

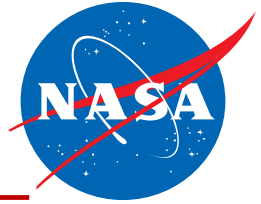
Behavioral Health and Performance for Future Space Exploration



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Canadian Space Health Research
Network Symposium 2024

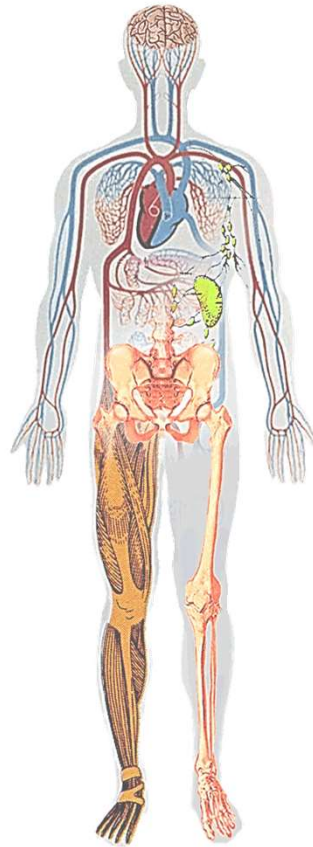


Hazards of Spaceflight

**Isolation and
Confinement**

**Altered
Gravity**

**Space
Radiation**

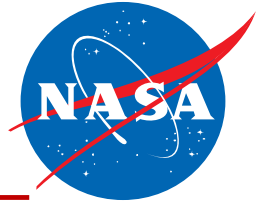


**Distance
from Earth**

**Hostile/
Closed
Environment**



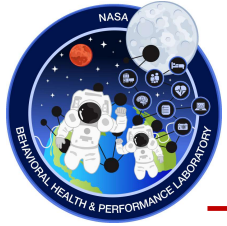
Current International Space Station (ISS) Operations



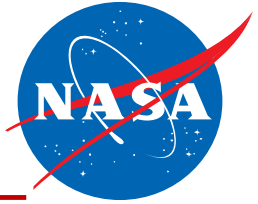
Low Earth Orbit

- Large volume
- Private crew quarters
- 6-12 month duration
- Real time communication with Earth
- Dynamic Composition
- Evacuation options
- Cupola, seeing Earth, and photography
- Exercise 2 hours a day
- High temp workload





Behavioral Health Intervention and Supports for Current Flight Operations



Pre-mission

- ASCAN Selection
- ASCAN Training
- Astronaut Training

In-mission

- Private Psychological Conferences (PPC)
- Private Family Conferences (PFC)
- BHP family support services
- Discretionary events
- Connectivity countermeasures
- Cognitive assessment
- Care packages
- Fatigue management
- Habitability countermeasures such as private crew quarters, lighting

Post-mission

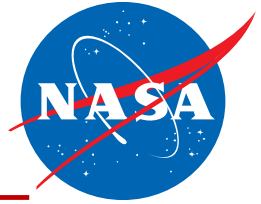
- Reintegration support (family, sleep, meaning)

Astronauts thrive on the ISS!





Scott Kelly's One Year Mission

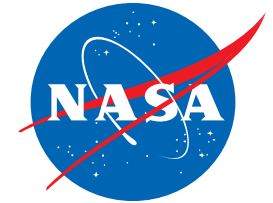
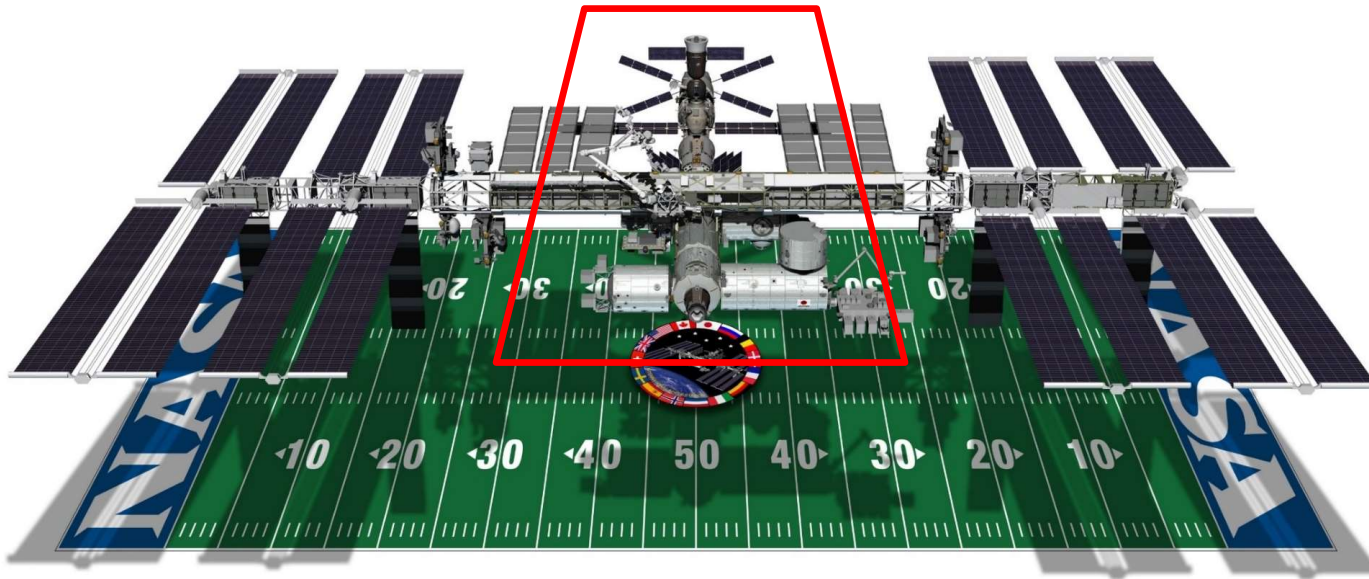


Every day, I was exposed to ten times the radiation of a person on Earth, which will increase my risk of fatal cancer for the rest of my life. Not to mention the psychological stress, which is harder to quantify and perhaps just as damaging.

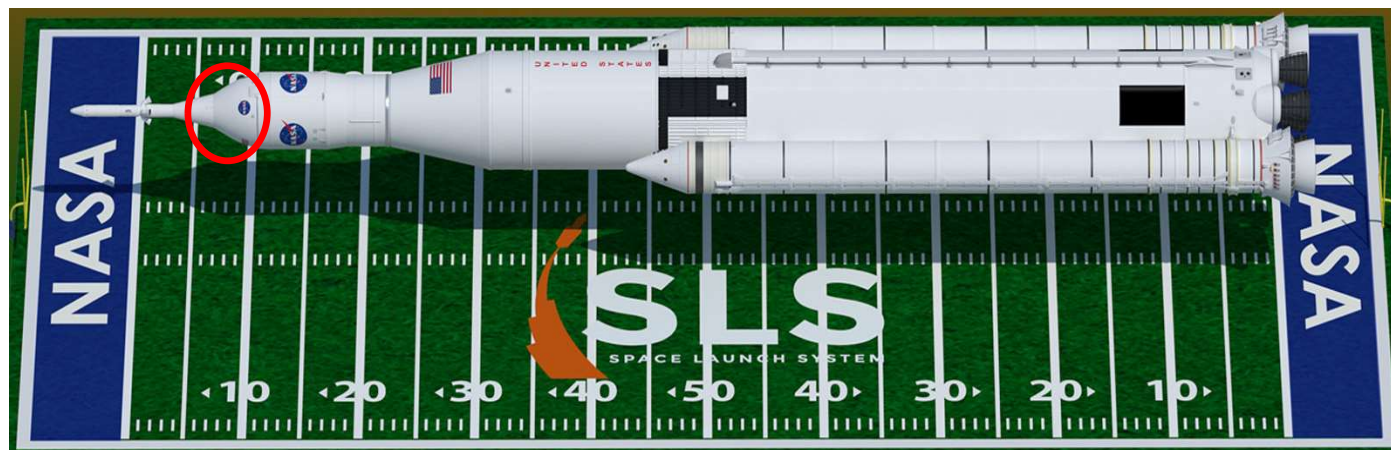
Scott Kelly, excerpt from
Endurance: My Year in Space and
our Journey to Mars



ISS

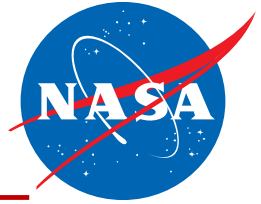


SLS & Orion





Artemis Missions



Living and working in
small spaces



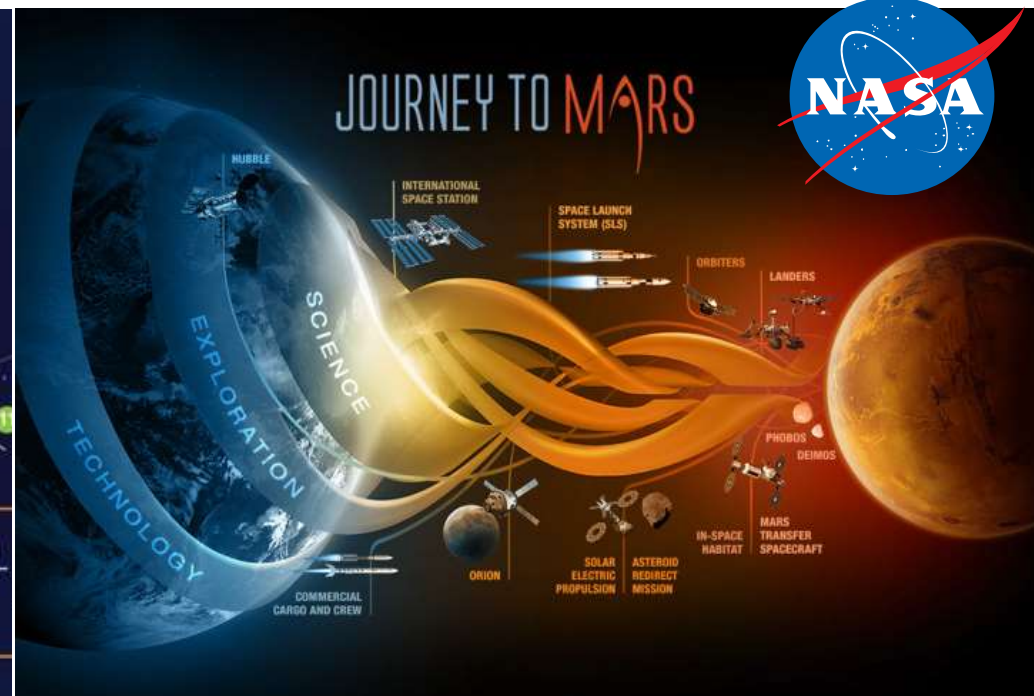
High workload with
repeated EVAs



Still have close support
from MCC possible







Risk Characterization and Reduction Research

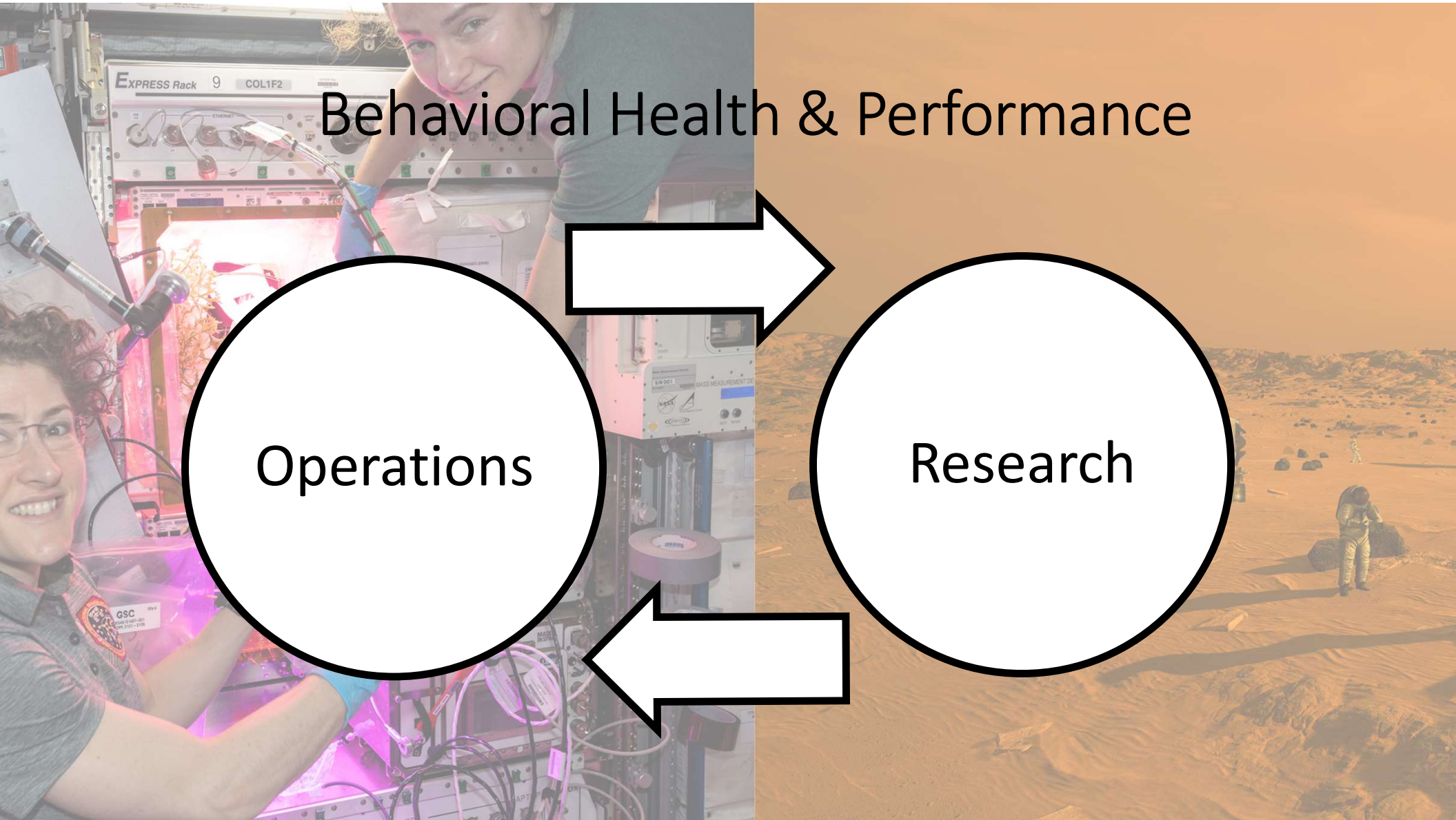
- **Behavioral Health:** Risk of Adverse Cognitive or Behavioral Changes, Psychiatric Disorders, and Long-Term Behavioral Health Consequences (BHeath)
- **Team:** Risk of Performance and Behavioral Health Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team, and between the Team and Mission Control
- **Sleep, Human Systems Integration Architecture (HSIA)**

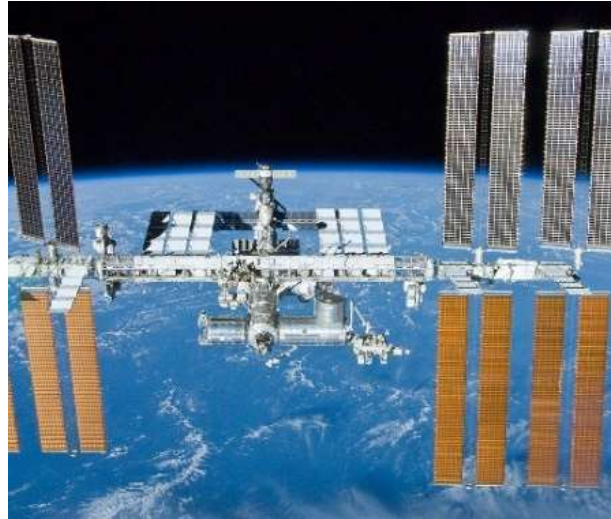
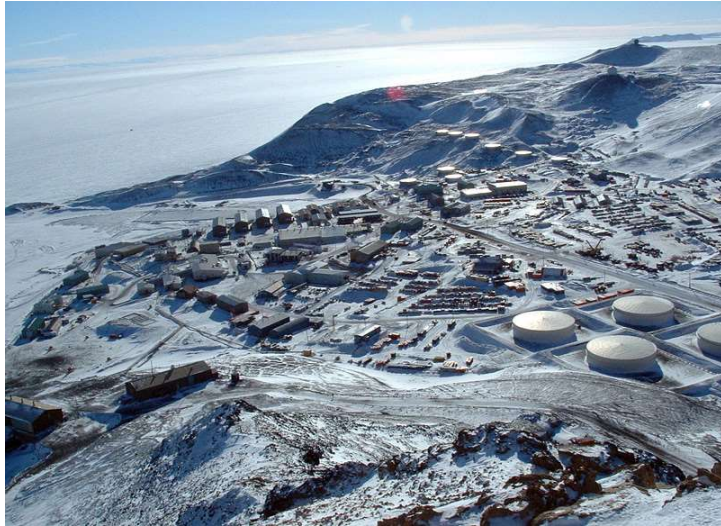
NASA's Human Research Roadmap <https://humanresearchroadmap.nasa.gov/>

Behavioral Health & Performance

Operations

Research





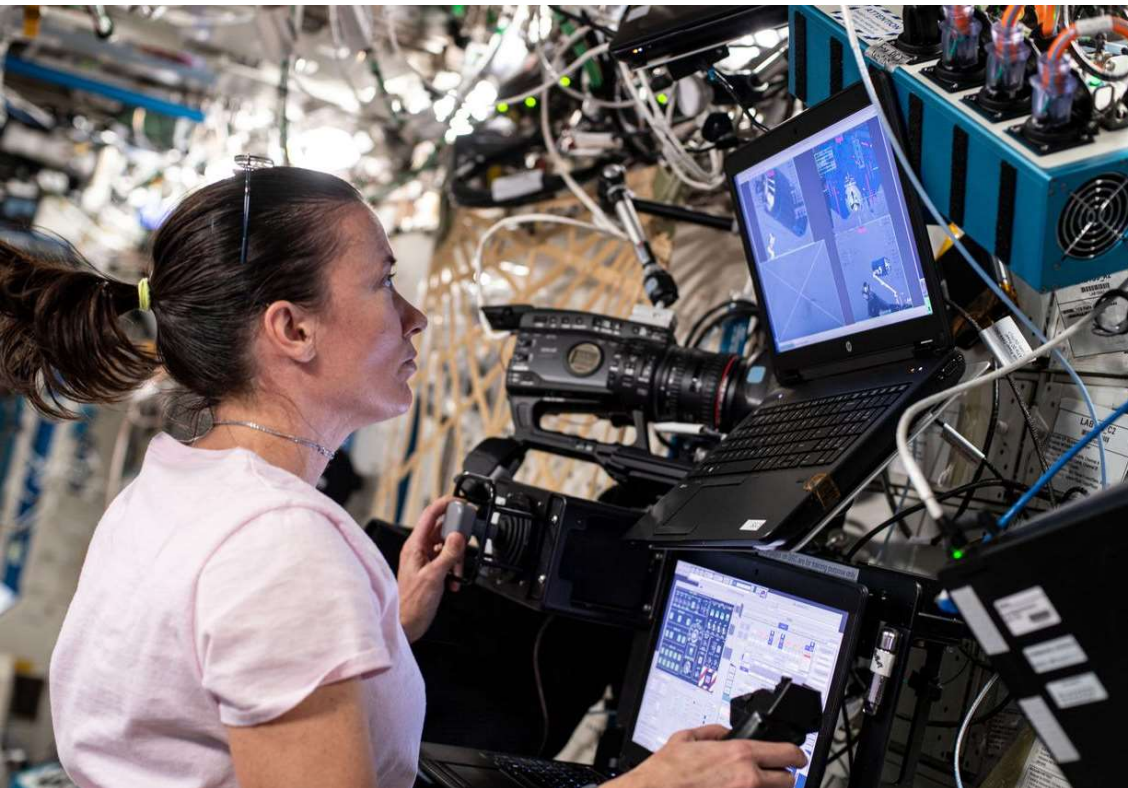
Research in Space and Space Analog Environments

Photo credits: NASA, National Science Foundation /Cody Johnson



Human Factors and Behavioral Performance - Exploration Measures (HFBP-EM)

Blue = Subset of measures administered on the ISS



HFBP-Exploration Measures

Physiology/Biomarkers

Sleep

Heart Rate

Individual Behavioral Health

Personality Assessment

Social Desirability

Depression

Mood and Affect

Neurobehavioral Function

Objective Performance

Cognition

ROBoT

Team & Social Dynamics

Team Performance: MCC Ratings

Team Performance: Crew Ratings

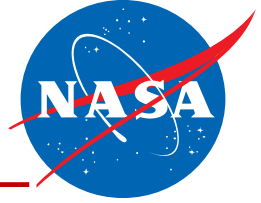
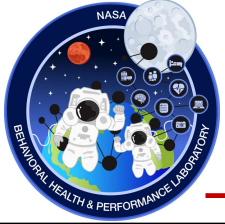
Team Cohesion

Team Processes

Psychological Safety

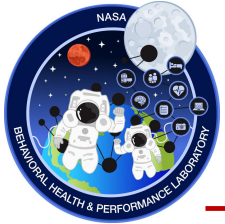
Social Support

Group Living

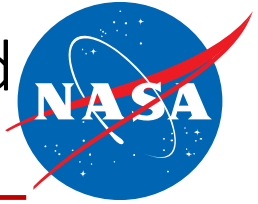


HFBP-EM Harmonized Database

	Indiv. <i>n</i>	Team <i>n</i>	Team Size	Age Mean (SD)	Sex	Education (% advanced degrees)	Military Exp. <i>n</i>	ICE Exp. <i>n</i>
HERA C4	20	5	4	39.26 (8.40)	7F 13M	75%	5	0
HERA C5	16	4	4	36.96 (5.68)	4F 12M	100%	6	2
HERA C6	16	4	4	37.47 (6.38)	8F 8M	100%	2	5
SIRIUS19	6	1	6	34.34 (6.26)	3F 3M	100%	2	4
SIRIUS21	6	1	6	33.63 (5.17)	3F 3M	100%	3	4
ISS	33	15	3 to 11	45.17 (7.20)	11F 22M	100%	NA	NA
Total	97	30	Ground = 4 Space = 7	39.94 (7.90)	36F 61M	95%	NA	NA



Recent Publications with Data from the Harmonized Database: Group Living Scale



ISS008E06699

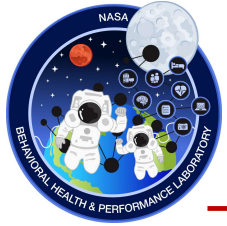
Landon, L. B., Miller, J. C., Bell, S. T., & Roma, P. G. (2024). When people start getting real: The Group Living Skills Survey for extreme work environments. *Frontiers in Psychology*, 15, 1348119.

Development and Validation of a Group Living Skills Survey

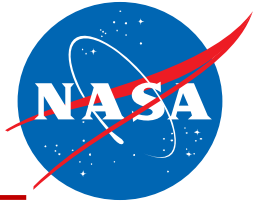
Crew-level referent instructions: In your experience, please rate your level of agreement with the following statements for your entire crew:

1. Clean and tidy with personal items
2. Clean and tidy with work items
3. Uses humor appropriately
4. Appreciates others' knowledge, skills, and abilities
5. Considerate of others' preferences
6. If I were doing another mission, I would want this exact same crew*

Free response: Please feel free to elaborate or provide details on any of the items above.



Recent Publications with Data from the Harmonized Database: Cognitive Performance in Low Earth Orbit



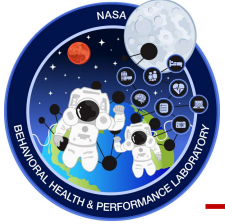
- A study of 25 astronauts on 6-month missions aboard the International Space Station
- Cognitive performance was relatively stable with some differences observed across mission phases and specific subtests
- Slowed performance was observed in early spaceflight for processing speed, visual working memory, and sustained attention
- Risk taking propensity decreased late in flight and post mission

Dev, S., Khader, A., Begerowski, S., Anderson, S., Clement, G., & Bell, S. T. (in press). Cognitive Performance in ISS Astronauts on 6-month Low Earth Orbit. *Frontiers in Physiology*.

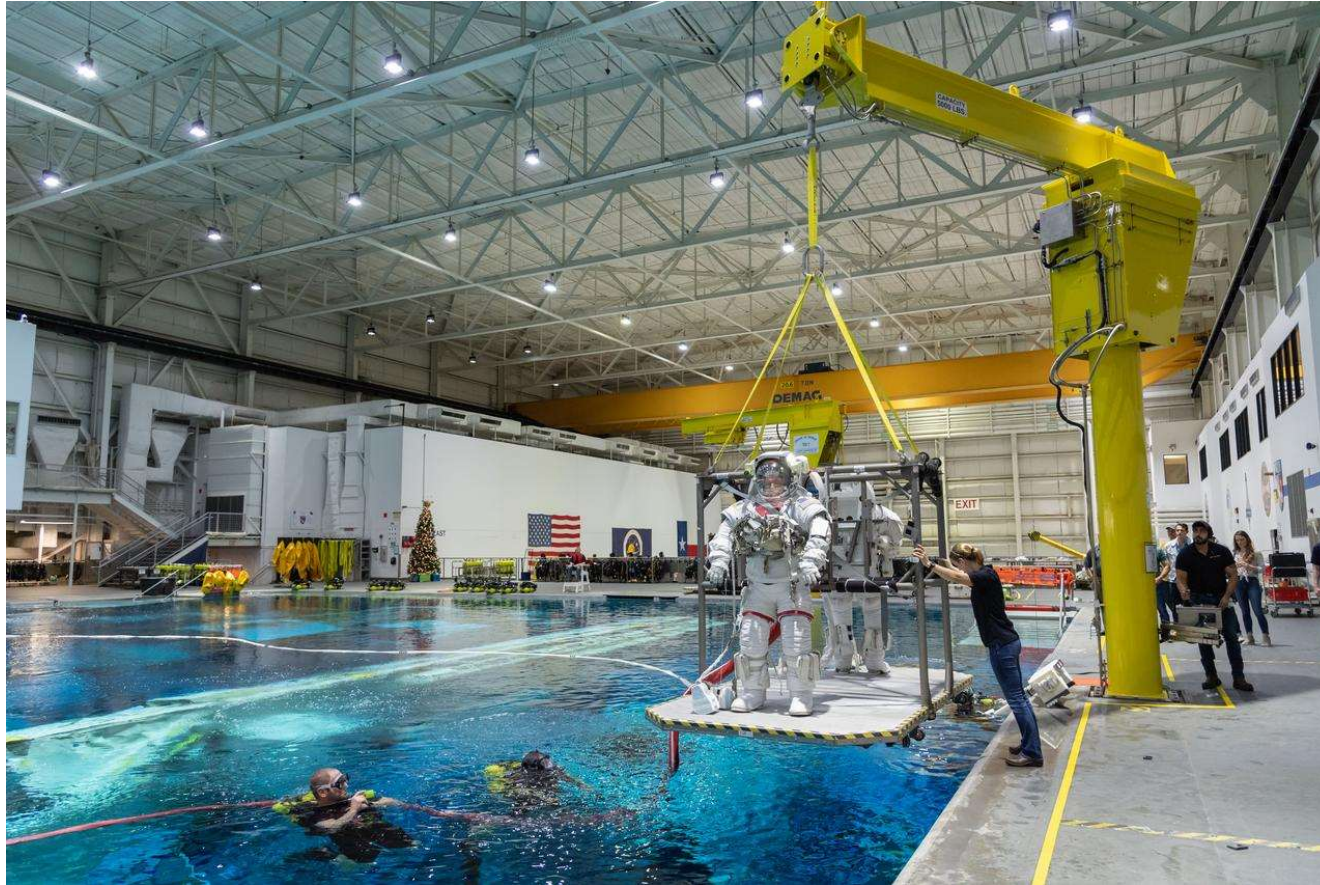
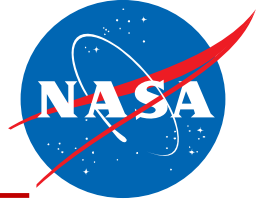


Human Factors and Behavioral Performance Research for Artemis II

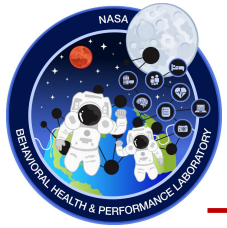
Goal: To utilize Artemis II data to further define the likelihood and consequences of BHealth, Team, HSIA, and Sleep Risks beyond LEO and to create a research infrastructure that can be expanded to include future Artemis missions.



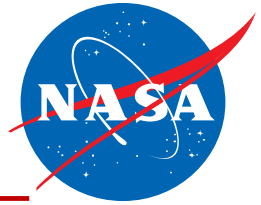
Extravehicular Activity Research



Characterizing risks and determining capabilities needed to inform training, suit design, task design, and concept of operations



Crew Health and Performance Exploration Analog (CHAPEA)



4 person crews in isolation and confinement for 378 days with Mars realistic resource restrictions



Select



Train



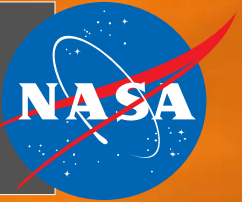
Compose



Train



Self-Correct



**Friends and
Family
Support**

Reintegration

**Design (vehicle,
concept of
operations, etc.)**

Monitor

**Counter-
measures**



Expedition 61 Astronauts



Questions?

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