Early attentional processes distinguish selective from global motor inhibitory control: an electrical neuroimaging study

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Introduction

The rapid stopping of specific parts of movements is frequently required in daily life. Yet, whether selective inhibitory control of movements is mediated by a specific neural pathway or by the combination between a global stopping of all ongoing motor activity followed by the re-initiation of task relevant movements remains unclear.

To address this question, we analyzed electrical neuroimaging responses to global vs selective inhibition stimuli presented during a Go/NoGo task. Participants had to respond as fast as possible with their two hands to Go stimuli (66% of the trials) and to withhold the response from the two hands (global inhibition conditions, GNG, 16% of the trials) or from only one hand (selective inhibition, SNG, 16%) when specific NoGo stimuli were presented.

Electrical Neuroimaging results

Selective (SNG) vs. Global (GNG) inhibition

a. Superimposed ERP waveforms

b. Global Field Power waveforms

c. Global Field Power: GNG vs SNG time-wise t-tests

d. Global Map Dissimilarity (Topographic modulation): GNG vs SNG

e. Source estimations: Time-wise GNG vs SNG t-tests

Conclusions

→ Behaviorally, we replicate stopping interference effects (RT: SNG > Go) [1,2]
→ We corroborate and extend the combination model of reactive selective inhibitory control:
  • Both selective and global motor inhibitory control depend on global stopping mechanisms
  • Yet, selective and global inhibition differ quantitatively at early latency within visual & attentional areas.
→ Higher attention in the GNG condition could have helped speeding up the triggering of prefrontal top-down inhibitory processes to reach fast global inhibition. In contrast, inhibitory processes had to be engaged with more restraint in the SNG condition to reduce the amount of interference induced by the global inhibition on the execution of the alternative response.

Methods

Participants
- 18 young participants (9 males; aged 25±3 years, Mean ± SD, range: 21-29).

Go–Nogo task

Figure a. Percentage of False alarms in the GNG (black) and the SNG (red) conditions. b. Mean response time ± SD in the Go (blue) and the SNG (red) conditions.


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