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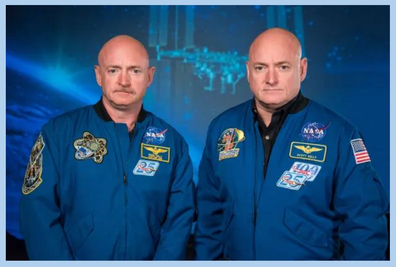
Cognition in Space: Insights from the NASA Twins Study

Post-flight cognitive changes in astronaut Scott Kelly

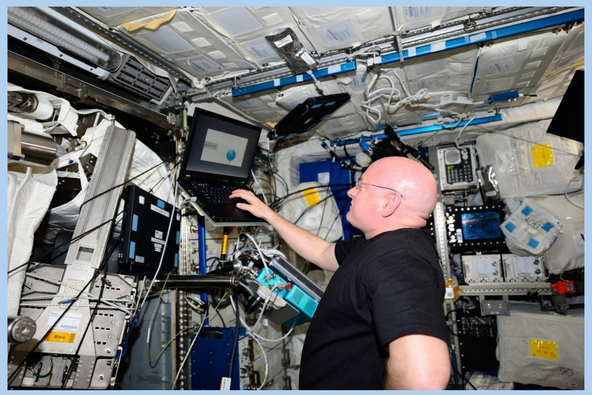
Introduction



Long-duration space missions expose astronauts to unique stressors, including microgravity, radiation, and altered circadian rhythms.

Maintaining cognitive performance is critical for mission success, safety, and adaptation. The NASA Twins Study provided an opportunity to investigate these effects by comparing Scott Kelly, who spent a year aboard the ISS, with his identical twin Mark, who remained on Earth.

Monitoring Cognitive Function



Scott underwent repeated cognitive tests before, during, and after his mission. These assessments measured mental alertness, spatial orientation, emotion recognition, and response speed. By comparing Scott's scores to Mark's baseline on Earth, researchers could determine which cognitive changes were specifically associated with long-duration spaceflight.

Key Findings

During flight, Scott maintained high levels of mental alertness, spatial awareness, and emotion recognition, indicating that astronauts can sustain critical cognitive functions over extended missions. However, after returning to Earth, a noticeable decrease in response speed and accuracy persisted for up to six months. These post-flight changes likely reflect the combined effects of re-adapting to Earth's gravity, physiological adjustments such as fluid redistribution and cardiovascular changes, and the demands of a busy post-mission schedule.

Mechanistic Insights

Microgravity causes body fluids to shift toward the head, which may affect brain perfusion and intracranial pressure. Changes in neurotransmitter balance and stress hormone regulation could further influence cognitive performance after long-duration spaceflight. Multi-omics analyses from the Twins Study suggest that telomere dynamics, epigenetic changes, and markers of inflammation may also play a role in how the brain adapts to and recovers from spaceflight.

Implications for Spaceflight and Earth

Understanding cognitive adaptation during and after long-duration missions is essential for planning future journeys to Mars and beyond. These insights inform post-mission rehabilitation timelines and strategies for mitigating cognitive decline. Research from the Twins Study may also have applications on Earth, such as improving recovery after prolonged bed rest, stroke rehabilitation, and performance under high-stress conditions.

References

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