Investigating the role of beta oscillations during motor learning with the FOOOF toolbox

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Background

Many studies showed modulations of **beta oscillations (~13–30 Hz)** during motor performance[1]. The increase of beta power at the end of the movement is named post-movement beta synchronization **(PMBS).** It is linked with **error processing[2], motor plan update[3] and learning strategies[4]**.

The functional role of beta in the sensorimotor system is still under debate. Although recently, new methodological approaches to analyze and interpret brain oscillation have been proposed[5,6].

Here, we aim to apply these tools to further elucidate the role of beta during motor learning.

Task

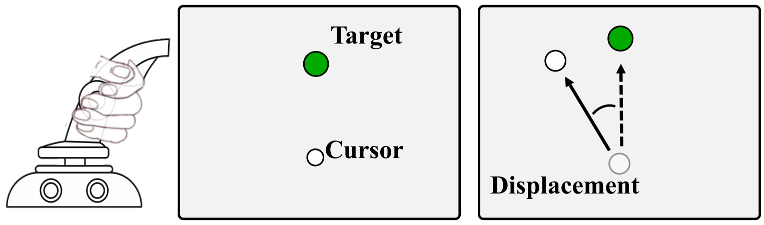

Figure 1. Subjects performed a joystick reaching task[3]. Some trials a displacement of cursor position was presented to induce motor adaptation. ***Dashed arrow***: Movement direction; ***Solid arrow***: Movement outcome.

Methods

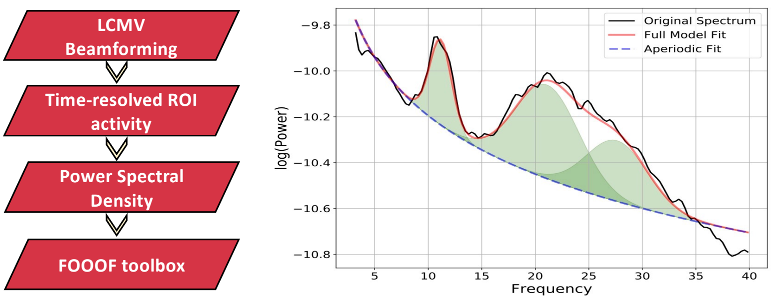

Figure 2. *(left)* Schematic representation of the pipeline used for selecting M1 virtual channel. *(right)* Visual example of FOOOF output. **Shaded green areas**: oscillatory peaks identified by the toolbox at 11/21/27 Hz.

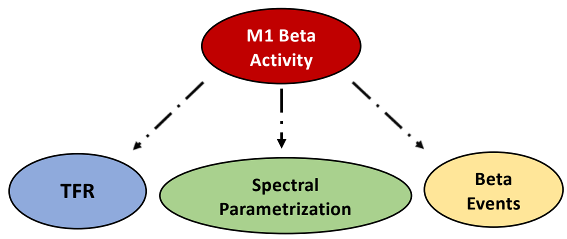

Figure 3. Summary of the analysis: Averaged Time-frequency representation - TFR; Periodic and Aperiodic parametrization of neural activity with the FOOOF toolbox; Bursting beta-events analysis (Timing, Rate).

Results

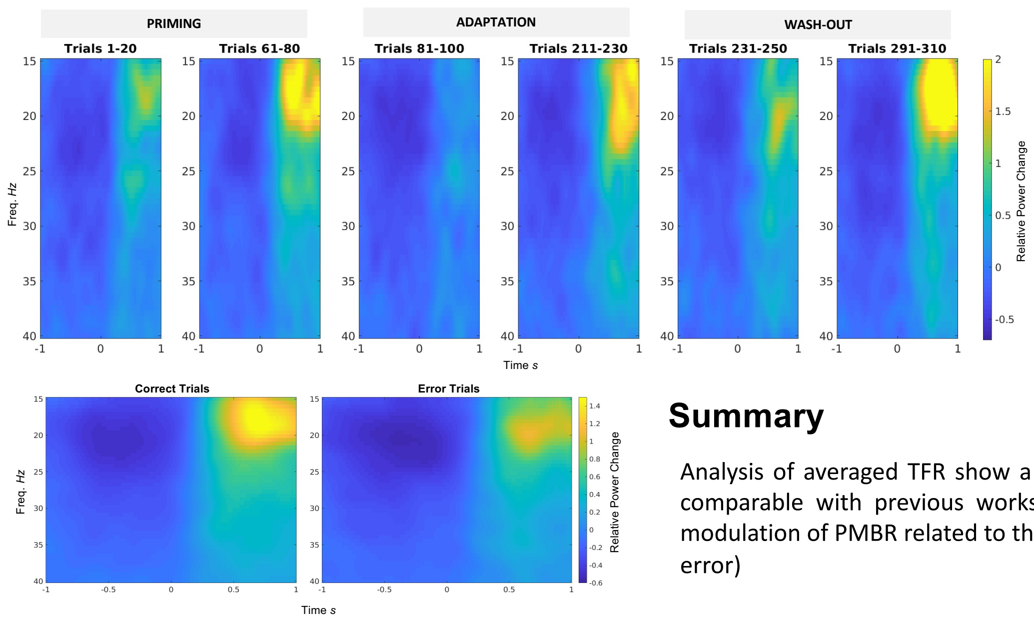

Figure 4. Averaged TFR across trials and subjects. Aligned to movement offset *(up)* Power's change at different phases shows PMBR fluctuation across the task. *(down)* Comparison of averaged power during small (*Correct*) *vs* large (*Error*) angular error trials. Showing a reduction of PMBR in Error trials.

Significant difference in the 15-30 Hz range in the 0.6-1s time window.

Summary

Analysis of averaged TFR show a change of PMBR during learning comparable with previous works[2,3,4]. Furthermore, we report a modulation of PMBR related to the error size (small vs large angular error)

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References:

[1]Kilavik et al., Experimental neurology 245 15-26, (2013). **[2]**Torrecillos et al., Journal of Neuroscience 35(37) 12753-12765, (2015). **[3]**Tan et al., Journal of Neuroscience 36(5) 1516-1528, (2016). **[4]**Haar, S., & Faisal, A. A. , Frontiers in human neuroscience 14 354, (2020). **[5]**Donoghue et al., Nature neuroscience 23(12) 1655-1665, (2020). **[6]**Shin et al., Elife 6 e29086, (2017).