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ASTROLAND, A NEW CAVE SPACE ANALOG EXPERIENCE TO INVESTIGATE HUMAN PERFORMANCE IN ISOLATED AND CONFINED ENVIRONMENTS

Abstract

Space analogs (SA) can arise incidentally from other human activities (e.g., during Antarctic expeditions), or they can be planned to simulate complex interactions of environmental, physical, physiological, and/or social aspects during space missions. Currently, a large variety of SA are being used to investigate different aspects of human performance in isolated and confined environments (ICE), and investigators need to carefully consider which type of analog is more suitable for their specific needs.

In recent years, there has been an increase of SA activities that include natural cave environments. For example, the European Space Agency (ESA) has recently developed the "Cooperative Adventure for Valuing and Exercising human behaviour and performance Skills" (CAVES) program. CAVES is a three-week training course in which a multicultural team of astronauts conduct a realistic scientific exploration mission in several caves across Italy and Slovenia. However, the CAVES program is not open to commercial partners or the general public.

Astroland is a Spanish private company that has stablished a new SA in a cave located in Arredondo, Cantabria (Spain). The Ares station, built inside the cave, provides an extraordinary opportunity to perform SA missions to investigate new technologies and human performance in the context of future planetary missions in a Mars-like environment. The cave is located 1 Km deep, has high ceilings, and it also contains a lake with live microorganisms. Thus, Astroland represents a unique SA cave exploration environment that encompasses multiple aspects of future space exploration missions, including isolation

and confinement, as well as the ability of pursuing scientific objectives (e.g., astrobiology) and realistic operations.

Our team participated in the very first analog mission of the Astroland SA. The objective of this first mission was to assess the Astroland and the Ares station as a potential SA to conduct research in human performance, as well as realistic Mars-like operations. Six analog astronauts spent 3 days in the two-module Ares station, and we investigated different aspects related to cognitive and behavioral health using standardized behavioral and psychosocial tests commonly used in SA. We provide a detailed description of Astroland cave as well as Ares station's capabilities. We will also fully describe the first mission in this SA, including operational protocols and first-hand experiences from the analog astronauts. We will also report the results from our pilot study on behavioral performance. Finally, we will discuss the potential of Astroland as a new SA cave environment, as well as future opportunities for others to participate (both as an analog astronaut or as a researcher) in future Astroland analog missions.