



Inhibitory effect of pain on motor cortex

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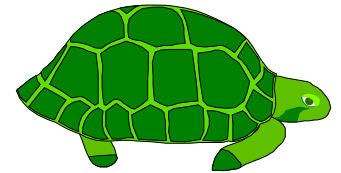
Dipartimento di Medicina dei Sistemi, Università Tor Vergata, Roma, Italy

Center for Sensory-Motor Interaction, Aalborg University, Denmark

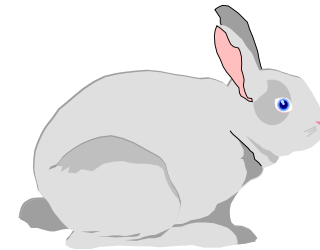


Pain → Motor System

Reduced motor abilities
(cutaneous silent period)

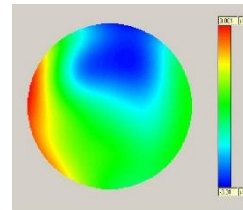
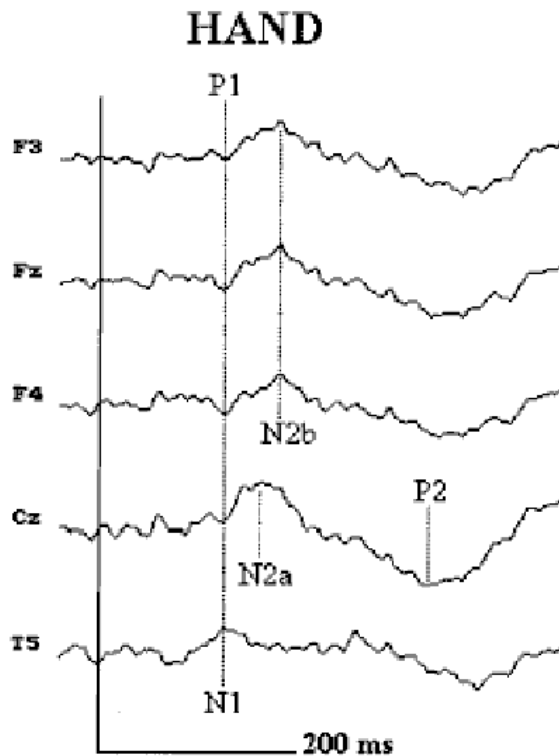


Escape
(withdrawal reflexes)



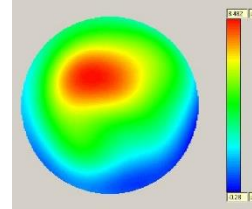


CO₂ laser evoked potentials (LEPs)



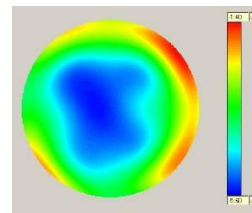
N1/P1

**Sensory-
discriminative aspects
of pain**



N2a

**Emotional-
motivational aspects
of pain**



P2

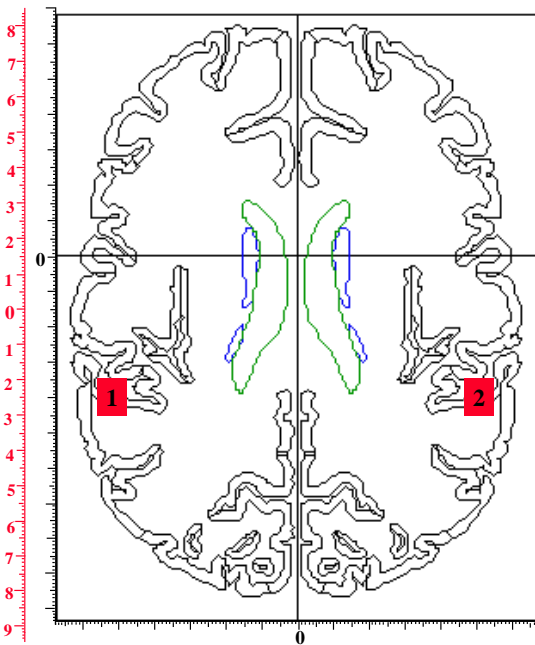


Dipolar source modelling

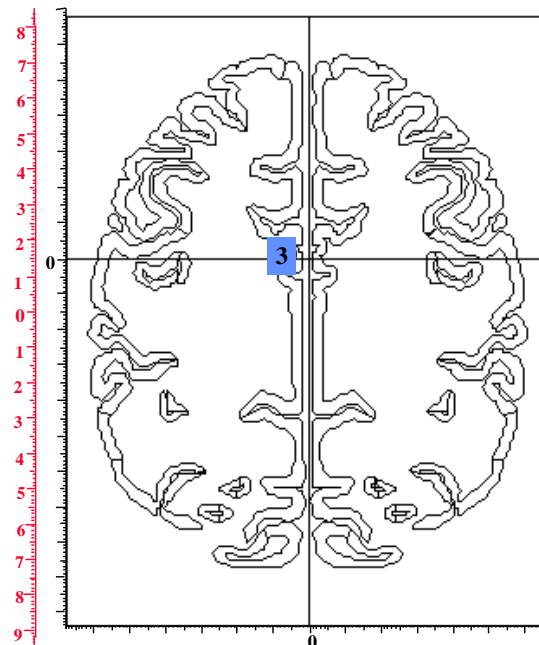
+20 mm

+35 mm

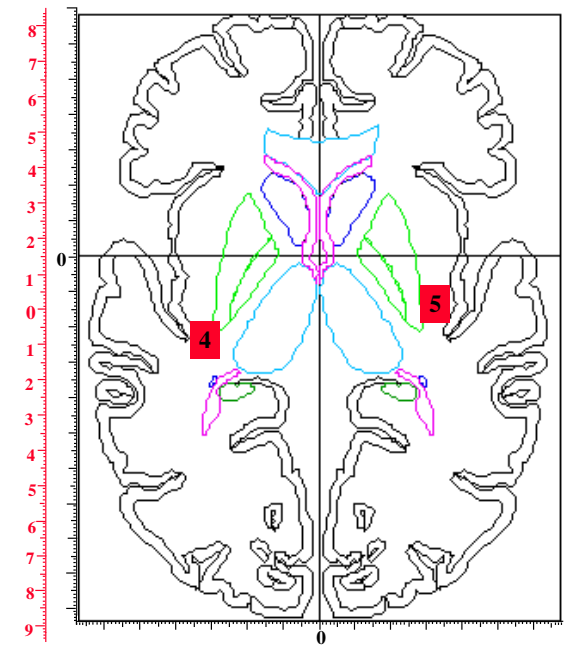
+4 mm



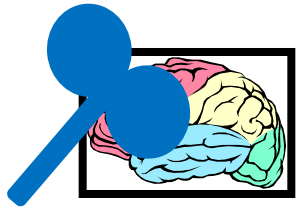
SII dipoles



**Anterior cingulate
dipole**



Insular dipoles



-100 ms

-50 ms

T0

+50 ms

+100 ms

+150 ms

+200 ms

+300 ms

+400 ms

N1 LEP



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Clinical Neurophysiology 110 (1999) 1475–1480



Inhibition of the human primary motor area by painful heat stimulation of the skin

Massimiliano Valeriani^{a,*}, Domenico Restuccia^a, Vincenzo Di Lazzaro^a, Antonio Oliviero^a,
Paolo Profice^a, Domenica Le Pera^a, Eleonora Saturno^a, Pietro Tonali^{a,b}

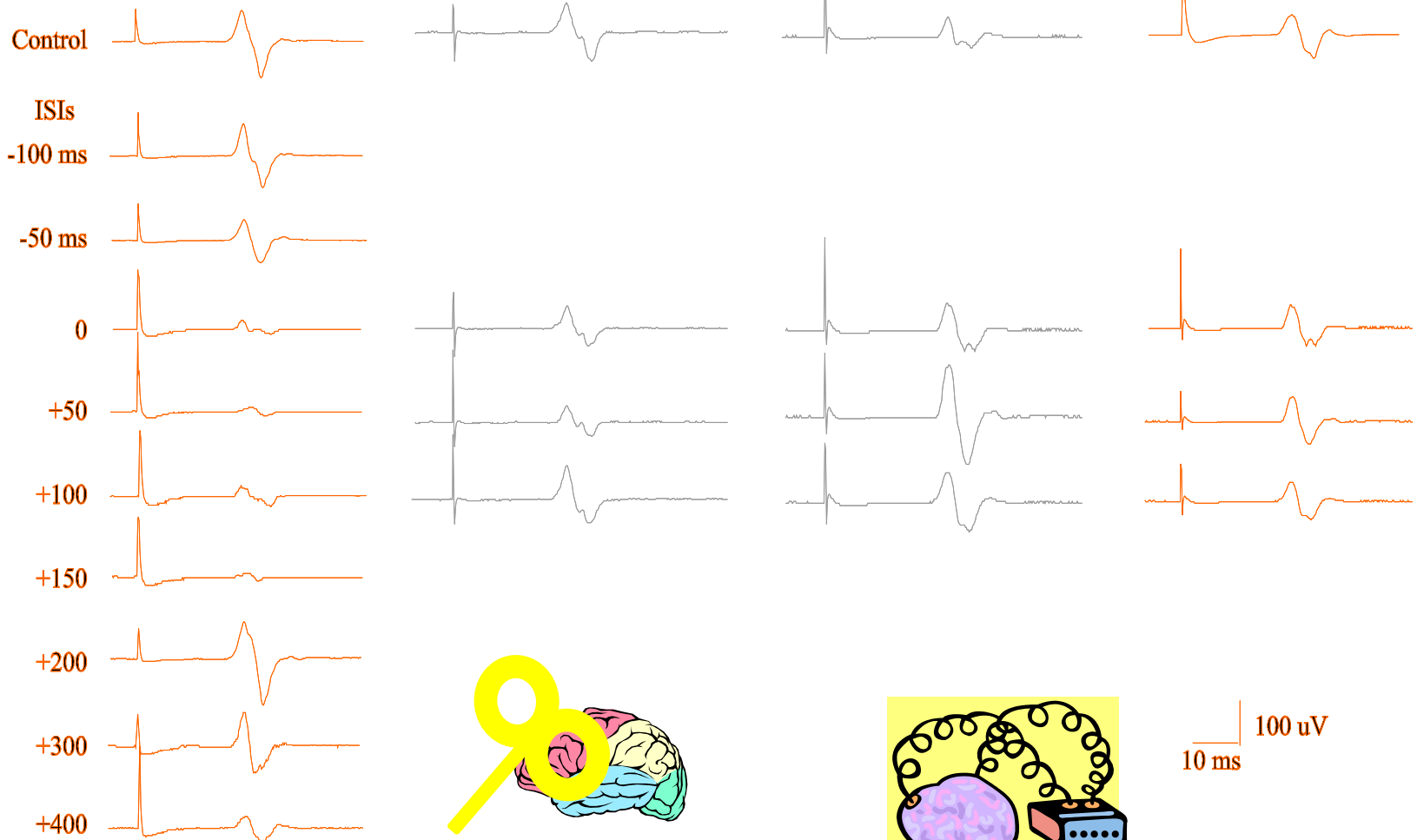
^aDepartment of Neurology, Università Cattolica del Sacro Cuore, L.go A. Gemelli 8, 00168, Rome Italy

^bCSS Hospital, IRCCS, San Giovanni Rotondo, Italy



Magnetic stimulation of the left motor cortex

Electric stimulation of the left motor cortex





Distal muscles



CSP

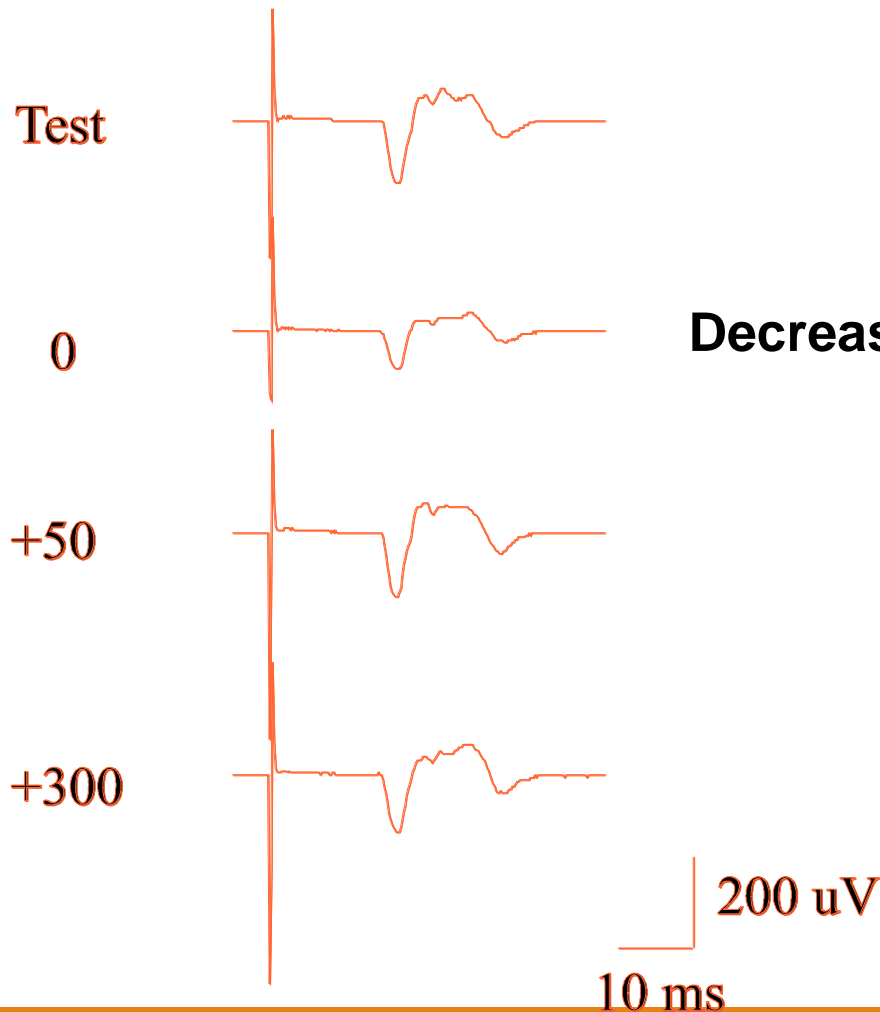
Proximal muscles



Increased EMG activity



Proximal Muscles



Decreased EMG response amplitude

Exp Brain Res (2001) 139:168–172
DOI 10.1007/s002210100753

RESEARCH ARTICLE

Massimiliano Valeriani · Domenico Restuccia
Vincenzo Di Lazzaro · Antonio Oliviero
Domenica Le Pera · Paolo Profice · Eleonora Saturno
Pietro Tonali

**Inhibition of biceps brachii muscle motor area
by painful heat stimulation of the skin**



Possible anatomical pathways:

1)

SII area



Motor cortex

2) Ventro-lateral thalamus



Motor cortex

3) Anterior Cingulate Gyrus



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Clinical Neurophysiology 112 (2001) 1633–1641



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Inhibition of motor system excitability at cortical and spinal level by tonic muscle pain

Domenica Le Pera^{a,b,*}, Thomas Graven-Nielsen^a, Massimiliano Valeriani^{b,c,d}, Antonio Oliviero^b,
Vincenzo Di Lazzaro^b, Pietro Attilio Tonali^b, Lars Arendt-Nielsen^a

Tonic muscle pain





Tonic muscle pain inhibits motor system

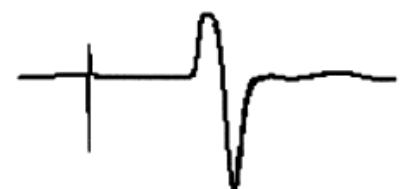
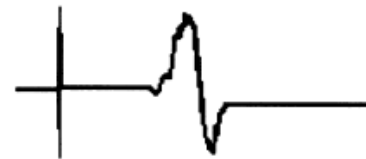
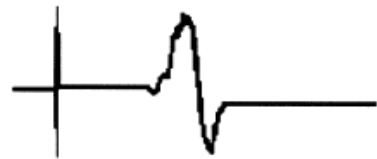
Painful injection in the right ADM muscle

Painful injection in the right FDI muscle

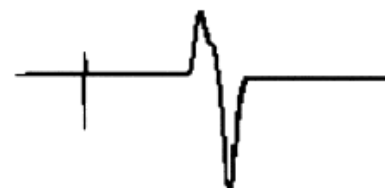
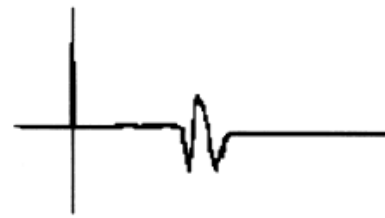
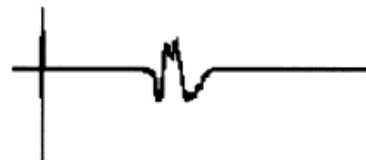
Non-painful injection in the right ADM muscle

100 μ V
10 ms

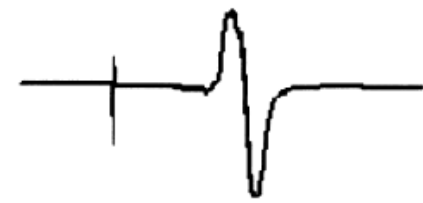
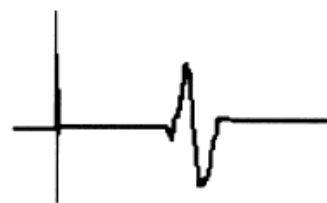
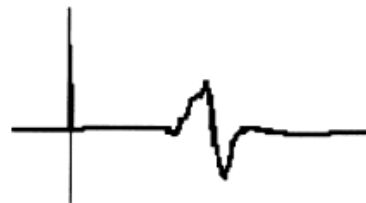
Baseline



Peak-pain

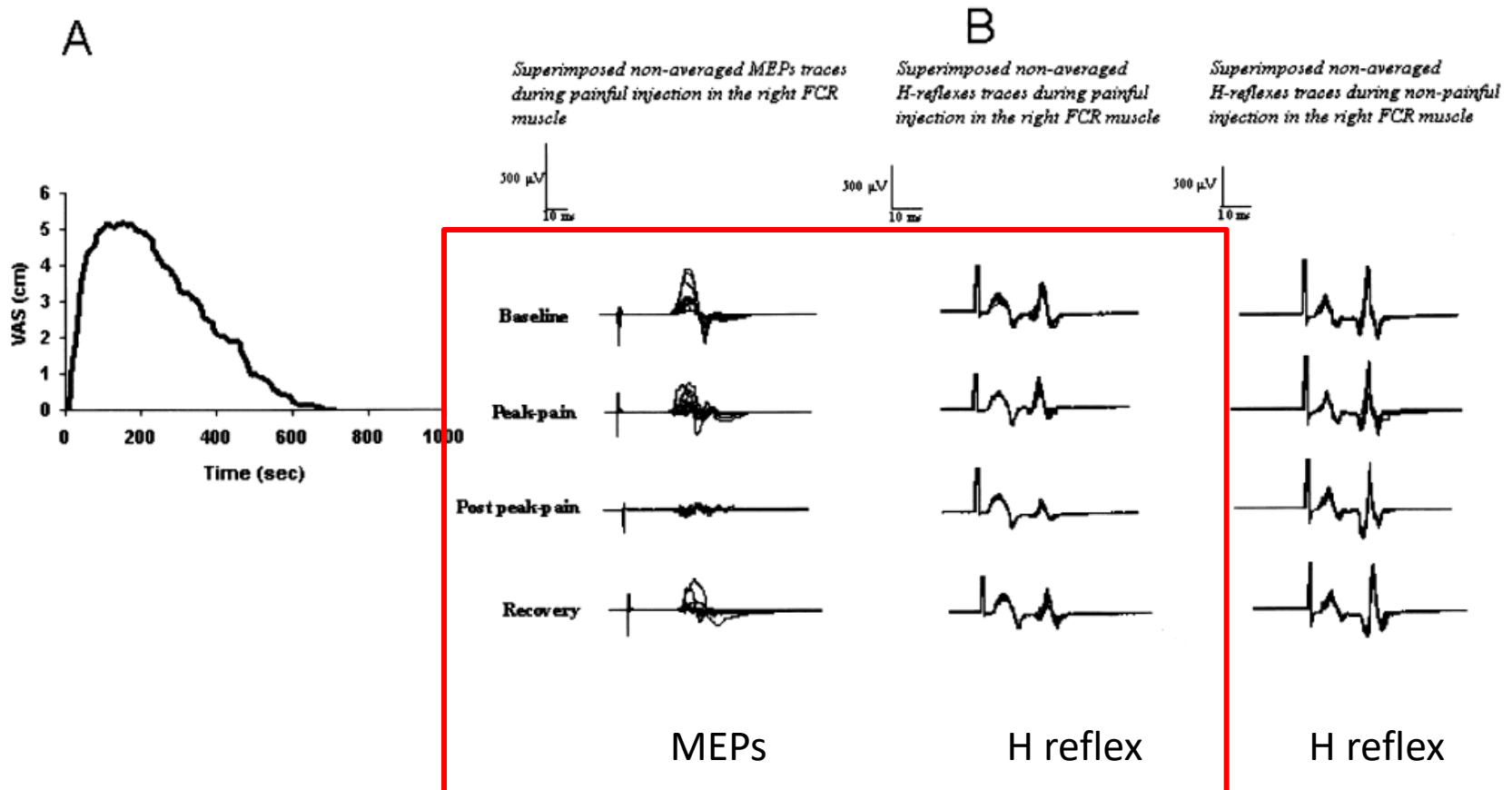


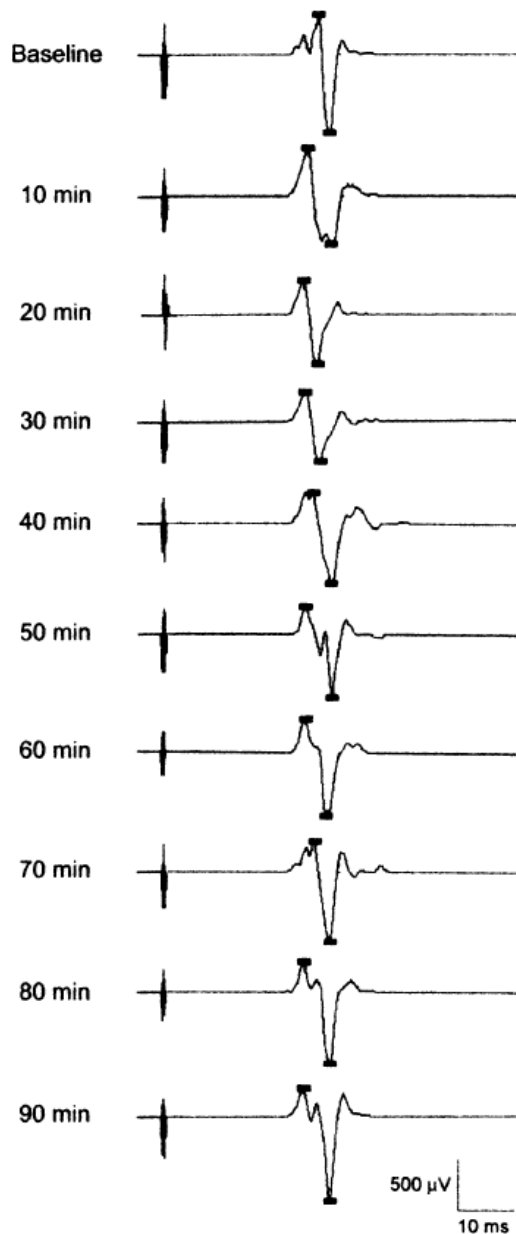
Recovery





Tonic muscle pain inhibits motor system (at both cortical and spinal level)

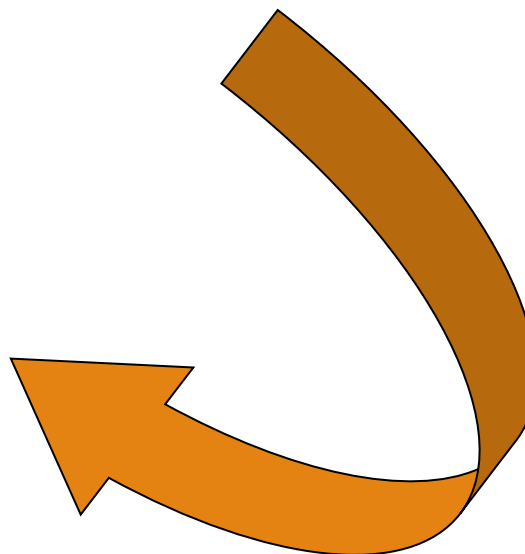




Transient inhibition of the human motor cortex by capsaicin-induced pain. A study with transcranial magnetic stimulation

Simona Farina^a, Massimiliano Valeriani^b, Tiziana Rosso^a, Salvatore Aglioti^c,
Stefano Tamburin^a, Antonio Fiaschi^a, Michele Tinazzi^{a,*}

Tonic cutaneous pain inhibits motor cortex



Acute pain drives different effects on local and global cortical excitability in motor and prefrontal areas: insights into interregional and interpersonal differences in pain processing

Enrico De Martino¹, Adenauer Casali², Silvia Casarotto^{3,4}, Gabriel Hassan³, Mario Rosanova³, Thomas Graven-Nielsen¹, Daniel Ciampi de Andrade^{1*}

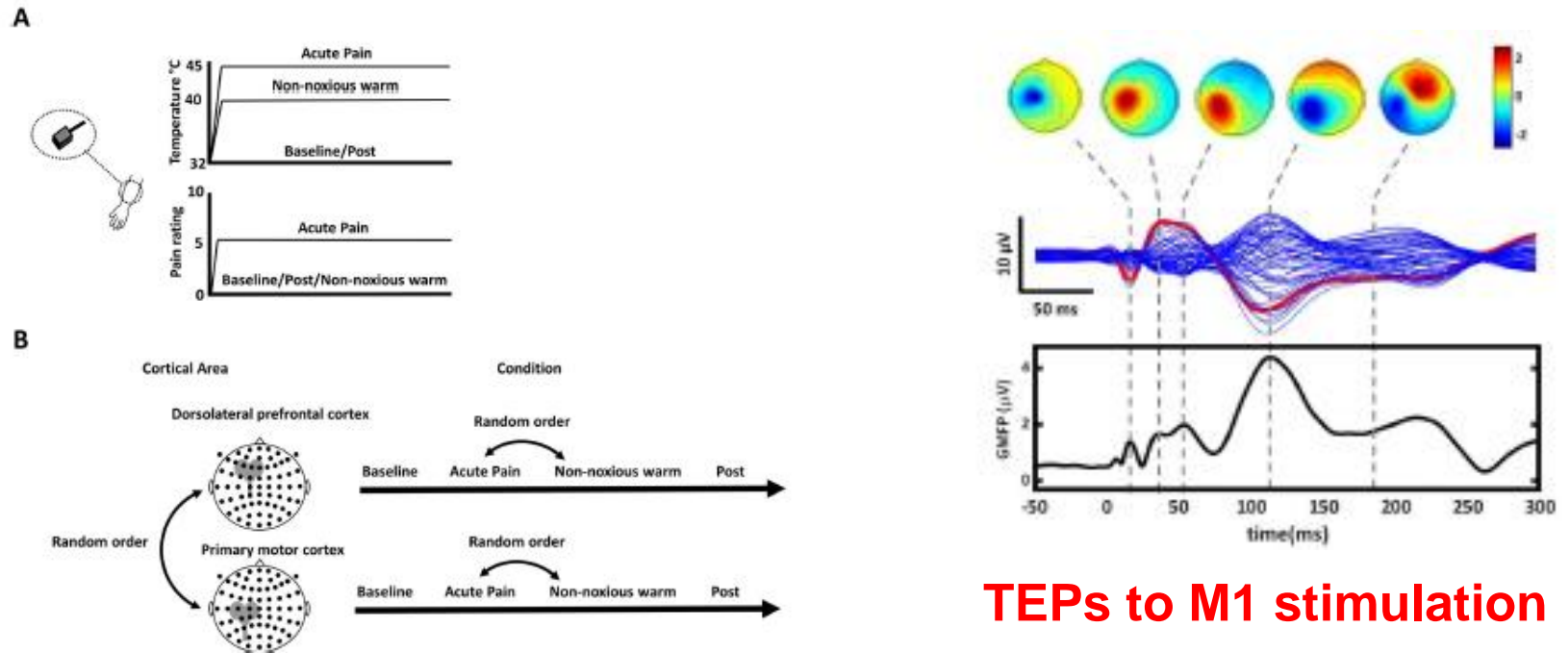
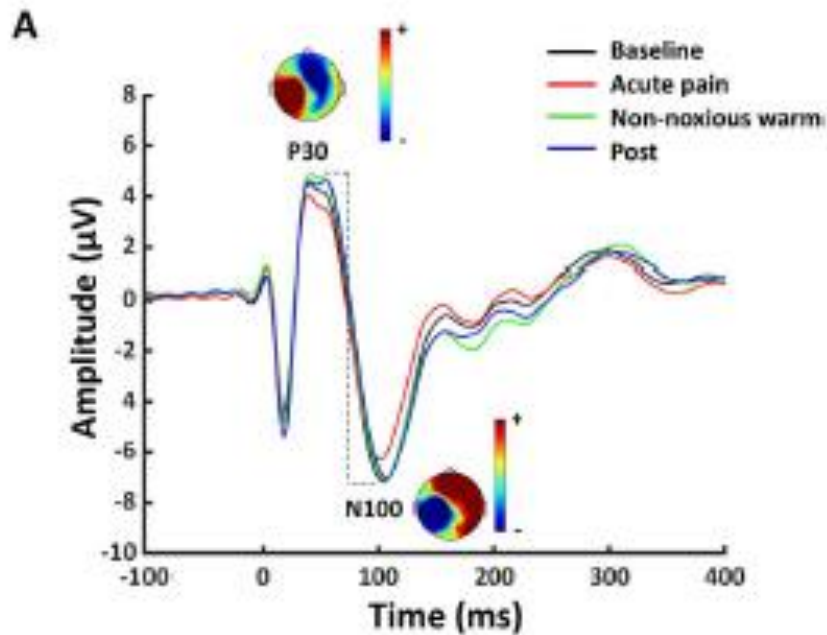
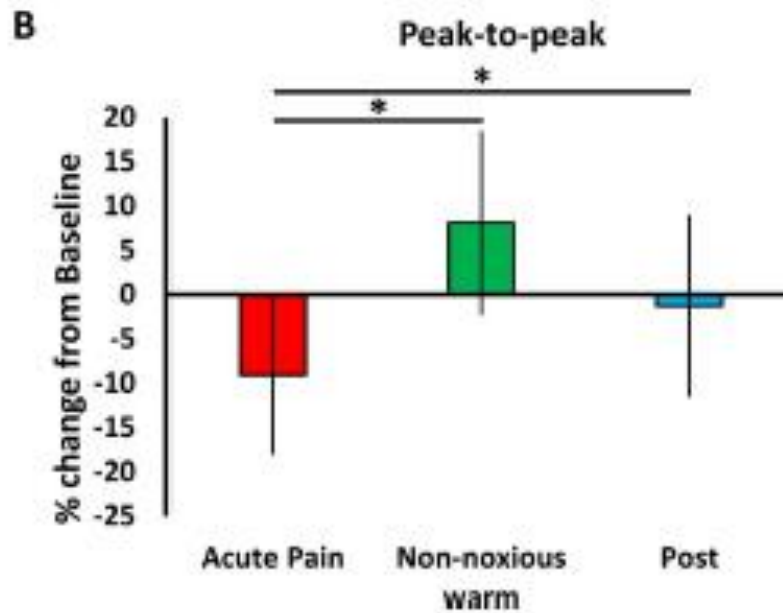


Fig. 1. (A) Baseline and Post (32 °C), Non-noxious warm (40.2 ± 0.8° C), and Acute Pain (45.2 ± 0.8° C) temperatures were applied to the palmar region of the right forearm. Participants experienced pain intensity of around 5 using an 11-point scale during Acute Pain. (B) TMS-electroencephalography was recorded in two cortical areas: the dorsolateral prefrontal cortex (DLPFC) and the primary motor cortex (M1). Four different conditions were recorded for each cortical area: Baseline, Acute Pain, Non-noxious warm, and Post. The order of cortical stimulation area (DLPFC and M1) and Acute Pain and Non-noxious warm conditions were randomized.



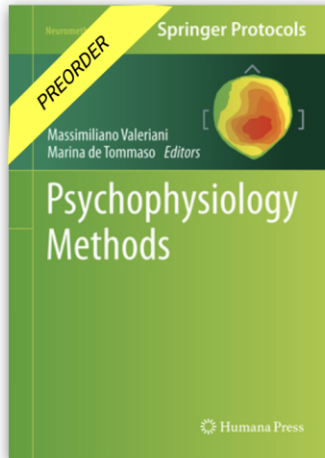
Acute pain
inhibits motor
cortex





To conclude:

- Pain inhibits motor cortex →
“motor cortex dysconnection”
- Spinal reflexes → protection
meaning



Psychophysiology Methods (Neuromethods #206)

Massimiliano Valeriani (Editor), Marina de Tommaso (Editor)

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Cutting-edge and practical, *Psychophysiology Methods* is a valuable resource for researchers who want to learn more about the use of psychophysiological techniques in the investigation of human cognition, and increase interest in the clinical puzzle of neurological and psychiatric disorders.

Pain Research and Management

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