


Industrial Neuroscience for Aerospace Applications

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The Context

Aerospace contexts

- **Confined and isolated environment**: human's and team members' mental states and behavioural monitoring
- **Extreme conditions** : human errors commission mitigation
- **Gravity impact**: neurophysiological changes

The Rationale

Conventional vs. Neurophysiological measures

- Self-assessed measures are subjective and **cannot be collected while** performing tasks (invasiveness and low temporal resolution).

- Supervisor assessment could have a certain **subjective bias** (personal experience, cognitive, and emotional biases, not perceivable from his behaviour).

- Behavioural data or debriefing often highlight risky behaviours "**after the fact**".

It is therefore clear how these measurements alone cannot be used to accurately assess the users' mental states and consequently their teamwork.

(Parasuraman et al., 2008; Borghini et al., 2017)

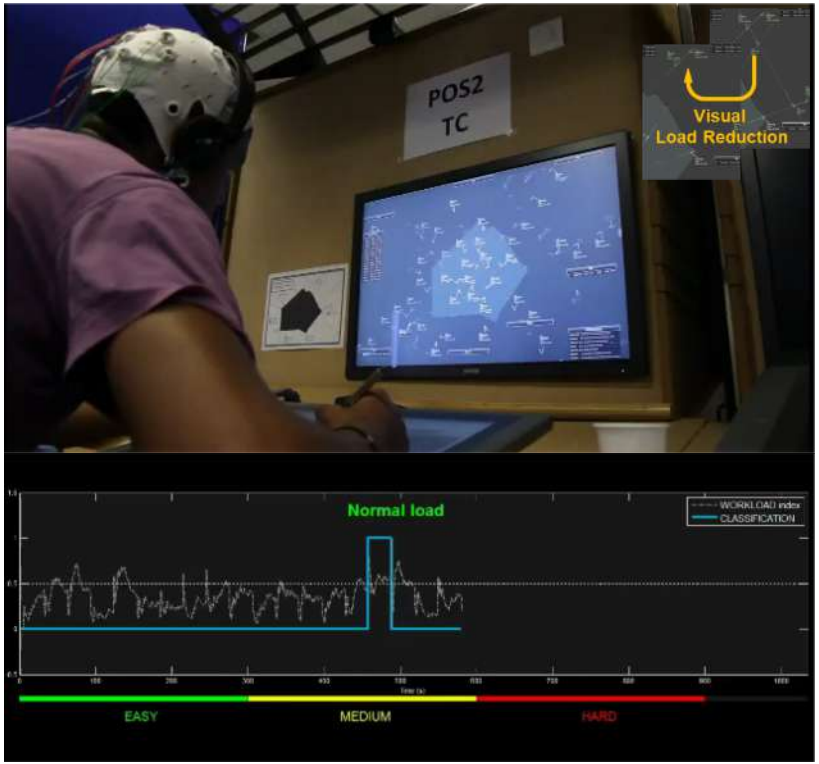
The idea

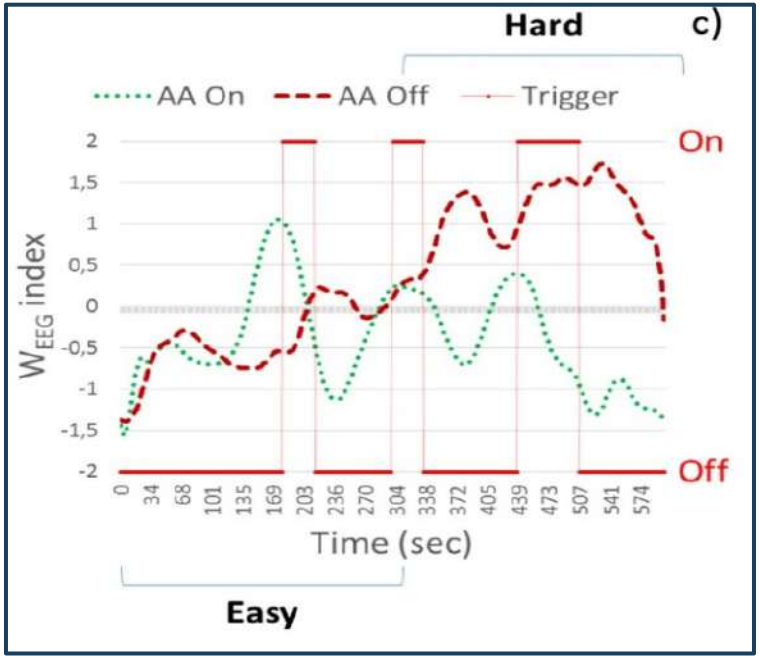

SCIENTIFIC
RESEARCH

Neuroscience benefits for Aerospace

Neurofeedback
and
Adaptive Automation

Adaptive automations: settings





(Aricò et al., 2016. *Frontiers in Human Neuroscience*)

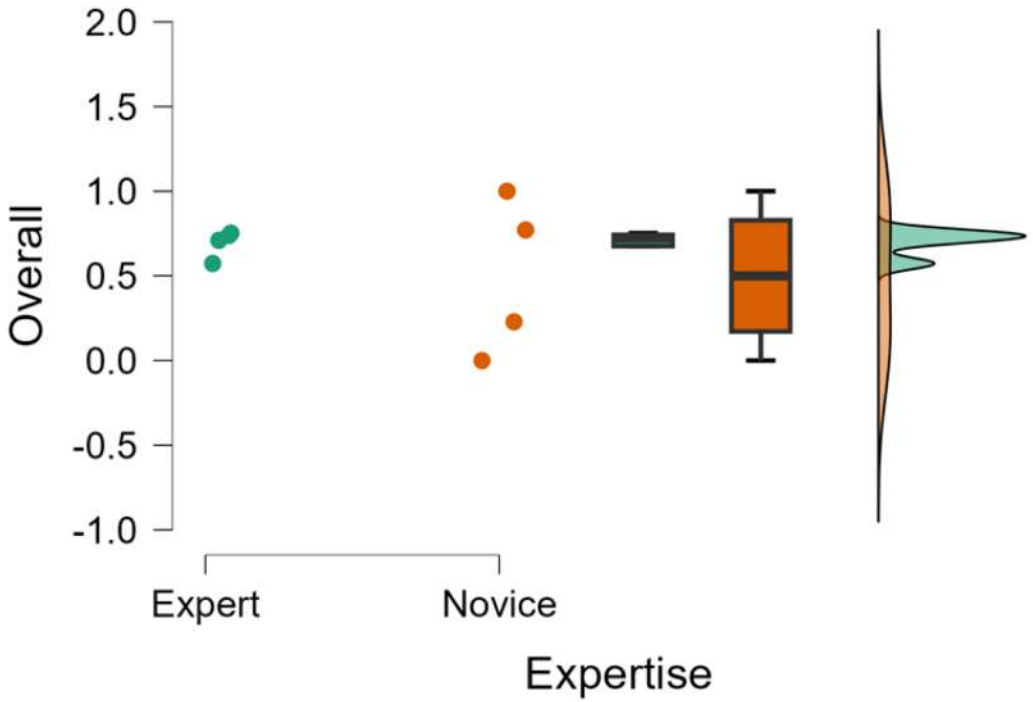
Teamwork Assessment

Surgeons' teamwork assesment

Subjective data

Combined Subjective SME (cSME):

combination of *SME workload evaluations*, *SAM questionnaire* and *SME collaboration evaluations*



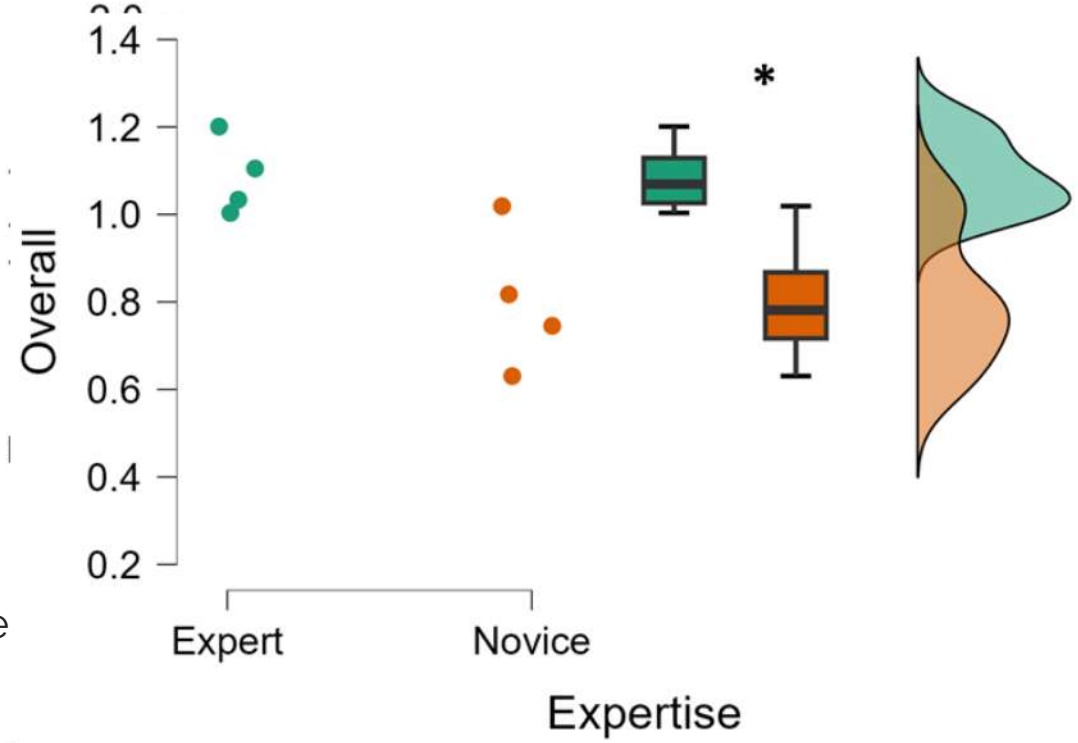
Neurophysiological – based Teamwork index

Teamwork Index:

mutual information between the mental states considered.

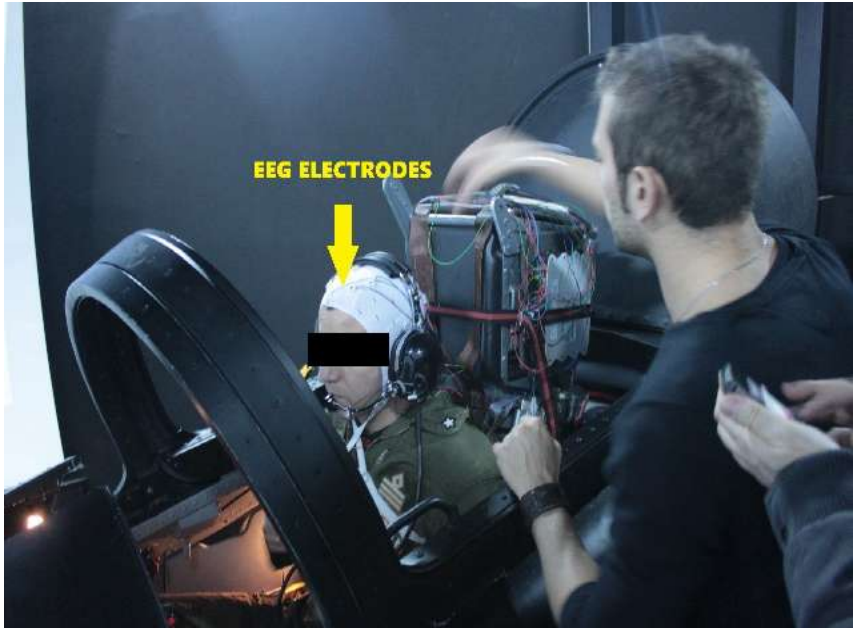
Real vs. Fake:

shuffling for each member with all the rest.



Expertise Evaluation

Air Force: Experts vs. Students

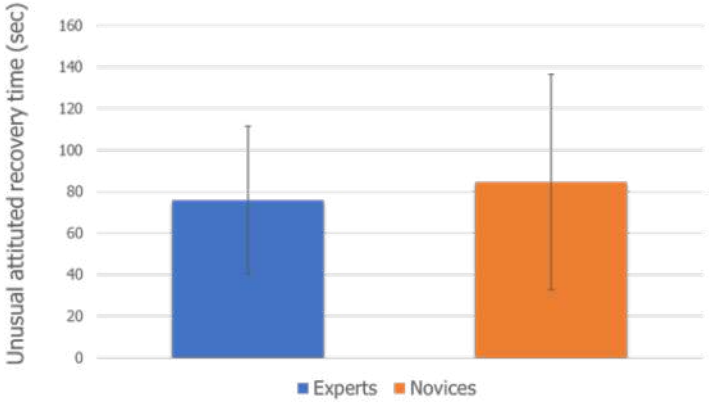


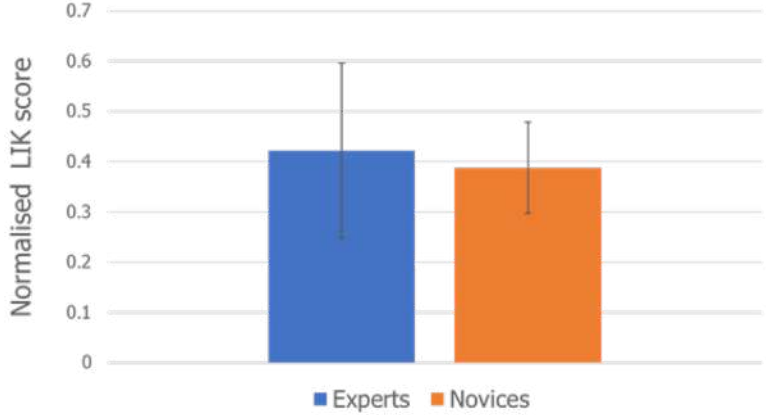
EEG recording along the entire flight simulation.

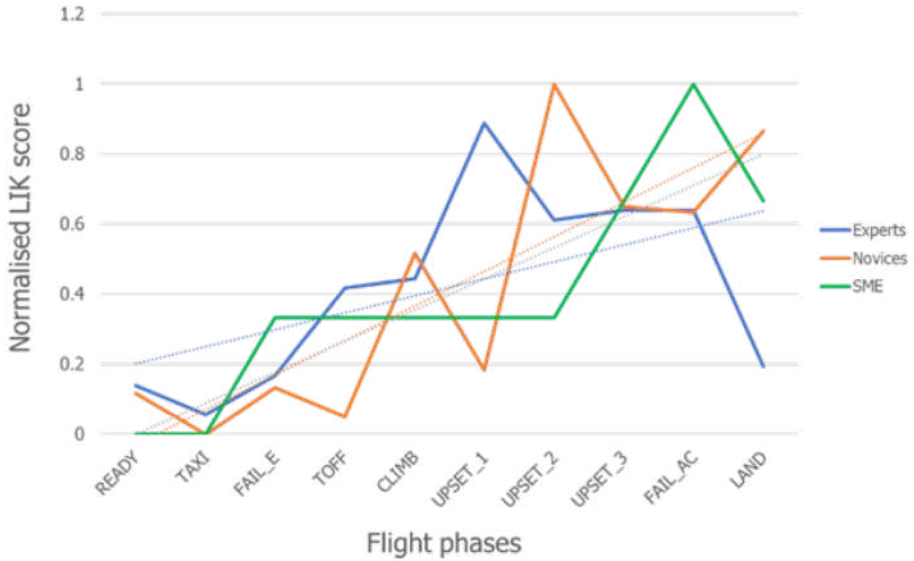
The Instructor could control the simulator and interact with the pilots.

(Borghini et al., 2022, Safety)

Experts vs. Students: Results

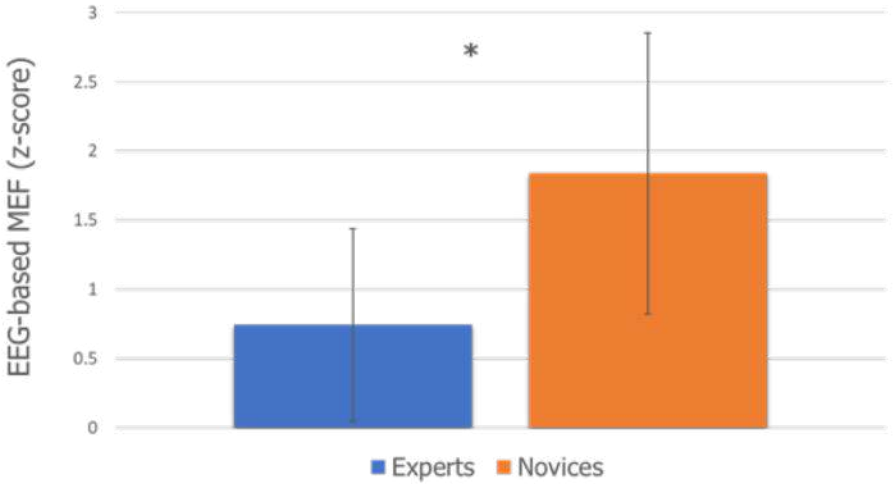


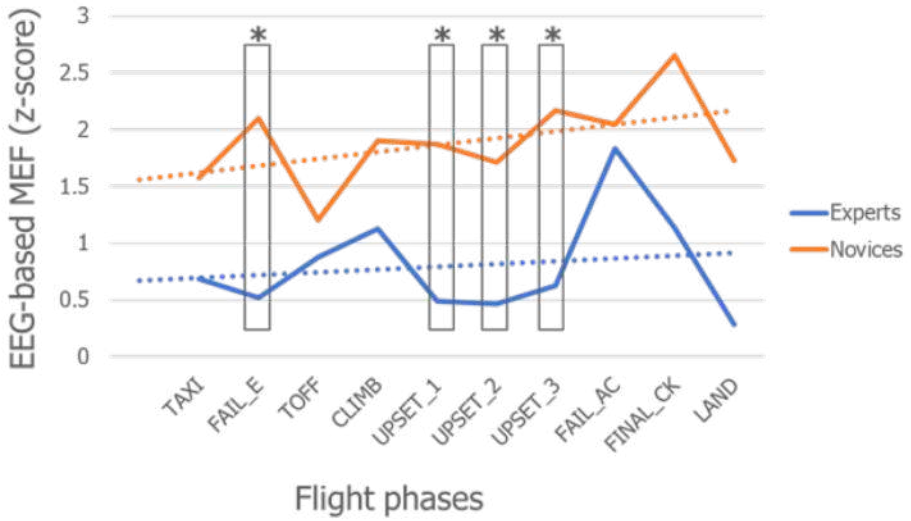




(Borghini et al., 2022, Safety)

Experts vs. Students: Results





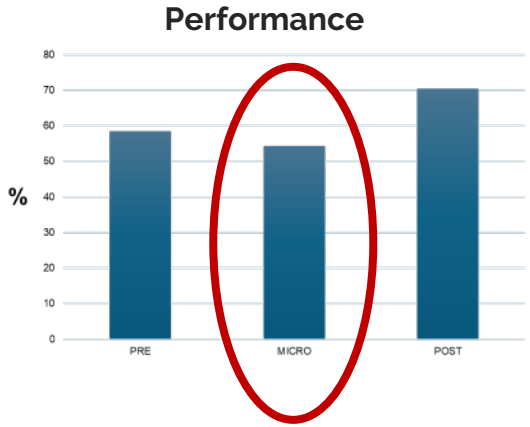
(Borghini et al., 2022, Safety)

Microgravity impact

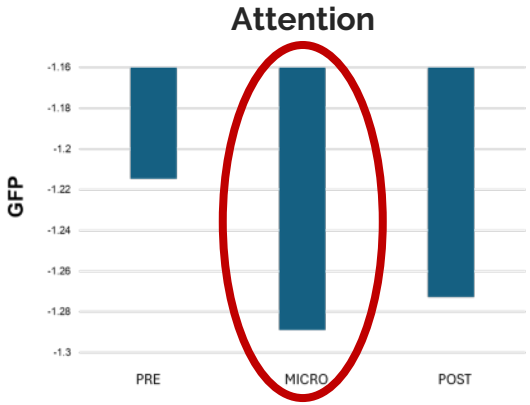
Virgin Galactic Suborbital Flight

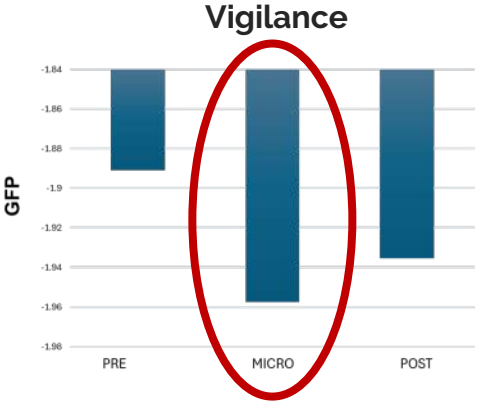
Multitasking: 2 levels (easy, hard)
When: PRE – uGravity – POST
Duration: 3 mins
Sample size: 2 pax
Data collection: Performance, EEG, ECG and EDA

Cognitive impairment assessment



Confirmed by **Cortisol** (+50%), **Dopamine** Dopamina (-19%) and **Brain derived neurotrophic factor BDNF**(+15%)



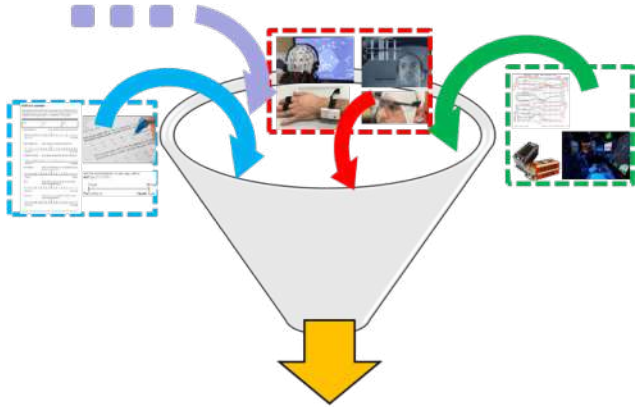


(Bosco et al. 2024)

General Conclusions

What are the benefits in using Neuroscience?

Neuroscience and multimodal approach will endow additional and objective information for a more accurate individual's and team members' monitoring and assessment in Aerospace contexts



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Discovering unconscious **Insights**

Any questions, comments, suggestions?

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