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Space Architecture: Habitats, Habitability, and Bases (1)

Author: Ms. Meriem Allani
The University of Adelaide, Australia

Dr. Amit Srivastava
University of Adelaide, Australia
Prof. Deborah Turnbull
University of Adelaide, Australia
Ms. Sarah Paddick
Australia

PSYCHOLOGY OF ISOLATION AND ARCHITECTURE OF LUNAR HABITATS: LESSONS FROM SPACE ANALOGS, ANTARCTIC MISSIONS, AND SECURE FACILITIES DESIGN

Abstract

Research shows that the most common psychological issues faced by astronauts during space missions stem primarily from confinement and isolation. Prolonged exposure to Isolated Confined Environments (ICE) leads to a three-fold experience of isolation—spatial-temporal, social, and sensory—manifesting through symptoms including fatigue, altered circadian rhythms, neurocognitive impairment, and sleep disturbances. When planning long-term lunar missions or settlements, it is therefore essential to account for these psychological challenges in habitat design.

This paper provides a systematic review of current research on the psychological effects of isolation in various categories of ICE on Earth: Space Analogs, Antarctic Missions, and Secure Facilities. The review follows a structured protocol developed according to the Joanna Briggs Institute (JBI) guidelines. For Space Analogs, we examine the literature relating to key experiments including the MARS-500 project by the Institute of Bio-Medical Problems (IBMP) in Russia, as well as more recent studies from HI-SEAS, FMARS, and MDRS analog facilities. For Antarctic Missions, we analyze research on "winter-over syndrome" and related conditions affecting the psychological well-being of participants, including comparable experiences from underwater habitats and submarine environments. For Secure Facilities, we investigate research on isolation's impact on inmates in high-security environments, conducted in collaboration with Grieve Gillett Architects (GGA) and focusing on case studies from Yatala Labour Prison and Adelaide Women's Prison.

By mapping the intersection of environmental design features and documented psychological effects across these varied ICE contexts, this review establishes empirical connections between spatial design elements and their psychological impacts. This approach allows us to identify potential relationships between specific architectural features and their effects on occupants' mental health across different isolated environments. The paper represents an initial step in systematically connecting the psychology of isolation with architectural design principles relevant to future lunar habitats. The findings will highlight environmental psychology's critical role in creating built environments that mitigate the adverse effects of isolation on occupants' mental health in extreme conditions.