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XXIX Congresso Nazionale SIPF 2021

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Neurophysiological correlates of ventral premotor cortex to primary motor cortex cortico-cortical paired associative stimulation

Casarotto, A., Dolfini, E., Cardelicchio P., Fadiga L., Koch G., D'Ausilio A.

- IIT@UniFe Center for Translational Neurophysiology, Istituto Italiano di Tecnologia
- Department of Neuroscience and Rehabilitation, Section of Physiology, Università di Ferrara

Andrea Casarotto

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PMv-M1 circuit

- This neural circuit is crucial in the transformation process of an object' geometrical properties into a specific motor command suitable for grasp (Murata et al., 1997; 2000; Davare et al., 2010).

dual-sites TMS protocol →

- PMv could both exert an inhibitory (or facilitatory!) influence on M1 at rest (Bäumer et al., 2006; Davare et al., 2008; Beukelaar et al., 2016).
- PMv exerts a facilitatory influence on M1 during the action preparation and the action observation (Davare et al., 2009; Koch et al., 2013; Beukelaar et al., 2016).

cortico-cortical paired associative stimulation (cc-PAS) →

PMv-M1 cc-PAS seems to increase the inhibitory influence of PMv at rest and the facilitatory influence during the action preparation (Buch et al., 2010).

cc-PAS

pre-PAS

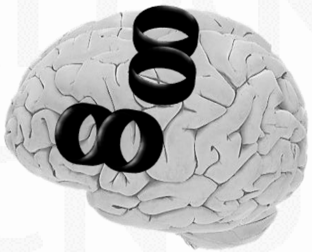
post-10

Experiment 1

post-30

Experiment 1
Experiment 2
Experiment 3
Experiment 4

- 100 couple of pulses with 6 ms ISI
- Frequency: 0.25 Hz (about ~ 6 min)
- left PMv was stimulated at 90% RMT
- left M1 was stimulated at 120% RMT



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***Exp 1**: effect of PMv-M1 cc-PAS on M1 intracortical circuits*

N = 14

- MEP *
- SICF - ISI 2.5 ms *
- ICF - ISI 15 ms
- SICI - ISIs 1 and 3 ms
- LICI - ISI 100 ms *

***Exp 2**: Is the SICF modulation specific?*

N = 21

- SICF (ISIs):
  - **1.3 ms**
  - *2.1 ms*
  - **2.5 ms ***
  - *3.3 ms*
  - **4.1 ms**

***Exp 3**: PMv-M1 connectivity modulation*

N = 18

- Connectivity:
  - CS intensity (% of RMT)
    - 30%,
    - 50%,
    - 70% *
    - 90%
  - TS intensity at 120% of RMT

***Exp 4**: cc-PAS with anterior-posterior (AP) M1 coil orientation*

N = 17

- MEP (PA orientation) *
- MEP (AP orientation)
- SICF 2.5 ms
- Connectivity
  - CS intensity (% of RMT)
    - 30%
    - 70% *
  - TS intensity at 120% of RMT

- Corticospinal Excitability (**MEP**)
- Short Intracortical Facilitation (**SICF**)
- Intracortical Facilitation (**ICF**)
- Short Intracortical Inhibition (**SICI**)
- Long Intracortical Inhibition (**LICI**)

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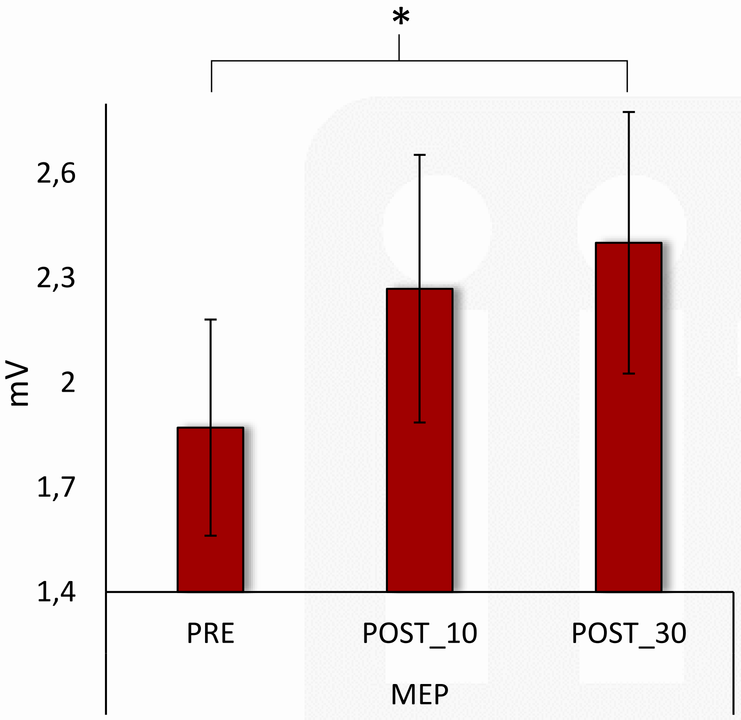

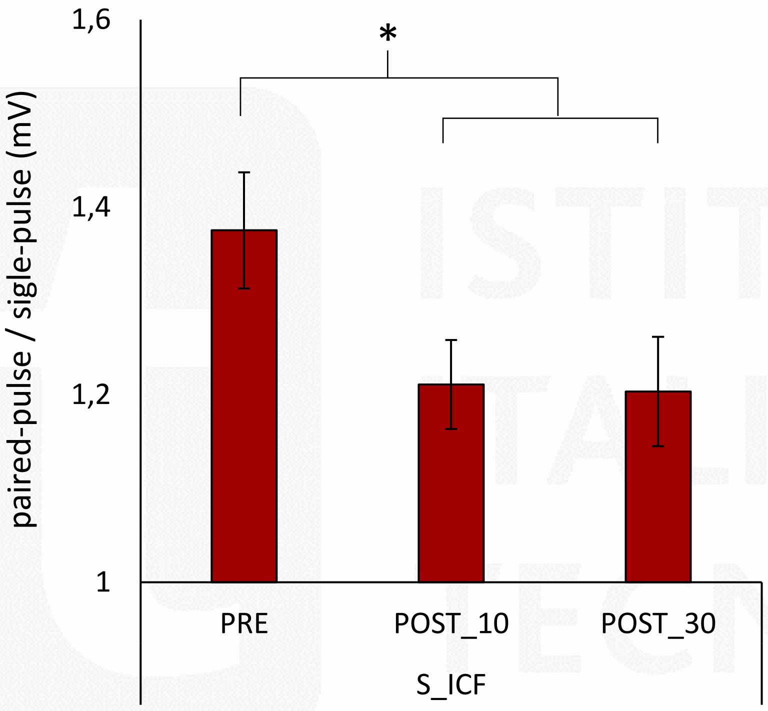

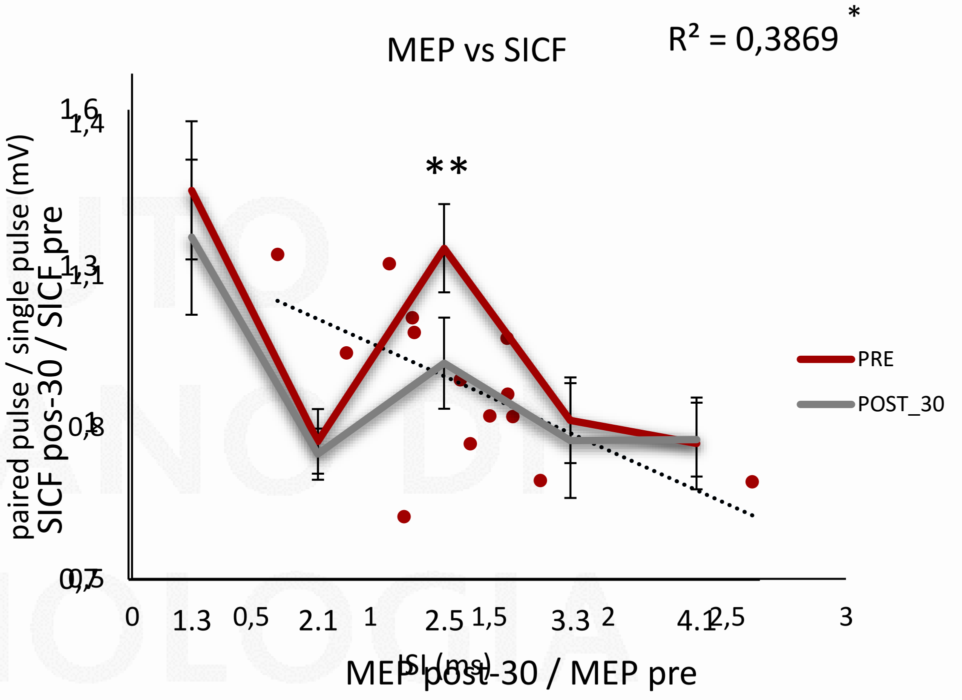

corticospinal excitability

SICF 2.5 ms ISI

MEP **SICF**

$* = p < 0.05$

$** = p < 0.01$

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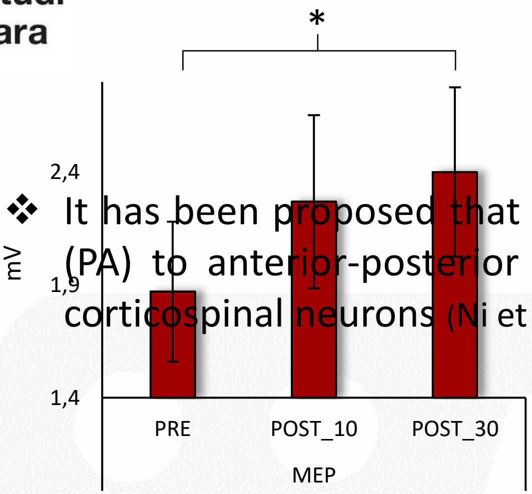
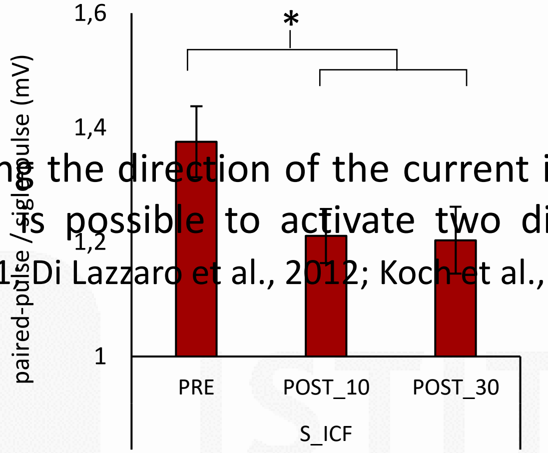
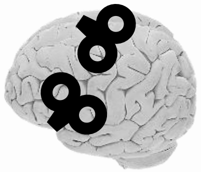
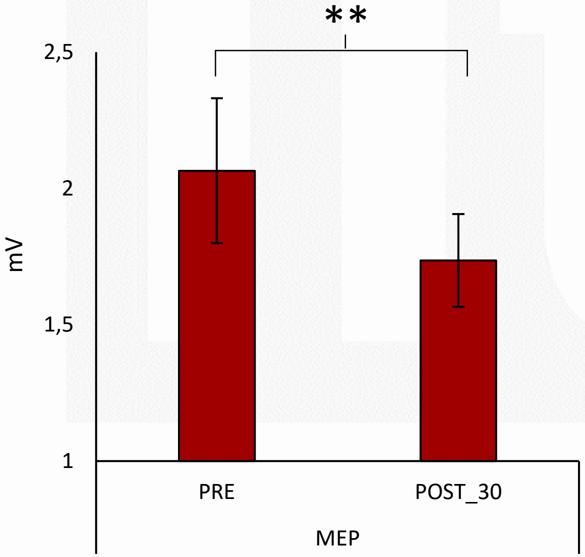
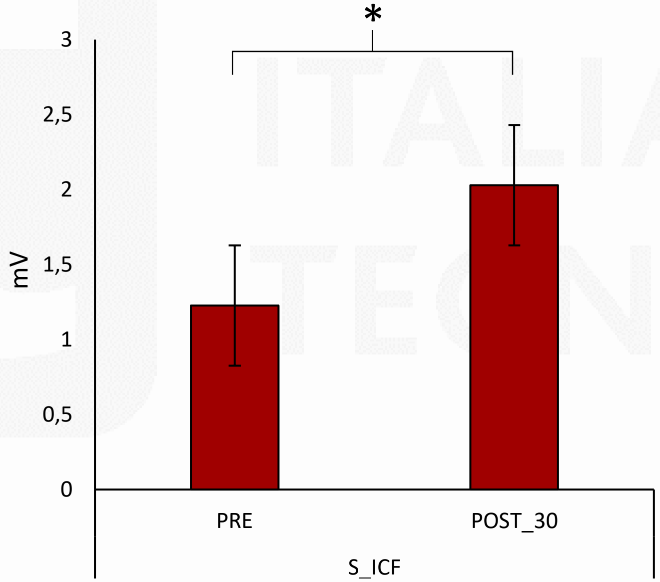
❖ It has been proposed that changing the direction of the current induced in M1 from posterior-anterior (PA) to anterior-posterior (AP) it is possible to activate two different sets of synaptic input to the corticospinal neurons (Ni et al., 2011; Di Lazzaro et al., 2012; Koch et al., 2013)

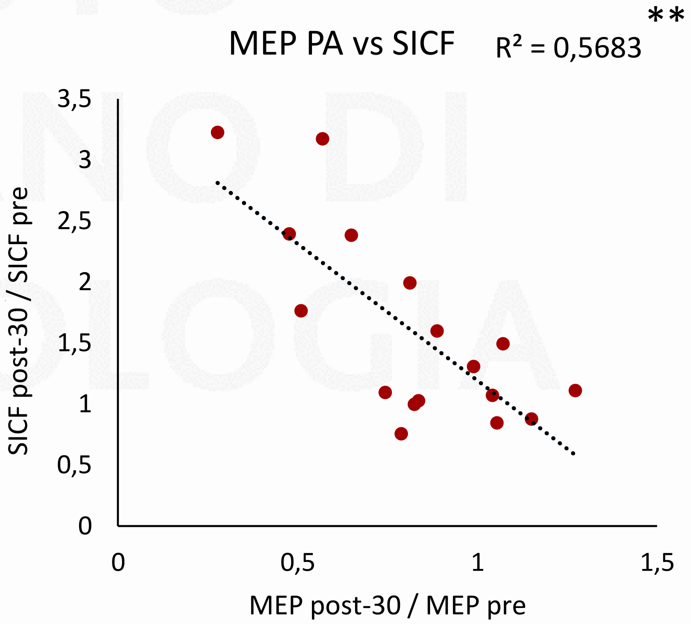












corticospinal excitability

SICF 2.5 ms ISI

*= $p < 0.05$
** = $p < 0.01$

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PMv-to-M1 cc-PAS lead to →

- ❖ **PMv-M1 connectivity modulation**
- ❖ **M1 local circuitry modification**

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❖ The strengthening of the PMv-M1 connections could lead to an increment → of the pyramidal neurons activity. / of the inhibitory activity.

❖ The increment of the gabaergic inhibitory activity could lead to the reduction of the SICF (Ziemann et al., 2015).

❖ SICF and MEP might be mediated by, at least in part, by distinct circuits.

↓ These circuits seem to influence each other.

MEP ↑ **SICF** ↓

❖ The results are specific for the cc-PAS protocol applied in postero-anterior (PA) orientation.

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Thanks to…

Elisa Dolfini

Pasquale Cardellicchio

Alessandro D'Ausilio

Giacomo Koch

Luciano Fadiga

Thank you all for your attention!