Effects of microgravity on motor awareness: self-monitoring of motor performance during Parabolic Flights

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Having conscious control of one's actions is a crucial aspect for coherent purposeful behavior. During space exploration missions, however, the effects of microgravity on motor awareness still need to be clarified. We took advantage of short periods of zero gravity (0g) during Parabolic Flights (PF) to investigate the acute effects of changes in gravitational input on Conscious Monitoring of Motor Performance[1]. We used a motor task in which subjects had to trace straight lines to a target with their (hidden) hand. During the task, participants received visual feedback of their action on a computer screen. In most trials, the line trajectories shown on the screen were deviated by a variable angle. Therefore, to trace straight trajectories, subjects had to deviate in the opposite direction. At the end of each trial, participants had to report if the line seen on the computer screen was the line actually drawn. Eighteen participants were tested during three ESA parabolic flight campaigns. Participants performed the motor task in four conditions: Pre-flight (PRE) at 1g on ground, on board during the flight at 0g (0G) and 1g (1G), and post-flight (POST) at 1g on ground. A repeated-measure ANOVA was performed to compare the effect of condition (PRE, 0G, 1G, POST) on the angle at which participants became aware of the deviation. In line with previous findings[1], participants did not recognize the deviation until a certain degree of angle in PRE, POST, and 1G conditions (M=8.28Â°). Importantly, in 0G, the amplitude of the angle at which participants became aware of the correction of their trajectory significantly increased (M=9.71Â°;p<.001) compared to PRE, 1G, and POST. These results show that reduction of gravitational input worsens motor awareness, as indexed by the increase, in 0g, of the angle's amplitude at which participants became aware of their trajectory correction. The unweighting of otolith inputs in microgravity may have increased the weight of vision, requiring a higher degree of trajectory perturbation for participants to become aware of the signals generated by their movements. The finding that motor awareness decreased in microgravity provides further evidence for the role of the vestibular system in motor control and intention[2,3]. The findings that vestibular input plays a crucial role in the action self-monitoring have relevant implications for the identification of countermeasures to be applied in altered gravity conditions and, on Earth, for the implementation of rehabilitation treatment in patients with vestibular disorders.

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