CUSTOMIZING COUNTERMEASURE PRESCRIPTIONS USING PREDICTIVE MEASURES OF SENSORIMOTOR ADAPTABILITY

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Astronauts experience sensorimotor disturbances during the initial exposure to microgravity and during the readapation phase following a return to a gravitational environment. These alterations may lead to disruption in the ability to perform mission critical functional tasks during and after these gravitational transitions. Astronauts show significant inter-subject variation in adaptive capability following gravitational transitions. The ability to predict the manner and degree to which each individual astronaut will be affected would improve the effectiveness of a countermeasure comprised of a training program designed to enhance sensorimotor adaptability. Due to this inherent individual variability we need to develop predictive measures of sensorimotor adaptability that will allow us to predict, before actual space flight, which crewmember will experience challenges in adaptive capacity. Thus, obtaining this information will allow us to design and implement better sensorimotor adaptability training countermeasures that will be customized for each crewmember's unique adaptive capabilities. Therefore the goals of this project are to: 1) develop a set of predictive measures capable of identifying individual differences in sensorimotor adaptability, and 2) use this information to design sensorimotor adaptability training countermeasures that are customized for each crewmember's individual sensorimotor adaptive characteristics.

To achieve these goals we are currently pursuing the following specific aims:

Aim 1: Determine whether behavioral metrics of individual sensory bias predict sensorimotor adaptability. For this aim, subjects perform tests that delineate individual sensory biases in tests of visual, vestibular, and proprioceptive function.

Aim 2: Determine if individual capability for strategic and plastic-adaptive responses predicts sensorimotor adaptability. For this aim, each subject's strategic and plastic-adaptive motor learning abilities are assessed using a test of locomotor function designed specifically to delineate both mechanisms.

Aim 3: Develop predictors of sensorimotor adaptability using brain structural and functional metrics. We will measure individual differences in regional brain volumes (structural MRI), white matter integrity (diffusion tensor imaging, or DTI), functional network integrity (resting state functional connectivity MRI), and sensorimotor adaptation task-related functional brain activation (functional MRI).

We decided to complete the data collection for Specific Aims 1, 2 and 3 simultaneously on the same subjects to increase data capture. By having the same subjects perform all three specific aims we can enhance our ability to detect how a wider range of factors can predict adaptability in a specific individual. This provides a much richer database and potentially a better understanding of the predictive power of the selected factors. In this presentation I will discuss preliminary data obtained to date.

This work is supported by the National Space Biomedical Research Institute through NASA NCC 9-58