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CHANGING CONNECTIVITY BETWEEN PREMOTOR AND MOTOR CORTEX CHANGES INTER-AREAL COMMUNICATION IN THE HUMAN BRAIN

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Strengthening connectivity between premotor and motor cortex increases inter-areal communication in the human brain

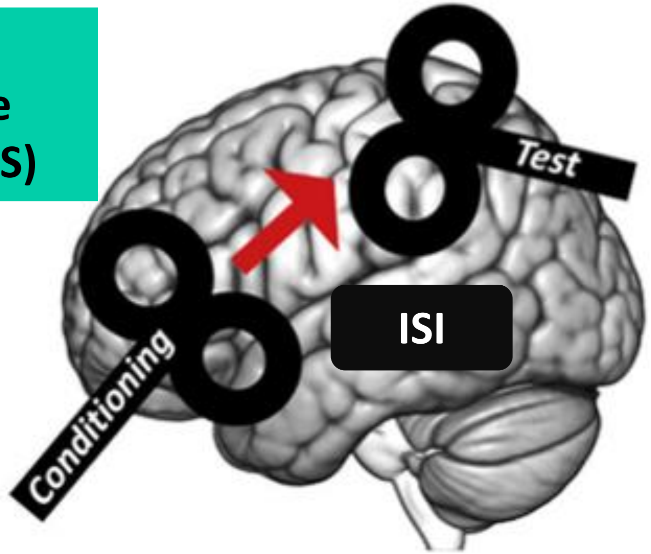
Oscillatory fingerprints of the interregional brain communication in the PMv-M1 pathway

The synchronization of neuronal oscillations: a key element in communication between brain areas?

Aim: Directly test this idea by carrying two types of reversible manipulations of a human brain circuit that have been established to either transiently increase or decrease physiological interconnectedness.

Examine whether the two types of intervention result in increased or decreased oscillatory coupling between activity in the component areas of the circuit.

Cortico-Cortical Paired Associative Stimulation (ccPAS)



Hebbian associative plasticity principle

instantiated by repeated sequential associative stimulation of pre- and postsynaptic subpopulations through ccPAS

The neural circuit mediating action control that runs between the ventral premotor cortex (**PMv**) and primary motor cortex (**M1**)

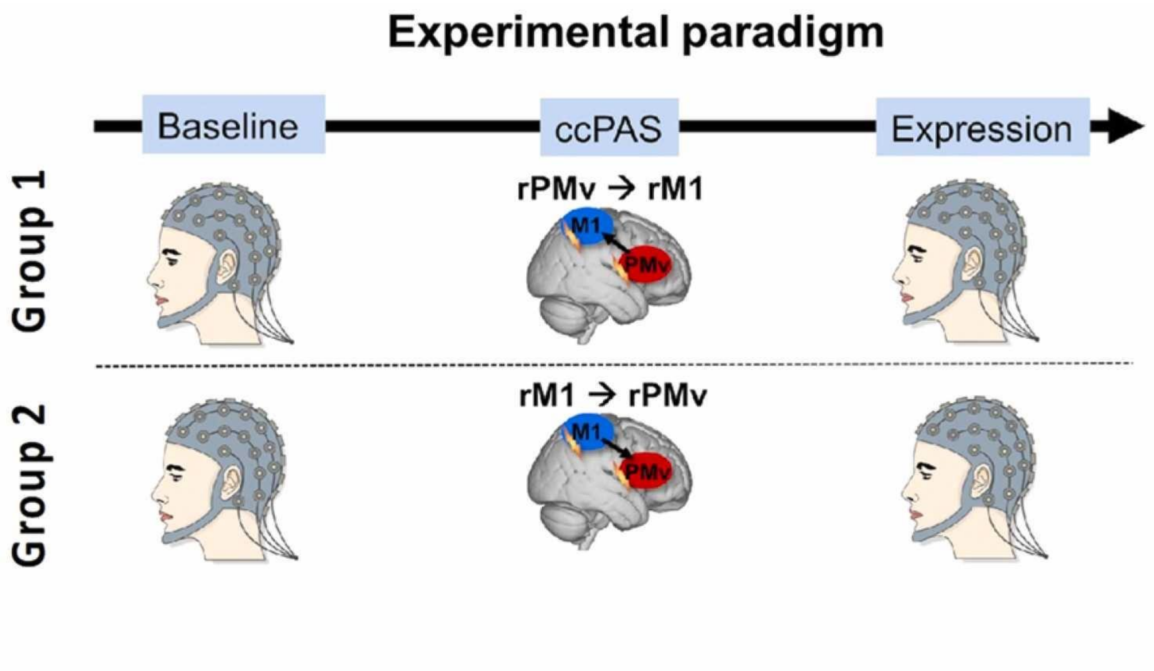
Trajkovic et al., 2023; *Prog. Neurobiol*.

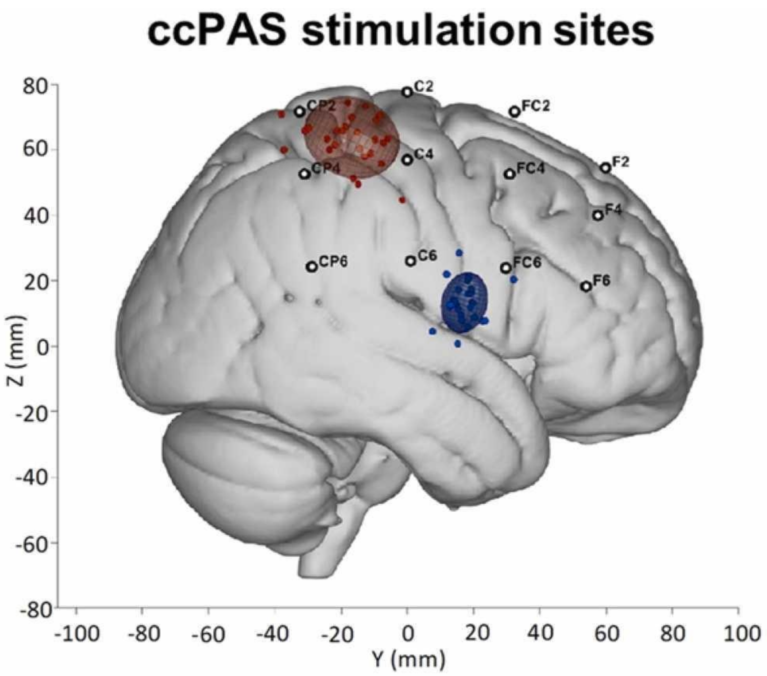
HYPOTHESIS:

- Augmenting the strength of PMv-M1 connections, by stimulating the PMv-to-M1 pathway, may result in increased interregional phase synchrony between pre-motor and primary motor cortices;

-Diminishing PMv-M1 connectivity strength, by stimulating the M1-to-PMv pathway, may lead to phase synchrony decreases across pre-motor and primary motor regions.

- These increases and decreases in interregional coupling between PMv and M1 areas may also relate to frequency amplitude changes that are related to top-down motor control during movement control.



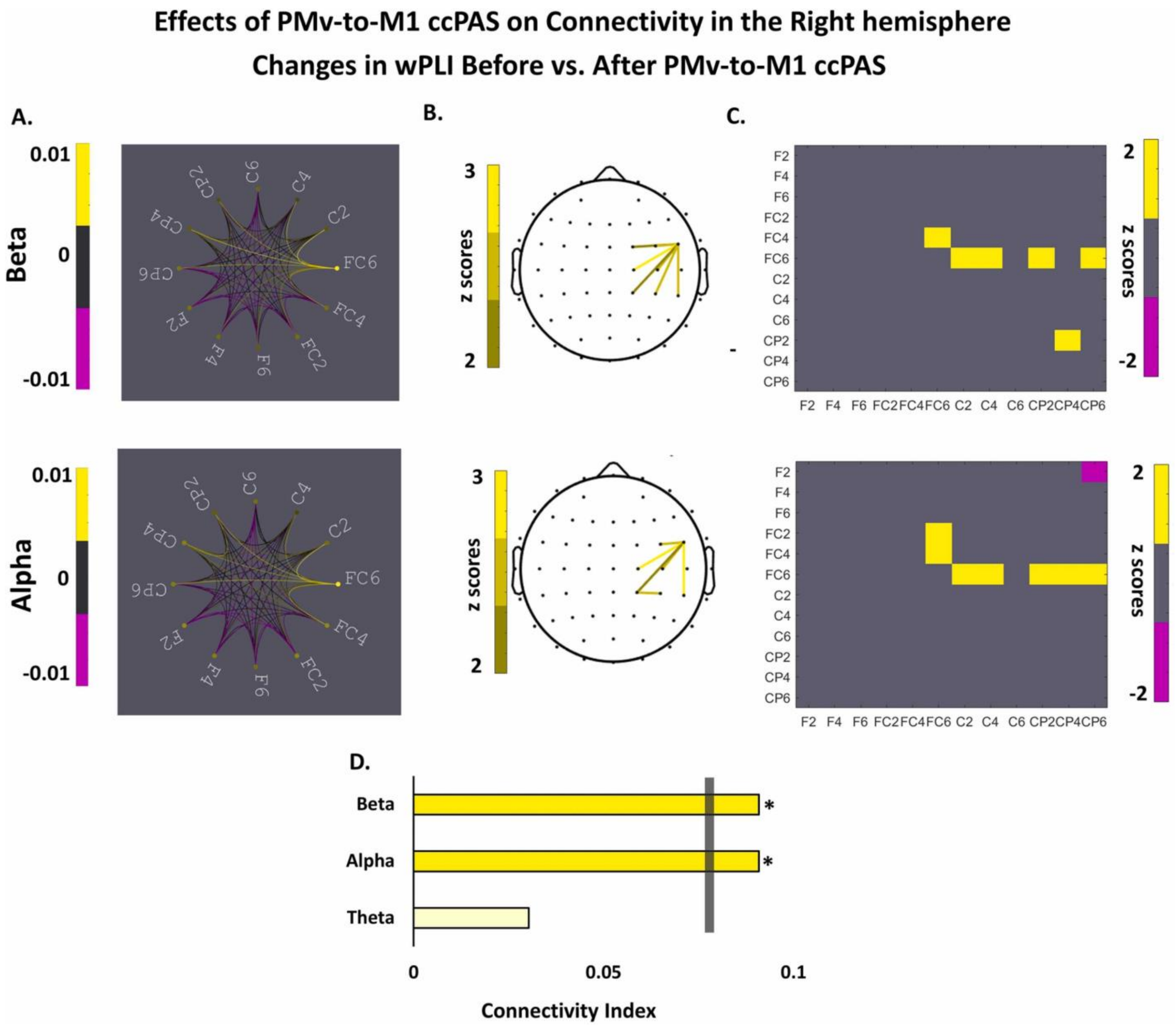


Trajkovic et al., 2023; *Prog. Neurobiol*.

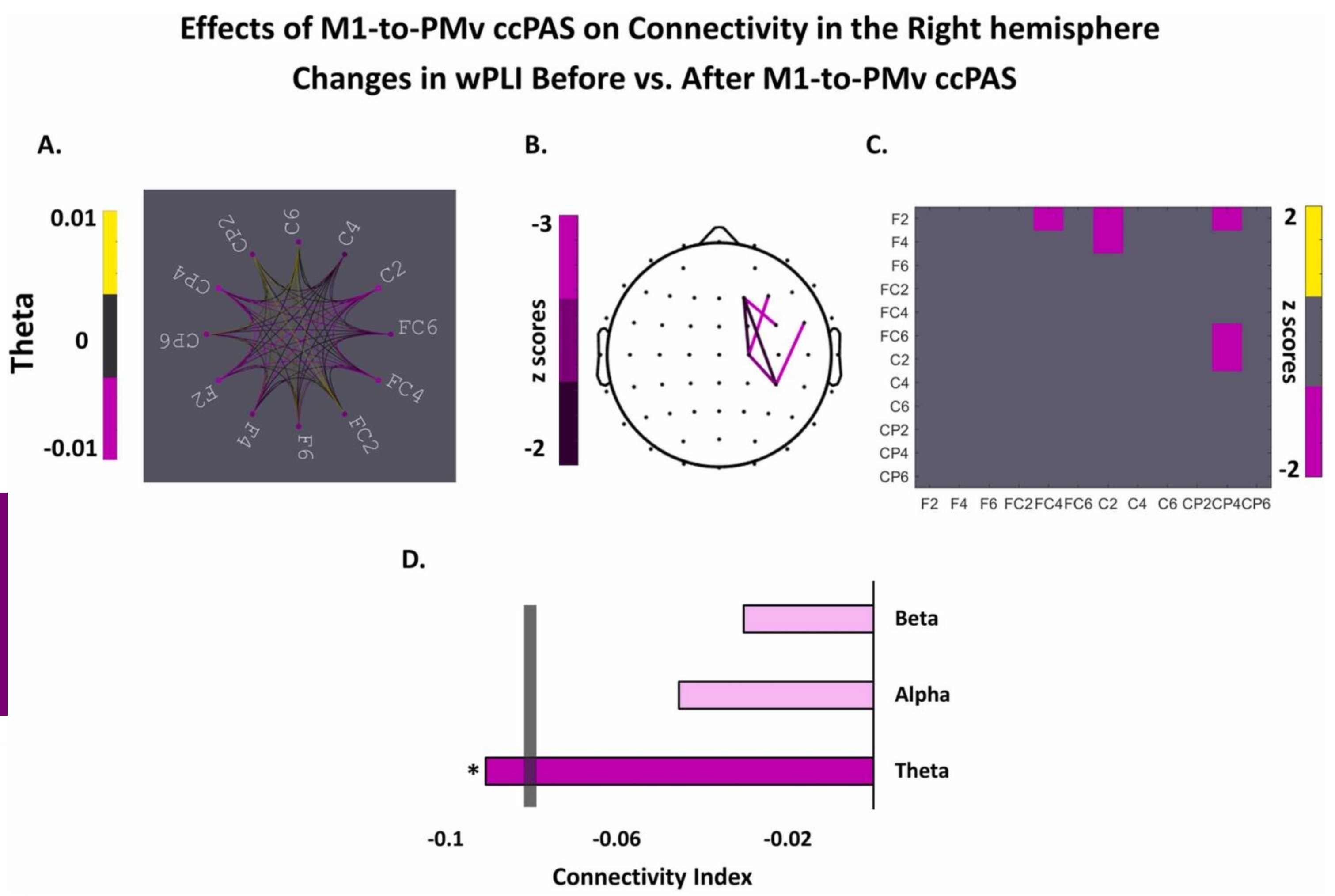
To assess the effect of ccPAS over PMv and M1 on their inter-site phase coupling, we used the weighted phase lag index (wPLI) connectivity measure.
Subsequently, non-parametric permutation analysis was used to compare wPLI before and after ccPAS stimulation

Group 1 (PMv-to-M1 ccPAS): an increase in the connectivity within the right ROI (stimulated network) in the alpha and beta band but not in the slower theta band

There were no significant differences in the connectivity in the non-stimulated (left) hemisphere



Trajkovic et al., 2023; *Prog. Neurobiol*.



Group 2 (M1-to-PMv ccPAS): a significant decrease in connectivity within the right (stimulated) ROI in the theta band but not in the alpha and beta band

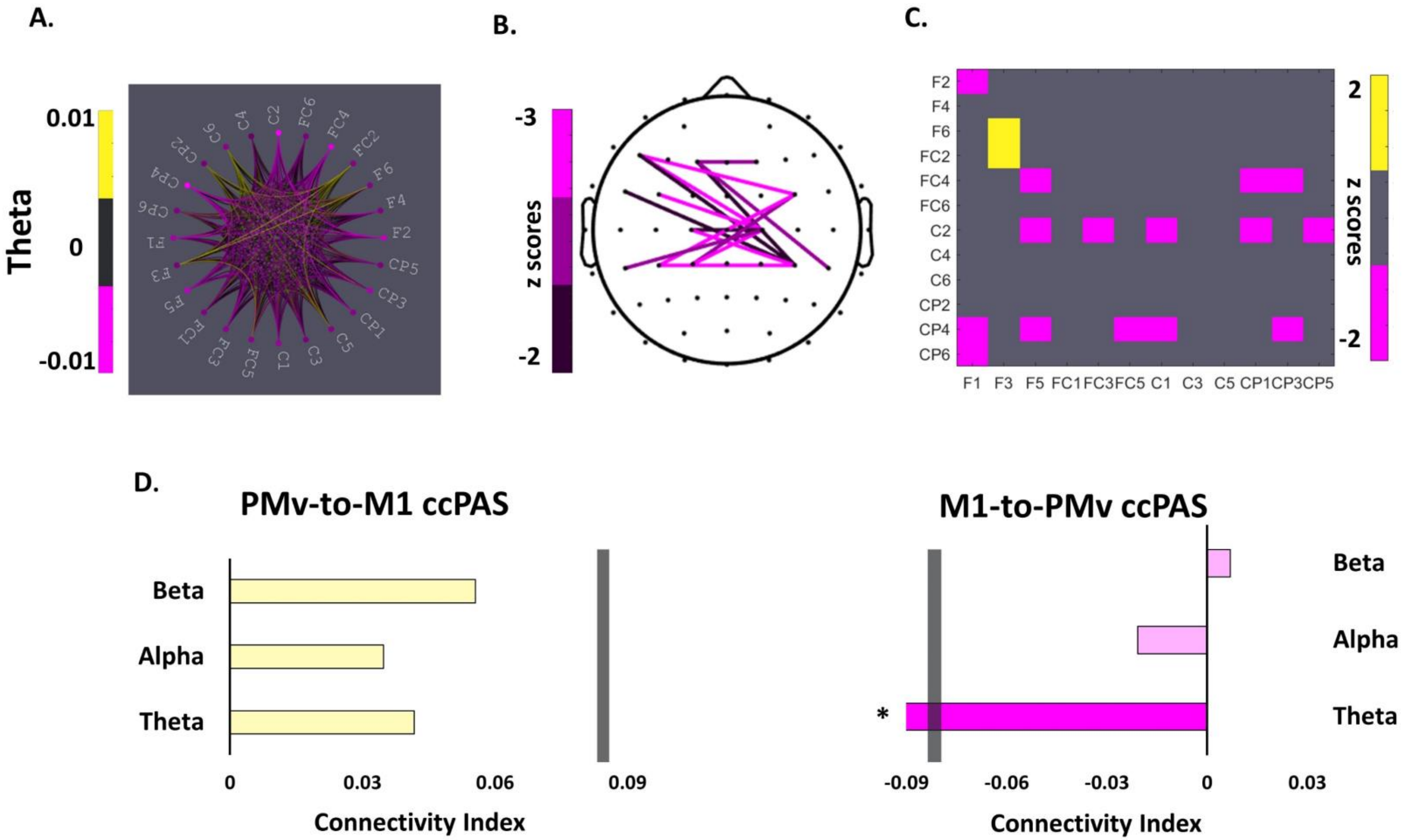
There were no significant differences in the connectivity in the non-stimulated (left) hemisphere

Trajkovic et al., 2023; *Prog. Neurobiol*.

Effects of ccPAS on Interhemispheric Connectivity
Changes in wPLI Before vs. After ccPAS

Group 1 (PMv-to-M1 ccPAS): no significant differences in the interhemispheric connectivity

Group 2 (M1-to-PMv ccPAS): a significant decrease in the interhemispheric connectivity in the theta band but not in the alpha and beta band

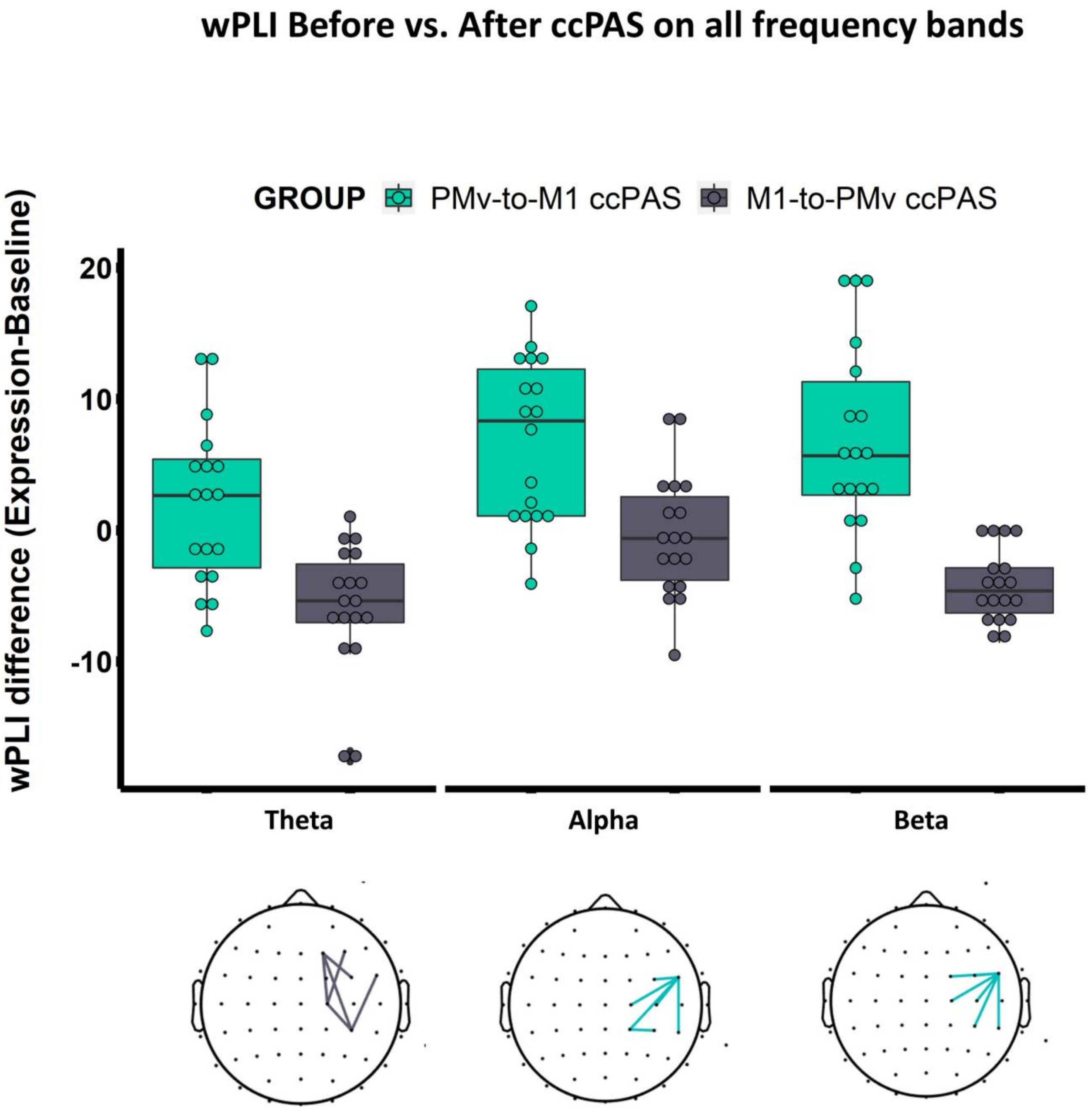


Trajkovic et al., 2023; *Prog. Neurobiol*.

Direct contrast of the connectivity changes (*Expression – Baseline*) between the two participant groups and across all frequency bands

Frequency x Cluster x Group interaction:

F (4, 136) = 3.285, p= .025, η_p^2 = .088

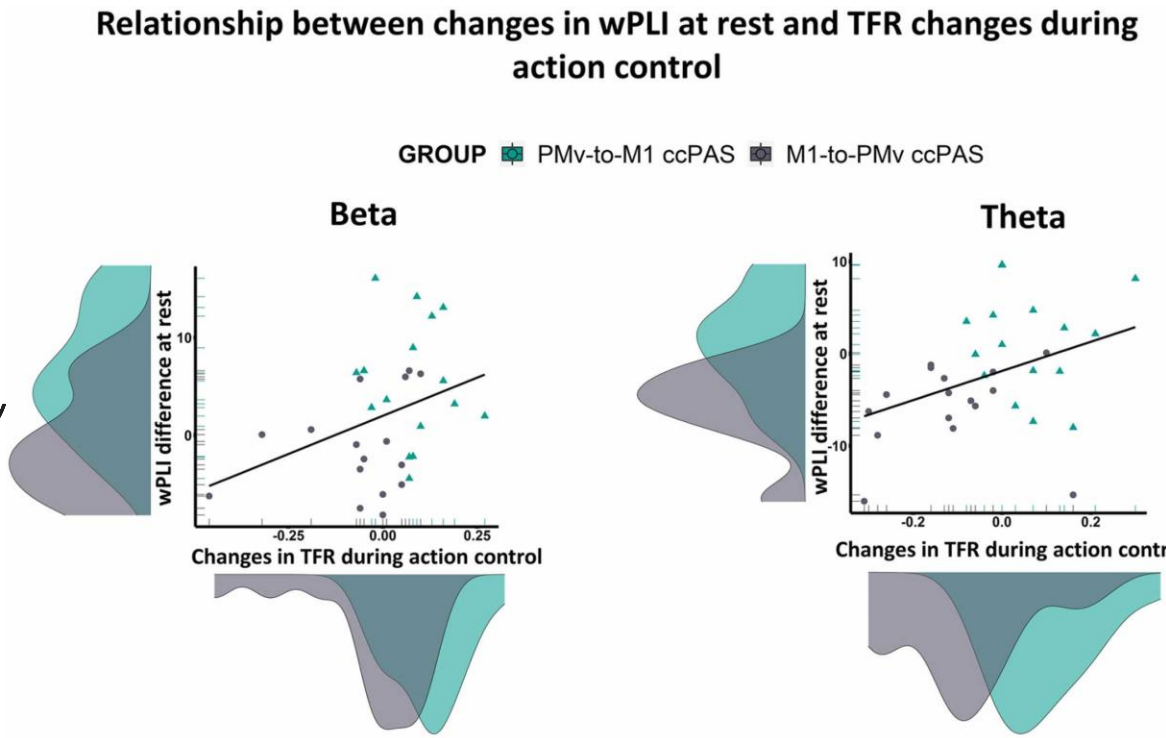


Trajkovic et al., 2023; *Prog. Neurobiol*.

Functional significance of these connectivity changes during the resting state?

Look at the link between the ccPAS-induced connectivity changes during the resting state and ccPAS-induced changes in time-frequency responses during a Go/No-go task performed by the same participants (both Groups 1 and 2)

The malleability of the PMv-M1 connections that resulted from ccPAS that was visible at rest predicted increases and decreases in oscillatory activity during motor control.



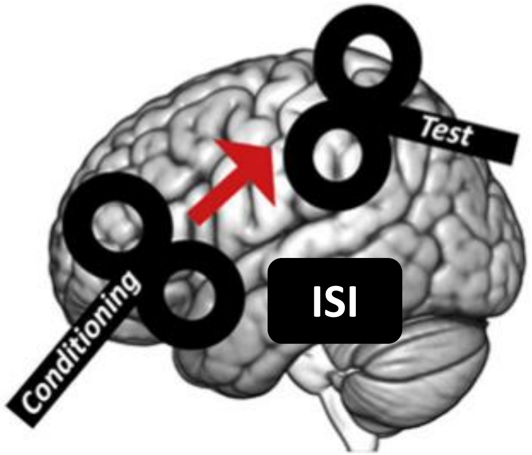
The greater the difference in resting-state connectivity before versus after ccPAS, the higher the effect of ccPAS on electrophysiological changes during the Go/No-go task

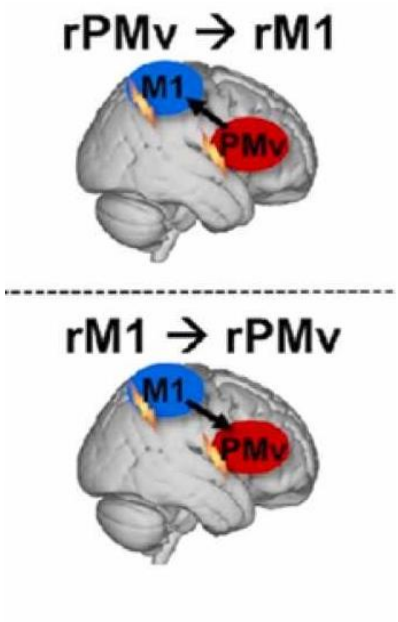
Trajkovic et al., 2023; *Prog. Neurobiol*.

Changing short-term synaptic efficacy of the PMv-M1 pathway changes ***frequency-specific*** interregional brain communication between the premotor and the primary motor control regions.

Interregional communication frequencies in the human PMv-M1 pathway can be manipulated

Possible spectral fingerprints of augmentation versus reduction of the PMv influence over M1. .





Consistent with Hebbian-like spike-timing dependent long-term potentiation and depression and with hierarchical models of action control

Trajkovic et al., 2023; *Prog. Neurobiol*.

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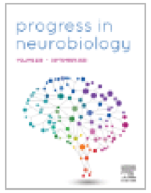

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