

PILOT FIELD TEST: RESULTS OF TANDEM WALK PERFORMANCE FOLLOWING LONG-DURATION SPACEFLIGHT

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BACKGROUND

Coordinated locomotion has proven to be challenging for many astronauts following long duration spaceflight. As NASA's vision for spaceflight points toward interplanetary travel and missions to distant objects, astronauts will not have assistance once they land. Thus, it is vital to develop a knowledge base from which operational guidelines can be written that define when astronauts can be expected to safely perform certain tasks. Data obtained during the Field Test experiment will add important insight to this knowledge base. Specifically, we aim to develop a recovery timeline of functional sensorimotor performance during the first 24 hours and several days after landing. A forerunner of the full Field Test study, the Pilot Field Test (PFT) comprised a subset of the tasks and measurements to be included in the ultimate set.

METHODS

Eighteen crewmembers consented to participate in the PFT (11 U.S. Orbital Segment [USOS] crewmembers and seven Russian crewmembers). The PFT was conducted twice preflight (for 6 crewmembers) and one to three times during the first 24 hours after landing. All 18 crewmembers were tested in Kazakhstan in either the medical tent at the Soyuz landing site (~one hour after landing), or at the airport (~four hours after landing). Eight of the 11 USOS crewmembers were tested two more times on landing day, at the refueling stop in Prestwick, UK (~12 hours after landing) and at the NASA Johnson Space Center (~24 hours after landing). The PFT consisted of three tasks, conducted in order of increasing difficulty, Sit-to-Stand (stand as quickly as possible from a seated position), Recovery from Fall (stand as quickly as possible from a prone position and stand for 3.5 minutes), and Tandem Walk. To perform the Tandem Walk, subjects began with their feet together, their arms crossed at their chest and eyes closed. When ready, they brought one foot forward and touched the heel of their foot to their toe, repeating with the other foot for about 10 steps. Three trials were collected with the eyes closed and a fourth trial was collected with eyes open. For a step to be counted as correct, the foot could not touch the ground while bringing it forward (no side stepping), eyes must stay closed during the eyes closed trials, the heel and toe should be touching, or almost touching (no large gaps) and there shouldn't be more than a three second pause between steps. The 'percentage of correct steps' was calculated to normalize the crewmembers' performance between testing sessions when the environment did not allow for 10 steps to be collected per trial.

RESULTS

For the first data collection in Kazakhstan, two of the 18 crewmembers were unable to perform any tests due to motion sickness, and four others requested to stop the testing before the Tandem Walk test. For the subsequent tests on landing day (12 and 24 hours after landing), all eight USOS crewmembers were able to complete the Tandem Walk test with assistance. The data show significant degradation in the 'percentage of correct steps', as compared to preflight, for all three test sessions conducted during the first 24 hours after landing, with recovery to preflight values around seven days after flight. For the trial with eyes open, crewmembers had a 40 % increase in 'percentage of correct steps' as compared to the eyes closed trials, with a return to preflight values by about 24 hours after flight. Performance and coordination improved with each subsequent session on landing day, indicating that interaction with the gravitational environment aids in the re-adaptation process.

CONCLUSION

The Tandem Walk data, collected as part of the PFT experiment, has provided invaluable information on the performance capabilities of astronauts during the first 24 hours after returning from long-duration spaceflight that can be used in planning future Mars, or other deep-space missions with unassisted landings.

The PFT was successful in paving the way for the full Field Test, which will conduct the same three PFT tasks as well as a multitude of other sensorimotor performance tests on crewmembers following long-duration spaceflight.