

ASSESSMENT OF PROFICIENCY DURING SIMULATED ROVER OPERATIONS FOLLOWING LONG-DURATION SPACEFLIGHT

S. J. Wood¹, S. L. Dean², Y. E. De Dios², H. G. MacDougall³, and S. T. Moore⁴

¹Universities Space Research Association, Houston, TX, ²Wyle Integrated Science and Engineering Group, Houston, TX, ³University of Sydney, Sydney, Australia, and ⁴Mt Sinai School of Medicine, New York, NY

INTRODUCTION

Following long-duration space travel, pressurized rovers will enhance crew mobility to explore Mars and other planetary surfaces. Adaptive changes in sensorimotor function may limit the crew's proficiency when performing some rover operations shortly after transition to the new gravito-inertial environment. The primary goal of this investigation is to quantify postflight decrements in operational proficiency in a motion-based rover simulation after International Space Station (ISS) expeditions. Given that postflight performance will also be influenced by the level of preflight proficiency attained, a ground-based normative study was conducted to characterize the acquisition of skills over multiple sessions.

METHODS

Rover Simulation

The rover simulation consists of a serial presentation of tasks to be completed as quickly and accurately as possible. Each task consists of 1) perspective-taking, using a map that defines a docking target, 2) navigation toward the target around an Martian outpost, and 3) docking a side hatch of the rover to a visually guided target. The simulator utilizes a Stewart-type motion base (CKAS, Australia), single-seat cabin with triple scene projection covering 150° horizontal by 50° vertical, and joystick controller. The dependent variables for each task include accuracy toward the target and time to completion.

Normative Ground Study

Twenty healthy subjects were tested in 5 sessions, with 1-3 days between sessions. Each session consisted of a serial presentation of 8 discrete tasks, with additional familiarization tasks during the first session. Subjects were randomly assigned to a control group (tasks identical in the first 4 sessions) or a varied-practice group.

Pre- and Post-Flight Study

This rover simulation has been incorporated into Steven Moore's study titled "Assessment of operator proficiency following long-duration spaceflight." Eight crewmembers returning from 6-month stays on board the ISS will be tested during 4 preflight and 3 postflight sessions 1, 4, and 8 days after landing. Overall operator proficiency will be based on how many rover docking tasks the crew member can complete during the 10-min time block. Changes in performance in the rover simulation will also be correlated with changes in a sensorimotor and cognitive test battery to be conducted during Dr. Moore's study.

RESULTS (NORMATIVE GROUND STUDY)

There was a low incidence of motion sickness during the normative study, with only negligible after-effects and symptoms after the familiarization session. The greatest improvements in time to completion occurred during the docking phase. The varied-practice group showed more improvement in perspective-taking accuracy. Perspective-taking accuracy was also affected by the relative orientation of the rover to the docking target. Skill acquisition was correlated with self-ratings of previous gaming experience.

DISCUSSION

Varying task selection and difficulty will optimize the preflight acquisition of skills for crew members performing this novel rover simulation. This simulation will provide functionally relevant evidence relating to the impact of sensorimotor adaptation on early surface rover operations and what countermeasures are needed.

ACKNOWLEDGEMENTS

Support was provided by the NASA Non-exercise Physiological Countermeasures (NxPCM) Project. The rover simulation was developed by Tietronix Software, Inc., Houston, TX.