

NASA's 'Twins Study,' landmark research for an eventual Mars mission

April 12 2019, by Chris Lefkow



Retired astronaut Scott Kelly, who spent a year on the International Space Station, is pictured on the right, opposite his identical twin brother Mark, also a former astronaut

A NASA study of a US astronaut who spent a year in space while his twin brother remained on Earth is providing valuable insights into the effects of extended spaceflight on the human body, a key to planning a future manned mission to Mars, researchers said Thursday.

US astronaut Scott Kelly spent a year on the International Space Station while his identical twin Mark Kelly, also a former NASA astronaut, stayed on the ground.

The researchers who carried out the "NASA Twins Study" found that most of the changes to Scott's body during his time in space returned to normal within months of his return to Earth—although not all of them.

The findings, published in the journal *Science*, were encouraging to scientists and engineers envisioning interplanetary travel such as an eventual trip to Mars, a mission that could last two to three years.

"The Twins Study is the most comprehensive review of the response of the [human body](#) to spaceflight ever conducted," said Dr Susan Bailey of Colorado State University.

Dr Steven Platts, deputy chief scientist of NASA's Human Research Program, said it will "guide future biomedical space research and allow us to have a safer journey to and from Mars."

Using Mark as a baseline, 84 researchers at 12 universities documented the molecular, cognitive and physiological effects of Scott's year in space.



Retired NASA astronaut Mark Kelly

Scott, a 50-year-old veteran of two US Space Shuttle missions, spent 340 consecutive days on the ISS—from March 27, 2015 to March 1, 2016.

He was monitored pre-flight and post-flight and during his time on the ISS. Blood, urine and stool samples were sent back to Earth on resupply vessels.

At the same time, scientists monitored Mark—a veteran himself of four Space Shuttle missions—on Earth as what they called a "genetically matched ground control."

'Nauseous, dizzy'

Bailey said the uniqueness of using twins was because the scientists could "attribute any kind of differences that we saw in spaceflight to spaceflight.

"It wasn't because of any genetic differences," she said.



Scott Kelly spent nearly a year aboard the International Space Station and was part of a landmark NASA 'Twins Study' along with his identical twin brother Mark

Dr Michael Snyder of Stanford University said there are "thousands of gene and molecular changes that occur as someone goes in space."

"Virtually all of those returned to normal (in Scott) by six months," Snyder said. "It's reassuring to know that when you come back things will largely be back to the same."

Scott Kelly said he was extremely fatigued after coming back from the ISS and attributed it mostly to the adaptation to gravity.

"I felt like I had the flu," he said.

"I was nauseous. I was dizzy," he said, and suffered from joint and muscle pain and rashes.

Dr Stuart Lee of NASA's Johnson Space Center said measurements were taken of the thickness in both Scott and Mark of the carotid artery wall, which can be a predictor of cardiovascular disease or stroke risk.



US astronaut Scott Kelly after returning to Earth on March 2, 2016 after a nearly one-year stay aboard the International Space Station

"Our main findings in Scott were that the carotid artery wall became thicker early in flight and remained so throughout the mission," Lee said.

Mark did not have any such thickening.

Thickening of the carotid artery wall has been observed in astronauts previously.

So has weight loss due to poorer nutrition in space and a lack of exercise.

Scott lost seven percent of his body mass during his time on the ISS

while Mark gained about four percent during the course of the study.

In one test, both Scott and Mark were administered a flu vaccination. It delivered a similar immune response.



US astronaut Scott Kelly (R) aboard the International Space Station

The twins also performed a battery of cognitive tests before, during and after the flight and found that Scott's cognitive performance declined post-flight in terms of speed and accuracy.

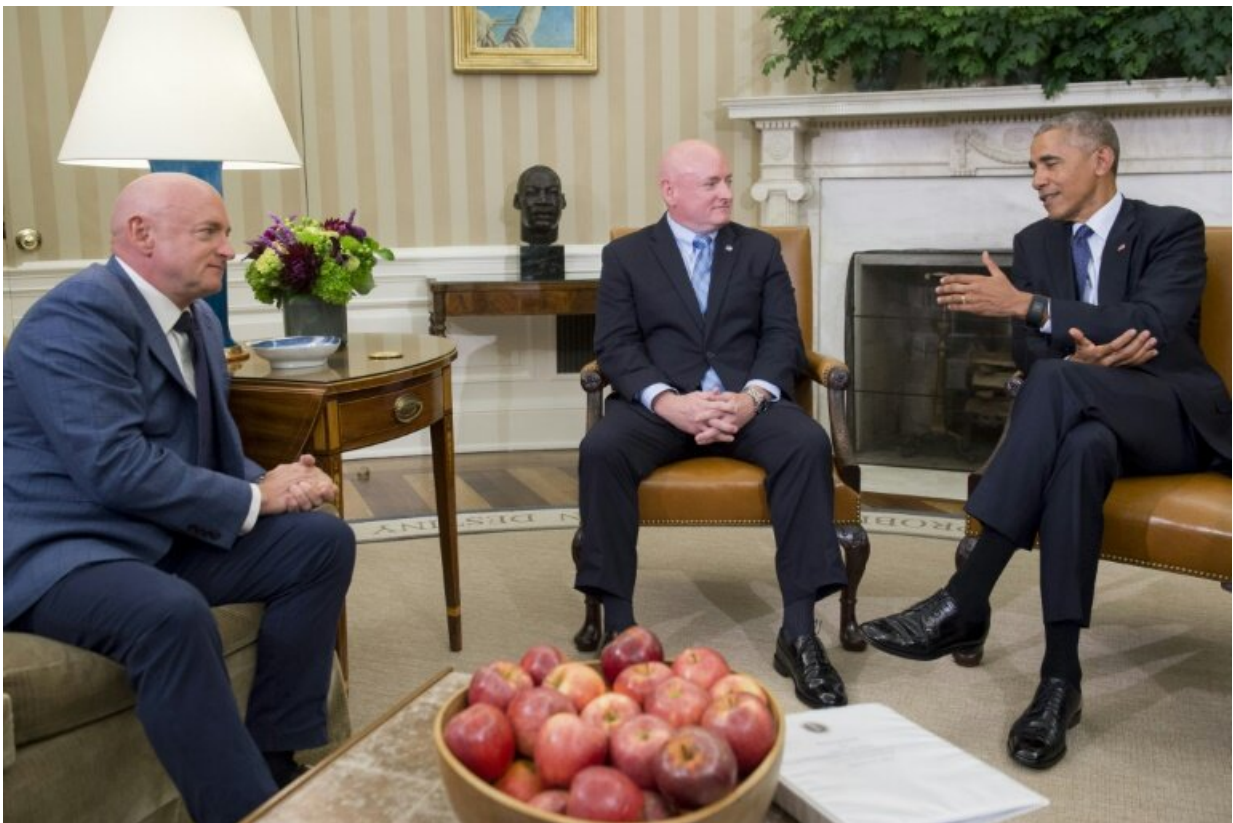
Telomere length

Chris Mason, a geneticist at Weill Cornell Medicine, looked at how the unique environment of space impacts genes.

"We catalogued basically what is the landscape of all these genes that have gone up and gone down at different stages during the mission," Mason said.

"We saw that the vast majority, over 90 percent of all these changes, all returned back to baseline coming back to Earth," Mason said.

Some of the most interesting research was done by Bailey's team at Colorado State University which looked at telomeres, the ends of chromosomes that typically shorten as people get older.



US President Barack Obama meets with NASA astronauts Scott Kelly (C) and his twin brother Mark Kelly in the Oval Office

Telomeres are considered a biomarker of aging or health risks from cardiovascular disease or cancer.

Bailey's team evaluated Scott and Mark's telomere lengths before the flight and found that they were very similar.

What surprised her team was that Scott experienced a "specific elongation of telomeres" during his time on the ISS.

Bailey cautioned that the finding "can't really be viewed as the fountain of youth and that people might expect to live longer because they're in space."

She said there was a "very rapid decrease" in telomere length upon Scott's return to Earth and he also experienced some unexplained telomere loss.

Bailey said her team has not come up with a reason for the telomere lengthening but was looking at whether the higher radiation exposure in [space](#), inflammation or stress may be responsible.

More information: F.E. Garrett-Bakelman et al., "The NASA Twins Study: A multidimensional analysis of a year-long human spaceflight," *Science* (2019). [science.sciencemag.org/cgi/doi ... 1126/science.aau8650](https://science.sciencemag.org/cgi/doi/10.1126/science.aau8650)

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