Investigating Human Factors in Analog Astronaut Missions: How Isolation and Darkness Shape Crew Interactions and Time Perception

Authors: Roblin Pauline, Bernard Foing, Agata Kołodziejczyk

Abstract

As part of my internship with EuroMoonMars, I participated in two analogue space missions (EMMPOL 21 & 22) in Poland in May 2025. These missions, conducted in a simulated isolated habitat, allowed us to study human factors in confined environments, focusing on group dynamics, communication, and psychological adaptation. A key aspect of the missions was the inclusion of two to three days of total darkness, which provided insights into the effects of light deprivation on interactions and time perception.

We investigate the role of structured interactions (morning briefings) and informal moments (shared meals) in supporting group cohesion and well-being. By comparing two crews with different profiles, we examine how interaction styles and emotional climate change during isolation, particularly how both formal and informal interactions evolve over time. We also focus on the role of hierarchy (e.g., the commander) and how it is reflected and adjusted through these interactions. Additionally, we explore retrospective time perception, analyzing how individuals estimate the passage of time when external time cues are limited. The contrast between light and dark periods helps us understand how environmental factors affect temporal awareness.

Data is collected through audio recordings and behavioral metrics, including speaking turns, silence periods, interaction patterns, and thematic content. Preliminary results show that structured briefings are essential for crew organization and self-evaluation, although their duration tends to decrease over time. In contrast, informal moments increase in duration, providing opportunities to step away from the mission context by diversifying interactions and topics, which supports emotional well-being. This firsthand experience after two weeks of isolation provides a foundation for better understanding human behavior in space-analog environments, offering valuable insights for the design of future missions and habitats on the Moon, Mars, and beyond.

Pauline Roblin – a short bio

I'm a 23-year-old student currently in my second year at the École Nationale Supérieure de Cognitique (ENSC) in Bordeaux, (France), where I focus on human factors, cognitive engineering, and user-centered design. I also hold a dual bachelor's degree in Sports Science and Engineering Science, which has sparked my interest in how humans adapt both physically and mentally in challenging environments. My research interests revolve around human performance under stress, particularly in extreme environments. Sports have always fascinated me because they push the limits of human endurance. This curiosity led me to the field of space exploration, where the environment is one of the most extreme, and mistakes can have serious consequences. I am particularly interested in how astronauts manage stress, make decisions, and maintain well-being while facing isolation and pressure.

I also have a strong foundation in neuroscience and psychology, which helps me understand the cognitive and emotional challenges astronauts face. The multidisciplinary skills that astronauts need to succeed in space—along with their ability to adapt to ever-changing conditions—are major sources of inspiration for me. I am also interested in the concept of space-time, especially how we perceive time, both scientifically and philosophically. In addition to my studies, I've gained research experience through internships in engineering and cognitive sciences. I have worked on projects involving protocol design, signal analysis, and programming human-machine interfaces. This summer, I am doing my second-year internship with EuroMoonMars, which represents my first step into the space field, specifically by participating in two analogue astronaut missions.

Looking ahead, I hope to contribute to training and risk management for high-risk professions, particularly in space exploration. I want to continue researching human performance in extreme environments to help improve support for those working in challenging and isolated conditions.