BEHAVIORAL ASSESMENT OF SPACEFLIGHT EFFECTS ON NEUROCOGNITIVE PERFORMANCE - EXTENT AND LONGEVITY

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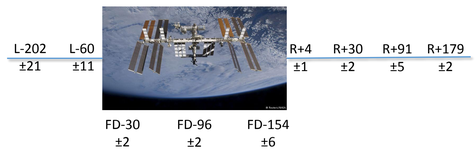
INTRODUCTION

Exposure to the microgravity environment during a spaceflight mission impacts crewmembers' sensorimotor function. A study conducted by Bock et al. [1] concluded that stress and scarcity of cognitive resources required for sensorimotor adaptation may be responsible for deficits during spaceflight. We are conducting this study to investigate the effects of spaceflight on the extent, longevity and neural bases of sensorimotor, cognitive, and neural changes. The data presented will focus on the behavioral measures that were collected pre-, in- and post-flight.

References: [1] Bock O, Weigelt C, Bloomberg JJ. Aviation, Space, and Environmental Medicine, 2010. 81(9): p. 1-6.

Neuromapping Data Collection Timeline



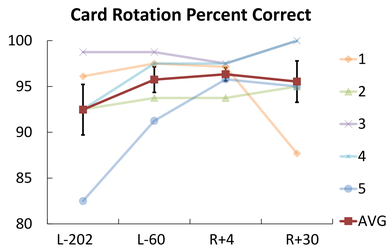
METHODS/RESULTS PRE/POST SPACEFLIGHT

To date, baseline data has been collected over the course of two pre-flight sessions and two post-flight sessions on five crewmembers (study n=13).

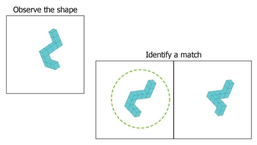
SPATIAL WORKING MEMORY TASKS

Thurston's Card Rotation Test

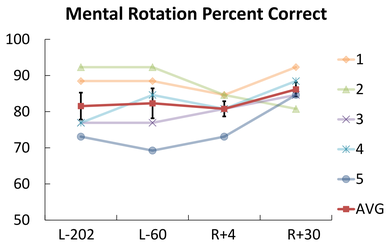
- S- Rotated image
- D- Mirrored image
- 3 minute time limit



Mental Rotation Test

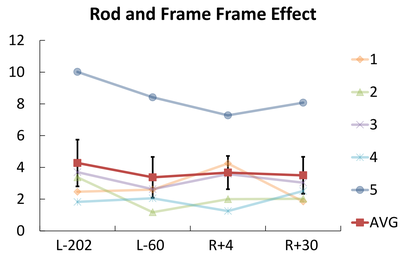


In this example, you would use the **Left** Trigger button to respond.



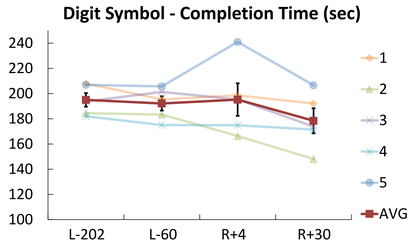
VISUAL DEPENDENCE TASK

Rod and Frame Test- Align the rod to earth vertical.



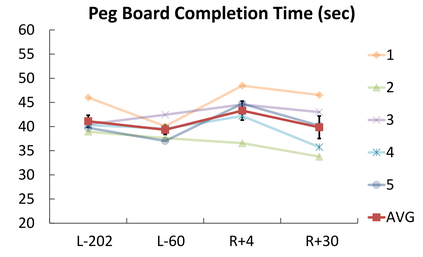
PROCESSING SPEED

The Digit Symbol Substitution Test- Fill out the table according to the coding key.



BIMANUAL COORDINATION

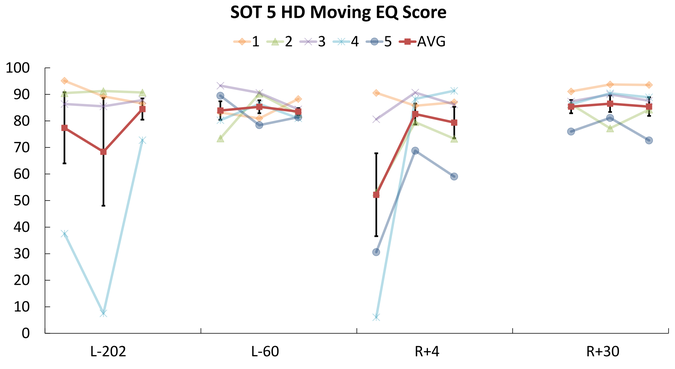
Purdue Peg Board Task- Insert pegs bimanually and simultaneously.



BALANCE CONTROL

Sensory Organization Test 5 (SOT 5) Head Movement

- Balancing on sway referenced base of support
- Eyes closed and head movement in a pitch plane
- Three trials per session



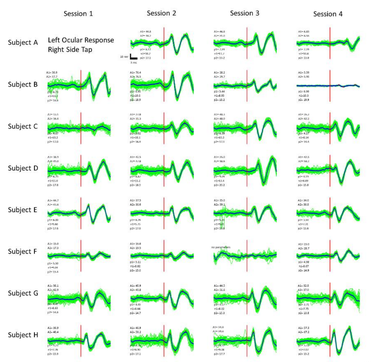
FUNCTIONAL MOBILITY TASK

Walking through an obstacle course

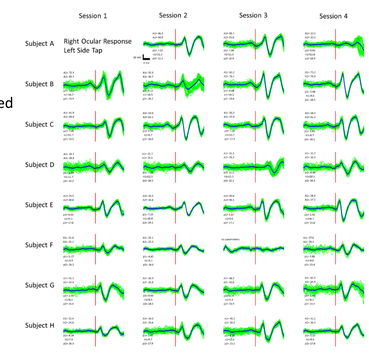
- Complete as quickly as possible without running
- Avoid hitting any obstacles
- Ten trials per session

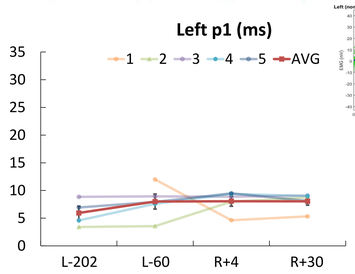
ASSESSMENT OF VESTIBULAR FUNCTION

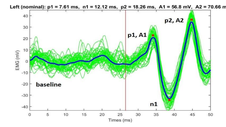
Vestibular Evoked Myogenic Potential (VEMP) Test - Elicited ocular vestibular evoked myogenic potential (oVEMP) via a hand held striker to the side of the face.



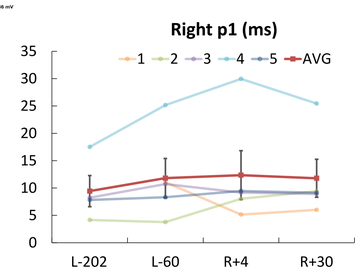
These two figures show oVEMP responses recorded for **control subjects** A-H over 4 sessions that spanned across 70 days.







Sample data of a typical oVEMP response elicited using a handheld striker. These graphs show p1 values for crewmembers.

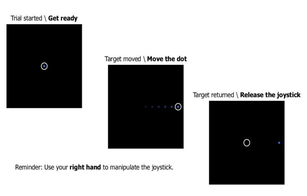


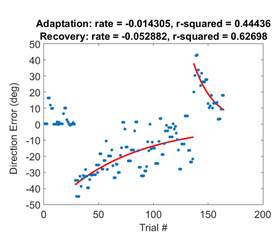
DISCUSSION

- Preliminary results for five subjects indicate that balance control and functional mobility tests show a decrement in performance on four days after return from long duration (6 months) spaceflight.
- Little to no change was observed for spatial working memory, visual dependence, processing speed, bimanual coordination and VEMP tests. This may indicate recovery of these tasks by 4 days after return from spaceflight.

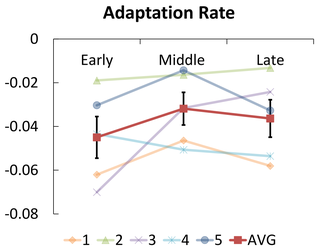
METHODS/RESULTS INFLIGHT

SENSORIMOTOR ADAPTATION TEST





Adaptation test sample data. Adaptation and recovery rates are determined by fitting exponential curves to response errors.

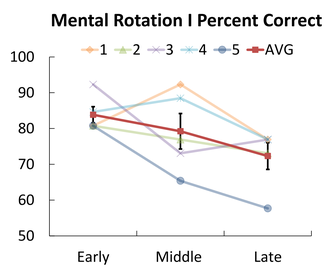


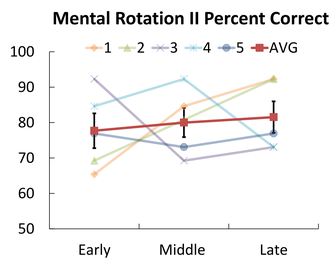
MENTAL ROTATION TEST

Mental Rotation Test Inflight Setup

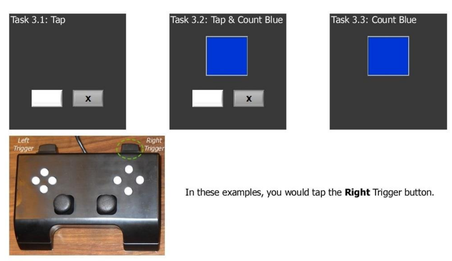
"Strapped in" (mimics a seated position)

"Free Floating" (No external stimuli on body that would mimic a seated or grounded" position)

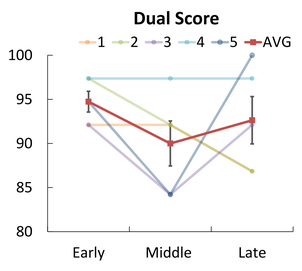


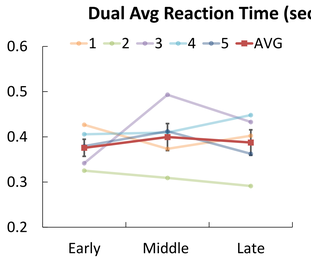


DUAL TASK TEST



In these examples, you would tap the **Right** Trigger button.





DISCUSSION

- Dual task test results indicate a decrement in performance both in time and percent correct midflight.
- Mental rotations task performed in the strapped configuration indicates decrement in performance.

Acknowledgements

This study was supported by NASA grant NNX11AR02G.