# The influence of emotions on actions: Boosting brain network plasticity to ameliorate action control

### ABSTRACT:

#### Background

Effective inhibitory control over prepotent actions is crucial. Understanding the brain mechanisms that enable humans to suppress unwanted behaviors remains a major scientific challenge that has been relatively underexplored. Notably, inhibitory control appears to be affected by the presence of emotional stimuli, although findings in this area have been mixed.

#### Aims

We aim to disclose the complex interplay between action control and emotions, investigating how emotional stimuli are able to behaviorally influence action control as well as the neural dynamics subtending such complex executive function.

#### Method

In a series of behavioral and Transcranial Magnetic Stimulation (TMS) studies, we asked healthy young participants to complete action control tasks. We investigated how action control capabilities can be ameliorated or suppressed due to different TMS protocol applications and whether individual neurophysiological indices may predict action suppression abilities.

#### Results

We demonstrated that negative emotions are able to influence action control and that the neural dynamics subtending action suppression are differently influenced in a neutral vs an emotional context. Interestingly, individual differences in intracortical mechanisms within the motor system may be considered as a biomarker for action control capabilities.

#### Conclusions

This project significantly advances the mechanistic understanding of the complex interplay between action and emotion, demonstrating that negative emotions can ameliorate action suppression. Taken together, our results pave the way for future TMS-based treatments in several psychiatric and clinical disorders with serious deficits in action control, especially in emotionrelated context.

#### Keywords

Action control, Emotions, Transcranial magnetic stimulation, Unconscious perception

# **Published Work:**

Battaglia, S., Nazzi, C., di Fazio, C., & Borgomaneri, S. (2024). The role of pre-supplementary motor cortex in action control with emotional stimuli: An rTMS study. *Annals of the New York Academy of Sciences*, *1536*, 151–166. <u>https://doi.org/10.1111/nyas.15145</u>

Quettier, T., Ippolito, G., Cardellicchio, P., Battaglia, S., & Borgomaneri, S. (2024). Individual differences in intracortical inhibition predict action control when facing emotional and neutral stimuli. *Frontiers in Psychology*, *15*, 1391723. <u>https://doi.org/10.3389/fpsyg.2024.1391723</u>

Cardellicchio, P., & Borgomaneri, S. (2025). Level of M1 GABAB predicts micro offline consolidation of motor learning during wakefulness. *NPJ Science of Learning*, *10*, 10. https://doi.org/10.1038/s41539-025-00299-1

## **Researcher's Contacts:**

Sara Borgomaneri Centre for Studies and Research in Cognitive Neuroscience – CsrNC Department of Psychology, University of Bologna Viale Rasi e Spinelli 176 47521 Cesena (FC) Italy

Email: sara.borgomaneri@unibo.it