

Field Test (FT)

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NSBRI August 28-29, 2013

Presenter: Jody M. Cerisano



Recovery of Functional Sensorimotor Performance Following Long Duration Space Flight (Field Test)



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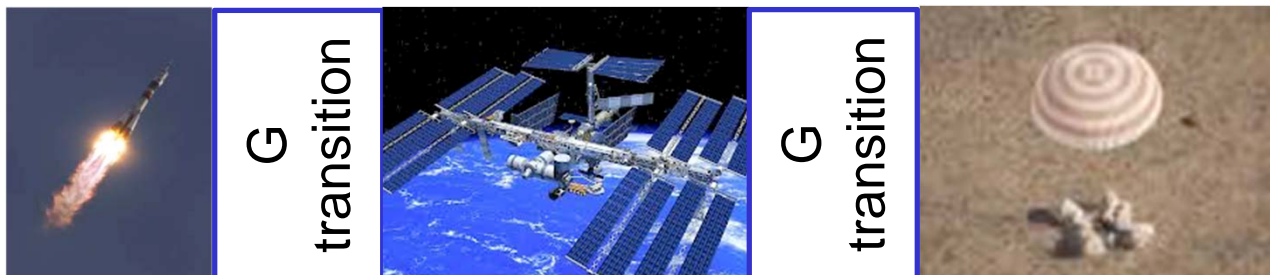
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Background

- Results from Dr. Bloomberg's Functional Tasks Test (FTT) study has shown decrements in functional performance following long duration spaceflight.
- R+1 is the earliest long duration (station) FTT data available.
- Changes are greatest immediately following gravitational transitions, where crewmember demand for emergency operations is most likely to occur.



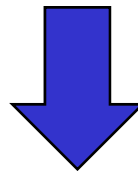
Astronaut.com



What are the implications for interplanetary travel where crew landings will be unassisted?

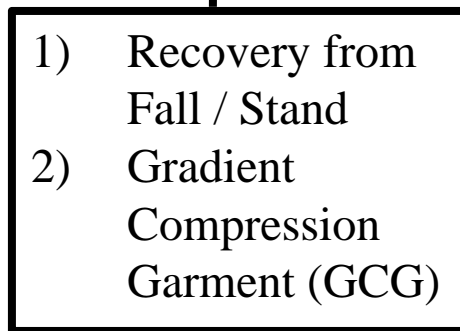
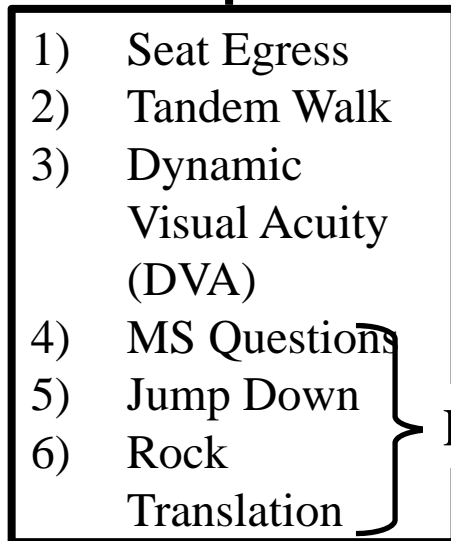
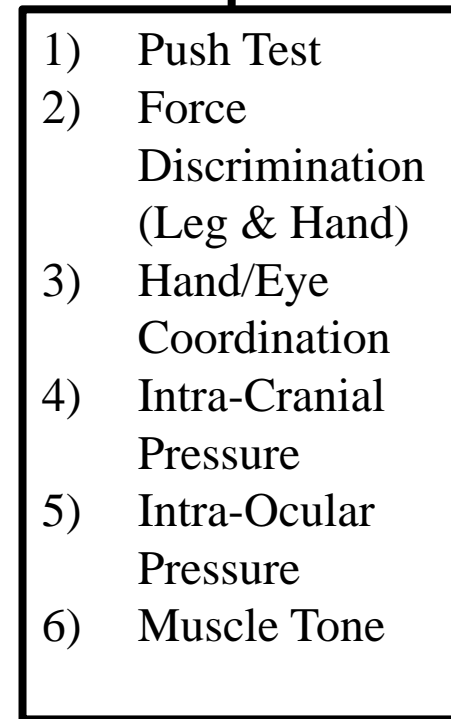
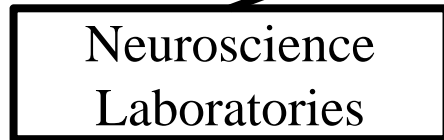
Goals

- 1) Characterize the functional decrements immediately after landing.
- 2) Construct a recovery timeline of crewmember functional performance starting within hours of landing through the return to normative preflight levels.
- 3) Compare efficacy of U.S. Gradient Compression Garment (GCG) as compared to the Russian Kentavr for control of orthostatic intolerance.



Aid in the development of programmatic risks for interplanetary travel.

Joint U.S. / Russian Effort



Pre / later-post only

7) Posture

Measurement Hardware

Wireless inertial measurement units (IMUs) on head, sternum, waist, wrists and ankles: kinematics

Portapres: continuous blood pressure

Electrodes: Postural muscle activation patterns (pre/late tests)

Pressure sensors worn inside shoes: Ground reaction forces



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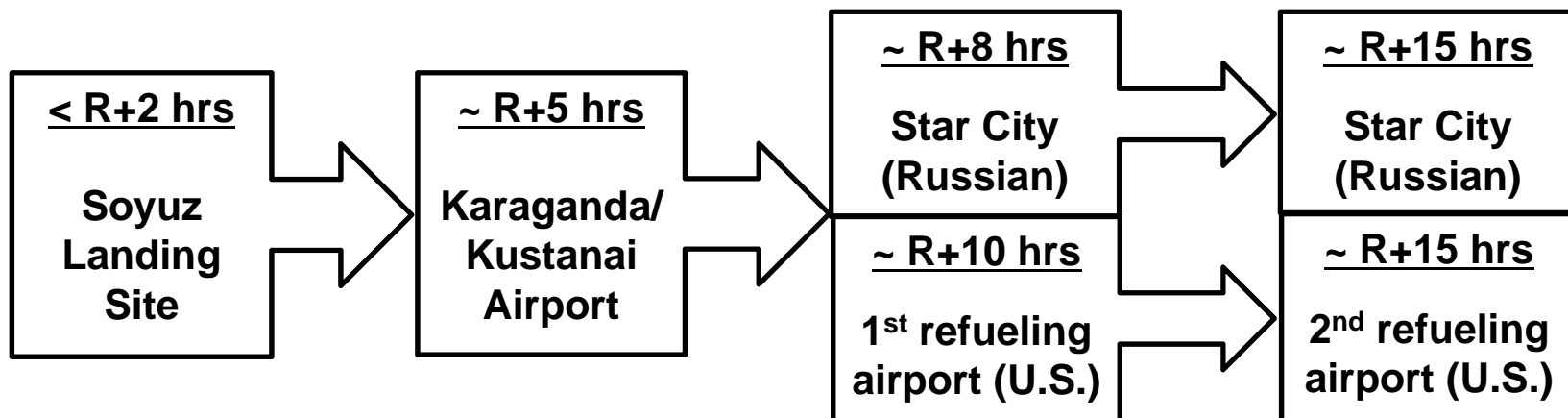
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Testing Schedule

- Three preflight tests on or about L-180, -60 and -30 at IBMP and JSC.
- Multiple R+0 (day of landing) tests desired:
 - 1) Soyuz landing site (U.S. and Russian crews)
 - 2) Karaganda/Kustanai airport (U.S. and Russian crews)
 - 3) Star City (Russian); 1st refueling site, e.g. Scotland (U.S.)
 - 4) Star City (Russian); 2nd refueling site, e.g. Nova Scotia (U.S.)



- Four follow-up postflight tests on R+1, +4, +6 and +30 at IBMP and JSC.

Field Tests

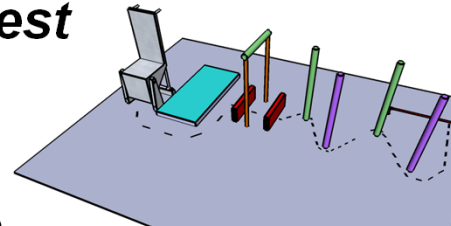
Note: on R+0 crewmembers will be wearing the Kentavr or GCG

1) *Seat Egress & Tandem Walk Test*

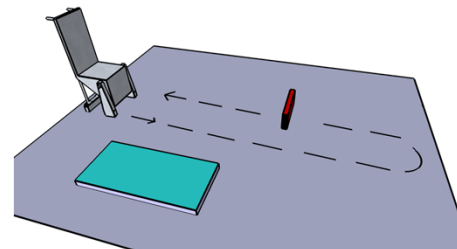
Unbuckle a harness, get up from a seat and complete an obstacle course. Repeated with chair supine.

10 tandem heel-to-toe steps will then be taken with eyes closed.

On R+0, obstacle course will have simplified components of preflight course.



Pre & late post course



R+0 course



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2) *Recovery from Fall / Stand Test*

After 2 minute period of lying prone, stand up as quickly as possible and remain standing for 3 minutes.

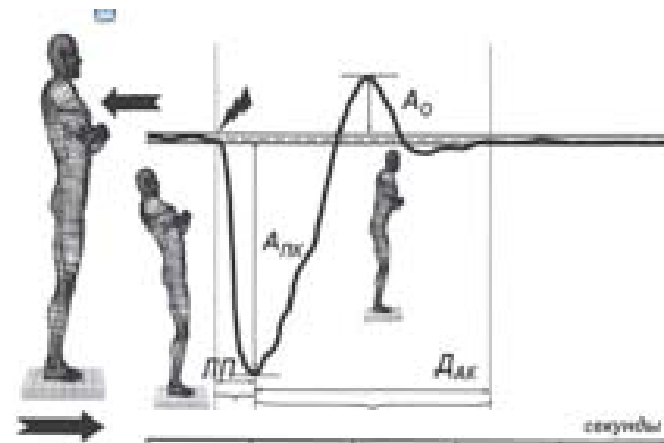
This is performed the same on R+0.



3) *Push Test*

Maintain balance following a random-force perturbation applied to the sternum.

This is performed the same on R+0.



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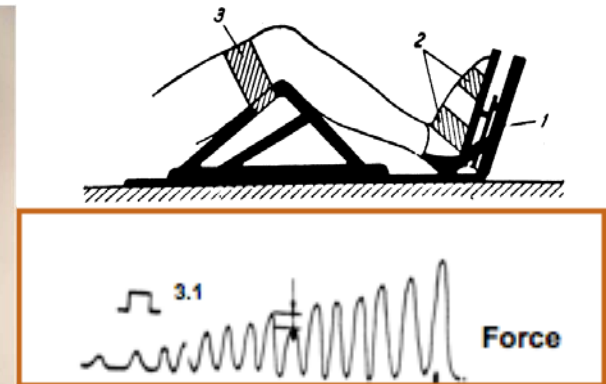
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4) *Force Precision Test (Leg and Hand)*

Apply a force to a hand or foot dynamometer such that each subsequent force increases from the last.



This is performed the same on R+0.

5) *Hand / Eye Coordination Test*

Accurately touch targets that are randomly presented on a computer touch screen using the finger, or a stylus.

This is performed the same on R+0. At the Soyuz landing site, it would be possible to collect this data while crewmembers are in the recovery chair.

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6) Intra-Ocular Pressure (IOP)

Look straight ahead and keep eyes open while IOP is obtained in the upright and supine positions.

This is performed the same on R+0.

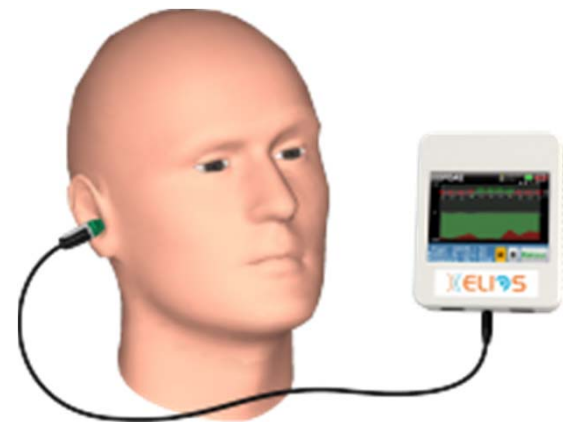


iCare, Finland

7) Intra-Cranial Pressure (ICP)

Stay relaxed and do not move as an audio tone is emitted through an earphone placed in the ear to obtain ICP in the upright and supine positions.

This is performed the same on R+0.



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8) *Postural Muscle Tone / Compliance*

Stay relaxed while a very small vibratory stimulus is applied to the lumbar muscles of the lower back and again to the postural muscles of the lower leg.

This is performed the same on R+0. However, the calf muscle compliance cannot be obtained until the GCG or Kentavr is removed.



9) *Dynamic Visual Acuity (DVA)*

Use a joystick to accurately indicate the direction of the opening of a Landolt C in a time-optimal fashion. This is performed while stationary and again while sitting in a chair that oscillates at 2 Hz with a vertical displacement of ± 2 cm to match natural locomotion.



This is performed the same on R+0.

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10) Motion Sickness (MS) Questionnaire

Reporting of MS symptoms will be performed using a computerized questionnaire and will be obtained periodically during testing. Overall MS rating will be reported on a scale of 1-20.

11) Jump Down

Jump down from a platform with a height of 30 cm onto a force sensing plate. Four surface electrodes will be placed on the leg to assess changes in neuromuscular activation patterns.

This IS NOT performed on R+0.



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12) Rock Translation Test

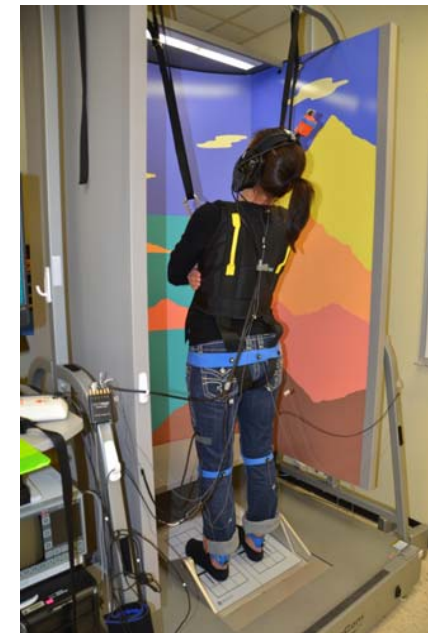
Transfer three weights (6, 10, 20 lbs) with handles, one at a time, a distance of 8 feet and place in a receptacle and then transfer the weights back to the initial receptacle.



This IS NOT performed on R+0.

13) Computerized Dynamic Posturography Test

Maintain balance on sway-referenced support surface with eyes closed. This test will be performed with and without head movements.



This IS NOT performed on R+0.

Study Relevance

- 1) Will allow us to develop a time constant of functional performance in the hours and days following long duration spaceflight that has not been captured previously.
- 2) Will allow us to determine which garment, the GCG or Kentavr, provides better protection against orthostatic intolerance.
- 3) Will provide a knowledge base from which programmatic risks for interplanetary travel can be developed.

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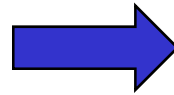
Questions?



Backup Slides

R+0 Possible Data Collection Scenario

Crew in
recovery chair



Hand/Eye Coordination & MS
Questions

Crew on cot
in tent



Muscle tone, supine and upright
IOP & ICP, & MS Questions

Crew on chair
in tent



Seat Egress, Tandem Walk
Test, Recovery from Fall, Push
Test, DVA Test, Force
Discrimination

Field Test (FT)

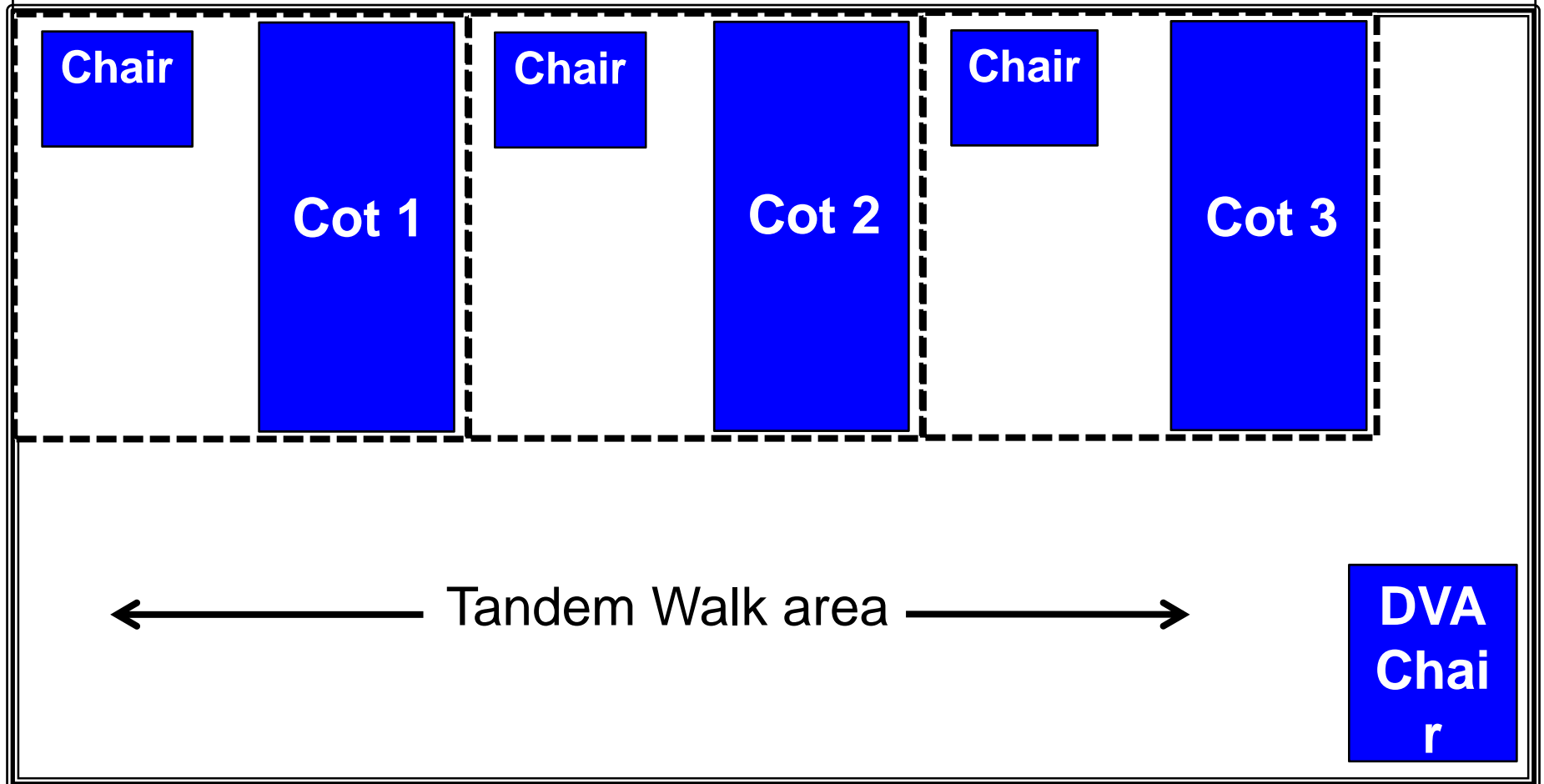
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Backup Slides

Soyuz Landing Site Tent Layout



Backup Slides

Pilot Field Test Protocol (Sept. 11, 2013 landing):

1. Sit-to-Stand Test – Once given command, stand as quickly as possible and stand relaxed for 10 seconds.
2. Recovery from Fall Test – Same as preflight.
2. Tandem Walk Test – same as preflight.

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Backup Slides



SOLES: foot pressure sensors



Kentavr



GCG



Oscillating Chair