The effects of a change in gravity on the dynamics of prehension.

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Abstract

Investigating cyclic vertical arm movements with a hand-held load in an airplane undergoing parabolic flight profiles allowed us to study how humans modulated their grip force (GF) when the gravitational and the inertial components of the load force (LF) varied independently. Eight subjects participated in this study; four had already experienced parabolic flights (ES) and four were inexperienced (NES). They had to move continuously an instrumented object up and down in three different gravitational conditions (1 *g*, 1.8 *g*, 0 *g*). In 1 *g*, GF precisely anticipated the fluctuations of LF which was maximum at the bottom of the trajectory and minimum at the top of the trajectory. However, as the subjects incompletely released their grip when LF was minimum, the grip-load force relationship was not linearly proportional as frequently described in the literature. When the gravity changed (0 *g* and 1.8 *g*), the grip-load force coupling persisted for all the subjects from the first parabola. In 0 *g*, GF was accurately adjusted to the two peaks of LF occurring at the two extremities of the trajectory due to the absence of weight. While the level of GF modulation was immediately adapted to the new force field for the ES, the NES dramatically increased their grip when he was faced with altered gravity for the first time. A progressive release of the grip occurred and a continuous grip-load force relationship with regard to 1 *g* was established after the fifth parabola. A new gravitational field was rapidly integrated into internal CNS models which could then be reused as required by the occasion.