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

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# THE USE OF ANIMAL MODELS TO SUPPORT LONG-DURATION MANNED SPACEFLIGHT

## Abstract

Animals have preceded humans in every stage of spaceflight exploration, from sub-orbit to orbit. Monkeys, apes, dogs, cats, tortoises, mice, rats, rabbits, fish, frogs, spiders, and insects have all been sent into orbit as analogs to understand human adaptation to the space environment. Initially focused on survivability and safety driven by the race to the moon, after the 1970s, animal research refocused on physiological adaptations in low-Earth orbit (LEO) to better understand risks to human health during long-duration zero-G missions. The international space agenda is now focused on establishing lunar bases as a basis for human-crewed missions to Mars, with a transit time of more than seven months each way. Venturing further into our solar system will require prolonged periods of isolation and confinement,introducing new physiological and psychological challenges for astronauts, in particular, through the challenges of sensory deprivation and isolation. While the benefits of using animal models to understand physiological adaptations to the space environment are well established, a better understanding of the psychological challenges introduced by these longer-duration space missions will benefit from further animal research.

A rich body of research exists on human performance in isolated, confined, and extreme (ICE) environments such as polar expeditions, submarines, and space analogs - environments or situations on Earth that simulate conditions found in space or on other celestial bodies.This data is a necessary substitute for actual data from space flights; as of 2023, fewer than 700 people have been in LEO or beyond, and very few have been in orbit continuously for over a week. Symptoms of depression, insomnia, irritability, anger, and anxiety have all been documented in both space flight and ICE analogs, but sample sizes are small, and there are limits to the level of experimentation that can be carried out with humans to understand neurological and physiology adjustments to the space environment. Using animal models can help fill this gap, as despite significant differences in the human brain, we are on the sameneurobiological continuum with other species, and similar biological mechanisms have evolved due to exposure to similar selection pressures.