Paper ID: 77790
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IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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ASSESSMENT OF AUDITORY COGNITIVE RESPONSES IN A TRANSIENT GRAVITATIONAL ENVIRONMENT

Abstract

A varying gravitational environment provides a fundamental tool to understand how sound perception and related cognitive processes take place. These conditions are usually achieved by resorting to parabolic flights wherein distinct accelerations can be felt, such as Martian and Lunar gravitational pull, microgravity, and hypergravity. The progression between different acceleration regimes also provides the opportunity to study the transient effects of changing acceleration in the human body, with special interest in the auditory system.

Short-term effects are often not overseen as the acceleration transient stage is of relatively short duration when compared with the current human space mission duration, taking place in highly-automated flight phases such as launch and reentry. Notwithstanding, utterly important tasks may be performed during these phases such as reacting to an alarming sound by pressing a control button during launch, which assumes a critical importance for mission integrity.

Reaction Times (RT) are known to vary on the basis of age, gender, and physical activity levels in subjects submitted to visual and auditory stimuli. The Psychomotor Vigilance Test (PVT) is a widely accepted methodology to assess that impact, and the auditory PVT (aPVT) allows to understand the impact of a given variable in outputs such as the median RT, thus being used to study how a varying acceleration regime in sound perception affects the reaction time.

As such, the experimental study presented in this manuscript uses a low-cost apparatus to measure finger dexterity triggered by auditory stimuli in an adaptation of the aPVT. The procedure takes place during a microgravity flight and consists in taking an action upon perception of an auditory stimulus. The stimulus is presented to the subject's ears through wired earphones at a frequency of 988 Hz, corresponding to the key B5. Only this frequency is emitted at a variable tempo, i.e. only the beat-per-minute count varies. The subject is intended to act upon perception of this sound by pressing a single key on a 2-octave keyboard with the index finger of the dominant hand.

It is intended to test the subject's reaction to both predictable and random tempo variations which assesses both cognitive perception of a repeating pattern varying in time, and pure reaction to auditory stimuli. Expected outputs comprise reaction times as function of vertical acceleration for both tempo variations so as to conclude about the impact of a changing gravitational environment in the reaction to auditory stimuli.