Cortical Neuroplasticity and Cognition in Extreme Environments

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Abstract

Space is one of the most extreme environments for human beings, yet space faring nations strive for deep space exploration and human settlement on Moon and Mars. These missions expose crews to various physiological and psychological stressors such as radiation, altered gravity conditions, social isolation and confinement, and reduced physical activity - stressors that are also known to alter neuroplasticity and cognitive functions. To ensure missions' success and safety, it is important to know how the brain adapts in response to these stressors and to understand the associated neurobehavioral risks.

hippocampus and parahippocampal gyrus. These changes could be largely counteracted by a high-intensity training intervention that was performed during the immobilization period. Second, bed rest associated social isolation and confinement evoked reduced Event Related Potential (ERP) amplitudes in participants while looking at highly arousing photographs. This emotional blunting was observed predominantly in centroparietal regions and did not occur in a control group. Source localization confirmed a lower electrocortical activity in the posterior cingulate gyrus, insula, and precuneus in the bed rest group for pleasant and unpleasant, but not for neutral photographs. Third, attentional performance during a Continuous Performance Task (CPT) was impaired by weightlessness. There was additional evidence that attentional performance was also influenced by participants' emotional states.

The results provide evidence of the adverse neurobehavioral adaptations brought about by these spaceflight associated stressors. The results go beyond applications of space medicine and provide further insight into the adaptational processes of the brain in response to physical inactivity, confinement, and vestibular deficiency.