



— 35th —
**SPACE
STUDIES
PROGRAM**

26 June - 25 August

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São José dos Campos - SP - Brazil

Behavioral Health and Performance for Future Space Exploration

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Agenda

- Module 1: Overview of Behavioral Health and Performance (30 minutes)
- Module 2: Behavioral Health and Performance Interventions and Supports
 - M2a: Astronaut Candidate Selection (45 minutes)
- *15 Minute Break*
 - M2b: Astronaut Candidate and Astronaut Training (30 minutes)
 - M2c: Debriefs (30 minutes)
- Module 3: Behavioral Health of the Future (30 minutes)

Module 1: Overview (30 min)

- Learning objectives
 - Identify spaceflight hazards and psychological stressors likely to impact behavioral health and performance
 - Describe how future spaceflight brings new challenges to behavioral health
 - Describe how operations and research can work together to provide evidence-based supports related to behavioral health and performance

Spaceflight Environmental Stressors

- μ gravity
- Space radiation
- High CO₂
- Launch/entry acceleration/vibration
- Geochemical properties of destination (g, volatiles, dust)
- Noise
- Altered light/dark cycles
- Distance from Earth
- Communication lag
- Hostile/Closed Environment
- Sensory deprivation
- Confinement
- Isolation
- Lack of privacy
- Tasks/workload



Scott Kelly's 1-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”***

Spaceflight Operations

Low Earth Orbit

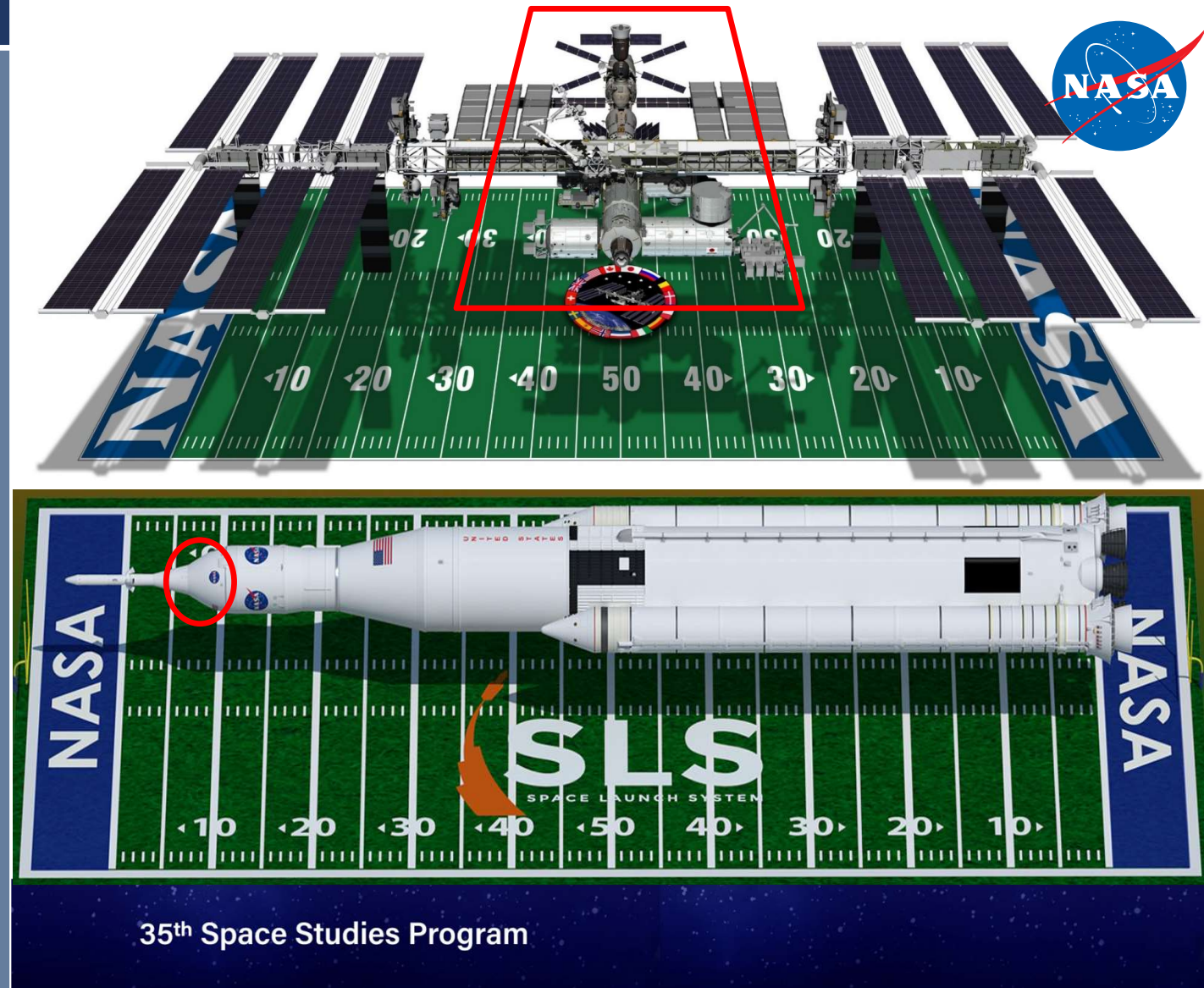
- 6-12 month missions
- Real-time comm. with ground operations, family
- Provision of crew care packages
- Evacuation options
- Cupola and Photography
- High tempo workload
- Private crew quarters

Future Missions

- Orion vehicle is much smaller
- Minimal privacy
- 2 ½ year missions
- 22-minute comm. Delay
- Limited abort capabilities and resupply

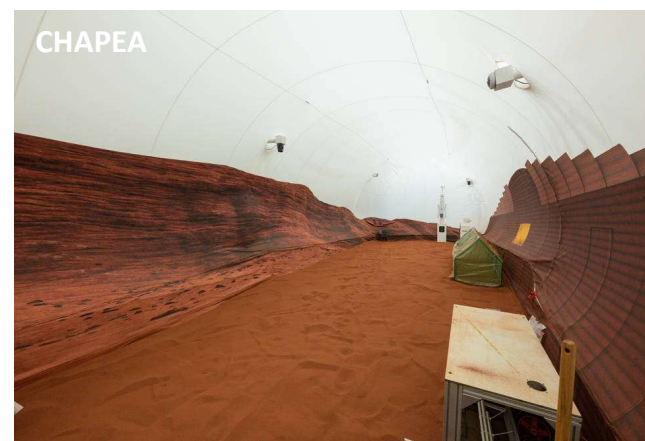
Characterize and Mitigate

- BMed: Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders
- Team: Risk of Performance and Behavioral Health Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team
- Sleep & Human System Integration Architecture

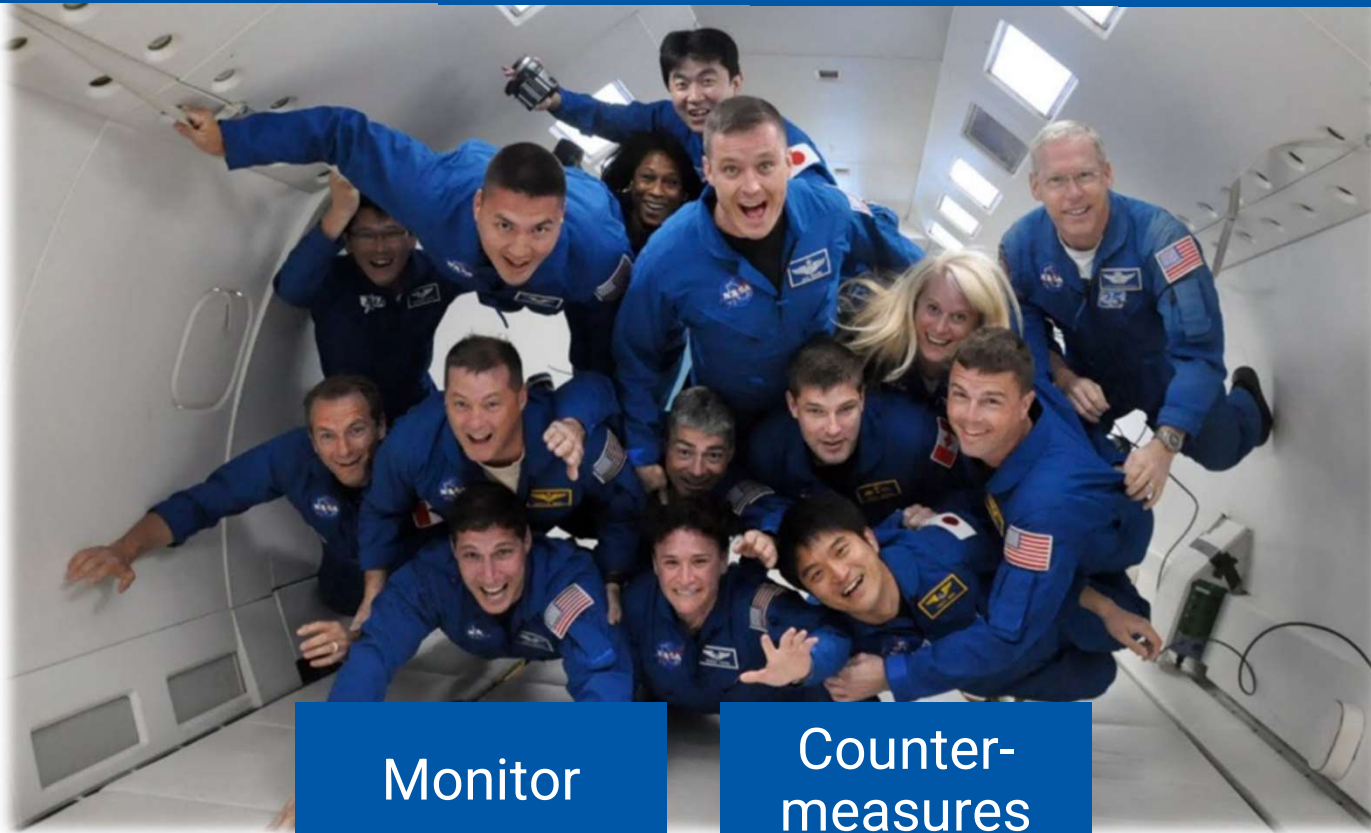


Example Research Analogs

- Human Exploration Research Analog (HERA)
- Crew Health and Performance Exploration Analog (CHAPEA)
- Antarctic Stations (e.g., South Pole)
- Arctic Stations
- NEEMO, deep sea
- Russian NEK
- :envihab
- Healthcare
- Military
- International Space Station



Select → Train → Compose → Train → Self-Correct



Monitor

Counter-measures



Module 1: Your Turn

- How might spaceflight environmental stressors impact the feelings, thinking behavior of astronauts, and ultimately their well-being and performance?

Module 2: Behavioral Health Intervention and Supports

- Learning objectives
 - Describe pre-mission, in-mission, and post-mission behavioral health interventions and support
 - Identify key behavioral health and performance consideration for astronaut candidate selection
 - Describe expeditionary skills and how they may be used in training and development

Behavioral Health Intervention and Supports for Current Flight Operations

- Pre-Mission
 - ASCAN Selection
 - ASCAN Training
 - Astronaut Training
- Post-Mission
 - Reintegration support (family, sleep, meaning)
- In-Mission
 - Private Psychological Conferences (PPC)
 - Private Family Conferences (PFC)
 - BHP family support services
 - Connectivity countermeasures
 - Cognitive assessment
 - Care packages
 - Fatigue management
 - Habitability countermeasures such as private crew quarters, lighting

Operational Psychology & Family Support

movie night



ISS Cupola



(Beven et al.,
2018, AsMA)

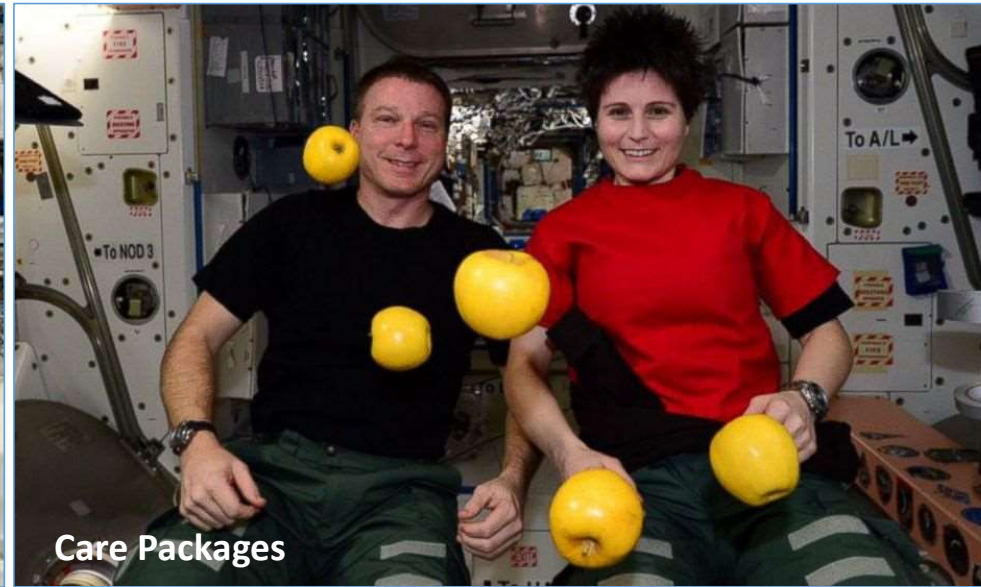
Operational Psychology & Family Support



family call



cognitive monitoring



Care Packages

(Beven et al.,
2018, AsMA)

Behavioral Health Intervention and Supports for Current Flight Operations

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Discussion Break Out (15 minute)

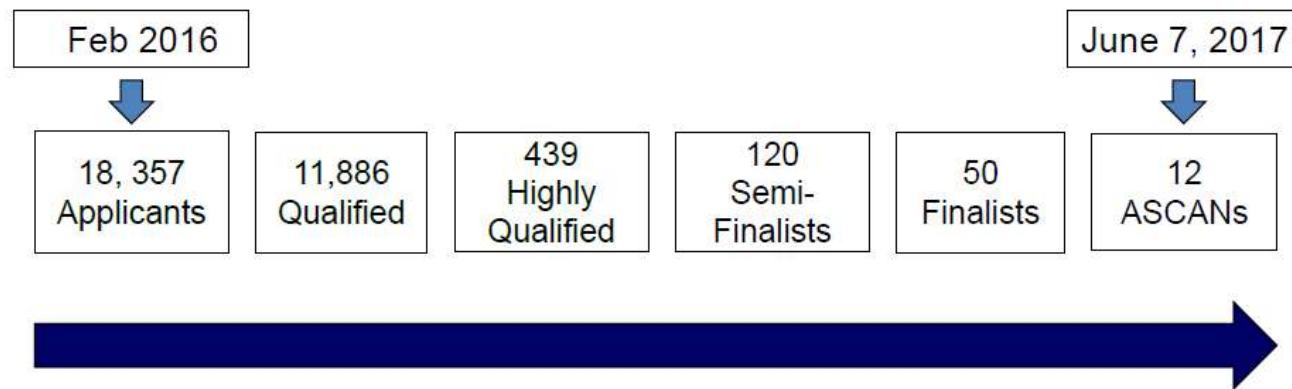
- What makes a good professional astronaut?
- Of these competencies and qualities, which can be trained and which are needed at upon hire?
- Do the requirements differ from professional astronauts to private astronauts?

BHP and Astronaut Candidate Selection

Mission Type: Mars		M
1	Self-Care	95.14
2	Technical	94.21
3	Small Group Living	94.07
4	Judgment	92.57
5	Motivation	92.00
6	Teamwork	91.50
7	Adaptability	91.00
8	Autonomous Worker	89.59
9	Communication	88.86
10	Leadership	87.64
11	Emo Independence	86.00
12	Sociability	85.79
13	Ops Orientation	84.14
14	Emotion Mgmt	83.71
15	Followership	83.29
16	Learner/Teacher	81.93
17	Confidence	81.00
18	Family	75.86

- Astronaut job analysis 2015 update (Barrett et al., 2015)
 - Astronaut SME panels, interviews, survey -> 18 competencies
 - Ranked by importance ratings
- 10 competencies “needed at hire” vs. enhance with training
 - Understanding that training will improve upon existing, high level of competency
- Avoid personality extremes; be team-oriented
- Monitor changes pre/in/post flight

BHP and Astronaut Candidate Selection



- .065% selection rate in 2017
- Psychiatric qualification + psychological suitability + medical qualification



(Beven et al., 2018, AsMA)

Astronaut Selection: Recent ASCAN Classes

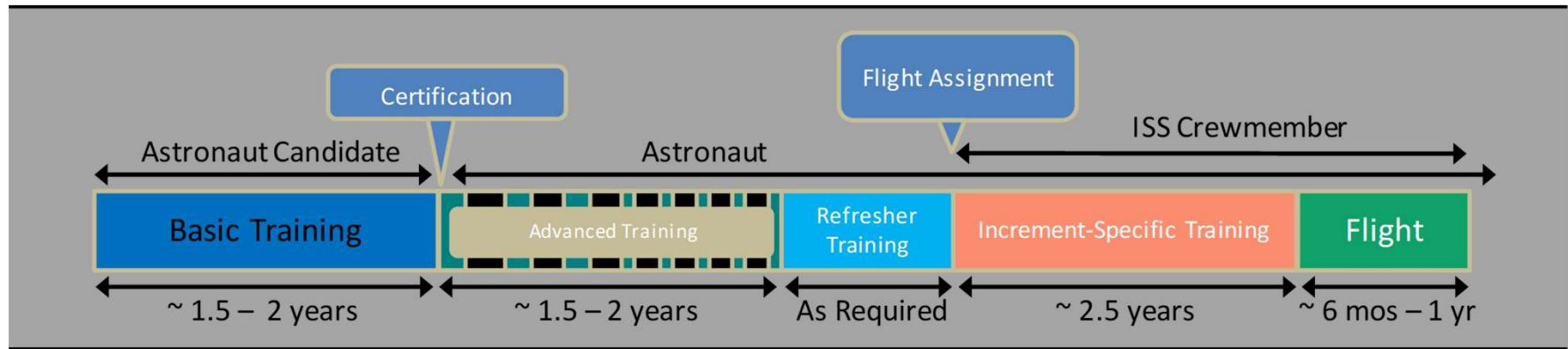
2017 – the “Turtles”

2021 – the “Flies”



with UAE partners

Astronaut Training Flow



- **ASCAN**

- Highly technical
- Some specific BHP and team skills training
- Analogs
 - National Outdoor Leadership School, team events, etc.
- Team skills becoming more prominent
 - Spaceflight Resource Management (SFRM)

- **Pre-Assignment**

- Advanced Training
- Analogs

- **Assigned**

- Technical, but more focused on specific tasks
- BHP
 - Psychological support
 - Psychological preparedness

(Slack, 2016, SIOP)

- **Expeditionary Skills**



35th Space Studies Program

Astronaut Training: Expeditionary Skills

Key Skills

- Self-Care/Self-Management
- Team Care
- Cultural Competency
- Leadership/Followership
- Communication
- Teamwork and Group Living



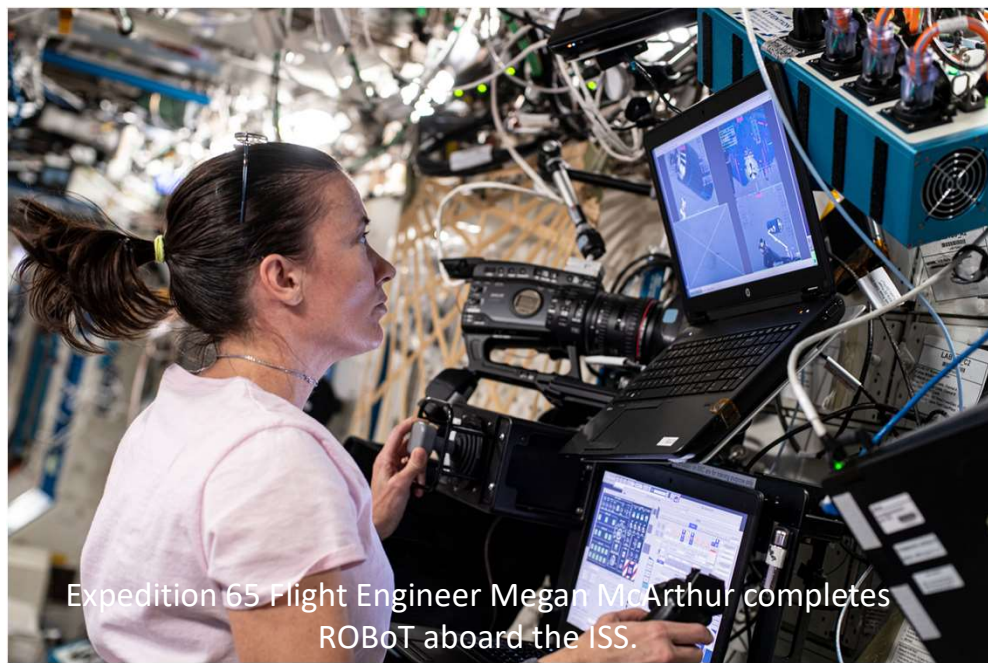
(Landon & Paoletti, 2021)

Module 3: Behavioral Health of the Future

- Learning objectives
 - Understand the challenges to behavioral health and performance the conditions of future space exploration are likely to bring
 - Describe what research is being done, what is needed, and how analog research can be used to characterize the risks and potential intervention and supports of the future

Example Projects: Human Factors Behavioral Performance (HFBP) Exploration Measures

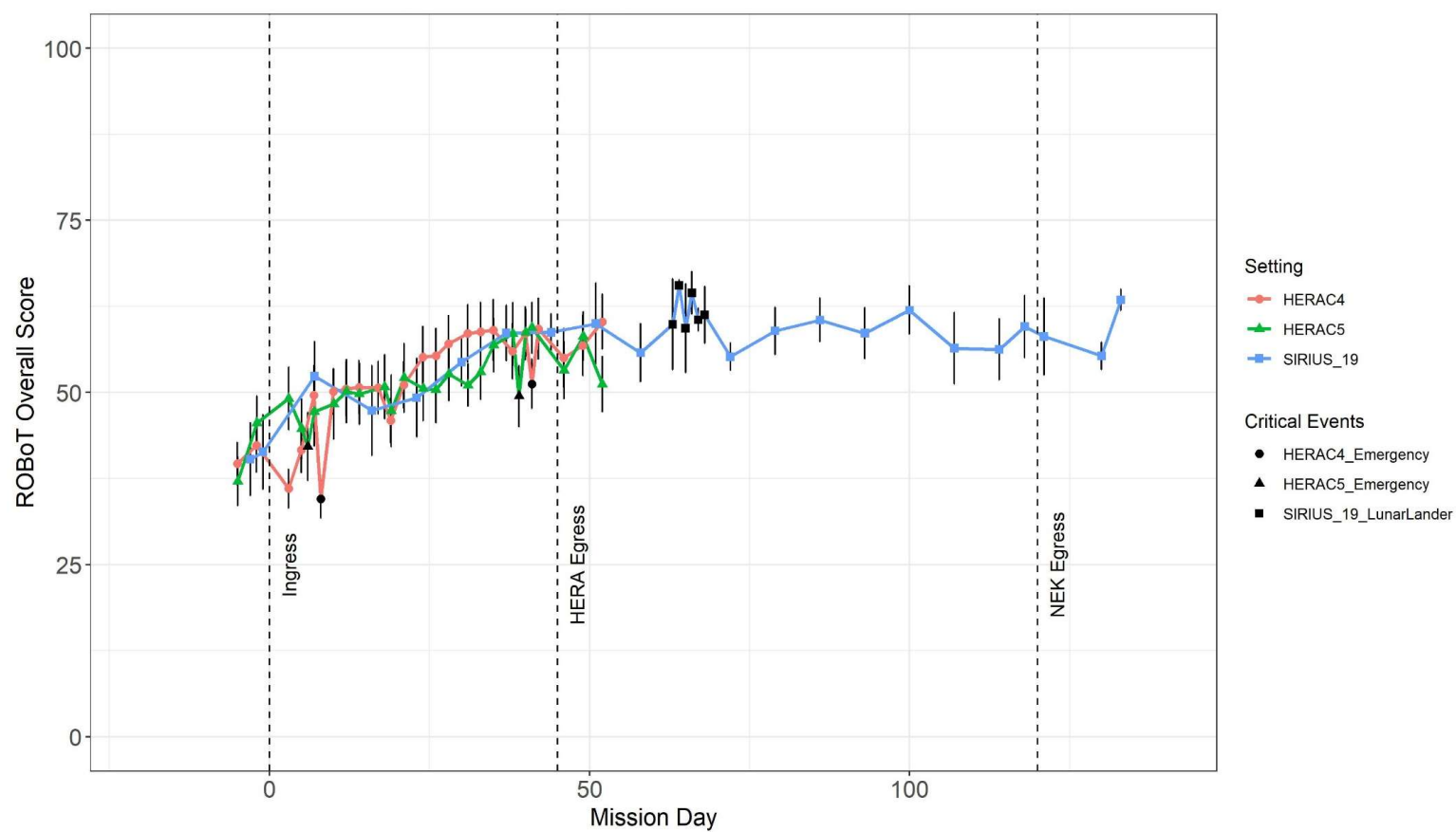
Blue = Subset of measures administered on the International Space Station (ISS)



Expedition 65 Flight Engineer Megan McArthur completes ROBoT aboard the ISS.

HFBP-EM	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

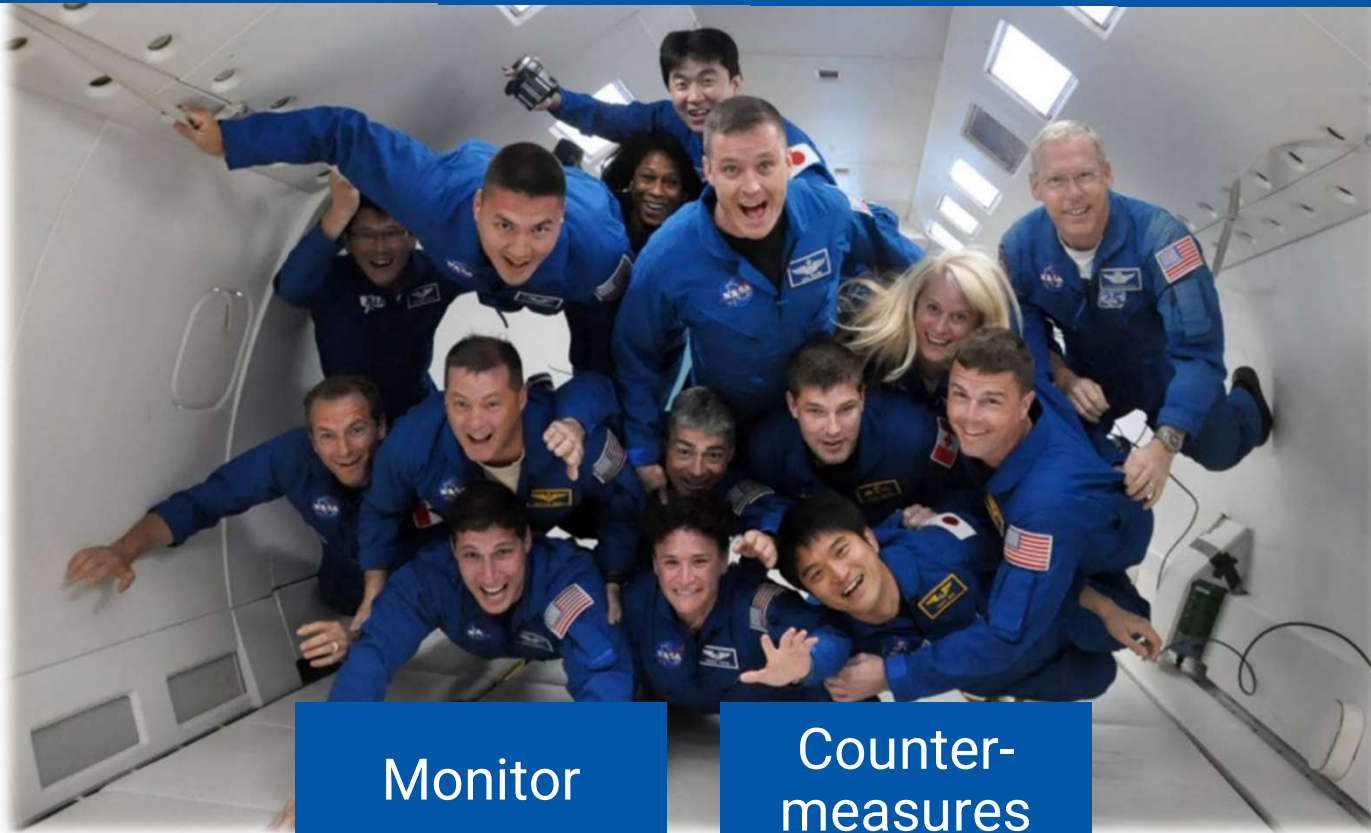
ROBoT-r, Operationally Relevant Performance Across Research Settings Over Time



Example Projects: Human Factors and Behavioral Performance Research for Artemis II



Select → Train → Compose → Train → Self-Correct



Monitor

Counter-measures



Example Projects: TEAMSTaR (Tool for Evaluation and Mitigating Space Team Risks)

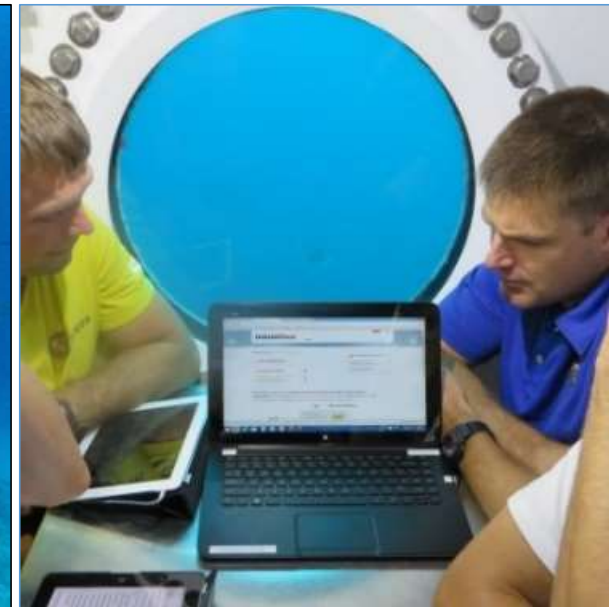
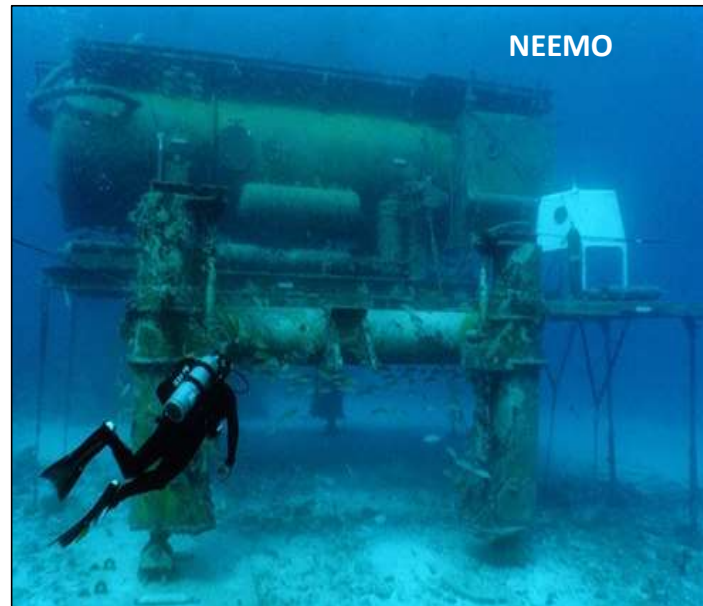
Team composition decision support system that can be used by mission stakeholders to predict how a hypothetical team's social relationships are likely to evolve and influence crew performance over the course of a mission.

With collaborators N. Contractor, L. DeChurch, & Alina Lungeanu
Northwestern University

Example In-Mission Self-Support: Debriefs

- Debriefs → 20-25% performance improvement

(Tannenbaum & Cerasoli, 2013;
Tannenbaum et al., 2015; DeChurch et al., 2022)



Module 3: Project Team Reflect & Adapt

- Break into project groups
 - What does it mean to have a successful project team?
 - What is contributing to our success so far as a team?
 - What are areas of opportunity to help drive our project to completion?



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Thank You

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