# Driving synaptic plasticity in motor-to-visual neural pathways to enhance action prediction

## ABSTRACT:

**Background**
Actions recognition is supported by an Action Observation Network (AON) including motor (inferior frontal cortex, IFC; motor cortex, M1) and visual (posterior superior temporal sulcus, pSTS) nodes. Despite backward projections being increasingly recognized as key components of perceptual systems, it is unclear whether they play a role in action execution (AE) and perception/prediction (AP).

**Aims**
1. To investigate motor resonance in IFC and M1 and provide evidence of backward modulation during AE/AP (Work Package 1, WP1);
2. To provide causal evidence that connections between IFC, M1 and pSTS play a role in AE/AP (WP2).

**Method**
In WP1, we combined TMS of IFC, M1 and pSTS with EEG (TMS-EEG, co-registration) to investigate motor resonance in IFC and M1 and provide neurophysiological evidence of motor-to-visual backward modulations during AE/AP. In WP2, we used cortico-cortical paired associative stimulation (ccPAS) protocol to manipulate the strength of cortico-cortical connectivity and test the effect on AE/AP.

**Results**
In WP1, we traced early motor resonance effects following IFC and M1 stimulation and motor-to-visual modulations during AE/AP. In WP2, we found that ccPAS of IFC-M1 and IFC-pSTS affected physiological interactions between targeted areas, and led to enhanced AE and AP abilities, respectively.

**Conclusions**
Using TMS-EEG, we provided evidence of motor-to-visual modulations reflecting a role of motor resonance in IFC/M1 in modulating visual areas such as the pSTS during AE/AP. Remarkably, ccPAS manipulation of the strength of IFC-M1 and IFC-pSTS projections resulted in enhanced AE and AP abilities, respectively, providing unprecedented causal evidence for the role of backward projections in AE/AP.

**Keywords**
Action perception and execution, Backward connectivity, Neuroplasticity, TMS-EEG coregistration, Cortico-cortical paired associative stimulation (ccPAS)

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