Training Enhances both Locomotor and Cognitive Adaptability to a Novel Sensory Environment

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Introduction: During adaptation to novel gravitational environments, sensorimotor disturbances have the potential to disrupt the ability of astronauts to perform required mission tasks. The goal of this project is to develop a sensorimotor adaptability (SA) training program to facilitate rapid adaptation. We have developed a unique training system comprised of a treadmill placed on a motion-base facing a virtual visual scene that provides an unstable walking surface combined with incongruent visual flow designed to enhance sensorimotor adaptability. The goal of our present study was to determine if SA training improved both the locomotor and cognitive responses to a novel sensory environment and to quantify the extent to which training would be retained. Methods: Twenty subjects (10 training, 10 control) completed three, 30-minute training sessions during which they walked on the treadmill while receiving discordant support surface and visual input. Control subjects walked on the treadmill but did not receive any support surface or visual alterations. To determine the efficacy of training all subjects performed the Transfer Test upon completion of training. For this test, subjects were exposed to novel visual flow and support surface movement, not previously experienced during training. The Transfer Test was performed 20 minutes, 1 week, 1, 3 and 6 months after the final training session. Stride frequency, auditory reaction time, and heart rate data were collected as measures of postural stability, cognitive effort and anxiety, respectively. Results: Using mixed effects regression methods we determined that subjects who received SA training showed less alterations in stride frequency, auditory reaction time and heart rate compared to controls. Conclusion: Subjects who received SA training improved performance across a number of modalities including enhanced locomotor function, increased multi-tasking capability and reduced anxiety during adaptation to novel discordant sensory information. Trained subjects maintained their level of performance over six months.

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