The differential effects of microgravity on the orienting of voluntary and automatic visuospatial attention

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Objectives. To ensure maximum performance during spaceflight, the effects of microgravity on spatial attention must be clarified. To this end, we investigated the effects of microgravity on automatic (i.e., exogenous) and voluntary (i.e., endogenous) orienting of visuospatial attention [1], using short periods of zero gravity (0g) during parabolic flights.
Materials. Two versions of the Posner spatial cueing task were used to assess the orienting of exogenous and endogenous attention. In both tasks, participants had to detect, as quickly and accurately as possible, the presence of peripheral visual targets (i.e., on the right or on the left of the screen) which could be preceded by valid, invalid, or neutral cues. In the endogenous task, central predictive cues directed attention endogenously, whereas in the exogenous task, peripheral non-predictive cues attracted attention exogenously.
Methods. Fourteen participants were studied during three ESA parabolic flight campaigns. They performed the attentional tasks at 1g before the flight (PRE), at 0g (0G) and 1g (1G) on board the flight, and at 1g shortly after flight (POST). For the two tasks, a series of repeated-measures ANOVAs were performed on accuracy and reaction times for correct responses, with validity (valid, invalid) and condition (PRE, 0G, 1G, POST) as within-subject factors. Post-hoc comparisons were conducted using paired t-tests with Bonferroni correction.
Results. For the exogenous task, a larger validity effect (invalidâ€”valid trials) was found in 0G compared to PRE, 1G and POST. An opposite pattern was observed for the endogenous task, where the validity effect decreased in 0G compared to 1G, and POST. No other comparisons were significant.
Discussion. The present study suggests that acute phases of microgravity differentially affect automatic and voluntary components of spatial attention. More specifically, microgravity enhanced orienting of automatic attention, as observed in the exogenous task, but reduced the ability to orient voluntary attention, as shown in the endogenous task. By unweighting the otolith inputs to brain regions that overlap with the ventral attentional system [1, 2], microgravity may have weakened egocentric reference frames in favor of allocentric reference frames [3], enhancing stimulus-driven

attentional capture and making participants more distractible.
Conclusions. Findings of this research may have implications for the development of optimal countermeasures to be applied in space exploration and, on Earth, for the identification of effective interventions for the rehabilitation of individuals with vestibular disorders.

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