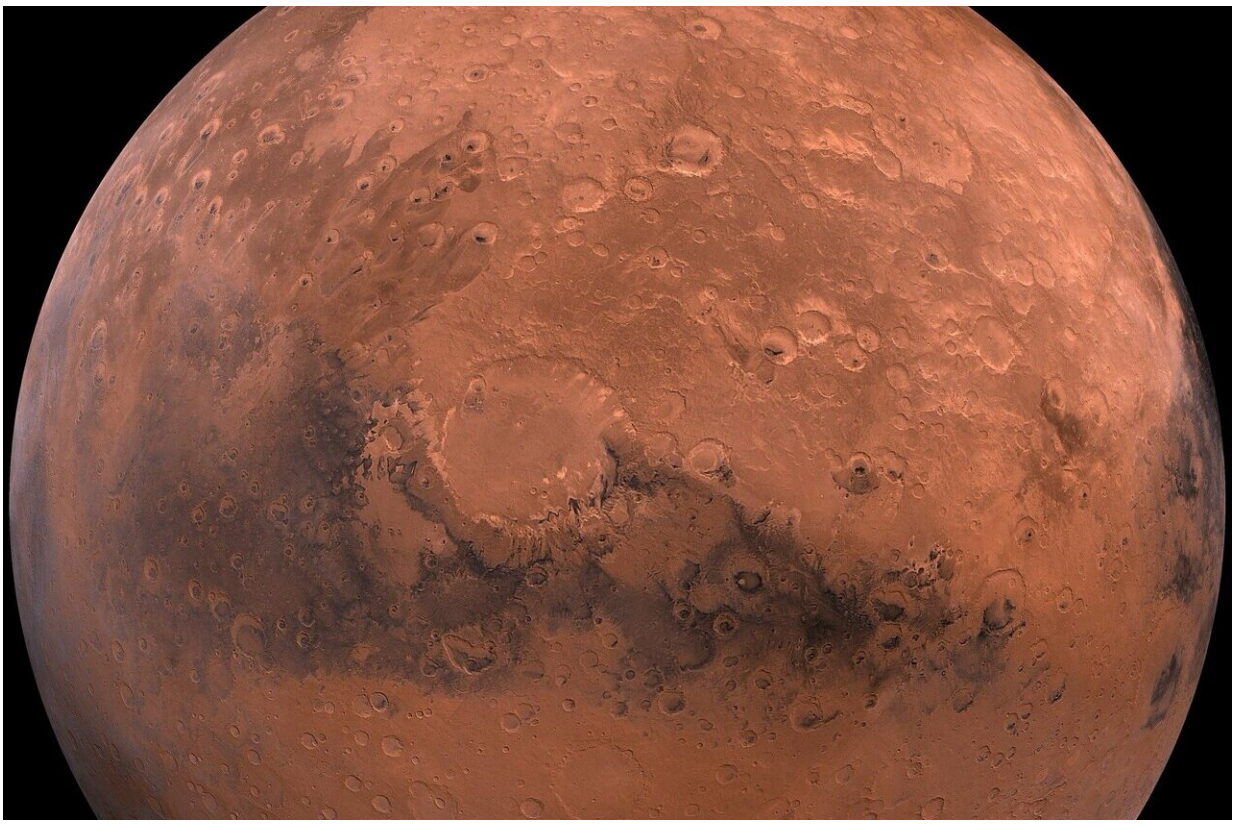

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Elton John famously sang that Mars "ain't the kind of place to raise your kids", but one day space agencies across the globe hope to prove him

wrong by seeing the first human set foot on the Red Planet, and potentially colonizing it or any other moon or planet.

However, those who make the journey will not only have to survive on a freezing planet with no breathable atmosphere, but live in isolation unlike any other explorers in human history.

At its closest proximity, Mars is still almost 55m km away from Earth, making communication delays and supply issues between the two worlds unavoidable. This requires crew members to effectively cope with stressful conditions by themselves, with limited autonomous resources available on board.

With little chance of conducting a trial run in space, scientists have resorted to terrestrial experiments to see how astronauts cope with such challenges. A previous isolation experiment called Mars-500 revealed a psychological detachment from mission control among those who took part, raising fears that it could lead to resistance from future crews in deep space to any commands.

In 2017 and 2019, two further isolation experiments dubbed SIRIUS (Scientific International Research in Unique Terrestrial Station) were conducted across periods of 17 days and four months, respectively, in a facility in Moscow, Russia using international, mixed gender crews. These missions studied the effects of isolation and confinement on human psychology, physiology, and team dynamics to help prepare for long-duration space exploration beyond Earth.

Hello, can you hear me?

Now, researchers have published a paper in *Frontiers in Physiology* revealing how the crews' communication with the outside world in these experiments not only diminished over time, but caused friction initially,

and eventually resulted in cohesion.

"The crews in such missions tend to reduce their communication with mission control during isolation, sharing their needs and problems less and less," said Dr. Dmitry Shved, of the Russian Academy of Sciences and the Moscow Aviation Institute, as well as an author of the study.

"The rare bursts of contacts were seen during important mission events (eg landing simulation). Also, there was a convergence of communication styles of all SIRIUS crew members, and an increase in crew cohesion in the course of their mission. This happened even though the crew composition was diverse by gender and also cultural background, with pronounced individual differences."

Among the different ways the crews' behavior was measured included the tracking of facial expressions and speech acoustic characteristics (intensity, frequency and variability of speech) from video recordings.

During SIRIUS-19, the researchers recorded 320 audio conversations with external observers lasting 11 hours in the first 10 days alone. However, this fell to just 34 conversations lasting a total of 77 minutes during the last 10 days.

11 days into the experiment, an artificial communications delay was added similar to what would be experienced by those living on the moon, Mars and beyond. Over the course of four months, the number of video messages sent to mission control decreased from 200 in the first week of isolation to between 115 and 120. The duration of these videos also decreased significantly.

Under these conditions, the researchers also noted differences in communication between men and women participants. In women, there were more manifestations of joy and sadness emotions, while, men were

more likely demonstrated anger.

"It should be generally noted that, while the male and female parts of the SIRIUS-19 crew showed significant differences in the style and content of their communication with the control center in the first month of isolation, then, during the course of the experiment, these differences were smoothed out," the authors wrote.

Promising for future colonists

According to Shved: "Our findings show that in autonomous conditions, the crews undergo psychological 'autonomization', becoming less dependent on mission control.

"Also, the crews in such conditions tend to increase their cohesion when crew members become closer and more similar to each other, despite their personal, cultural, and other differences. So, these phenomena look promising for future solar system exploration—or for any teams living and working in isolation on Earth."

Looking to the future, Shved and his fellow researchers aim to analyze more data from the latest isolation experiment, SIRIUS-21, which began on 4 November this year. This, he said, will help in overcoming the limitation of a small sample size that comes with such unique experiments.

"Our findings pose serious questions that should be taken into consideration [before sending crews to Mars]," Shved said.

"The promising part is, that the crews seem to become more autonomous and independent from Earth. The increasing crew cohesion should also help them in dealing with various problems during their mission."

More information: Natalia Supolkina et al, External Communication of Autonomous Crews Under Simulation of Interplanetary Missions, *Frontiers in Physiology* (2021). DOI: 10.3389/fphys.2021.751170