Crew Scheduling Performance

Crew Autonomy through Self-Scheduling: Guidelines for Crew Scheduling Performance Envelope and Mitigation Strategies

J.J. Marquez, NASA Ames Research Center

Crew Scheduling Performance

PI: J.J. Marquez, Ph.D. (jessica.j.marquez@nasa.gov)

J. Karasinski, Ph.D., J. Zheng, J. Bresina, Ph.D., & S. Shelat

Human-Computer Interaction Group

NASA Ames Research Center
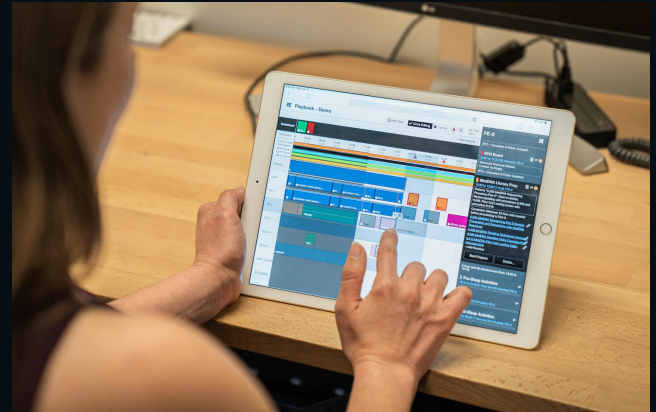
What is Self-Scheduling?

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

Credit: NASA

Research Aims

1. Quantify crew performance envelope for the task of self-scheduling spaceflight operational plans.
2. Develop countermeasures that mitigate deficient crew self-scheduling performance.
3. Validate self-scheduling countermeasures by evaluating changes in crew performance with countermeasures in spaceflight analogs.
4. Recommend standards and guidelines appropriate for autonomous crew in long duration exploration missions with regards to self-scheduling.

Spaceflight Analog HERA Campaign 6

Investigating self-scheduling as part of crew autonomy in HERA C6.

- Assess self-scheduling performance in a spaceflight analog environment.
- Assess impact on performance with self-scheduling countermeasure aids.
- Explore holistically self-scheduling at an operational level.

Credit: NASA

Experimental Design
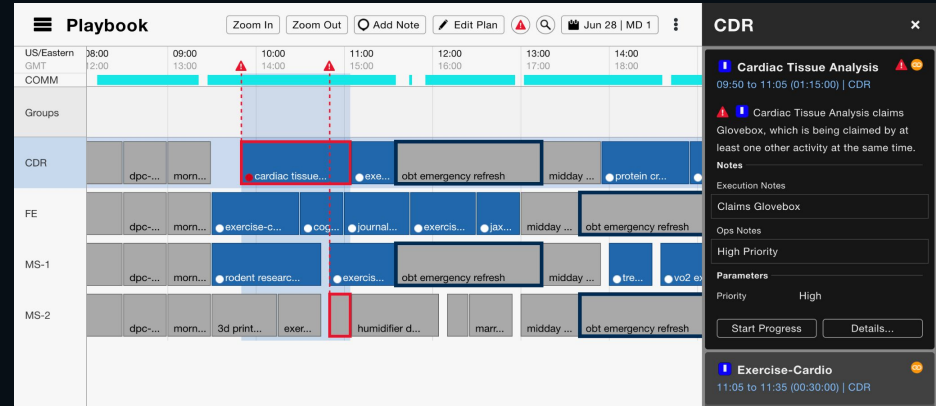
Mission 1 & 2

Each crew self-scheduled a day for team.

Mission 3 & 4

Each crew self-scheduled a day for team using countermeasures.

Optional self-scheduling throughout mission.

Timeline software for Self-Scheduling: Playbook
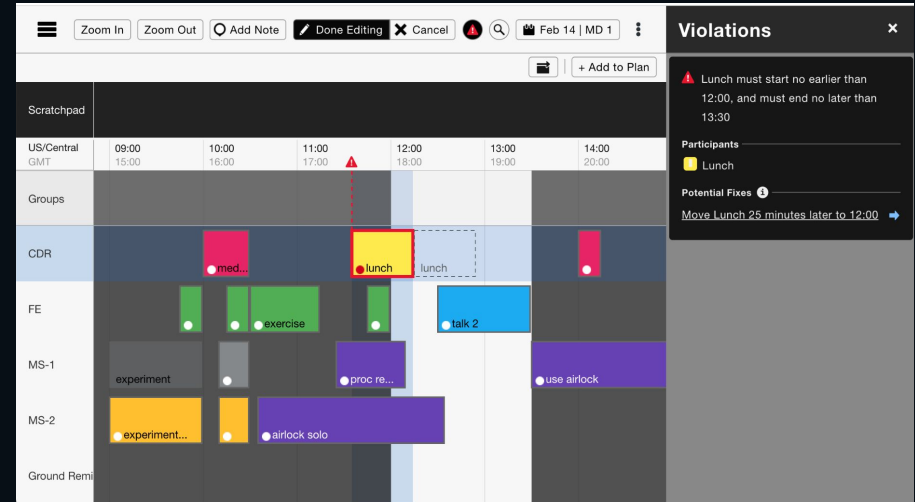
Experimental Design

Mission 1 & 2

Each crew self-scheduled a day for team.

Mission 3 & 4

Each crew self-scheduled a day for team using countermeasures.

Optional self-scheduling throughout mission.

Countermeasure Aids

Data Collection

Team Preferences

Crew was given time to discuss as a team what their scheduling preferences may be. This is to be completed before self-scheduling is to be done.

Self-Scheduling

Each crew self-schedules a list of activities (and groups) from Task List, creating the team's schedule for one mission day. Self-scheduling occurs at least two days before day must be executed. They receive feedback from MCC about schedule.

Execution

Crew executes self-scheduled timeline. At the end of the day, crew that self-scheduled provides feedback about how the day went.

Data Collection

Inferring Performance

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), self-report of plan's quality (plan goodness), & usability.
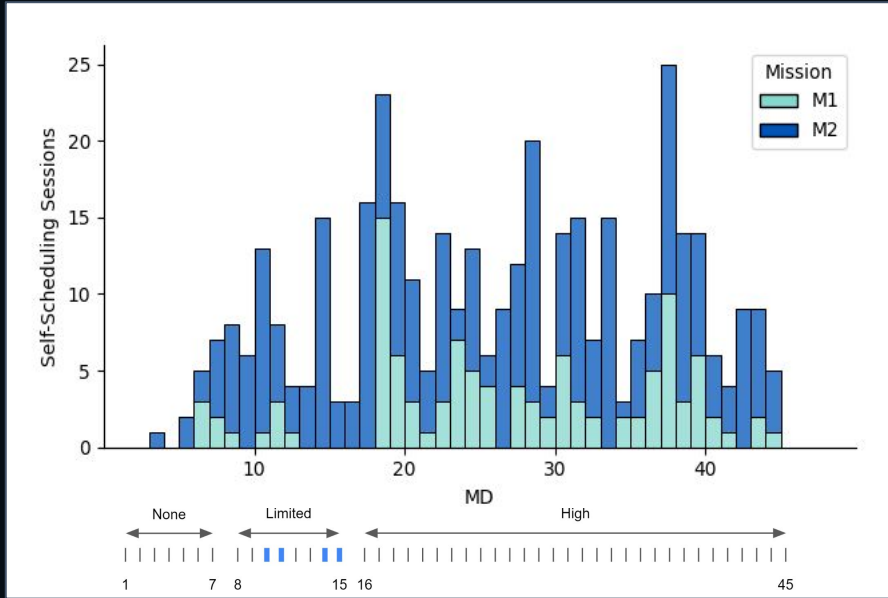
First Time Collection

Voice-recordings as proxy for "observing" planning and scheduling process.

- Content analysis of recordings

Tracking each spontaneous self-scheduling events during Limited and High Autonomy phases of mission.

Sneak Peak at HERA C6 Results

- Spontaneous self-scheduling events are occurring throughout mission though the amount varies by team and day.
- While assigned as an individual task, voice content analysis seems to indicate that crew are self-scheduling in a collaborative manner.

Future Work

HERA C6M4 data collection, participation in HERA C7.

Post-processing and analysis of HERA interaction data.

Additional publications from controlled, lab experiment.

Summarize findings through proposed self-scheduling guidelines for crew autonomy.

Questions?

Email jessica.j.marquez@nasa.gov

<u>Year 4 Publications</u>:

Karasinski, Zheng, & Marquez (2022) "Integrating Mission Timelines and Procedures to Enhance Situational Awareness in Human Spaceflight Operations", SpaceCHI

Shelat, et al. (2022) *Evaluation of User Experience of Self-Scheduling Software for Astronauts: Defining a Satisfaction Baseline.* HCII.

Marquez et al. (2022) *The Role of Trust and Usability in Enabling Spaceflight Crew Autonomy.* AIAA ASCEND.

Marquez et al. (2022) *Promoting Crew Autonomy in a Human Spaceflight Earth Analog Mission through Self-Scheduling.* AIAA ASCEND.

Karasinski et al. (2023) *Exploring Self-Scheduling Strategies and Heuristics in Novice Schedulers.* AIAA SciTech.