IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Interactive Presentations - IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (IP)

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TIME PERCEPTION AND DESYNCHRONIZATION OF BIOLOGICAL CLOCK DURING ANALOG MISSIONS IN LUNARES HABITAT IN POLAND

Abstract

Nearly all living organisms evolved circadian rhythms as synchronization to rotational movement of Earth. Lunares habitat is a biological clock laboratory established in 2017 in Poland by Space Garden Company. The facility is designed to investigate optimal for physiology and health lighting conditions for future Moon and Mars human space missions. Within two-week analog simulations astronaut crews, insects, plants and algae undergo multiple experiments in fully isolated from natural sunlight and UTC time environment. A prototype of physiological lighting administrated inside the habitat activates or inhibits multiple types of photoactive proteins responsible for homeostatic regulatory pathways including nervous, endocrine, digestive and immune systems in humans as well as growth and development processes in insects and plants. The habitat is additionally equipped with programmed LED lighting system to simulate dawns and dusks [1].

Subjective time perception was analyzed in astronauts and control groups for 30 days: 1 week before the mission, 2 weeks during the mission and 1 week after the mission [2]. Data were collected using STPA software (www.astrotech.io/subjectivetimeperception). Subjects were performing the test twice a day just after waking up and just before going to sleep. During the mission subjects were able to see their results and based on them improve their performance. Effects of training were observed in both analog astronauts groups as well as in controls.

During each of three organized analog simulations in 2017, circadian rhythms of 18 analog astronauts with independent control groups were monitored for one month. Biological clock desynchronization levels were measured in tested subjects. During stay in the habitat, analog astronauts were exposed to 4 following circadian phases: first 3 days were 24h, next 4 days 26h, next 4 days 22h, and finally 3 days 24h before end of the mission. Jet lag effects were analyzed including levels of stress, water consumption, urine production, motivation and basic physiological parameters.

Our results reveal the importance of lighting conditions in future designs of astronaut spaceships and habitats. We propose our idea and first results for this issue.

References:

[1]Kolodziejczyk A. M., Orzechowski L. and Lakk H., Time Architecture, Acta Futura 10 (2017), ISSN 2309-1940.

[2]Kolodziejczyk A. M., Harasymczuk M. et al. (2017) Circadian Clock and Subjective Time Perception: A Simple Open Source Application for the Analysis of Induced Time Perception in Humans, Conference Proceedings, Prague Czech Republic Mar 23-24, 19(3) Part VIV p. 1664-1668.

Additional Information: www.lunares.space, www.space.garden