

How to prevent mind-wandering during an EVA ? Presentation of mind-wandering detection method using ECG technology in a Mars-analog environment.

The purpose of our study is to detect mind-wandering in an EVA (Extra-Vehicular Activity) context during a long supervision task. The detection will be realized by an electro-cardiogram, actually one of the most effective means to detect cognitive events thanks to measures of heart rate variability

Experienced by everyone, mind-wandering depicts the state of mind where thoughts are not related to the current action. Its deleterious aspect regarding performances suggests a need to take mind wandering seriously as an impediment to manned space missions safety, all the more as the perception stage of situation awareness has been empirically shown to account for over 75% of pilot errors.

Previous work conducted by the lead author has confirmed the hypothesis according to which pupil diameter online monitoring using an eye-tracking device could be an effective mean to detect the apparition of mind-wandering, as an increase in pupil size is detected prior to an error during a supervision task. But other physiological responses can also be used to track down mind-wandering: among them, ECG recordings are both easy to obtain and analyze, statistically related to mind-wandering, and way easier to record during extra-vehicular activities than pupil diameter.

Data will be recorded during a Mars-analog mission (MDRS 164), from February 20 to March 6 at the Mars Desert Research Station (Utah). During various cognitive tasks, the subject will have his ECG and awareness levels monitored at the same time to see if the correlation between these two measures, established in previous research, can be replicated in a Mars-mission environment.

Four different tasks will allow us to measure heart rate metrics and mind-wandering in segments of high physical demand but low cognitive demand (1), low physical demand/low cognitive demand (2), high physical demand/high cognitive demand (3), low physical demand/high cognitive demand (4). At different time intervals, probes will interrupt the subject to inquire about his thoughts. Values of Heart Rate and Heart Rate Variability (which power in high frequencies is related to the parasympathetic system and mind wandering) will be computed from recorded data, and their statistical changes during on-task and off-task thoughts will be assessed.

This protocol for the detection and prevention of mind-wandering during manned aerospace activities will benefit from improvements and practical tests during the simulation, and will open a more general discussion on human factors experimentation during analog missions.