ISSMP	EFFECTS OF LONG-DURATION MICROGRAVITY ON FINE MOTOR SKILLS	Fine Motor Skills

Principal Investigator

Kritina L. Holden, Ph.D.

Description

Fine motor skills will be critical during long-duration space missions, particularly those skills needed to interact with technologies required in next-generation space vehicles, spacesuits, and habitats. They will be necessary for performing tasks in transit or on a planetary surface, such as information access, just-in-time training, subsystem maintenance, and medical treatment. Fine motor control studies conducted to date have not been comprehensive, or conclusive regarding the effects of microgravity. The aim of the proposed study is to determine the effects of long-duration microgravity and of different gravitational transitions on fine motor performance. Crew subjects will be asked to perform a set of four brief, interactive tasks on a tablet computer using either a touchscreen or stylus. Data collection sessions will occur at regular intervals over the course of the year-long mission. A matched subject to the U.S. subject will complete the same tasks on the same schedule on Earth. This study will also supplement two other ISS sensorimotor investigations by providing an additional measure of functional performance post-flight, and a new sensorimotor functional test in-flight. These data will contribute to closure of several NASA research gaps and may drive in-flight mitigations and design decisions for future vehicles and habitats.

Objectives

Objective 1: Determine the effects of long-duration microgravity on fine motor performance, as measured by interaction with a tablet computer (touchscreen and stylus) on several tasks involving pointing, dragging, pinch-rotate, and tracing. Key questions:

- How does fine motor performance in microgravity trend/vary over the duration of a year-long space mission?
- How does fine motor performance on orbit compare with that of a matched subject on Earth?

Objective 2. Determine the effects of different gravitational transitions on fine motor performance. Key question:

- How does performance vary before and after gravitational transitions, including the periods of early flight adaptation, and early post-flight?

Relevance

There has not been a complete, systematic study of fine motor performance to include different phases of microgravity adaptation, long-term microgravity, and the sensorimotor recovery period after transition to Earth gravity. In addition, the fine motor control studies conducted to date have not been conclusive regarding the effects of microgravity. Space Human Factors Engineering (SHFE) is particularly interested in spaceflight impacts to the fine motor abilities required to interact with computer-based systems that will be prevalent throughout future spacecraft and habitats. Crewmembers' lives will depend on the ability to autonomously and safely control technology-based environments. Crews on long-duration missions must be able to operate emergency controls immediately after landing, and once on the surface, it is likely they will need to operate a variety of technologies associated with a spacesuit or rover. Fine motor decrements due to long-duration spaceflight will impact functional performance, and these decrements will be exacerbated during pressurized, gloved operations. We need to understand how a crewmember's fine motor abilities may have changed during the journey and after the gravitational transition. This knowledge may drive design decisions for equipment to be used, or spawn mitigations, such as in-flight training of fine motor skills. The data can also be used in computational models for predicting performance on future exploration mission tasks.

BDC Summary

Preflight - Subjects will require one pre-flight study orientation session and four pre-flight training sessions within two weeks of launch.

Postflight – Subjects will require 1-2 sessions post-landing on the plane from the landing site (as allowed/tolerated), and test sessions at: R+1, R+3, R+5, R+10, R+20, R+30.

In-flight Operations Summary

Subjects will complete test sessions lasting approximately 20 minutes each for three days during the first week of flight, and once every five days for the remainder of the year-long mission. Subjects will use a tablet (iPad) to perform several simple tasks involving pointing, dragging, pinch-rotate, and tracing. They will be given instructions for use of restraints, general posture, etc. and will be asked to complete the tasks as quickly and accurately as possible. Each session will also include several questions aimed at providing context or metadata

– e.g., activities performed in the past hour, quality of sleep, medications. Tasks will be performed with the finger or stylus as prescribed in each task. Some game-like incentives will be offered for consistently completing the sessions – e.g., photo puzzle.
Subject Selection/Participation Criteria
No requirements.