Workshop on Interstellar Exploration Habitability and Human Factors

Dr. Ing. Sandra Häuplik-Meusburger Vienna Technical University | space-craft Architektur ESA-ESTEC, Juni 2019

HABITABILITY



Image: Häuplik-Meusburger | Space Habitability

link: http://www.space-craft.at/portfolio/haus-im-see/



rst boot print on the Moon

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Image taken by Scott Kelly (NASA)

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Deep Space Exploration:

Mission Duration: one way

Delayed Communications No Resupply – Limited Supplies No Evacuation Increased High-energy Radiation Very confined habitable Volume

Risk # 5: Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders Risk #10: Risk of an Incompatible Vehicle / Habitat Design

Image: Hubble Ultra Deep Field

... and unless we give the engineers a good reason why living spaces need particular features for the health of the astronauts, they will continue their efforts to minimize the space requirements for humans onboard.



Image: NASA | Valeri Polyakov looking out of Mir space station



Figure: adapted from the Space Station Crew Safety Human Factors Interaction Model (Cohen & Junge, 1984)

What is the minimum requirements to sustain human life, health and well-being

versus

What do we give up and leave behind?

Who is the client?





A. Restricted Diet:

How will it affect crewmembers' health and moral to never eat fresh fruit or vegetables more complex than lettuce for many years?

< Nature Morte Aux oranges Et Citrons, Jean Capeinick (1838-1890)

"How do we weigh the morale value of a kilogram of filet mignon against a kilogram of propellant?" (Alan B. Chambers)

Paper Link: Marc Cohen and Sandra Häuplik-Meusburger. What Do We Give Up and Leave Behind? July 2015, Conference: ICES 2015, 45th International Conference on Environmental Systems

https://www.researchgate.net/publication/282849028_What_Do_We_Give_Up_a nd_Leave_Behind?

< Salyut 7 cosmonauts Lebedev and Berezevoy (1982)





B. Constant Confinement:

What will it mean to never go "outside" without a spacesuit, to never feel the wind or breathe "fresh air," to never swim in liquid water?"

< The Swimming Pool, Henri Matisse

"Safety hazards that pertain to confinement, isolation, and separation include mental depression.(Dudley Rowley, 2004)

Paper Link: Marc Cohen and Sandra Häuplik-Meusburger. What Do We Give Up and Leave Behind? July 2015, Conference: ICES 2015, 45th International Conference on Environmental Systems https://www.researchgate.net/publication/282849028_What_Do_We_Give_Up_a nd Leave Behind?

< ISS crewmembers Burbank, Shkaplerov, Ivanishin inside the Soyuz capsule, 2012, NASA)





C. **Disconnection from the Natural World:** What would it be like to lose contact entirely with the environment of the natural world in which humans evolved: no seasons, no swimming, no long walks in the woods?

< Boys Fishing in Gloucester Harbor, Winslow Homer (1836-1910)

Paper Link: Marc Cohen and Sandra Häuplik-Meusburger. What Do We Give Up and Leave Behind? July 2015, Conference: ICES 2015, 45th International Conference on Environmental Systems https://www.researchgate.net/publication/282849028_What_Do_We_Give_Up_a nd_Leave_Behind?

< Inside the ISS (NASA)



D. No Separation of Work and Social Life: What will it mean to socialize only with the people with whom we work, never go on a picnic outside?

< The Luncheon of the Boating Party, Pierre-Auguste Renoir (1841-1919)

Paper Link: Marc Cohen and Sandra Häuplik-Meusburger. What Do We Give Up and Leave Behind? July 2015, Conference: ICES 2015, 45th International Conference on Environmental Systems https://www.researchgate.net/publication/282849028_What_Do_We_Give_Up_a nd_Leave_Behind?

< Astronauts eating together (NASA)



E. No Family Life:

How will it affect crewmembers emotionally to live without children or pets?

< Mary Cassatt, Motherhood (1844-1926)

"... family problems can be expected to become more salient as tours-of-duty in space become longer in duration. Family problems are a normal part of life and are mitigated better when an open avenue is available for people to express themselves." (Dudley Rowley, 2004)

Paper Link: Marc Cohen and Sandra Häuplik-Meusburger. What Do We Give Up and Leave Behind? July 2015, Conference: ICES 2015, 45th International Conference on Environmental Systems

https://www.researchgate.net/publication/282849028_What_Do_We_Give_Up_a nd_Leave_Behind?

< NASA astronaut Chamitoff gives a hug to departing spaceflyer Garrett Reisman, STS-124, 2008 (NASA)

1. You need to know the human needs.

Human missions to Mars and beyond can succeed only if they take fully into account how best to accommodate and support the crew's needs across the broad spectrum of human experiences.



Artwork by Ralo Mayer, Kinder zwischen Mond und Erde, niemand weiß was dann passiert, 2014

2. You have to deal with everything by yourself. What you take is what you have.

UN-Nr.:1219



Paper link:

Häuplik-Meusburger, Lotzmann, Meusburger. Dental Treatment during a human Mars Mission with remote support and advanced technology, July 2016, 46th International Conference on Environmental Systems (ICES) https://www.researchgate.net/publication/3 19543528_Dental_Treatment_during_a_hum an_Mars_Mission_with_remote_support_an d_advanced_technology?



3. You have to find technical solutions for those things that are not naturally there.



Paper link:

Bishop, Häuplik-Meusburger, Guined, Peldszus: Bionomic Design Countermeasures for Enhancing Cognitive and Psychological Functioning and Crew Performance in Isolated and Confined Habitats, July 2016, 46th International Conference on Environmental Systems (ICES)

https://www.researchgate.net/publication/309807825_Bionomic_Design_Count ermeasures_for_Enhancing_Cognitive_and_Psychological_Functioning_and_Cre w_Performance_in_Isolated_and_Confined_Habitats

http://www.space-craft.at/portfolio/greenhouse-design-integration/



"I've often heard people say: 'I wonder what it would feel like to be on board a spaceship,' and the answer is very simple. What does it feel like? That's all we have ever experienced. We are all astronauts on a little spaceship called Earth." -R. Buckminster Fuller



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