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Isabelle Bonan

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# Bimodal EEG-fMRI Neurofeedback for Stroke Rehabilitation

Giulia Lioi<sup>\*1</sup>, Mathis Fleury<sup>1</sup>, Simon Butet<sup>2</sup>, Anatole Lécuyer<sup>1</sup>, Christian Barillot<sup>1</sup> and Isabelle Bonan<sup>2</sup>

<sup>1</sup> Teams Visages and Hybrid, Univ Rennes, Inria, CNRS, IRISA <sup>2</sup> Service MPR, CHU Pontchaillou, Rennes

## BACKGROUND

Neurofeedback (NF) has potential to be applied for stroke rehabilitation [1],[2] however the effectiveness of NF for stroke has not been thoroughly assessed yet.

Bimodal EEG-fMRI NF [3],[4] is a promising technique to achieve a more efficient and specific self-regulation, which may be crucial for clinical application.

## AIMS

Within the project **HEMISFER** (Hybrid Eeg-Mri and Simultaneous neuro-FEedback for brain Rehabilitation), the aims of this preliminary study are to:

- Test the feasibility of applying bimodal EEG-MRI NF for stroke rehabilitation in two chronic patients affected by left hemiplegia (subcortical lesion).
- Identify problematics and guidelines in view of a clinical study on stroke patients.

## METHODS

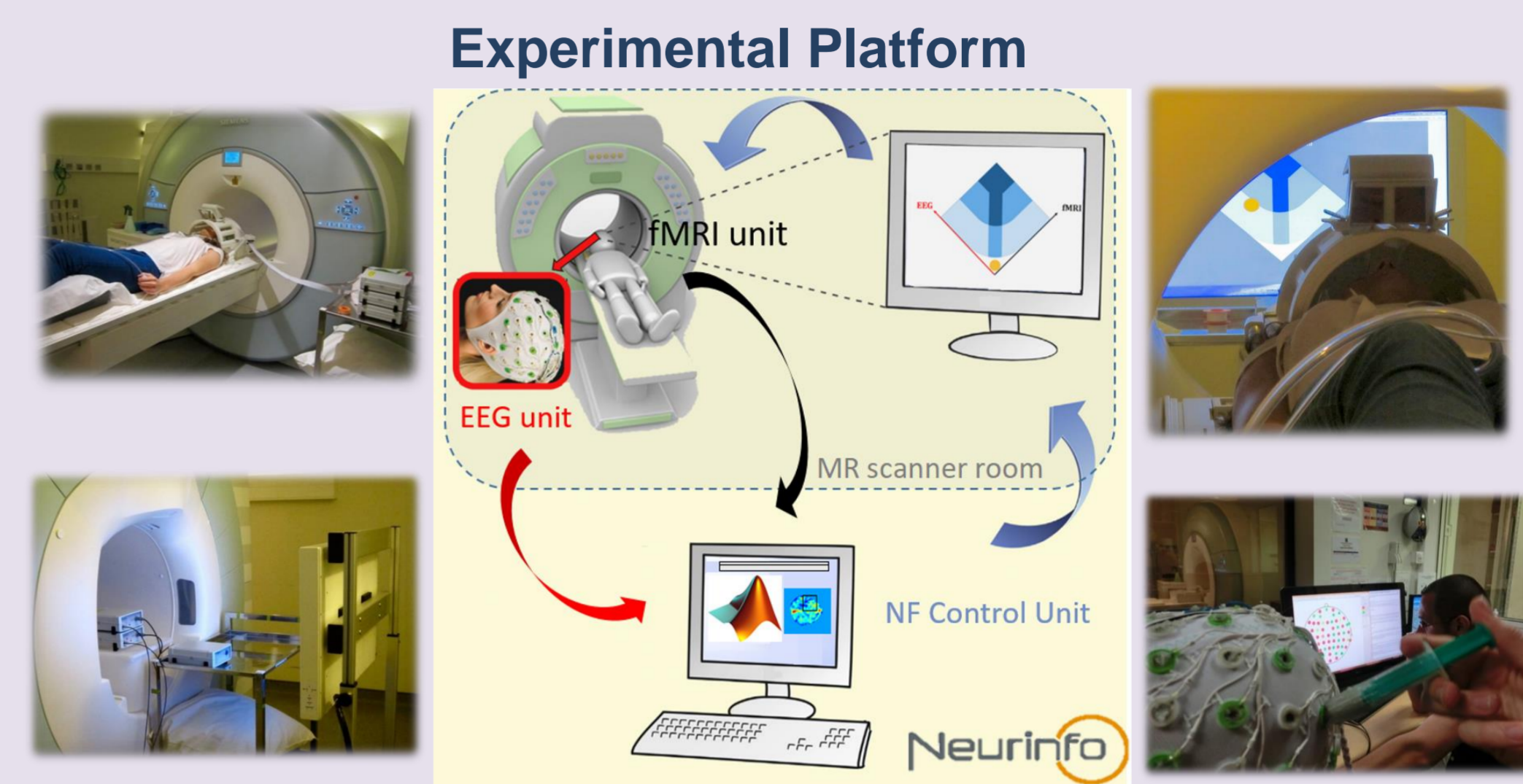


Figure 1. Bimodal EEG-fMRI NF platform [5] (Neurinfo, CHU Pontchaillou, Rennes). The platform integrates and synchronizes EEG and fMRI subsystems and signal flow for the computation and visualization of the bimodal NF.

## Neurofeedback Protocol

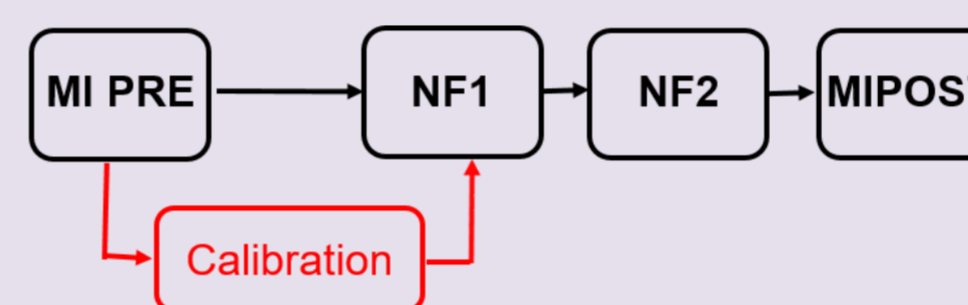


Figure 2. Schematic of the experimental protocol. Each session consisted of 8 blocks of 40 s (20 s rest, 20s task). MI=Motor Imagery (without NF display). MI\_PRE=preliminary session used for calibration (ROI, EEG filter). MI\_POST=transfer session.

## PRELIMINARY RESULTS

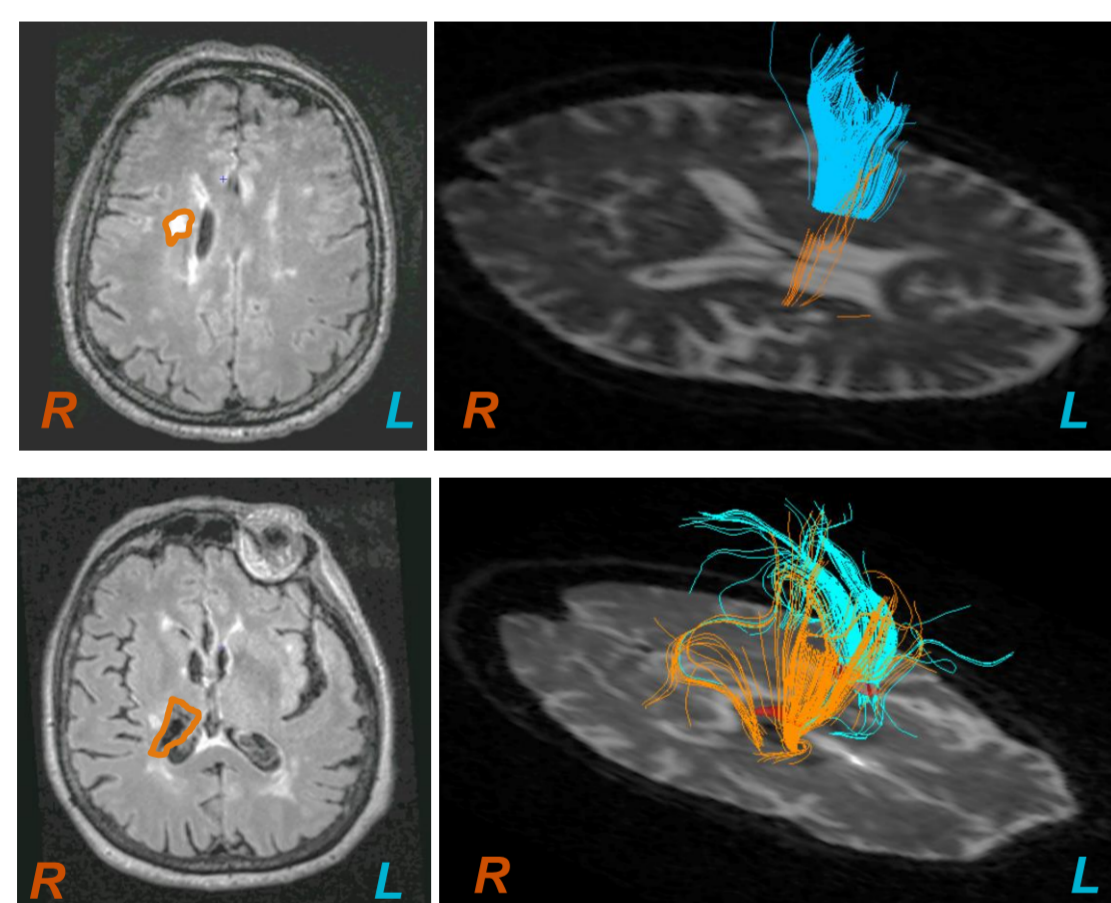


Figure 3a. Lesion and cortico-spinal tract (CST) of patient 1 (Right ischemic stroke). The CST was estimated from tractography of diffusion weighted images [6].

Figure 3b. Lesion and CST of patient 2 (Right hemorrhagic stroke)

— Ipsilesional  
— Contralateral

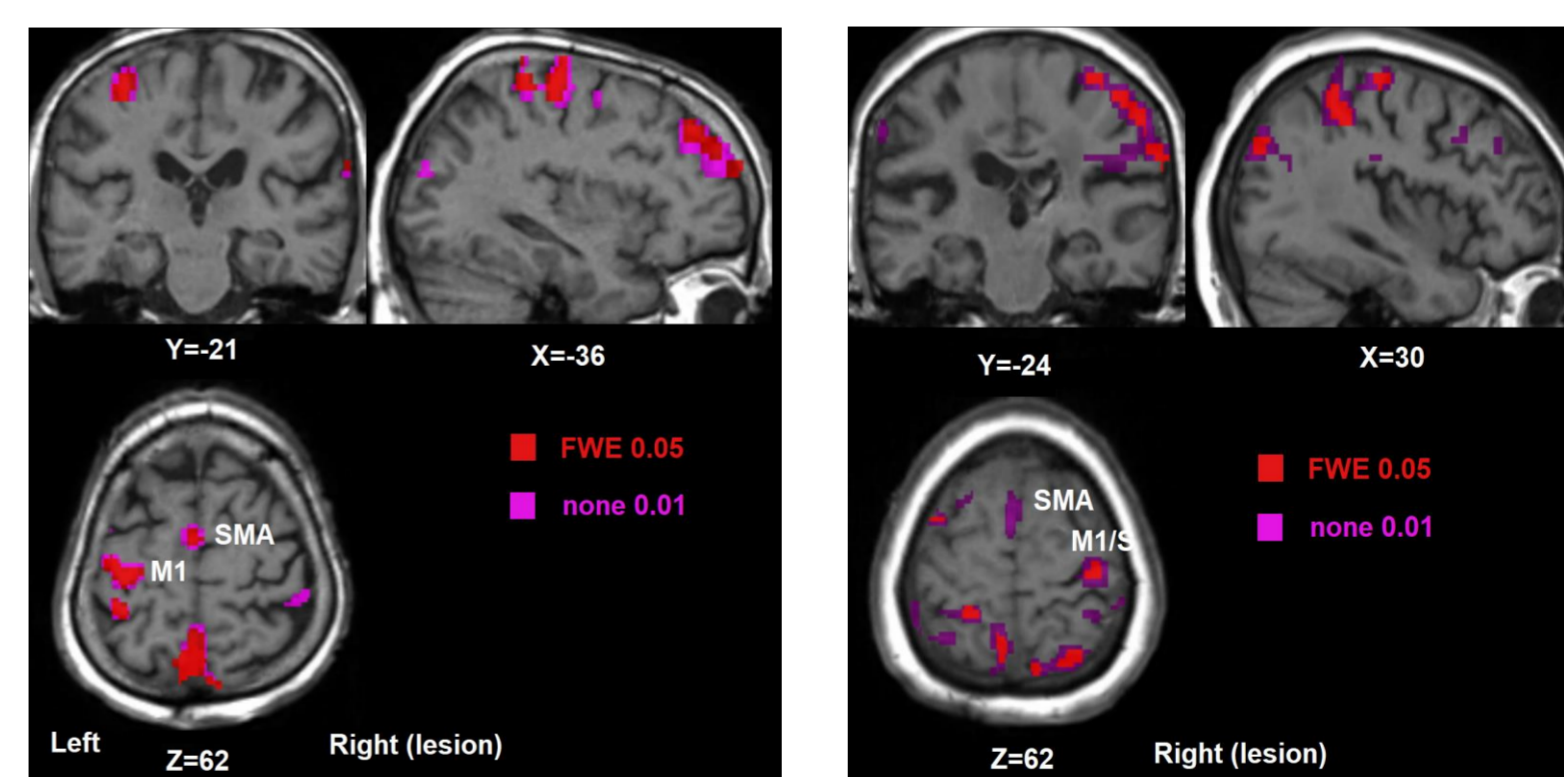


Figure 5. Average BOLD activations maps over the two NF sessions for patient 1 (left) and 2 (right) (TASK>REST;  $k > 10$  voxels).

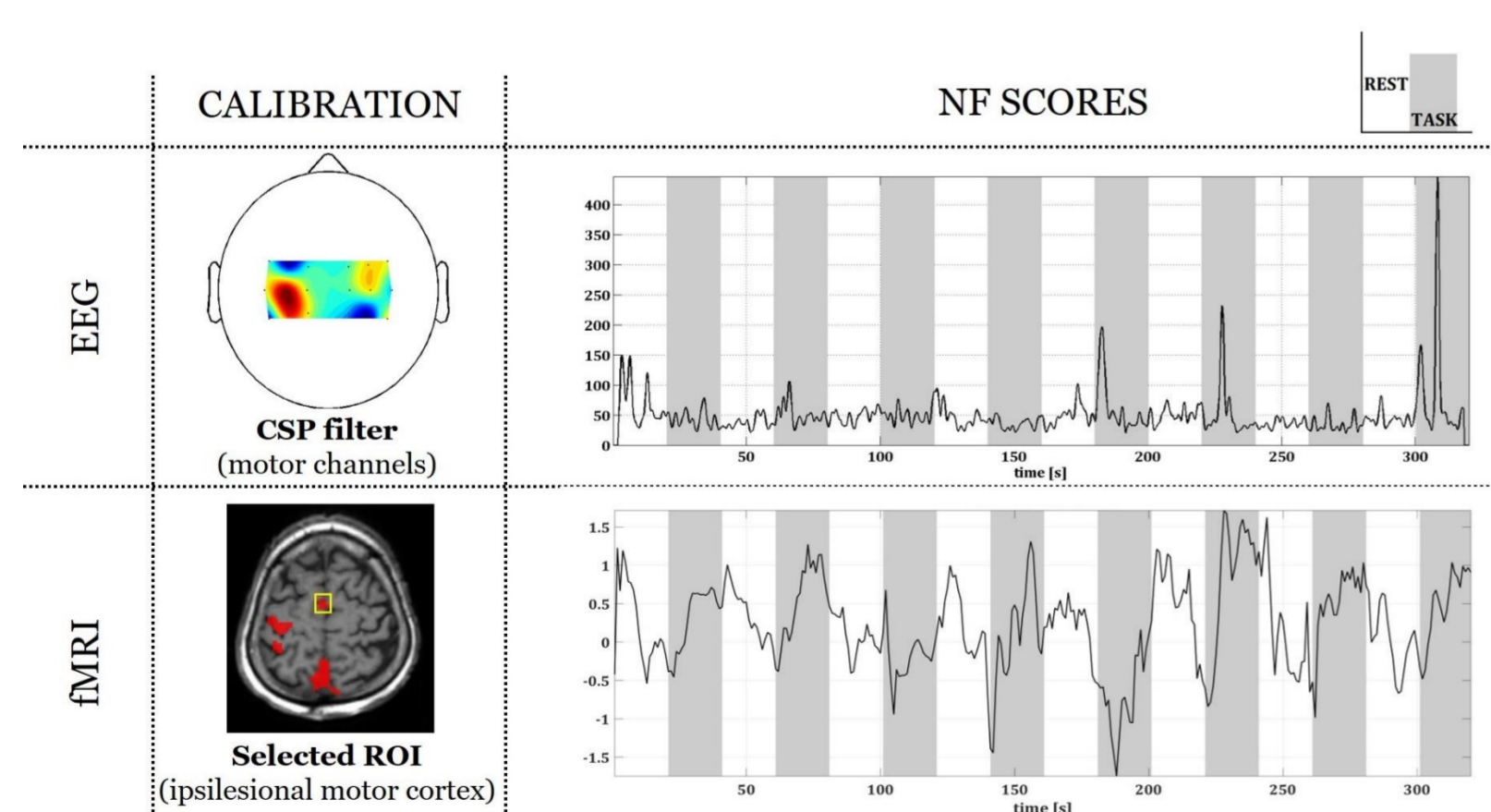


Figure 4. EEG and fMRI NF scores during a NF session. Example from one patient (1). The left column shows the filter and the ROI selected for NF computation during calibration.

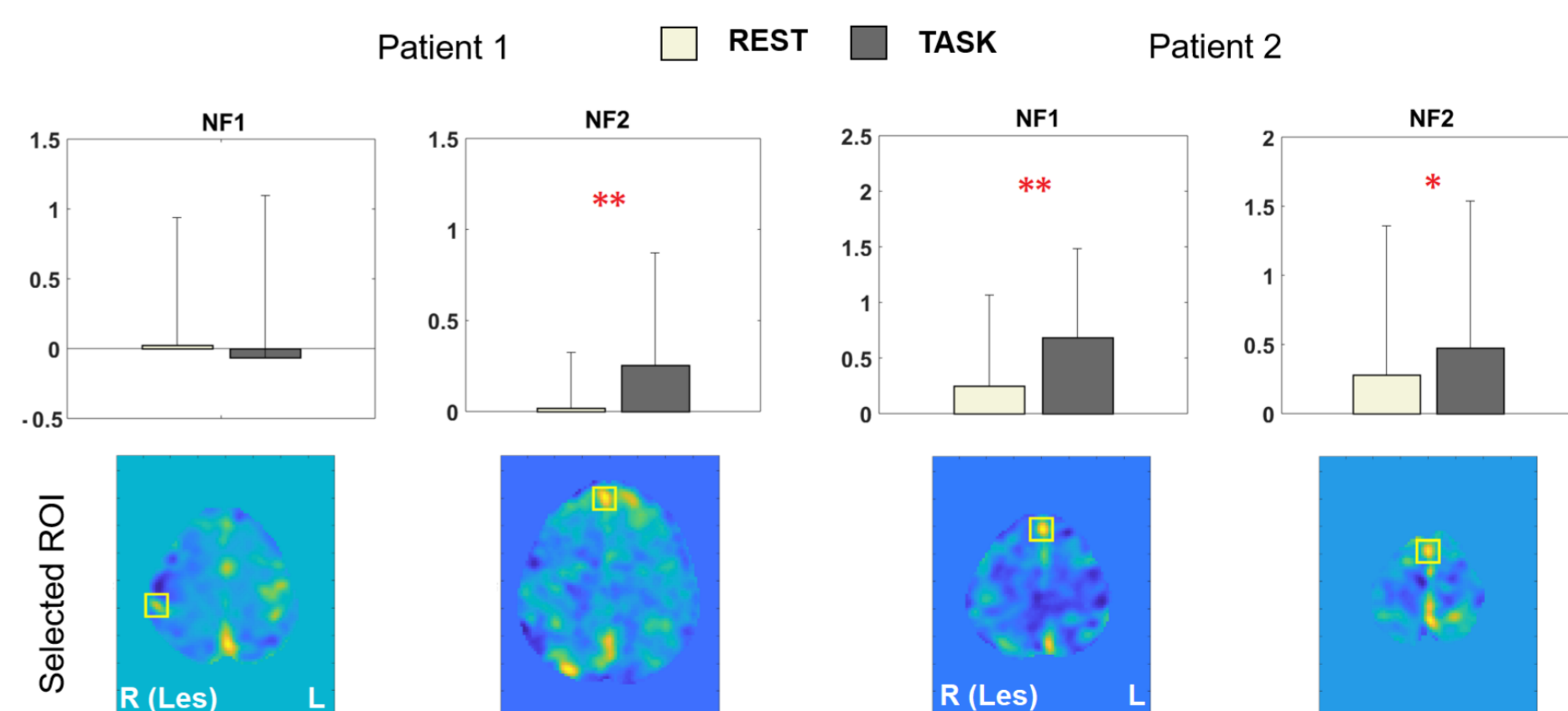


Figure 6. fMRI signal regulation as a function of the selected ROI. The bar plots represent BOLD activity in the selected ROI with respect to background (mean+std across blocks) during rest and NF. Relative statistics are shown (Wilcoxon tests, \*  $p < 0.05$ , \*\*  $p < 0.01$ )

## CURRENT AND FUTURE WORKS

- Improve performances and simplify the workflow of the bimodal NF platform.
- Clinical study on Stroke patients to test the efficacy of multisession bimodal NF for rehabilitation.

## REFERENCES

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\*contact: [giulia.lioi@inria.fr](mailto:giulia.lioi@inria.fr)