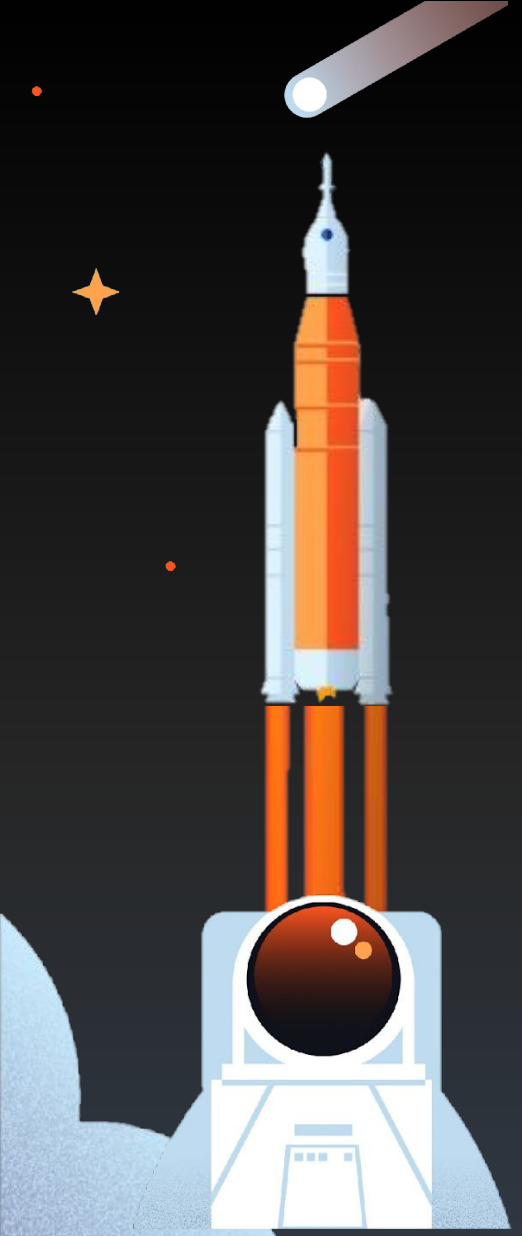


CREW AUTONOMY THROUGH SELF-SCHEDULING: GUIDELINES FOR CREW SCHEDULING PERFORMANCE ENVELOPE AND MITIGATION STRATEGIES

2024 Human Research Program Investigators' Workshop

Jessica J. Marquez, Ph.D. (NASA)

Jimin Zheng (SJSU), Shivang Shelat (SJSU), John Karasinski, Ph.D. (NASA), & John Bresina, Ph.D. (NASA)

Crew Autonomy in HERA C6

Summarizing preliminary results from Crew Autonomy through Self-Scheduling research performed in HERA Campaign 6 (C6).

No crew autonomy

Limited crew autonomy

High crew autonomy

Part of crew autonomy experience was to give crew the ability to conduct **self-scheduling** throughout mission.

What is Self-Scheduling?

Self-scheduling is the ability for an astronaut to autonomously manipulate their own spaceflight schedule.

Currently, ISS astronauts do not have the ability to rearrange schedules. Self-scheduling is a new concept of operations that our team has been exploring for years.

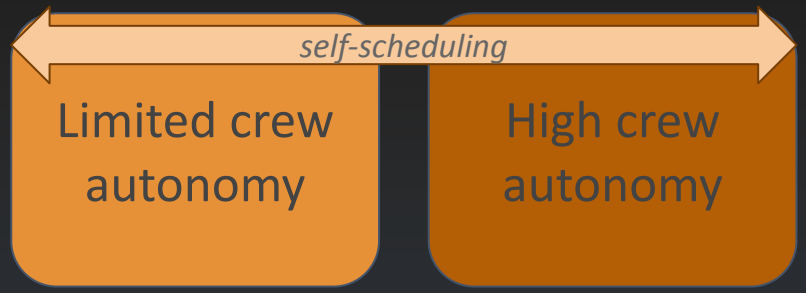
Software Tool + Performance + Operations

Crew Autonomy through Self-Scheduling

Crew Autonomy in HERA C6

Crew self-scheduled:

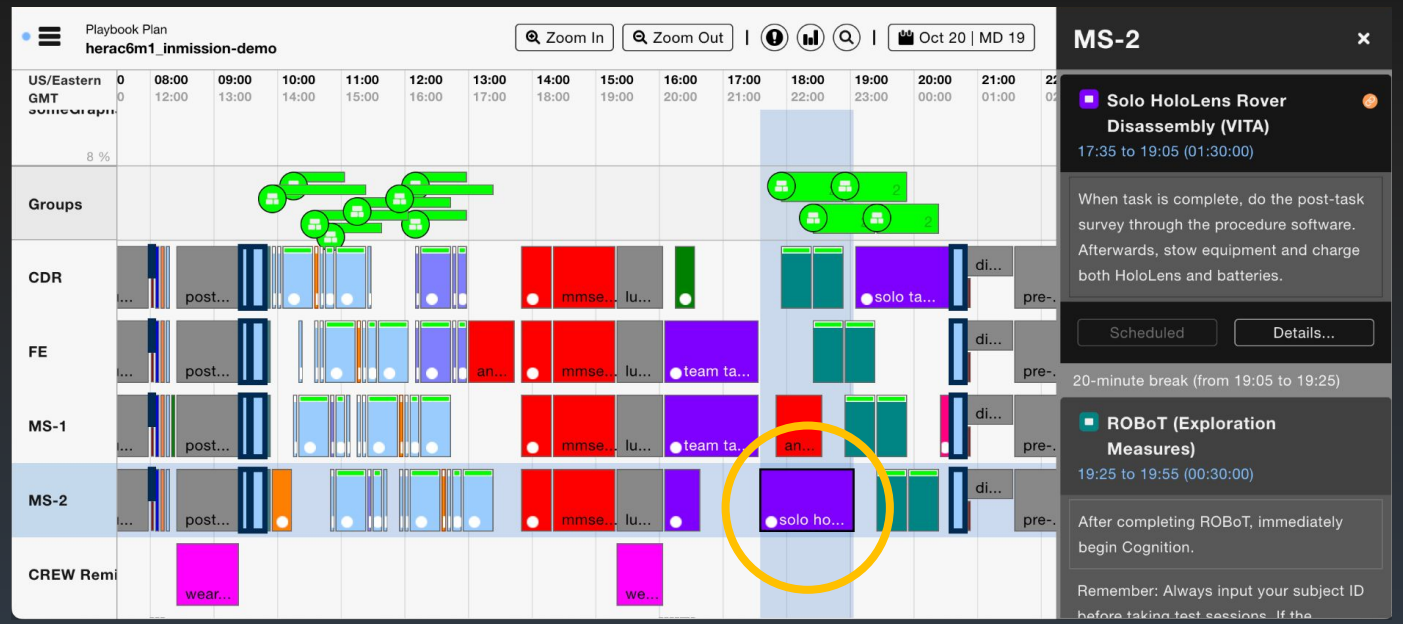
- one day for their whole team (required);
- any flexible day (optional).



Assessing performance and operational impact within missions; evaluating countermeasures between missions.

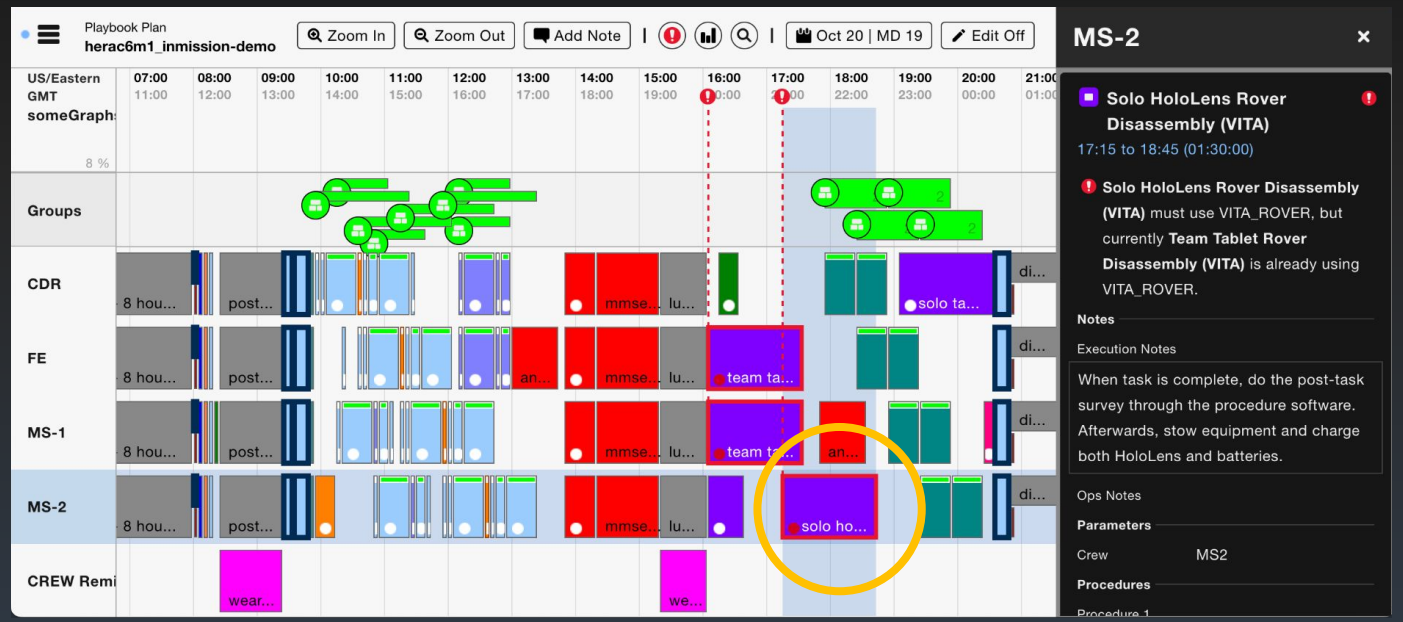
Self-Scheduling in HERA C6

Timeline has activities / groups that are either flexible or not flexible.



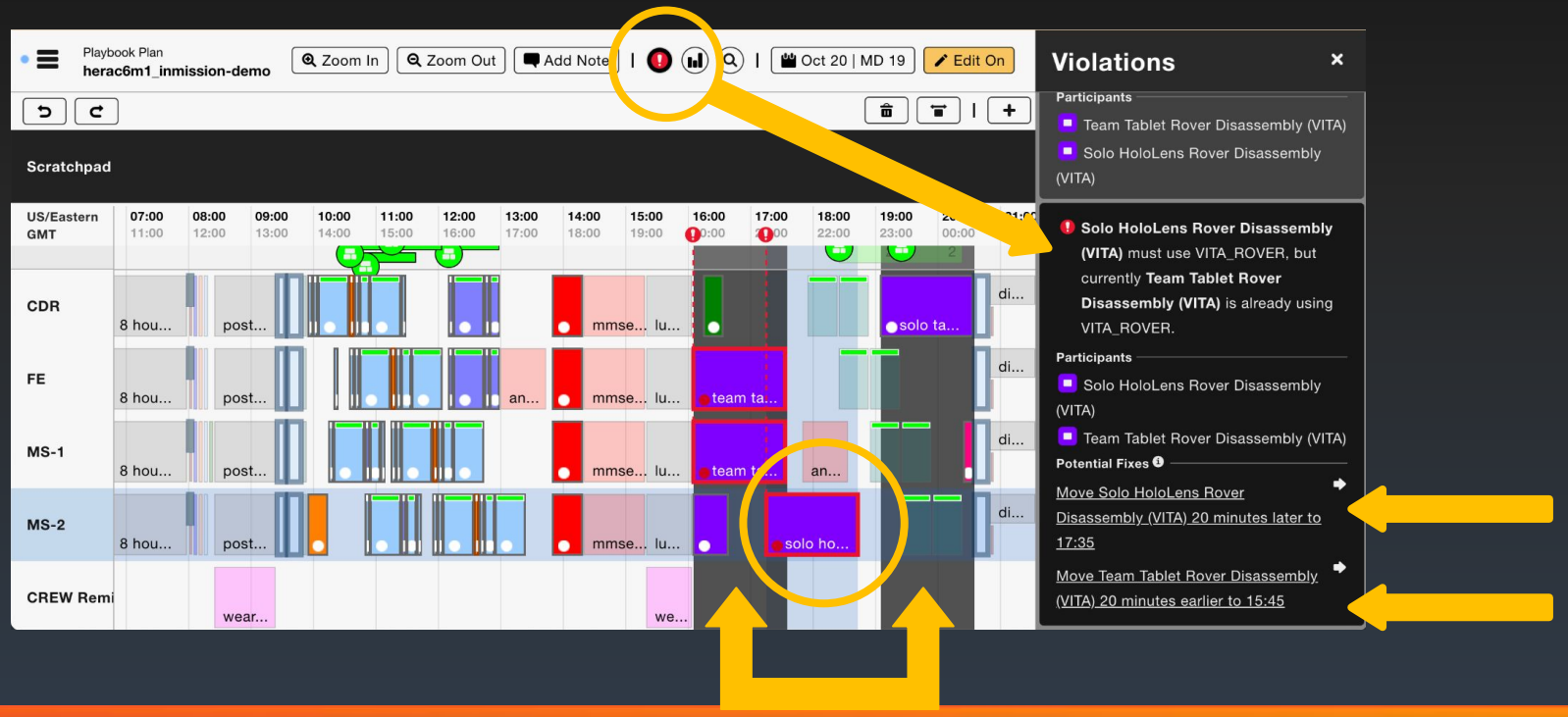
Self-Scheduling in HERA C6

Rescheduling can lead to violations — i.e., activity doesn't meet plan requirements and/or constraints.



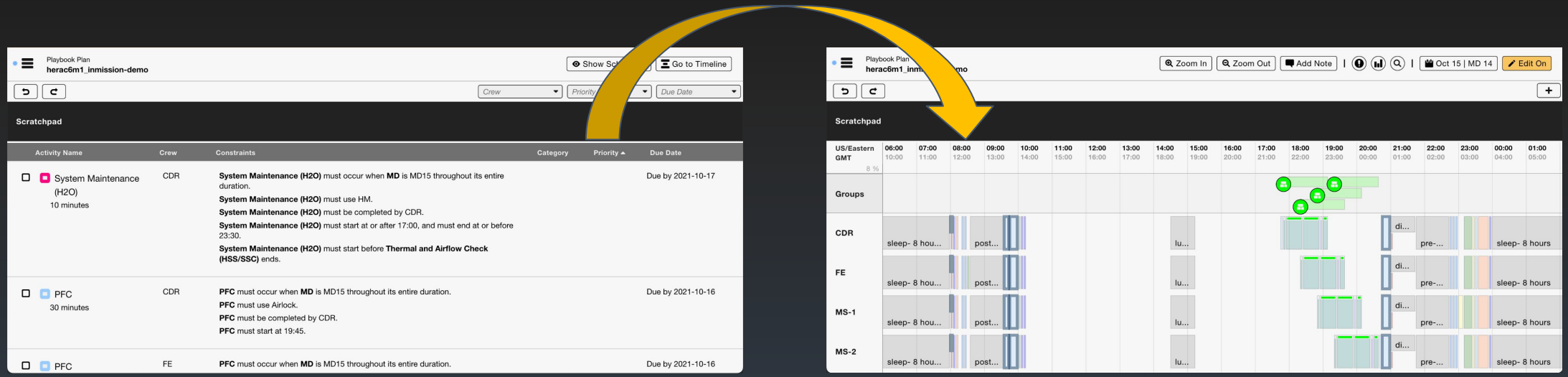
Self-Scheduling in HERA C6

Playbook provides visual countermeasures to help crew fix scheduling violations.



Self-Scheduling in HERA C6

One day is completely scheduled by each crew member, creating a timeline of dozens of activities and groups for team.



Data Collection

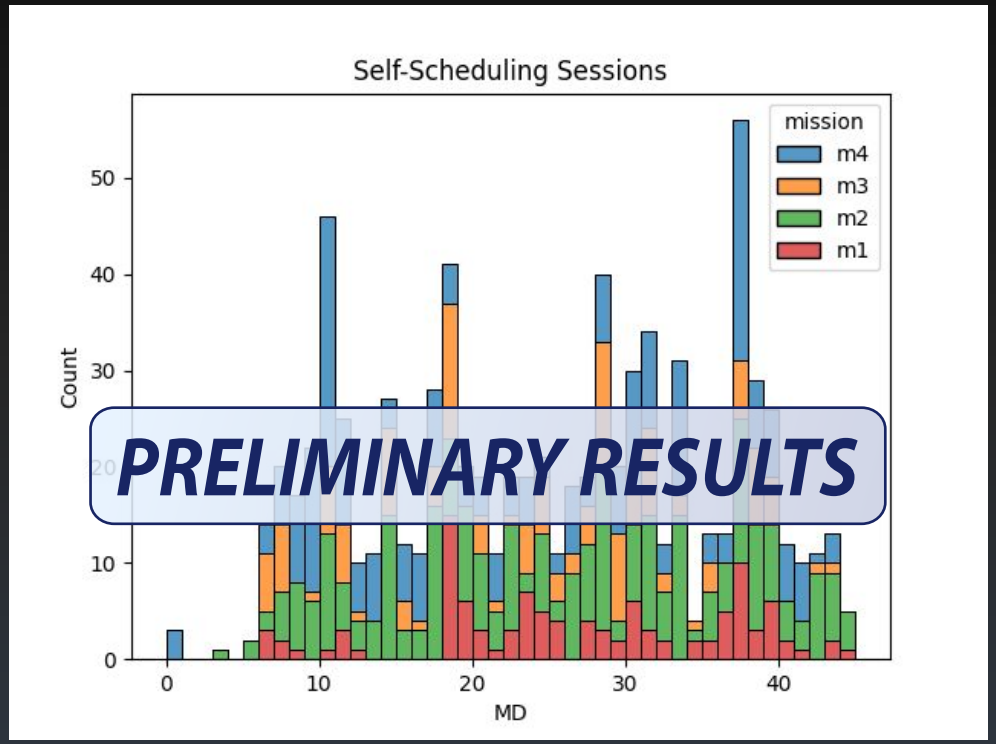
- Counts for spontaneous self-scheduling throughout mission.
- Required self-scheduling day:
  - Voice recordings as proxy for “observing” planning and scheduling process: content analysis of recordings
  - Interaction logs will be post-processed to obtain performance measures related to efficiency and effectiveness: time on task, number of violations
  - Surveys capture workload (NASA-TLX), perceived plan quality (plan goodness), usability

Counts of Self-Scheduling Events

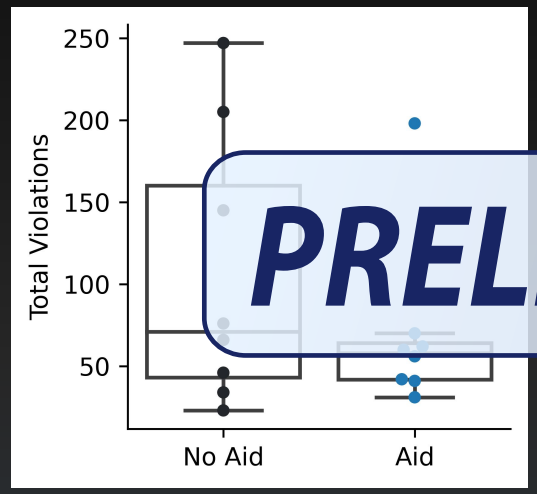
HERA C6 crew conducted spontaneous self-scheduling regularly throughout the mission.

Amount not seemingly affected by presence of countermeasure.

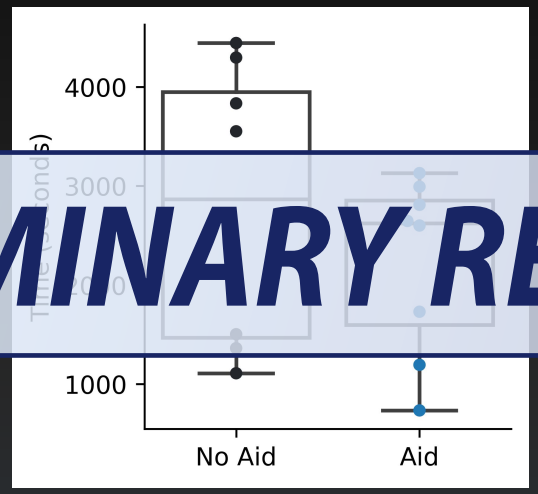
Self-scheduling is impacted by operational circumstances that are not easily tracked or noted.



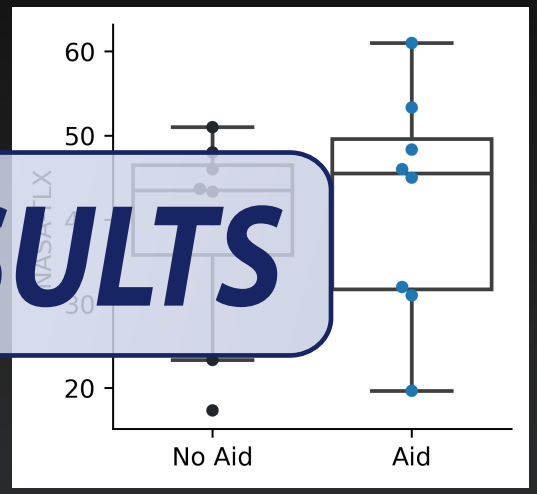
Individual Human Performance (C6)



Countermeasure reduced the number of violations created by crew (from median of 71 to 58).



Countermeasure reduced the time spent on self-scheduling crew (from median of 2866 to 2624; 47.8 min to 43.7 min).

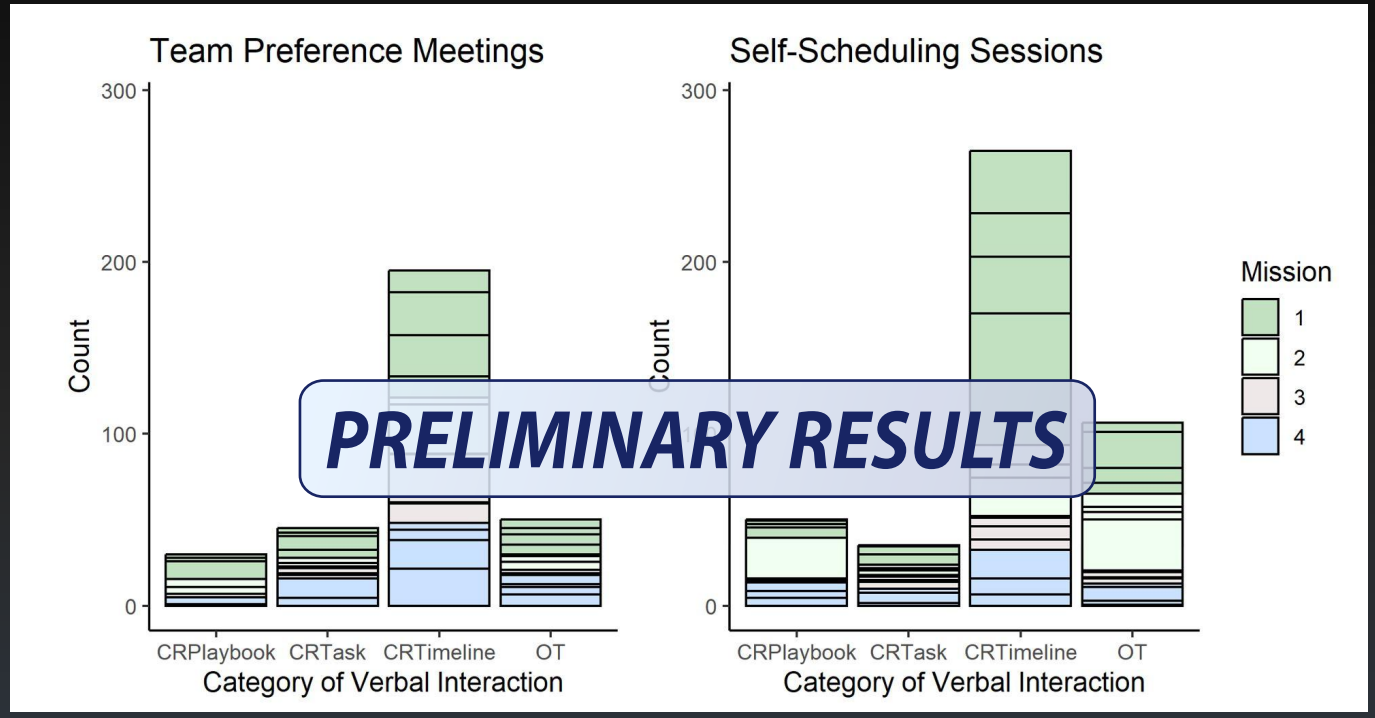


Countermeasure had no effect on workload (from median 43 to 45).

T-tests were not significant

PRELIMINARY RESULTS

Content Analysis



Self-scheduling is more of a collaborative task than expected, despite asking crew to complete task individually.

Future Work

Continued analysis:

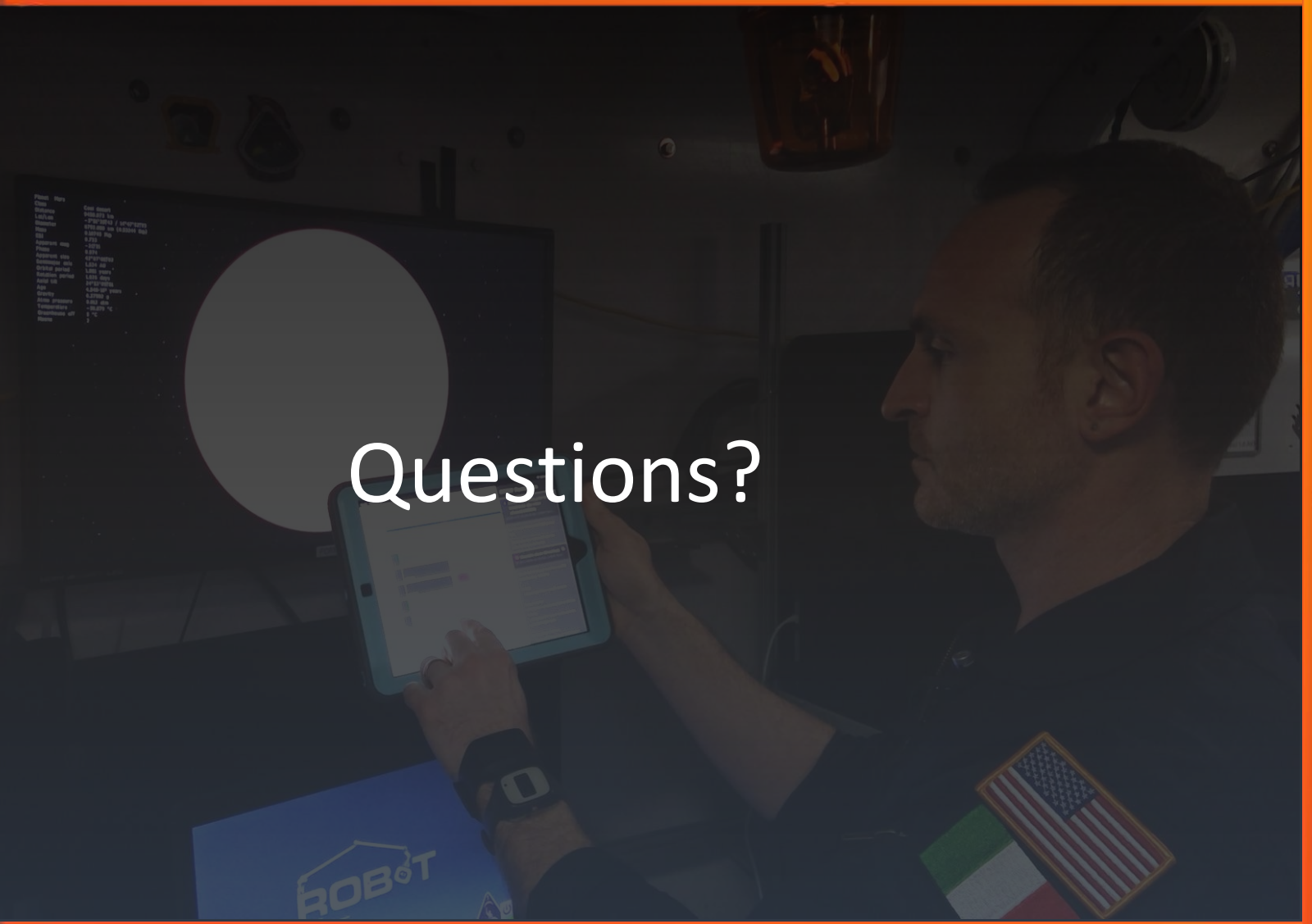
- spontaneous self-scheduling: individual session performance is not feasible but we can investigate operational circumstances (e.g., type of task, comm delay).
- relationship of plan goodness measure against HFBP-Exploration Measures (BHP).

More data collection: participation in HERA C7

- Each crew are required to self-schedule two days, totaling 18% of mission.

Collaboration with Mosier & Fischer addressing improving negotiating crew autonomy between crew and MCC, including self-scheduling.

Questions?



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Relevant Publications from Last Year

Zheng, J., Shelat, S., and Marquez, J.J. (2023, June) Facilitating Crew-Computer Collaboration During Mixed-Initiative Space Mission Planning. *SpaceCHI*. Cambridge, MA.

Marquez, J.J., Shivang, S., Zheng, J., & Karasinski, J.A. (2023, August) Inferring Collaboration Strategies and Usability from Remote Observations in a Spaceflight Analog Environment. *Applied Human Factors and Ergonomics (AHFE) Conference*. San Francisco, CA.

Marquez, J.J., Landon, L.B., & Salas, E. (2023) The Next Giant Leap for Space Human Factors: The Opportunities. *Human Factors*. 65(6). https://doi.org/10.1177/00187208231174955.

Shelat, S., Marquez, J.J., Zheng, J., & Karasinski, J.A. (under review) Collaborative System Usability in Spaceflight Analog Environments through Remote Observations. *Applied Sciences*.

Categorizing Crew Interactions

Label	Category	Description	Example
CRTimeline	Collaboration Regarding Timeline	Discussion on timeline content and preferences	*“I personally like the questionnaires stacked together… knock ’em all out.”*
CRTask	Collaboration Regarding Task	Discussion on the nature of the assigned task at hand (either TPM or SS)	*“We can talk about what our preferences are.”*
CRPlaybook	Collaboration Regarding Playbook	Discussion on how to use the tool or navigate the interface	*“But where do you see the tasks?” “They’re right there on add-to-plan.”*
OT	Off-Topic	Jokes, tangents, or unrelated topics	*“Have you watched the latest season of that show?"*