Journal of Vestibular Research 28 (2018) 367
DOI:10.3233/VES-180641
IOS Press

Letter to the Editor

To the Editor,

We thank Drs. Micarelli, Candidi, Viziano, and Alessandrini for their thoughtful commentary on our paper [7]. Our study does, indeed, add support to the findings of Candidi et al. [1] and shows the importance of vestibular input in spatial orientation.

In a microgravity environment, the reduced influence of the gravitational vector affects the sensorimotor integration process, causing re-interpretation of both inputs from the vestibular end organs and somatosensory information from the different parts of the body. Two interesting studies by Clement and his colleagues that examined subjects' abilities to perform mental rotation tasks in microgravity may elucidate this problem. In a study on the space shuttle Discovery [3], upon initial exposure to microgravity, crewmembers had decreased performance of mental rotation skills; however, they improved after three days as they adapted to the absence of the gravitational vector. Thus, the absence of the gravity vector was not the unitary cause of the performance decrement: as their nervous systems developed adaptive changes in response to the loss of the gravitational vector acting upon all sensory and motor systems, the influence of both the vestibular and somatosensory systems may have been felt more acutely. During the microgravity portion of parabolic flight [4], subjects showed performance decrements in perception of long body axis orientation compared to conditions of additive tactile cues to their chests using an inflated cushion during some trials. Thus, the investigators concluded that the absence of somatosensory input can contribute to the decrements in accuracy of subjects' spatial orientation relative to their surroundings in microgravity during space flight, supporting other studies that showed similar results with applied pressure to the feet or tactile stimulation of the torso in microgravity [2, 5, 8]. These studies bring to mind the comment by Mittelstaedt that somatic gravity receptors in the body, perhaps the kidney, are particularly important for spatial orientation [6].

Together, these interesting studies indicate that we still have much to learn about the complexity of multisensory inputs on the problems of spatial orientation and postural control. This information will be pertinent in future research as we look towards developing countermeasures for problems ranging from spaceflight to clinical care using augmented/virtual reality techniques.

Sincerely,
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