Spatial coding of eye movements relative to perceived orientations during roll tilt with different gravitoinertial loads

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This purpose of this study was to examine the spatial coding of eye movements during roll tilt relative to perceived orientations while free-floating during the microgravity phase of parabolic flight or during head tilt in normal gravity. Binocular videographic recordings obtained in darkness from six subjects allowed us to quantify the mean deviations in gaze trajectories along both horizontal and vertical coordinates relative to the aircraft and head orientations. Both variability and curvature of gaze trajectories increased during roll tilt compared to the upright position. The saccades were less accurate during parabolic flight compared to measurements obtained in normal gravity. The trajectories of saccades along perceived horizontal orientations tended to deviate in the same direction as the head tilt, while the deviations in gaze trajectories along the perceived vertical orientations deviated in the opposite direction relative to the head tilt. Although subjects were instructed to look off in the distance while performing the eye movements, fixation distance varied with vertical gaze direction independent of whether the saccades were made along perceived aircraft or head orientations. This coupling of horizontal vergence with vertical gaze is in a consistent direction with the vertical slant of the horopter. The increased errors in gaze trajectories along both perceived orientations during microgravity can be attributed to the otolith's role in spatial coding of eye movements.

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