

# Impact of a Martian lifestyle on memory and reflexes

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## Abstract

An inhabited Mars expedition is the next big step in space exploration. Thousands of scientists are working on making it possible. A major problem is the distance separating Earth from the red planet. The Earth-Mars distance varies from 54.6 million to 401 million km, with an average distance of about 225 million km. In comparison, the International Space Station is only 400 km away from Earth. This means that Earth won't be able to physically help the crew if something happens in the base. It is then very important to stay at the top of your game during the whole expedition on Mars, which will probably last a couple of years.

A Mars expedition can cause stress to the body. This stress can have consequences on reflexes, memory and other cognitive performances. The experiment detailed below aims at measuring these consequences and helping preventing them.

## 1 Objectives

The objective of this experiment is to measure the impact of a "Martian lifestyle" on memory and reflexes. Several factors can actually have consequences on our organism:

- Relative space/relational confinement: few space to live in, almost no external contact;
- Change of scene: living in the desert, being in a hostile zone for two weeks;
- Energy consumption due to an EVA (extravehicular activity): staying at base all day long causes little energy consumption because of the little space available; however, sometimes we must go on EVA for hours which can cause sudden fatigue.

These factors can induce fatigue that leads to decreased attention and memory performance, and increased reaction time<sup>1</sup>.

## 2 Procedure

We want to measure our ability to stay at the top of our game, which is really important during a Mars expedition: there can be a problem that needs to be immediately solved in the base. In order to do so, we intend to measure several factors during the simulation:

- Every morning at the same time, ask questions to crew members in order to evaluate their fatigue level;
- Testing reflexes and memory in the hour after waking up and within 30 minutes after an EVA through a tablet application;
- Testing the time needed to fully recover from an EVA.

### 2.1 Fatigue

Fatigue will be assessed using the following questionnaire<sup>2,3</sup>:

#### Physical symptoms.

1. Do you have problems with tiredness?
2. Do you need to rest more?
3. Do you feel sleepy or drowsy?

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<sup>1</sup>Dinges D.F., J Sleep Res, 1995; 4(S2):4-14

<sup>2</sup>Neuberger G.B., Arthritis Care Res, 2003;49(S5):175-83

<sup>3</sup>Chalder T. et al., J Psychosom Res, 1993;37(2) :147-53

4. Do you have problems starting things?
5. Are you lacking in energy?
6. Do you have less strength in your muscles?
7. Do you feel weak?

#### Mental symptoms.

8. Do you have difficulty concentrating?
9. Do you have problems thinking clearly?
10. Do you make slips of the tongue when speaking?
11. How is your memory?

#### Scoring

- Better than usual = 0
- No more than usual = 1
- Worse than usual = 2
- Much Worse than usual = 3

The score range is 0-33. The higher score indicates more fatigue. Two different scores can also be used: one for physical fatigue (1-7) and one for mental fatigue (8-11).

### 2.2 Reflexes

The reflexes measurements will be acquired through a “psychomotor vigilance task” (PVT). The PVT is a task where the subject presses a button as soon as a visual stimulus appears. This test has already been used on the International Space Station in order to evaluate sleepiness and vigilance of astronauts<sup>4</sup>.

### 2.3 Memory

The short-term memory test is a very simple test. The subject is presented with a set of letters to be recalled. The number of letters increases from 3 to 12. The performance is then scored based on the number of letters recalled.

A baseline will be acquired before starting the expedition. Each crew member will undergo each test three times before departure. In this way, each member will be its own “control” and we will be able to compare the evolution over time of their skills. Data will then be analyzed. Statistical tests will be performed in order to verify our hypothesis.

Both tests will be performed daily. The crew will also undergo the reflex test within 30 minutes after EVAs and every 15 minutes until reaching the basal level (max 4 times).

## 3 Material

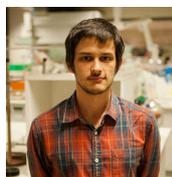
A tablet with the following applications:

- Reflex Test by in-trinity
- Short-Term Memory Test by Femi Mobile

A computer with the following softwares:

- Microsoft Excel by Microsoft to collect the data
- GraphPad Prism by GraphPad Software, Inc. to analyze and illustrate the data

### About the author



Martin recently graduated in pharmaceutical sciences at the Université catholique de Louvain. During his studies, he decided to work in a research group (Bioanalysis and Pharmacology of Bioactive Lipids research group) as a researcher student. His work consisted in analyzing biological samples such as cell cultures, blood, plasma or tissues, using a mass spectrometer. This formation brought him scientific rigor, communication skills and the ability to teamwork. He now works in the same group as a PhD student and teaching assistant. As a pharmacist, he has strong scientific knowledge, particularly in medical sciences, chemistry and biology. His multidisciplinary training makes him a good addition to the crew.

<sup>4</sup>[www.nasa.gov/mission\\_pages/station/research/experiments/982.html](http://www.nasa.gov/mission_pages/station/research/experiments/982.html)