

# **Unraveling the mechanisms behind automatic and emotional control: Psychophysiological, cortical excitability and functional connectivity measures**

## **ABSTRACT:**

### **Background**

Sufficient repetition of similar contextual information leads to automatic behaviours. The ability to inhibit actions, thoughts or emotions may also run under automatic control. Yet, little is known about how inhibition becomes automatic and the underlying neurobiology.

### **Aims**

We will test the presence of a brain network behind automatic inhibition. Also, how emotional cues influences on automatic inhibition mechanisms.

### **Method**

On 3 experiments, a modified Go/NoGo learning task (automatic inhibition task) assessed learning of stimulus-stop associations throughout days of training. Formation and expression of automatic inhibition was assessed by comparing first vs last behavioural sessions. Subjects had to learn to emit or withhold a keypress upon the presentation of a primary object picture (6 neutral images: 3 go vs 3 no-go) with varying feedback probabilities. Reversal and slips of action tests were performed on the first and last sessions to assess automatic behaviour. In 3 experiments, behavioural, emotional cues and neuroimaging tools (fMRI and TMS) were exploited.

### **Results**

After considerable training, significant better performance was seen across go and no-go learning trials and harder to suppress when asked to revert automatic actions. Emotional cues did not influence mean average on automatic inhibition but exploring single-trial changes showed negative images enlarged costs to revert automaticity. The neural circuitry responsible for the automatic inhibition engaged the SMA, putamen, caudate, substantia nigra and subthalamic nucleus. Finally, cortical excitability across different stages of learning (analysis of changes in MEPs) did not reveal significant time-related disparity between go and no-go trials compared to baseline trials.

### **Conclusions**

We have defined a neural circuitry associated to automatic inhibition that is influenced by emotional cues. This behaviour and associated brain responses may be of value to neuropsychiatric conditions where automatic control is impaired.

### **Keywords**

Cognitive control, Emotions, Automatic cognition, fMRI, TMS

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**Researcher's Contacts:**

Ignacio Obeso  
Avenida Carlos V, 70  
28938 Madrid  
Spain  
Email: [i.obesomartin@gmail.com](mailto:i.obesomartin@gmail.com)