TEAMS IN SPACE:

Knowledge gained, and more to explore

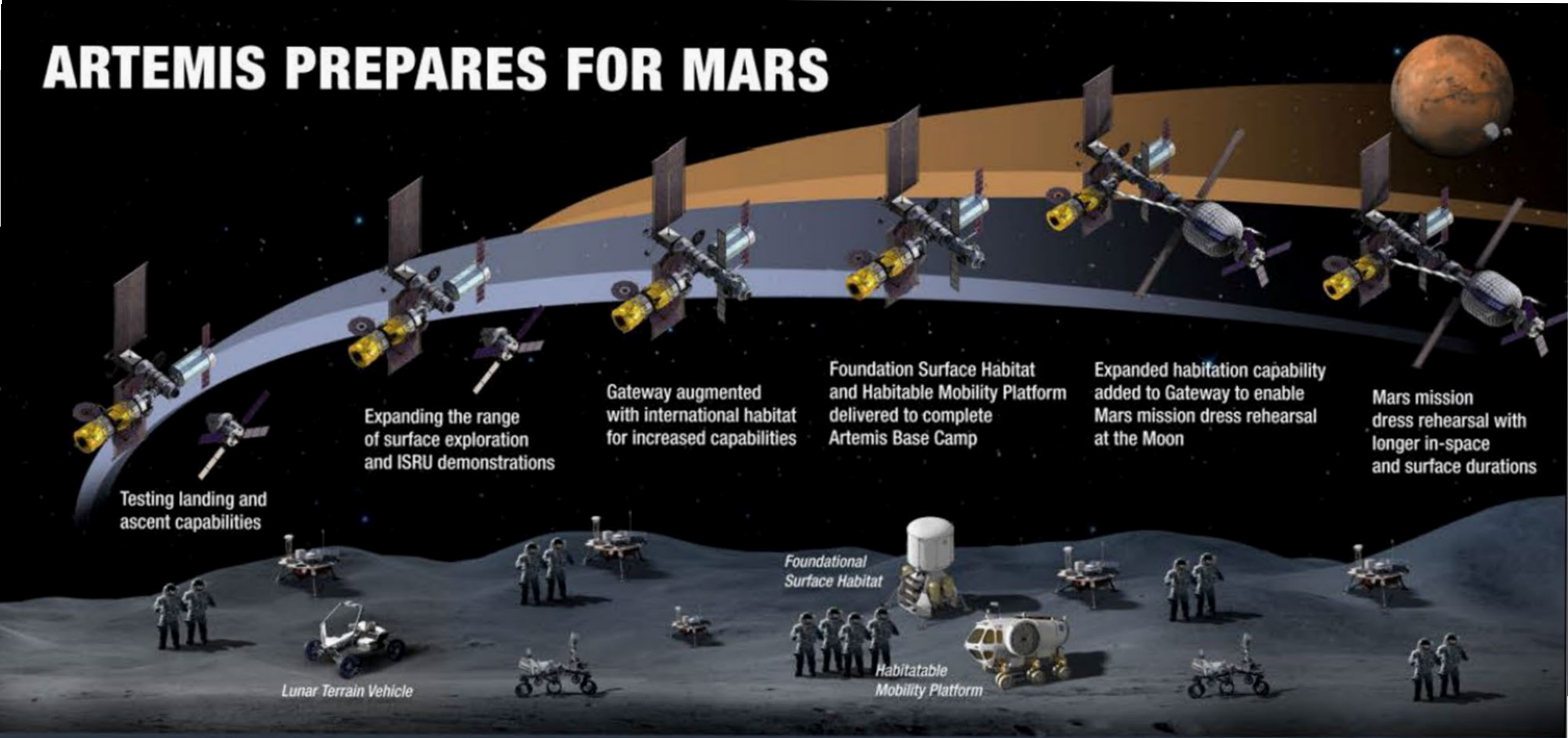
Lauren Blackwell Landon[1] & Suzanne T. Bell[2]

Behavioral Health & Performance (BHP) Laboratory

[1]KBR; [2]NASA; Johnson Space Center

lauren.landon@nasa.gov; suzanne.t.bell@nasa.gov

ARTEMIS PREPARES FOR MARS



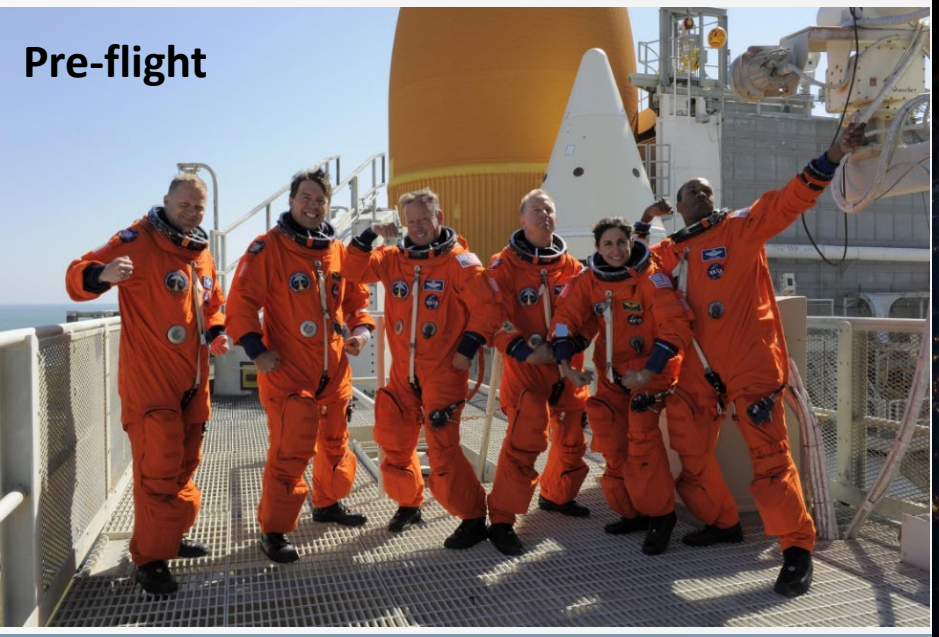
SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION

MULTIPLE SCIENCE AND CARGO PAYLOADS | INTERNATIONAL PARTNERSHIP OPPORTUNITIES | TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS

For effective teams, 2 + 2 = 5

Spaceflight Teams

Crew in space



Pre-flight

Launch

MCC in Houston

Spaceflight Environmental Stressors

- Space radiation
- Altered light/dark cycles
- High C02
- µgravity
- Acceleration/vibration
- Geochemical properties of destination (g, volatiles, dust)
- Sensory deprivation
- Noise

- Tasks / workload
- Isolation
- Confinement
- Comm delay
- Lack of privacy

Interdisciplinary Research is Key

Select → Compose → Train → Self-Correct

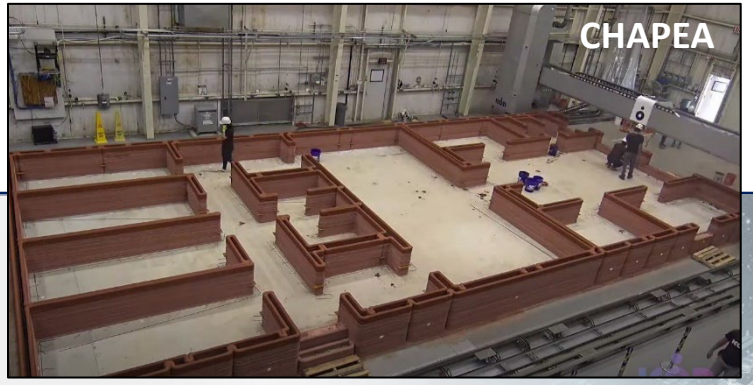
Monitor

Counter-measures

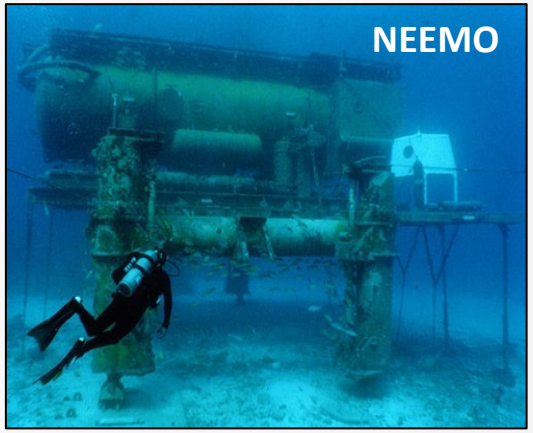
Analogs

Military

HERA
HYGIENE MODULE

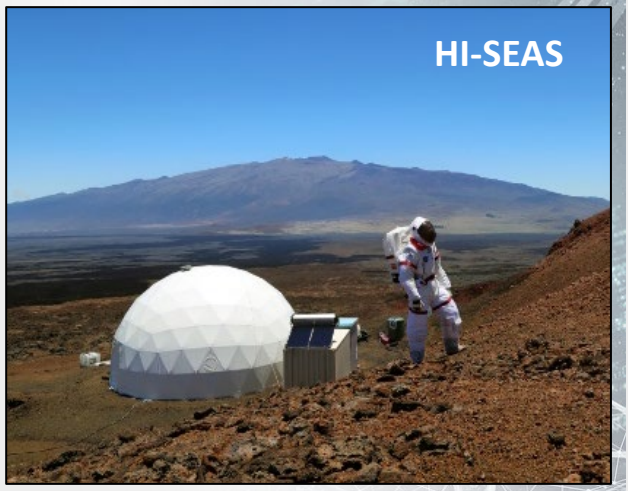

CHAPEA

Aviation


NEEMO

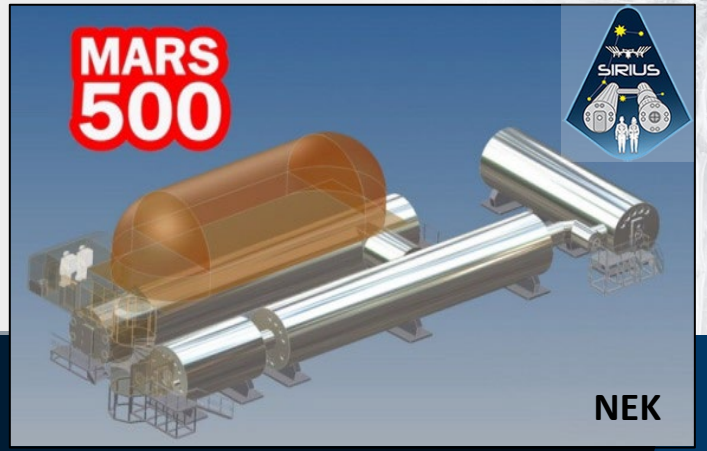
Antarctica

ISS


HI-SEAS

:envihab

Healthcare


MARS
500
SIRIUS
NEK

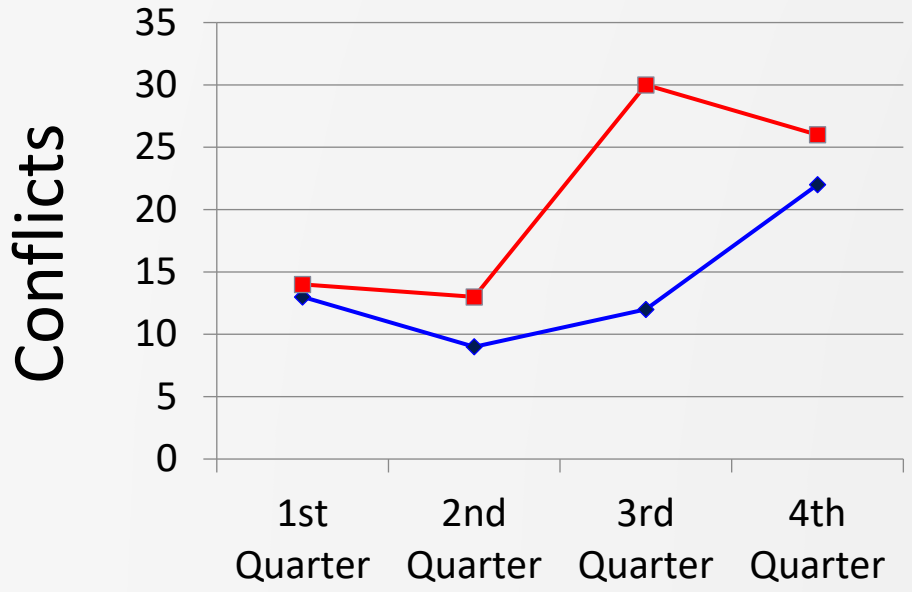
Interpersonal Relationships – duration matters

Over time, conflict increases and communication/cohesion/positivity decreases

ISS Astronaut Journals Studies

- Journal entries on **conflict by mission quarter** (Stuster, 2010, 2016)

(group interaction comments- red n=718, blue n=244)



Mission simulations – *all had conflict*

- Conflict in ICE/ICC differs
  (Marcinkowski, Bell, & Roma, 2021)
  - Early minor tensions → conflicts later
  - Discords vs disagreements vs tensions vs breakdown

- Cohesion declines w/in crew, w/ "ground"

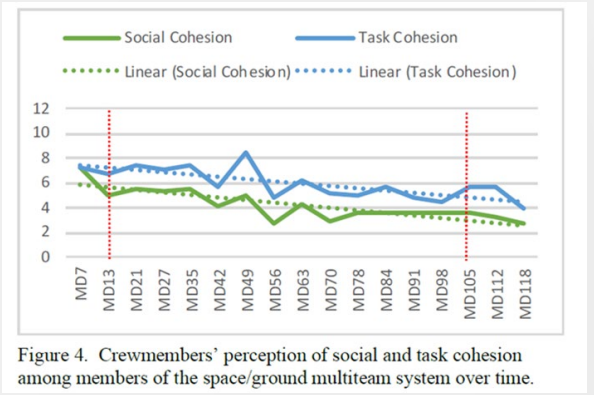
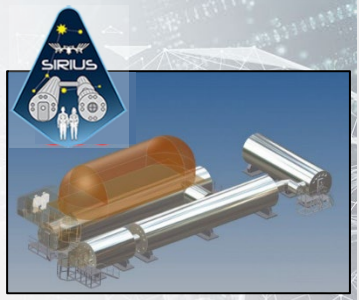


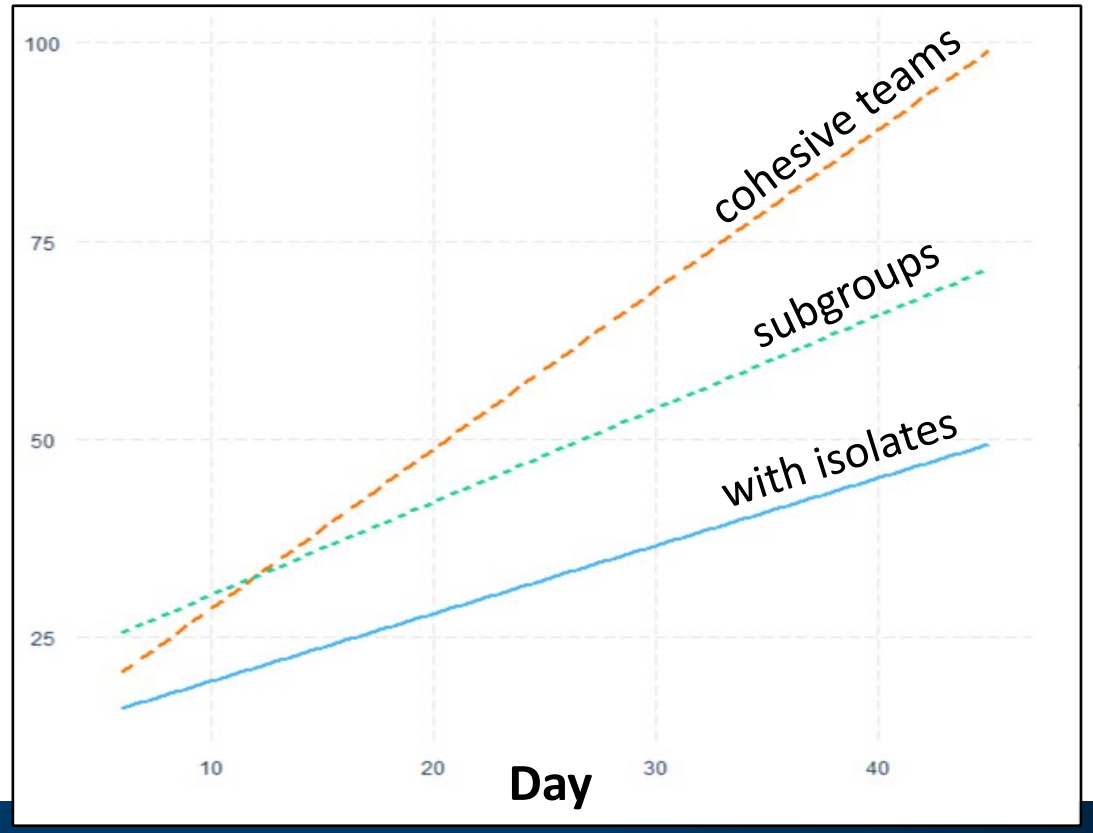
Figure 4. Crewmembers' perception of social and task cohesion among members of the space/ground multiteam system over time.



Teams in ICE

Cohesion predicts objective performance

- **Meta-analytic evidence, analog evidence** – reciprocal relationship
  (Kozlowski et al., 2019; Gedik et al., 2022)
- **Example:**



HERA C4/5 Multi-Mission Space Exploration Vehicle (MMSEV) task

(PI: Suzanne Bell, with Institute of Biomedical Problems (IBMP) Co-Is Gushin, Vinokhodova)

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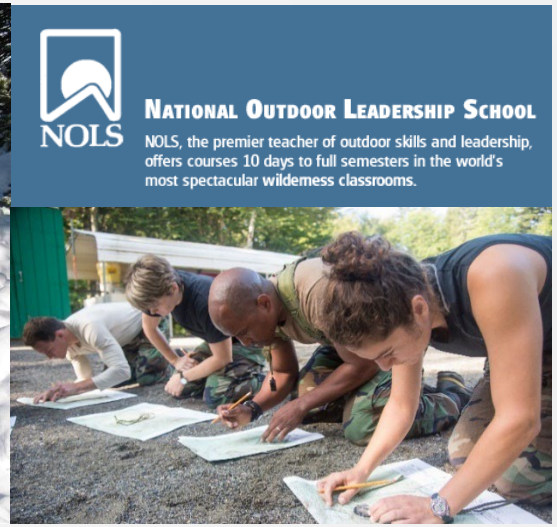
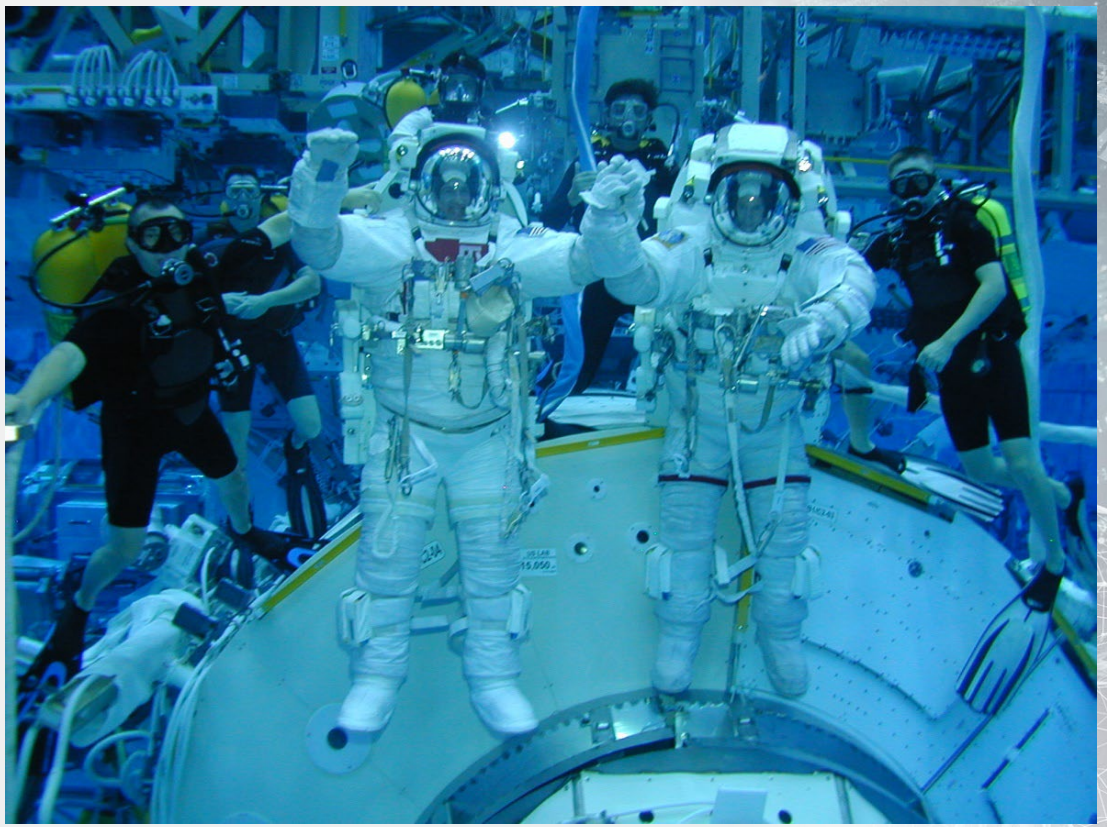
Astronaut Training: Expeditionary / Crew Office Skills

5 Key Skills

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





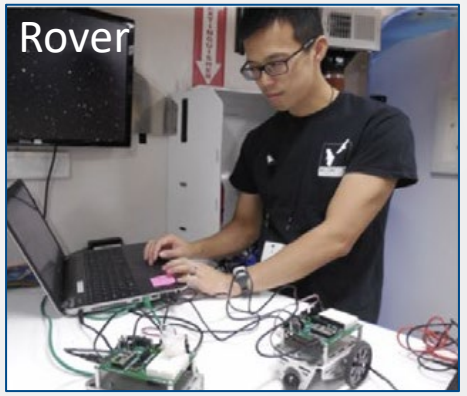
(Landon & Paoletti, 2021)

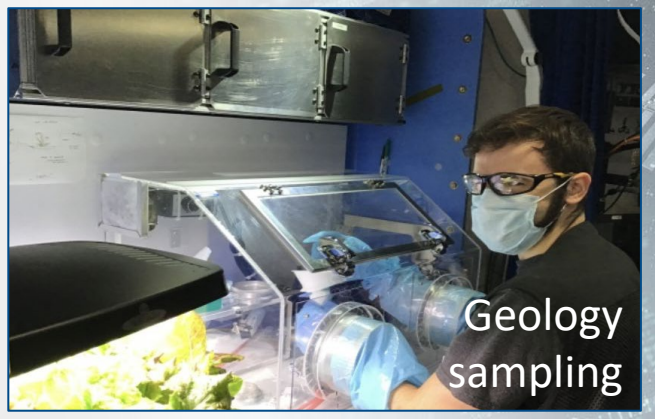
Interpersonal Relationships & Cohesion

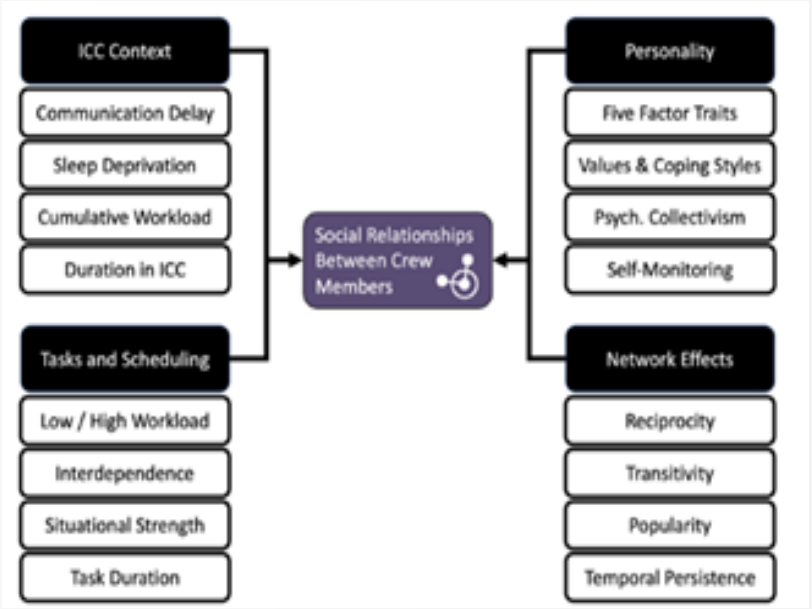
Data-driven, dynamic team composition can support interpersonal relationships

- HERA C3/C4 data used to build crew pairing prototype
- HERA C5 tested prototype

❖ **Finding:** 'Best' pairings increased constructive, decreased destructive effects to relationships

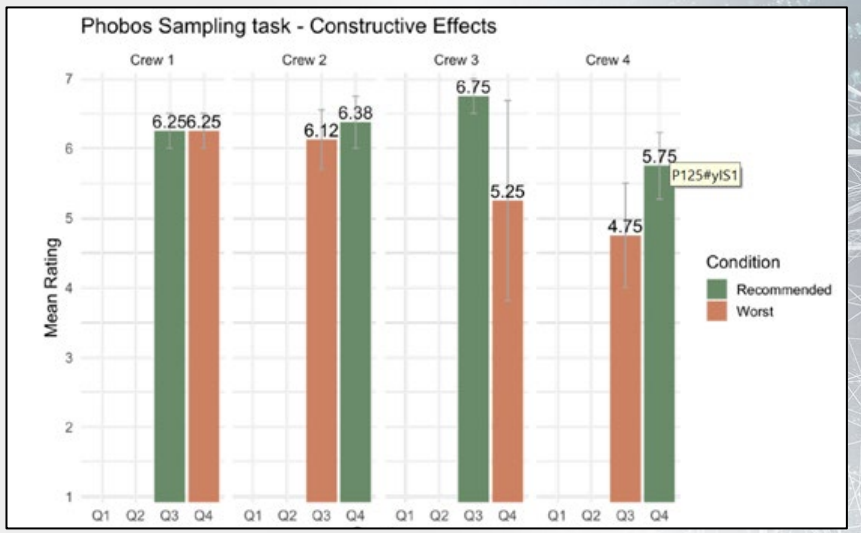




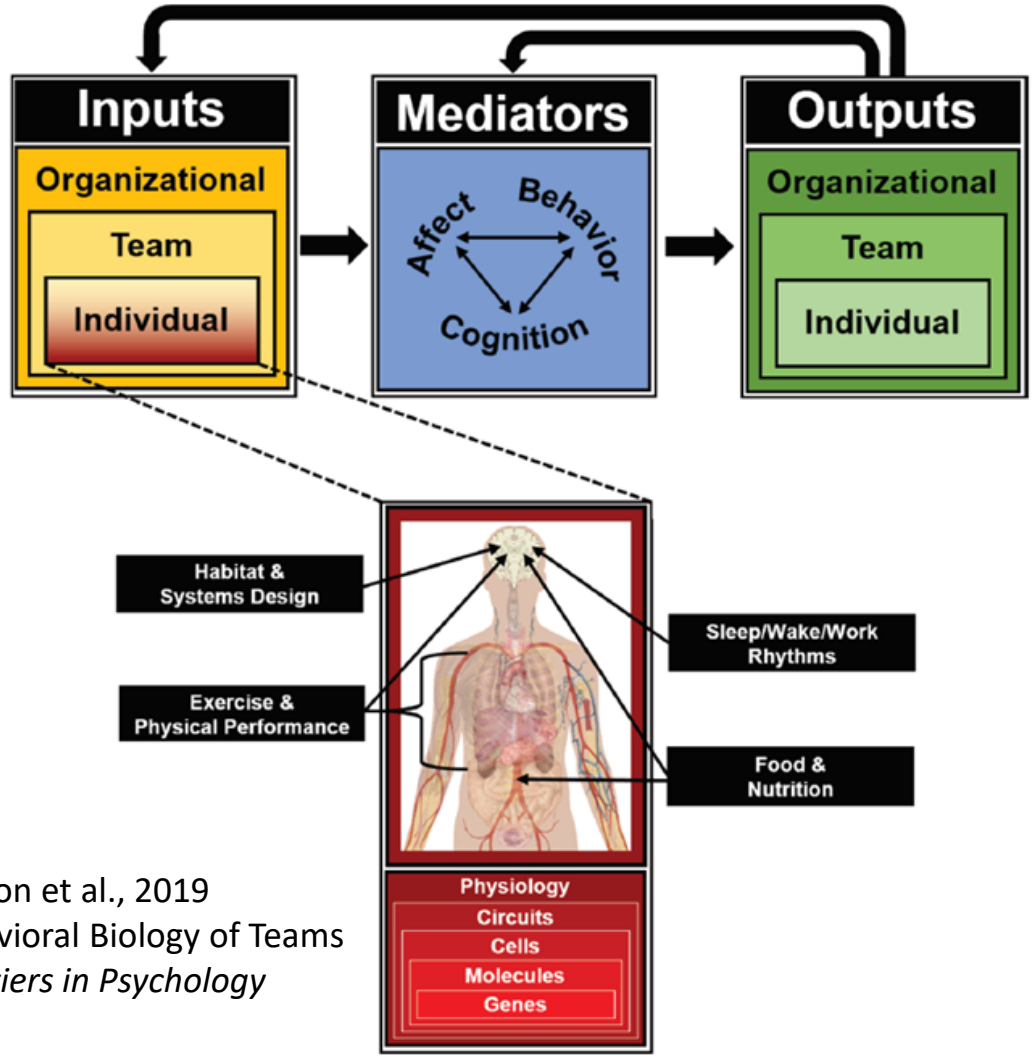


	Quarter 1: Days 1-11	Quarter 2: Days 12-22	Quarter 3: Days 23-34	Quarter 4: Days 35-45
Crew 1	Best pairing (CMD-MS1) (FE-MS2)	Worst pairing (CMD-FE) (MS1-MS2)	Best pairing (CMD-MS1) (FE-MS2)	Worst pairing (CMD-FE) (MS1-MS2)
Crew 2	Worst pairing (CMD-MS2) (FE-MS1)	Best pairing (CMD-MS1) (FE-MS2)	Worst pairing (CMD-MS2) (FE-MS1)	Best pairing (CMD-MS1) (FE-MS2)
Crew 3	Best pairing (CMD-FE) (MS1-MS2)	Worst pairing (CMD-MS1) (FE-MS2)	Best pairing (CMD-FE) (MS1-MS2)	Worst pairing (CMD-MS1) (FE-MS2)
Crew 4	Worst pairing (CMD-MS2) (FE-MS1)	Best pairing (CMD-FE) (MS1-MS2)	Worst pairing (CMD-MS2) (FE-MS1)	Best pairing (CMD-FE) (MS1-MS2)

(Antone, Lungeanu, DeChurch, Bell, Contractor, 2021, IAC proceedings)



BHP Lab at Johnson Space Center



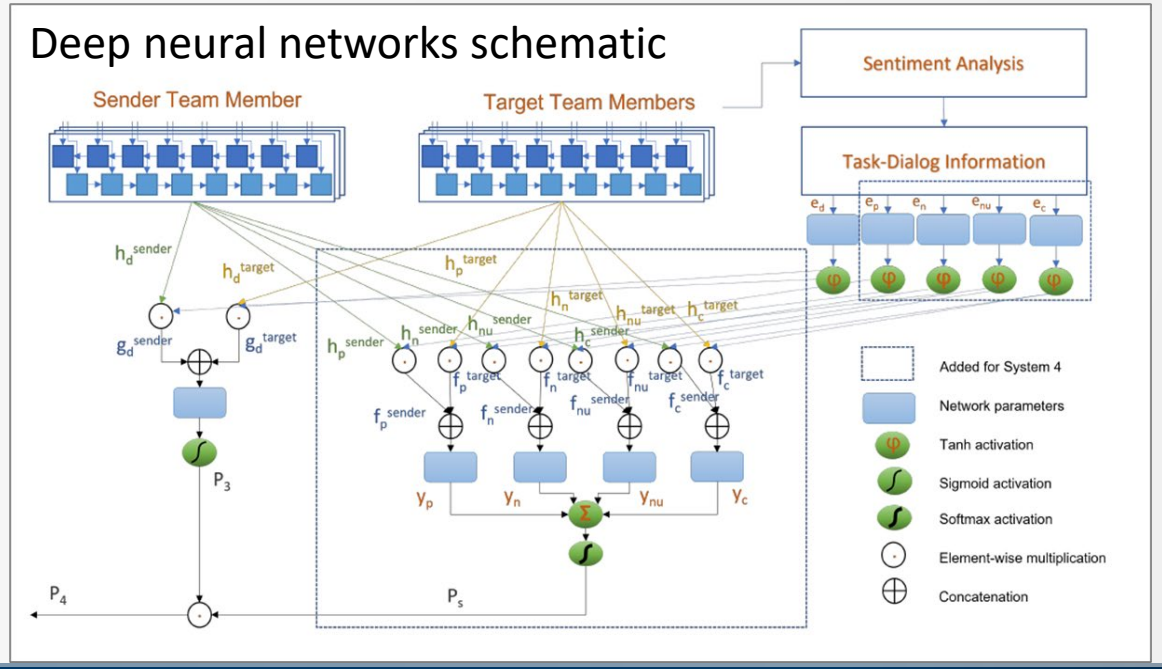
Landon et al., 2019
Behavioral Biology of Teams
Frontiers in Psychology

BHP Lab expertise

- SMEs in:
  - Industrial/Organizational psychology
  - Health psychology
  - Neuroscience / clinical neuropsychology
  - Sleep/fatigue
  - Statistics and complex research coordination
- Conducting research in mission simulation analogs and extreme environments
- Interdisciplinary work with application to medical and operations settings

Selected BHP Lab Projects

- Small sample sizes, but rich longitudinal datasets
- Standard Measures in extreme environments
  - Data harmonization across environments
- Micro-behaviors AI detection in HERA (PI: T. Chaspari)



Standard Measures

- Cognition, neurobehavioral, sensorimotor
- Mood, well-being
- Team dynamics
- Sleep, fatigue, workload
- Habitability
- Actigraphy
- High fidelity mission tasks (ROBoT)
- Individual and team performance

Goal: feasible, acceptable, validated, unobtrusive, short forms

Deployed in space, space analogs, Antarctica, military

Selected BHP Lab Projects

- DoD partnerships
  - Past project examples:
    - Army War College – comparative norms for astronauts on cognitive test battery (WINSCAT, Cognition)
    - DARPA – measures of allostatic load in mission teams
    - Army MRMC – examining cognition, emotion regulation, and team dynamics under sleep restriction
    - Consulting for Special Forces at Ft. Bragg
  - Army Research Office grant – predictive algorithm of shared mental model convergence over time
    - Analyzed BHP Lab's HERA data and expert ratings
    - PI: Dr. Deanna Kennedy, Uni. Of Washington-Bothell
  - Navy Surface Fleet Sr. Officer Survey - meaningful work to support resilience
    - Deployed BHP Lab's meaningful work items in the Sr. Officer Survey
    - Partnered with Naval Health Research Center

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