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6 Guys in a Capsule: 520 Days on a Simulated Mars Mission

By Bill Donahue [✉](#) October 21, 2011 | 8:48 pm | [Wired November 2011](#)



To crack
the

Six men, locked in a capsule on a simulated mission to Mars. Here's what 520 days in isolation does to the body and mind.
Photo: Corbis, NASA

mysteries of interplanetary space travel, you first consult with the old woman in the shack. She sits inside, surrounded by windows in a dingy little room warmed by a portable heater. You stand in the chill of the larger reception area, stooping down to a slit in the glass, and then you slide your identification papers toward her so she can give them a sour once-over. She scribbles something in a spiral notebook (there are no computers involved), and then, after a wait, you are released into the outdoor courtyard, which gives way to the monolithic concrete-walled buildings of the Institute for Biomedical Problems, in Moscow, where today—a gray morning in October 2010—the winds are howling, the pewter skies threatening snow. The grass in the courtyard is dead. On the cork bulletin board, there is a single note. Handwritten, it advises employees where to procure foam for their fire extinguishers. It is all so bleak that you feel the urge to grab a bottle of vodka and cling to it for dear life.

But wait, for there is romance alive at the institute as well. Everywhere in its vast, drafty building there are ancient gilt-framed photographs of Sergei Korolev, the mid-20th-century rocket engineer whom the Russians revere as the “father of space.” The pictures are black-and-white and dramatically shadowed, the better to highlight Korolev’s virile black eyebrows and his dreamy ambition. By 1956, Korolev had become a pioneer among space scientists, his designs inspiring serious plans to launch a manned mission to Mars. And now, at the institute he cofounded in 1963, mankind is making one small, decidedly unglamorous step toward that goal.

In a secluded area on the ground floor, six brave young men (three Russians, an Italian, a Frenchman, and a Chinese national) are simulating a mission to Mars. For 520 straight days—that's more than 17 months—the volunteers will be sequestered in a tubular steel stand-in for a spacecraft whose 775-square-foot living area is so cramped and spare it might have been designed by Dostoyevsky himself. Mars500, as their mission is called, is jointly sponsored by the Institute for Biomedical Problems and the European Space Agency. It seeks to answer a question that looms as the EU, the US, Russia, and India all look to put a man on Mars by the 2030s: Can the human animal endure the long isolation and boredom implicit in traveling to a planet that is, at its closest, 35 million miles—and roughly six months of rocket travel—away? Will one of the volunteers crack before the faux mission's scheduled conclusion on November 5, 2011?

When I visited the institute last year, it was hard to tell. The voyagers were sealed off from terrestrial life, each one allotted a private bunk room just 32 feet square and access to a common living room, a small gym, a greenhouse, and two minuscule lavatories. The crew's food storage room is almost as big as their living quarters, and when they entered isolation on June 3, 2010, it contained every single calorie they would consume as they soared through "space," then spent nine days on "Mars" (in this case a small pit of red sand) before returning and exiting a year and a half later.

Mars500 is unprecedented. Never before have six healthy males been so thoroughly isolated under such unvarying circumstances. Both public health researchers and space scientists regard them as the perfect experiment subjects—and in fact the astronauts spend much of their days pricking their arms for blood and handling vials of their own urine. They are taking part in more than 100 experiments.

But what else is going on in their tube? Last fall, I was able to make a videotape posing questions to the astronauts. I heard back from the two western Europeans—France's Romain Charles and Diego Urbina, a Colombian-born Italian. They appeared on camera one at a time, in a dimly lit room, and their tone was earnest and plaintive. "So far we've done 130 days," said Charles, 31, who has worked mostly as a quality engineer for auto companies like Tesla Motors. "But I am not counting the days one by one."

In his video, Urbina, a 27-year-old career astronaut, said, "I believe in a humankind that is space-faring, that expands its frontiers. I believe we cannot risk losing everything we have done by putting all our eggs in one basket—Earth. "

After I watched these clips, I turned to study the four nearby surveillance monitors that track activity in the Mars500 module. Charles and Urbina were slouched in the spaceship's living room, staring at a TV screen.

Charles was strumming on a plastic instrument, playing *Guitar Hero*. Urbina was singing. They were wearing socks without shoes, both of them, and they were killing time. It would still be more than a year until they could step out and see sunlight.

"I like Star Wars the most, but being in here feels more like Star Trek, so I think if I had to pick sci-fi characters to feel identified with, I'd say the crew of the Enterprise."—Diego Urbina

The Institute for Biomedical Problems is a world leader in the torture of isolation. Over the years, it has done dozens of isolation experiments, starting with a brutal yearlong trial in 1967. Today's isolates bear the added burden of living in a reality-TV sort of fishbowl: A team of psychologists and representatives from China, Russia, and the ESA is watching the closed-circuit television monitors 24/7. "We're looking to see if they have breakfast together and whether they are playing together," says Elena Feichtinger, a psychologist who works for the European Space Agency and serves as the deputy project manager. "During the experiment, they are dependent on us like children. They aren't getting care and support from other people. So they lose their basic sense of safety. They need us."

Feichtinger,
an



The members of Mars500 after spending one full year confined in their “spaceship.” Only 155 days to go.
Photo: ESA

effervescent redheaded Austrian, is the western European astronauts’ link to civilization. It is she who sends them daily news, filtering out potentially depressing stories, and it is she who forwards the emails of family and loved ones. (On a brief time delay, of course. On a real space flight, an email would

take up to 17 minutes to reach a Mars-bound spaceship.) When I visited, she suggested that I strike up a correspondence with the stimulation-starved astronauts.

I started emailing them soon after I left Moscow. It was a tricky endeavor, for I was hoping to glimpse the dark soul—the Russian-novel quality—of their long isolation. I aimed to pick my way into their hearts. But what tools did I have? We were all guys, so if I got too touchy-feely it was certain to backfire. And then there was the fact that I could move freely about and they couldn’t. Would I make them hate me by writing about my vacation to Mexico? I wrote about it anyway, and about riding my bicycle through Oregon wine country, in hopes that they might open up, too. Before long, responses from the astronauts began arriving.

“It definitely feels like we are in the middle of nowhere,” Urbina wrote.

“Half of us feel like we’re traveling far away,” Charles said, “while the other half still feel like we’re standing on Earth. I’m in this second half. Since the beginning of the experiment, I find too many hints of a surrounding presence to feel like I’m in a real spaceship. However, even if I can’t forget that I’m on Earth, I feel like I’m far away from anybody. As if the Mars500 modules had been moved to a strange and unknown place.”

Over time, isolated people undergo a social narrowing. They stop eating together. Their I.Q. goes down 5 to 10 points. they lose all affect. You look into their eyes and nobody’s

home.

Charles came off as pensive and quietly genial. When I sent him a song by singer-songwriter Andrew Bird, he reminisced about seeing Bird once live in Angers in western France and marveled over Bird's use of a loop pedal on the album *The Mysterious Production of Eggs*. Urbina, meanwhile, seemed restlessly creative and geeky. He was setting up a computer program that would, he said, gather statistics on his email and tweeting "to see if there is any correlation of the communications with my mood."

But the emails I got rarely plumbed emotional depths. They seemed circumspect and of a piece with the G-rated stories that prevail on the European Space Agency website, esa.int, whose Mars500 coverage seems calibrated for schoolchildren. "Our Halloween party was great," Charles wrote me. "With Diego and Wang Yue, we dressed up in our costumes in the morning and we spent the whole day like that. If anybody had some free time, he could play *Resident Evil 4*, which Diego had installed on the big screen of the living room. In the evening we watched two horror movies while eating gummy bears and other sweets.

"Our main challenge right now," Charles added, "is to avoid being bored. Every single day is very similar to the previous one."

"I miss the presence of women and especially mine. We've been away from each other for nearly five months now, and it's not really easier to deal with it. It's not harder either. Some weeks we need to communicate every day while another week could be spent without any message. We have ups and downs like in a normal relationship."—Romain Charles

Isolation is hard; being deprived of fresh air and social variety makes you go batshit. That narrative is so ingrained in the collective psyche that when the Irish bookmaking chain Paddy Power set odds on Mars500, it all but anticipated failure. If a bettor wagered a dollar that the original six-member crew would not last the whole mission, he was, by Paddy's lights, practically predicting the sun would rise tomorrow—he'd only get \$1.20 back. Paddy, meanwhile, set 8-to-1 odds that at least one crew member would go "clinically insane" after leaving the Mars500 experiment. (Fairly long odds until you consider that most jobs don't come with an 11 percent chance that you'll go clinically insane in a year and a half.) The Irish bookie even set odds as to who'd be first to quit. It tapped the sole Chinese astronaut, Yue Wang, putting him at 2-1. (Yue was, after all, the most culturally isolated.) Diego Urbina was next, at 5-2. Urbina had deep experience. He'd designed a star compass for a nanosatellite in Italy, and just before joining Mars500 he'd spent two weeks in the Utah desert, in a space suit, simulating a Mars landing. But he was the youngest crew member, and in press photos he always bore the most eager grin.

All three Russians got, relatively speaking, a vote of confidence from Paddy Power. Indeed, captain Alexey Sitev was the long shot in the quitting department, at 10-1. Which is a bit weird, because during the 1970s and 1980s three Russian space missions ended early on account of psychological problems. In 1976, for instance, two Russian cosmonauts abruptly cut about 10 days off a planned nine-week mission aboard the Salyut 5 space station. The oft-repeated reason for the early return was "interpersonal issues," but one cosmonaut, Vitaly Zholobov, would later report that he experienced almost hallucinatory fears when he looked out at a star. Zholobov apprehended space as "a bottomless abyss," he said.

CLOSE ENCOUNTERS

The Mission

The six astronauts crammed into the Mars500 simulator have all the comforts of home. Will that be enough to stave off space madness?

The Food

Most sustenance comes from the storage area, but the crew also experiments with

The Lander growing food in small greenhouses.

A landing simulator sequestered three men for the “trip” from orbit to the Martian surface.

The Beds

Smaller than cells on Alcatraz, 32-square-foot bunks provide a modicum of privacy for the 17-month slog.

The Entertainment

The Experiments

In space, no one can hear you scream—even if you’re belting out Bon Jovi on *Guitar Hero*

to pass the time.

The mission members are constantly tested on every conceivable metric: stress, metabolic rates, group dynamics, and more.



Time to get to Mars: **175-225 days**. // Miles traveled: **70 million**. // Total length of a round-trip: **500-1,000 days**. // Food required for a crew of 6: **29,200 pounds**. // Samples to be brought home: **550 pounds**. // NASA’s goal for a manned Mars mission: **mid-2030s**. // Estimated cost: **\$100 billion**.

Illustration: James Provost

Christian Otto, an emergency physician who studies space medicine for NASA, explains that isolation all but bores us to death. “As humans, we’re novelty-seeking creatures,” he says. Millions of years ago, he explains, our ancestors stood up “to seek food sources in the high grass. We look for refuge, for vistas. We have opioid receptors in our brain, and when we go outside—for a run, say—opioid release gets triggered. That’s good; we need that. But if you deprive the senses of variety, the hippocampus atrophies and the brain’s cortisol level rise.” High cortisol is associated with stress, depression, and post-traumatic stress disorder.

Otto has spent two winters as a physician in Antarctica. “I was busy all the time with mental health issues,” he says. “Over time, isolated people undergo social narrowing. They stop eating in the cafeteria; they just take food back to their rooms. Their IQ goes down 5 to 10 points. They lose all affect. There’s little inflection in their voices. You look into their eyes and you think, their lights are on, but they’re not home.”

Social tension has cropped up in past missions carried out by the Institute for Biomedical Problems. On a 240-day international experiment there in 2000, Russian crew member Vasily Lukyanyuk ruined a drunken New Year’s Eve celebration by shoving a Canadian, Judith Lapierre, away from the video monitors and forcibly French-kissing her twice, against her will. The astronauts weren’t supposed to have alcohol (drinking is also banned on Mars500), but scientists surreptitiously supplied it, crew commander Norbert Kraft later said.

The booze wasn’t the only contraband aboard that simulated space station run. The ship’s Russian cosmonauts regularly watched pornography, Kraft admitted, and one Japanese man, Masataka Umeda, left the mission two months early in protest. Meanwhile, there were cockroaches in the showers and mice crawling up through cracks in the floor.

“The walls are thin and with poor acoustic isolation. It is not a huge problem, but a bit annoying in that you have to make an active effort not disturb other people that can hear every little sound you make even from two or three rooms away. I think it is comparable to when you have to share rooms in college.”— Diego Urbina

Our six astronauts are multicultural, friendly, and given to horsing around. At one point, they joined forces to create a music video in which they wailed with gleeful exuberance through “Song 2,” by Blur, complete with a go-bananas “Woo-hoo” scream.

But there were serious duties to attend to as well. On February 12, 2011, the crew “landed” on Mars—or, more accurately, gained access to the small expanse of red sand, a facsimile of Mars’ Gusev Crater, just upstairs from their living quarters. “We opened the hatches of the Martian module,” Charles wrote me, “and it was like a second Christmas!” Before landing, the crew split into two groups of three. Urbina, Yue Wang, and the ship’s physician, Alexandr Smoleevskiy, positioned themselves in a tiny landing craft; the other astronauts stayed behind, feeling lonesome. “The main modules seemed big and empty,” Charles wrote me. “It was a strange feeling that I only experienced when I was younger. During the holidays it happened that my brothers and sister went away, leaving me alone at home with my parents.”

The Mars-faring trio “journeyed” to the Red Planet, holing up in the lander module, doing preparations for four days. “Europe has for centuries explored Earth, led by people like Columbus and Magellan,” Urbina said after he took his first steps in the sand wearing a 66-pound space suit. “Today, looking at this red landscape, I can feel how inspiring it will be to look through the eyes of the first human to step foot on Mars. I salute all the explorers of tomorrow and wish them godspeed.” Over the course of nine days, they took three walks on the Martian surface, each roughly an hour long.

The ESA website put the word “landed” in quotes, but among the astronauts, the suspension of disbelief was almost total. Urbina pretended that it was September 2018. He pictured the half-empty Mars500 mother ship orbiting 280 miles overhead and then reckoned that it could contact the landing crew only when it was directly above the Gusev Crater. Under such strictures, the Mars party would relay their reports from the surface only during prescribed intervals.

Despite such conscientious verisimilitude, the Mars500 crew drew mixed reviews among the space cognoscenti. Christian Otto of NASA questioned whether Mars500 was a useful exercise at all. “If you were actually going to Mars and a person made an error, that could have serious consequences,” he says. “A true space mission is more dangerous, more stressful. And also more rewarding: You actually get to go to Mars.”



In

These steel tubes are a kind of reality-TV fishbowl: Psychologists watch the events inside on closed-circuit monitors 24/7.
Photo: ESA

Russia, I encountered deeper skepticism among cosmonauts, who tend to live just outside Moscow in an elegant, tree-lined enclave known as Star City. When I ventured there one day, I spoke to Sergei Krikalev, who has spent 803 days in outer space—more than any other human being—and he scoffed at Mars500. “If you spend 500 days sitting in a chair,” he asked, “does that make you a race car driver?”

*“As you guessed, the private messages that we receive from the outside are always a ray of light in our days. I spend a lot of time writing emails because it makes me very happy when I receive an answer.”—
Romain Charles*

Being aboard Mars500 is mostly menial and toilsome—the astronauts are glorified lab rats. Scientists are keeping close tabs on how the isolates’ hearts are coping with the stress of confinement. They are

monitoring the microflora in the crew's intestines, subjecting them to questionnaires on their interpersonal dramas, and hitting them with regular doses of blue light to gauge its effect on their psychological states.

The regimen is at times exhausting. "The biggest challenge for me," Charles wrote in one email, "is the width of my bed—60 centimeters. As soon as I have more than one device to wear during the night (for blood pressure tests, electrocardiograms, electroencephalograms, etc.), I can't move."

"We have to collect urine the whole day," Urbina said. "And in the morning we have to take samples of the previous day's urine with syringes. That was pretty disgusting at the beginning, but now we've gotten used to it."

The urine samples may help reshape notions of male hormonal fluctuations. Jens Titze, a nephrologist at University of Erlangen, in Germany, is using them to test a hypothesis. "Men might have periods, too," he says. "We always thought it was females only, but it looks like there's a clock ticking for men also." Titze explains that the rhythms are related to the body's excretion and retention of salt. With the Mars500 crew, Titze is measuring salt in and salt out—and reveling in the purity of his study sample. "Usually, there are so many variables in public health," he says. "But with these guys we know their exact sodium intake." (During Titze's experiment, each astronaut is required to *finish* every meal.) "It might be that if you pee less," Titze adds, "you are in a bad mood. We don't know yet. We still have 6,000 urine samples to analyze, and we have to correlate those with mood reports."

Moods aboard Mars500 aren't just self-reported. David Dinges, a professor of psychiatry at the University of Pennsylvania, has the astronauts sitting in front of videocams once a week, to gauge their emotional states with facial-recognition software. "We're asking: How fast are they blinking? Are their facial expressions slowing down?" says Dinges, whose research could help show soldiers how to contend with stress and fatigue.

I wished I could see Dinges' findings, for the astronauts' missives to me were growing increasingly reserved. Still, in March, nine months into the mission, Charles wrote, "We haven't had any conflict so far."

I could gauge the astronauts' stress levels only by trying to decipher hints. In June, at the mission's one-year point, esa.int posted a small photo of Charles. It was a self-portrait; you could see his left hand reaching out for the camera. He was staring at the camera, not smiling. His eyes looked weary and tender, and as he leaned forward slightly, there was something plaintive in his posture, like he was showing us his heart and beseeching us to register the weight of a full year in isolation.

"We are now heading back to Earth, and we are prepared to deal with this hardest part of the trip, as the psychologists call it."— Romain Charles

"Are we almost there?"

Whether this question is asked from the back of a minivan or from the hull of a mock spaceship, a "yes" answer always has a soothing effect. What's most difficult about traveling is the part before almost-there. The third lap of a mile race always feels the slowest.

I hoped that my correspondence with the astronauts would finally blossom during their almost-there agony. I hoped that in their misery they might take to their laptops to proffer me something brooding and confessional. But no, they were fading from me. It was as though I were watching a movie and the screen kept getting dimmer and dimmer. On April 3, seven months before Mars500's "return," I got my last letter.

The withdrawal shouldn't have surprised me. Feichtinger, the Austrian psychologist, had told me that isolated groups often grow skeptical of outsiders. "They have to focus their aggression on the outside," she said. "This is normal. This is even good. It helps them to bond."

After four more months of silence (it was now August), Feichtinger intimated that the astronauts were scarcely writing to anyone. “They’ve become close to each other, and they’re not paying so much attention to the outside world,” she said. “They’re doing that to survive. I still try to get them to write to their families, but I can’t be too pushy. This is a very delicate moment.”

When I spoke to Christian Otto, the NASA physician, late this summer, he struck an ominous note. “I cannot divulge information that has been shared with me in confidence by the researchers,” he said, “but I’d be absolutely shocked if they walked out of there in tip-top shape.”

I’d be shocked, too. And still, I ended my reporting awed by the astronauts. They are living, as all of us do, circumscribed lives. They’re obliged to grind through certain routines inside a small box, and they have to amuse themselves inside that box and to find meaning in their pursuits. And they are, it seems, succeeding. Their messages have been hopeful. They are surviving.

Still, I can only guess what is going on with them now. And I suspect that for years after they emerge, smiling and waving, we will all still be guessing. In their sealed lair, astronauts aboard Mars500 will have journeyed to a remote and unique psychological place—to a new planet that we won’t ever wholly understand, even after the data is crunched. They went on a mission and they came home, as travelers always do, changed in ways that they will forever protect as secret, and also in ways they may never quite fathom themselves.

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