# POWER COMPARISON BETWEEN DATA FROM HEAD-DOWN TILT BED REST AND DURING SPACEFLIGHT

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## INTRODUCTION

Spaceflights expose crew members to adverse conditions such as **microgravity**, isolation, or radiation. Although it has been well observed that these factors affect the human brain organization and its physiology, their clinical and behavioral consequences are poorly understood.

In particular, microgravity seems to be affecting the vestibular system and the cerebrospinal fluid distribution of the body [1]. Moreover, several **sensorimotor deficits** have also been reported during spaceflights [1]. Nevertheless, the relationship between microgravity and these deficiencies in the sensorimotor cortex has not been stablished yet. To this end, **electroencephalography** (EEG) seems like a promising technique to investigate it.

With the aim of studying the impact of microgravity on the body on Earth, the **head-down bed rest** (HDBR) 6° tilt position has been stablished as one of the most used experiments. However, this analogue faces some limitations [2], that might suggest it is not as much as reliable as we thought it was. To elucidate this, a **power comparison** between actual microgravity and HDBR is made here.

## MATERIALS & METHODS

21 male participants (HDBR) [3]
5 EEG recordings (1 pre, 3 HDBR, 1 post)

-8 | 5 | 30 | 58 | +9 DAYS

5 male ISS astronauts (NEUROSPAT) [4]
9 EEG recordings (3 pre, 2 in-flight, 4 post)

-67 | -43 | -28 | 9 | 55 | +3 | +7 | +17 | +20 DAYS

32-channels (EC) EEG
eLORETA source reconstruction

| | |
|---|---|
| δ | 2 - 4 Hz |
| θ | 4 - 8 Hz |
| α | 8 - 12 Hz |
| β | 12 - 30 Hz |
| γ | 30 - 60 Hz |

**BRAIN NETWORKS**
Whole Brain Network (WBN)
Default Mode Network (DMN)
Salience Network (SAL)

**POWER CALCULATION** — Relative power value for each subject, condition, frequency band, and network

**STATISTICAL ANALYSIS** — One-way ANOVA with Tukey test for multiple comparisons

## RESULTS

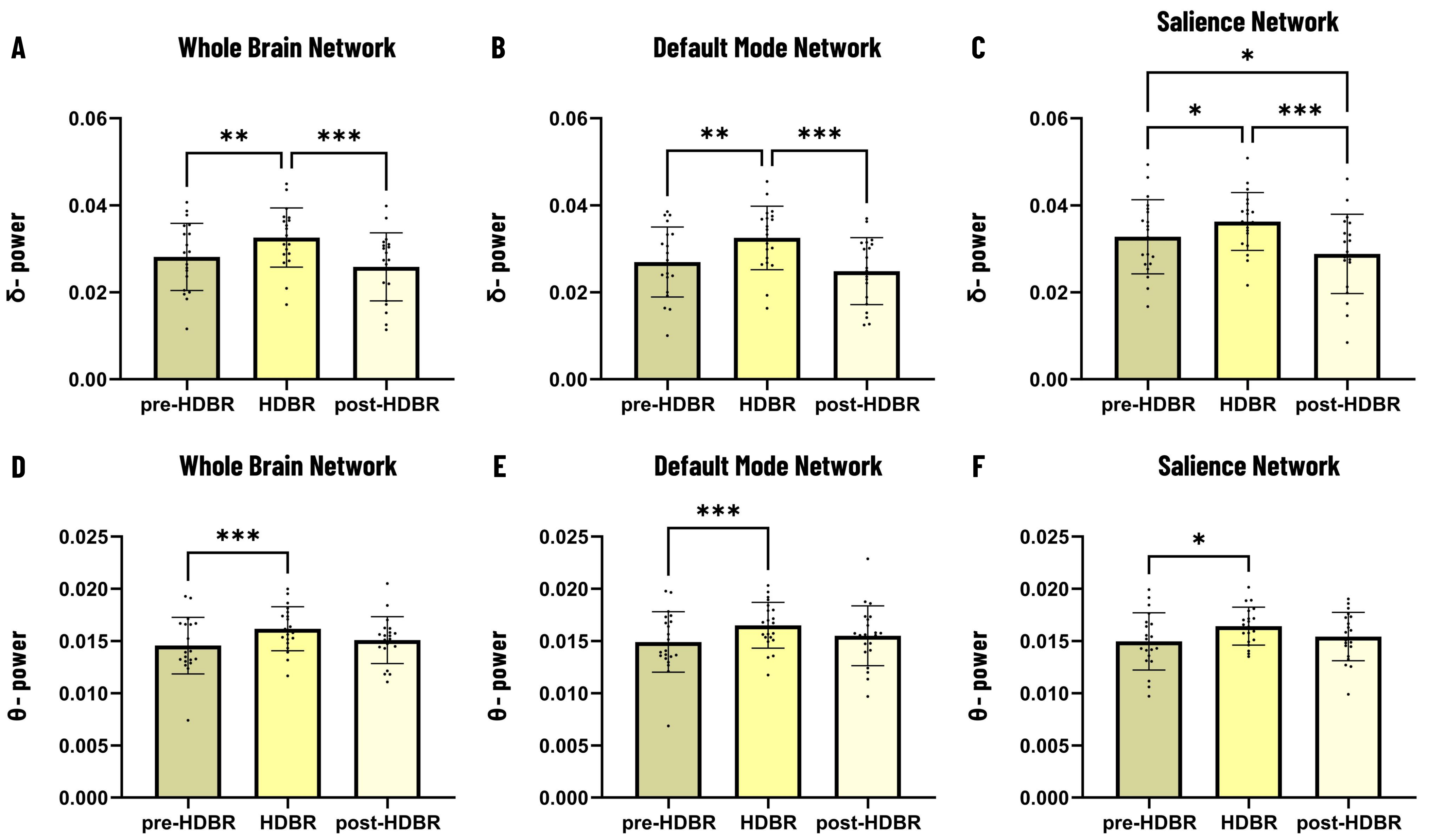


**Figure 1. Statistically significant results between conditions in the HDBR experiment.** The bar graphs depicts the mean ± SEM (Standard Error Mean) of the corresponding network and frequency band for each condition (*$p$ < 0.05, **$p$ < 0.01, ***$p$ < 0.001). (A) WBN δ power increase during HDBR *vs.* pre-HDBR and *vs.* post-HDBR. (B) DMN δ power increase during HDBR *vs.* pre-HDBR and *vs.* post-HDBR. (C) SAL δ power increase during HDBR *vs.* pre-HDBR and *vs.* post-HDBR and between pre-HDBR and post-HDBR. (D) WBN θ power increase during HDBR *vs.* pre-HDBR. (E) DMN θ power increase during HDBR *vs.* pre-HDBR. (F) SAL θ power increase during HDBR *vs.* pre-HDBR.

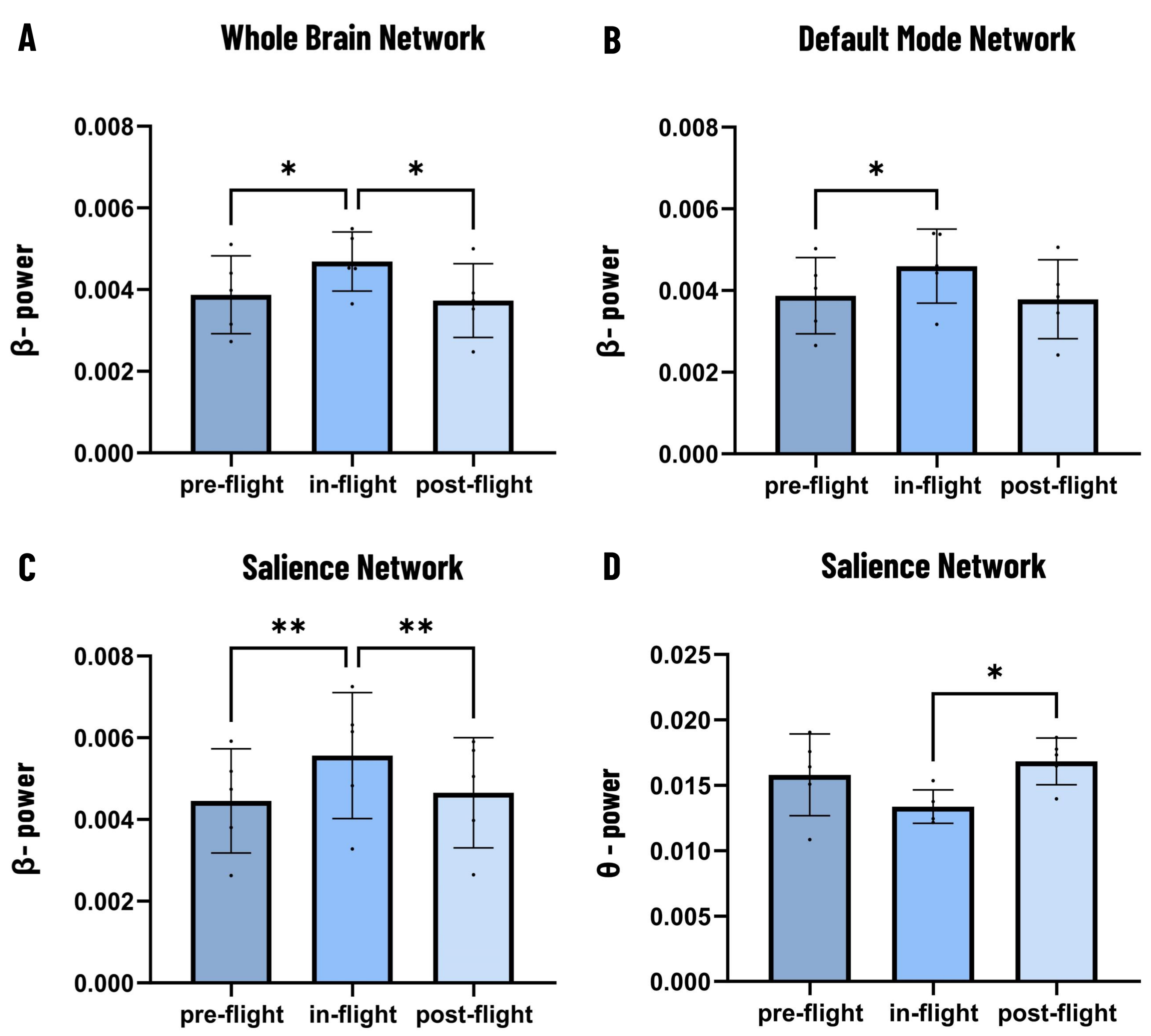


**Figure 2. Statistically significant results between conditions in the NEUROSPAT experiment.** The bar graphs depicts the mean ± SEM of the corresponding network and frequency band for each condition. β power increase in (A) WBN during in-flight *vs.* pre-flight and *vs.* post-flight, (B) DMN during in-flight *vs.* pre-flight, (C) SAL during in-flight *vs.* pre-flight and *vs.* post-flight. (D) SAL θ power decrease during in-flight *vs.* post-flight.

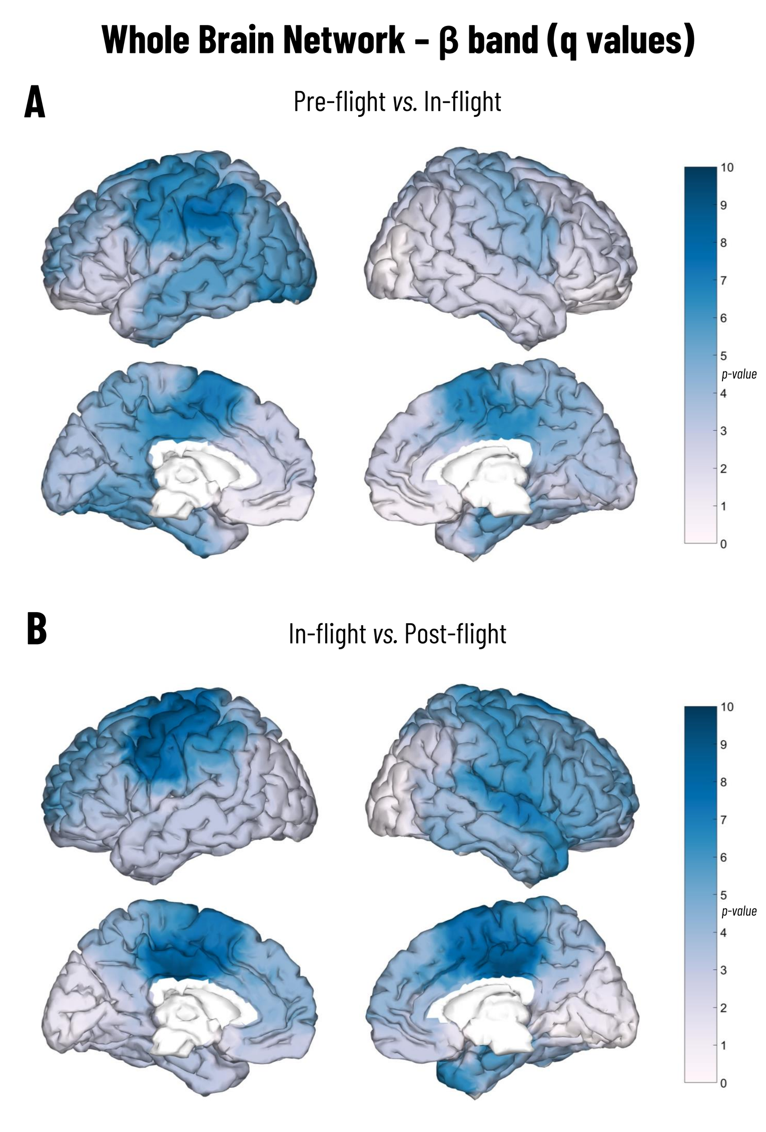


**Figure 3. Brain figures represent the Whole Brain Network areas with higher statistical power differences in the β band when comparing ROIs in the NEUROSPAT experiment.** (A) Pre-flight *vs.* In-flight. (B) In-flight *vs.* Post-flight. The color bar is displayed as a family-wise corrected significance level of q value > 4, corresponding with a minimum p value of 0.05.

## CONCLUSIONS

**↑ δ and θ in HDBR** → Due to different body positions while EEG recordings [5] → Seated upright (pre-HDBR and post-HDBR) / -6° Supine (HDBR)

**↑ θ in HDBR ≠ ↓ θ in NEUROSPAT**
Dissimilarities between the HDBR EEG findings and those obtained during microgravity
**More data/experiments needed**

**↑ β in NEUROSPAT** → Unusual inputs in the vestibular and proprioceptive systems → Altered physical self-motion perception [6]

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