ASTRONAUT PLAYSCAPES

Table Football in space – a crazy idea …
… or a sensible contribution to keeping astronauts functioning in complex space systems?

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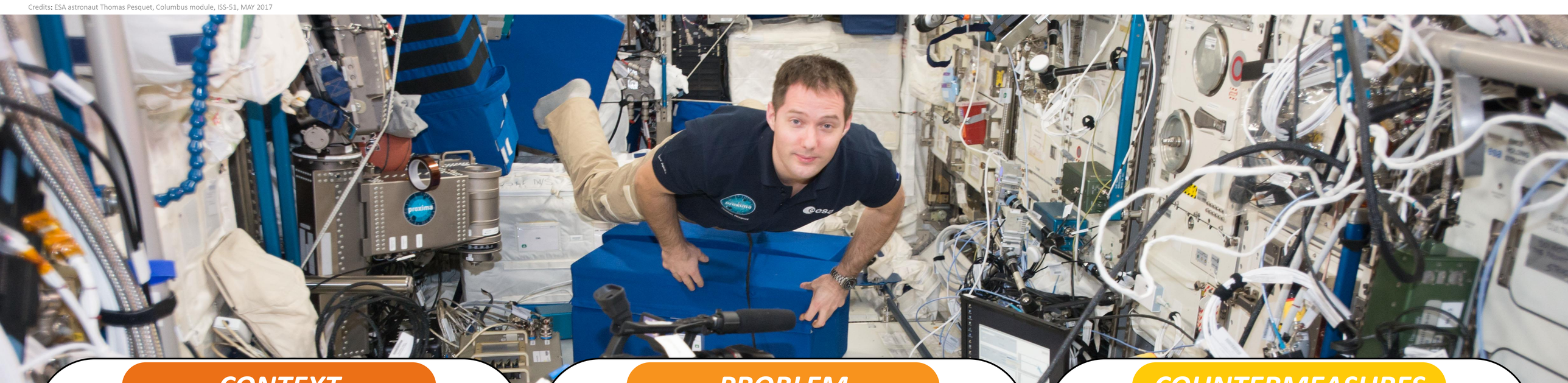
Credits: ESA astronaut Thomas Pesquet, Columbus module, ISS-51, MAY 2017



CONTEXT

A growing anticipation of near-future **long duration, deep space human missions**:

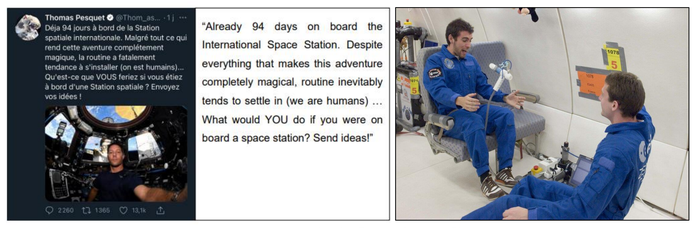
- Returning humanity to the Moon
- Sending humanity to Mars

Credits: NASA, ESA, timknowles.medium.com, NASA/JSC

PROBLEM

Exposure to space environments result in **degraded human psychology and physiology** including:

- Isolation and team dynamic issues
- Altered sensorimotor & visuospatial control



Credits: Thomas Pesquet, ESA

COUNTERMEASURES

Established problem of astronaut muscle and bone loss addressed by exercise countermeasures

… but there is no countermeasure for team dynamics / play / psychomotor skills

Treadmill

Advanced Resistance Exercise Device

Credits: abcnews

ASTRONAUT PLAYSCAPES - THE CONCEPT

MONITORING AND MAINTAINING PERFORMANCE THROUGH RECREATON / GAMES / PLAY

- In the extreme isolation of deep space missions, maintaining astronaut team dynamics will be challenging
- Exposure to, and transitions between, various space environments appear to affect mission critical practical human skills such as fine sensorimotor control and ability to maintain visuospatial attention
- For future human space systems, new countermeasures are required to addresses these issues and that can be efficiently incorporated into space systems and their operations
- **New concept of "Astronaut Playscapes" proposed** – a micro- / partial-gravity compatible and instrumented version of a recreational activity requiring social interaction and fine sensorimotor and visuospatial control and to be used in space systems as an operational countermeasures and research facility

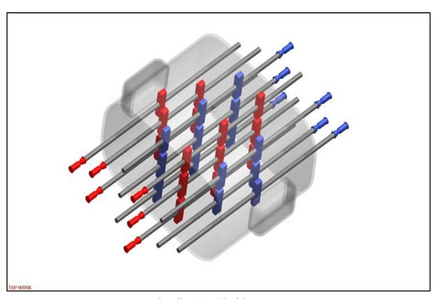
AN INITIAL EXAMPLE – TABLE FOOTBALL

- **Table football – initial choice** to explore and develop the concept given its wide societal appeal, ability to be instrumented, variants compatible with micro-gravity and partial-gravity and can be envisaged
- Involves multiple players and team interaction / social interaction
- Is dynamic and unpredictable
- Requires sensorimotor and visuospatial control
- **Instrumentation of table:** machine vision, MEMs IMUs on control rods, array of pressure sensors around handles
- **Instrumentation of players:** smartwatches, IMUs suits, eye-tracking device
- **Self-reported data (psychological):** questionnaires, private medical and psychological conferences

Concept "spark" on 3rd Feb 2010 at ESA ESTEC

Credits: David Cullen

3D micro-gravity table football concept



Credits: Ian Kitchingman

OBJECTIVES

OPERATIONAL OBJECTIVES

- **Contribute** and **validate contribution to social interaction and team dynamics** within space-systems
- **Encourage faster adaptation of the sensorimotor and visuospatial system to a new gravitational environment** (dexterity, reaction time, coordination, force control)
- **Monitor sensorimotor** and **visuospatial performance** and flag any inappropriate level of performance
- Potential long-term objective: instrumentation / actuation of the hardware to **enable astronauts to play remotely with family and friends from Earth** (teleoperation) or via AI system

RESEARCH OBJECTIVES

- A platform / facility to **study crew social cohesion and team dynamics**
- A platform / facility to **expand knowledge on various physiological, neuroscience and motor control aspects**

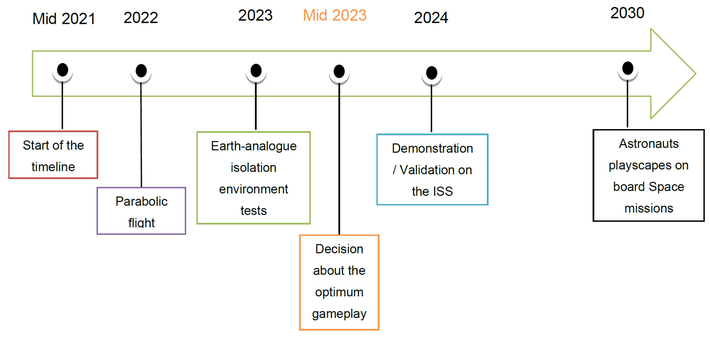
CURRENT PROJECT STATUS

- Diverse team assembled of space performance psychologists, physiologists, ergonomist, games developer, and space systems engineers
- Modification and instrumentation of a commercial table football and instrumentation of players planned
- Anticipation of early micro- and lunar-gravity testing via parabolic fight

Credits: ESA

DEVELOPMENT ROADMAP

A plan leading to operational implementation in future spaceflight



INITIAL CRITIQUE

- Is table football the most appropriate gameplay?
- … and if not, what could be alternatives?
- Is it simpler to use computer games and / or virtual reality?
- … and is there / what are the added benefits of physical and interactive gameplay?

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