We Have the Spaceship; But Where’s the Start Button: Human Engineering Issues in the Age of Long Duration Space Exploration

George Hamilton, NASA
Chris Adams, Raytheon
Conclusion

There's a lot of work left to do.

- Imminent hazards exist that must be researched and mitigated.
- The clock is ticking.

Instituting design principles into the basic architectures that will take us to and shelter us on distant bodies must be done within the next few years.
Long Duration Space Exploration Issues

- Gravitational Adaptation
- 2-D to 3-D Movement Adaptation
- Everything’s a Handle
- Exercise Posture
- Space Ergonomics
Gravitational Adaptation

- Crew have a history of reverting to micro-gravity while on Earth.
- A mission to Mars can have a cycle of 9 gravitational environments.
- Will the crew maintain gravitational adaptation for menial tasks?
- Cues specific to an environment can constantly “remind” the crew which gravity they’re operating in.
2-D to 3-D Movement Adaptation

- Crew switches to 3-D movement within 1-3 days.
- NASA operation planners allow for this adaptation to make the most efficient use of crew time and capabilities.
- Hardware designers typically do NOT design for this capability and lose any efficiency gains 3-D movement would allow.
Everything’s a Handle

- Micro-gravity corollary
  - “When in need, everything’s a handle.”
- Optical Quality Window Vacuum Jumper
- If it looks like a handle, feels like a handle, and acts like a handle, then it is a handle.
- Form Follows Function vs. Function Follows Form
Exercise Posture

- Proper exercise posture on Earth includes a healthy S-curve.
- The classic micro-gravity Neutral Body Posture places the spine in a C-curve.
- Will micro-gravity work and exercise degrade a healthy S-curve?
- An S-curve orthotic could aid in maintaining a healthy S-curve.
Space Ergonomics

- Current space hardware is typically designed from a technical standpoint.
- A systematic approach stemming from the operation and human-machine interface should be used.
- PERS – a success story.