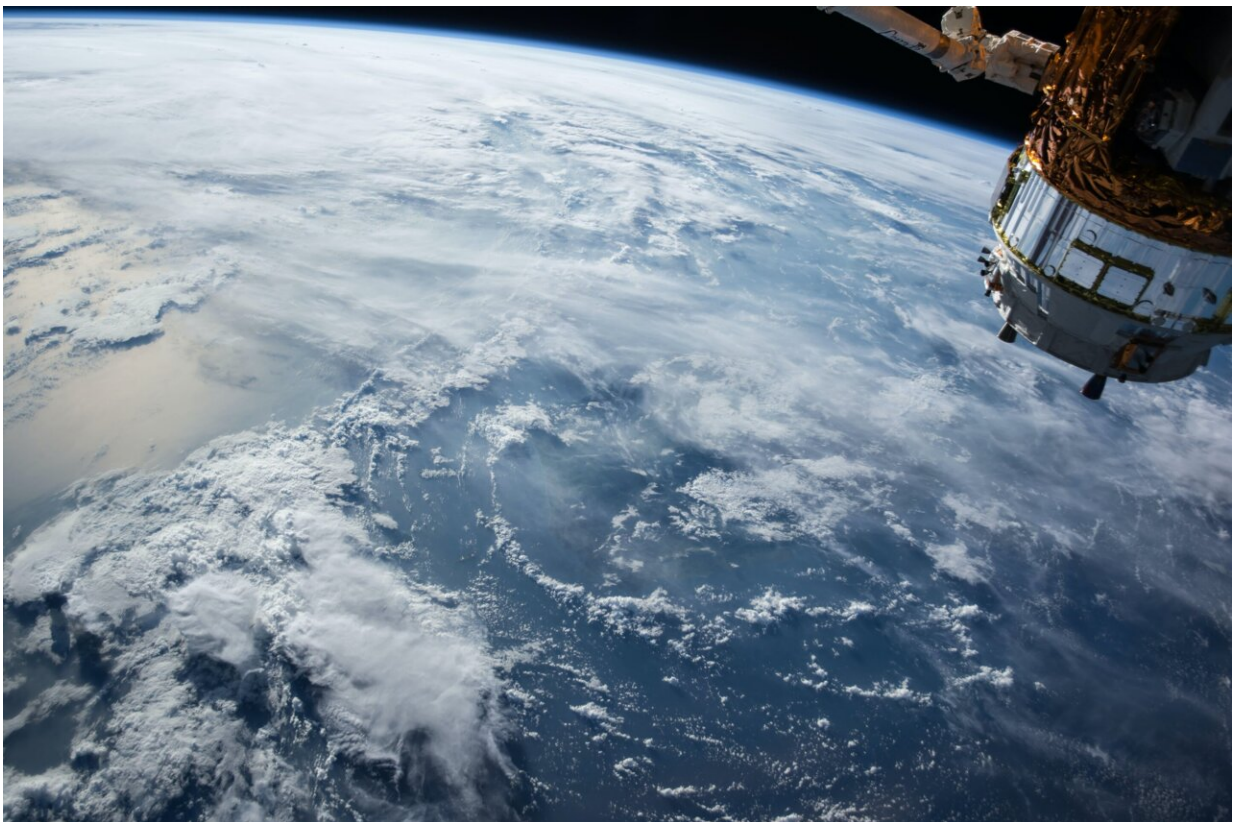


First study of civilian space crew charts course for research as commercial flight heats up

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As a new space race revs up, propelling humans back to the moon and toward a Mars landing for the first time, mysteries remain about the

unique pressures of space flight on humans—especially for those blasting off through new commercial space travel operations.

For the first time, researchers have data on the physical and psychological impact of spaceflight on an all-[civilian crew](#). The Penn Medicine team's study of the two-woman, two-man crew (dubbed Inspiration4; I4) lays the foundation for a biomedical database that will be critical for studying and addressing spaceflight health risks for civilian crews, at a time when investment in [non-governmental spaceflight continues to grow](#).

"Health monitoring during spaceflight has traditionally been reserved for a few highly-selected and highly-trained professionals," said the study's co-senior author, Mathias Basner, MD, Ph.D., a professor of Psychiatry and Director of Behavioral Regulation and Health Section in the Department of Psychiatry in the Perelman School of Medicine at the University of Pennsylvania.

"This marks an important first step in determining the safety of space flight for civilians, at a time when the possibility of space travel is opening up for more people."

Basner's team was responsible for monitoring changes in I4 crew physiology and neurobehavioral functioning in response to the spaceflight environment. This included gathering data on things such as [heart rate variability](#) and blood oxygen saturation, as well as cognitive performance and ratings of stress and behavioral states.

The research team investigated the I4 crew on their three-day mission, which launched from Kennedy Space Center in September 2021 on the SpaceX Dragon capsule. The crew reached nearly 367 miles above the Earth, beyond the International Space Station and the furthest humans have been to space since the Gemini program, which ran during the

mid-1960s. The I4 crew spent their time in low Earth orbit (LEO) and faced the same hazards of spaceflight as astronauts, such as galactic radiation exposure, altered gravity fields, and isolation and confinement.

The crew performed a neurocognitive test battery called Cognition before, during, and after the orbital flight on an Apple iPad with the JoggleResearch app. The test was designed by Penn Medicine researchers for NASA and consists of 10 brief tests that assess diverse aspects of cognition such as memory, risk taking, and attention. The crew also wore an Apple watch to gather information on movement activity, sleep, and cardiovascular reactions, and repeatedly filled out a brief alertness and mood survey.

I4 crew exhibited performance deficits on three cognitive tests in-flight, primarily involving attention, visual search, working memory, and sensorimotor speed. Cardiovascular changes were modest and similar to what the researchers expected, as the heart beats slower, not having to work against Earth's gravity vector in the microgravity environment of space.

Crew mood and alertness remained stable in-flight and they reported no conflicts among the crew. Almost all of the cardiovascular and neurobehavioral changes the research team observed returned to pre-flight levels after returning to Earth, which is consistent with findings from the other I4 research projects.

"As the capacity for humans to reach space expands, we hope this will serve as an important benchmark for how their mental, emotional and physical well-being will be impacted," added lead co-first author Christopher W. Jones, Ph.D., a research assistant professor of Psychiatry.

The research is [published](#) in the journal *Nature*.

More information: C. W. Jones et al, Molecular and physiologic changes in the SpaceX Inspiration4 civilian crew, *Nature* (2024). [DOI: 10.1038/s41586-024-07648-x](https://doi.org/10.1038/s41586-024-07648-x)

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