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Emeline Pierrieau, Léa Pillette, Claire Dussard, Nathalie George, Camille Jeunet. Unveiling the role of beta activity in motor motivation: an EEG study of effort using neurofeedback and pupillometry. CORTICO 2022, Mar 2022, L'Escandille, France. 2022. hal-04131997

**HAL Id: hal-04131997**

**<https://hal.science/hal-04131997v1>**

Submitted on 17 Jun 2023

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# Unveiling the role of beta activity in motor motivation: an EEG study of effort using neurofeedback and pupillometry

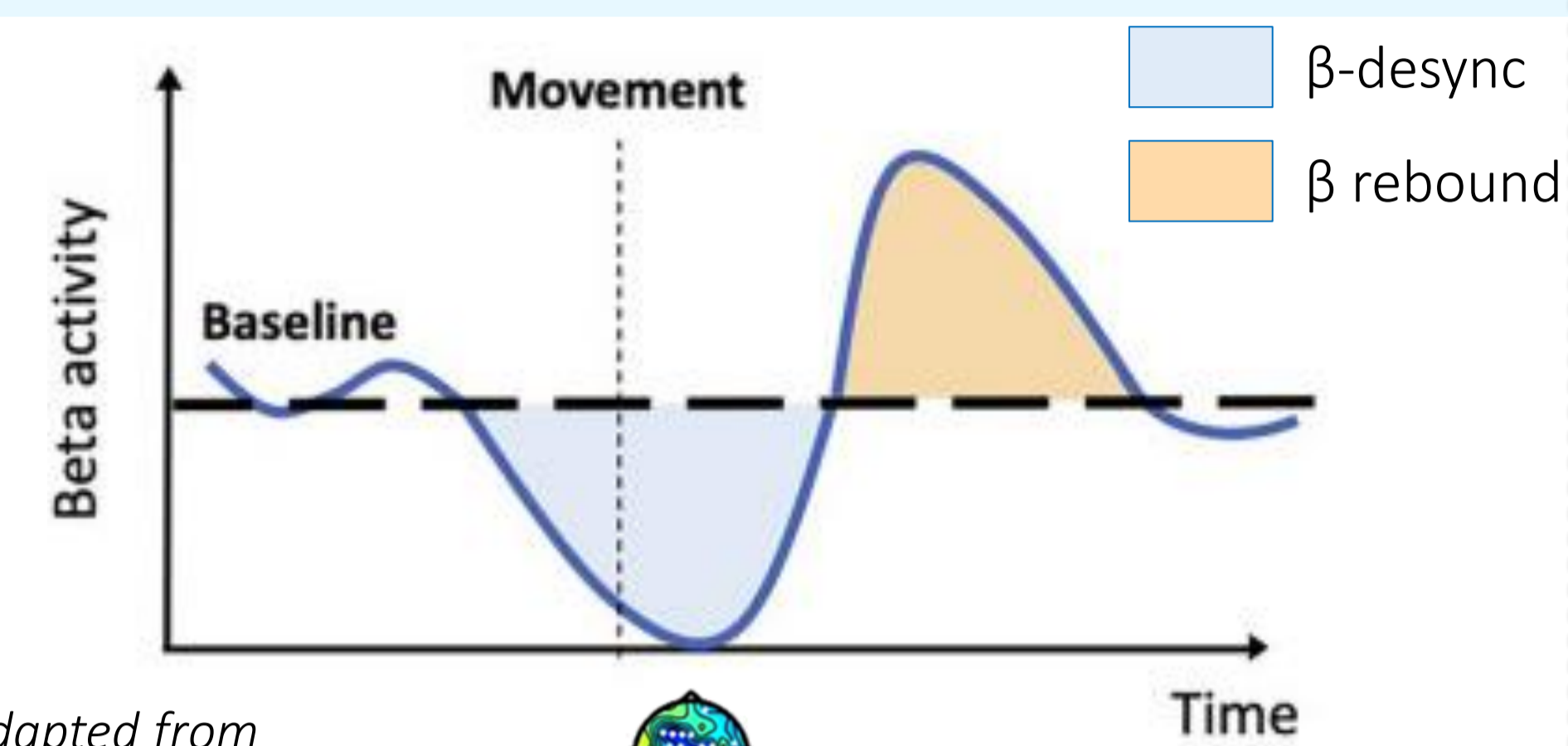
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## Introduction - Understanding the role and origin of motor beta-band activity.

- > Movement initiation is associated with a **decrease in the amplitude of beta-band oscillations ( $\beta$ ; 15-25 Hz) over sensorimotor regions**, commonly referred to as  $\beta$  desynchronization ( **$\beta$ -desync**).<sup>[1,2]</sup>
- > The magnitude of  $\beta$ -desync has been positively correlated with **movement speed**<sup>[3,4]</sup> and **force**.<sup>[5]</sup>
- >  $\beta$ -desync is **attenuated in Parkinson's disease**, and this abnormal activity pattern has been associated with **dopamine depletion** and related motor symptoms such as **bradykinesia**.<sup>[6]</sup>

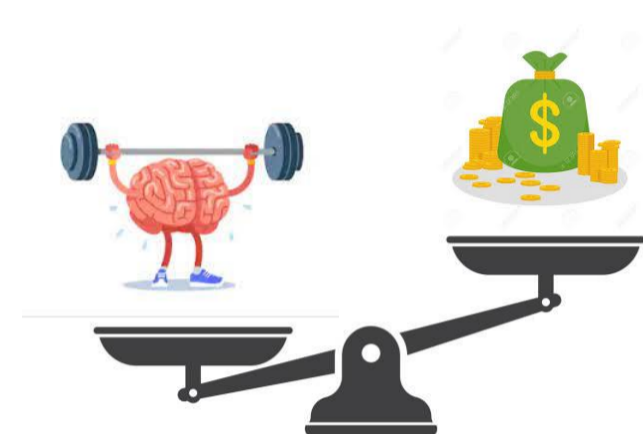
However, the functional role of  $\beta$ -desync and its neurophysiological foundation are still unclear.<sup>[7]</sup>



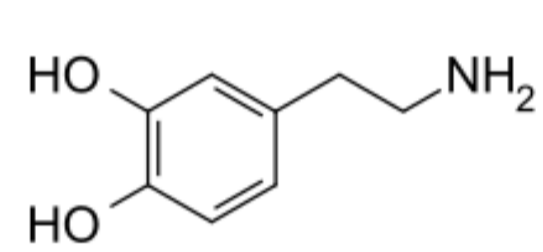
Adapted from Barone & Rossiter (2021).<sup>2</sup>

## Research question - Is $\beta$ -desync a reflect of motor motivation?

During motor planning, the upcoming action is valuated.



Action value shapes dopaminergic activity...

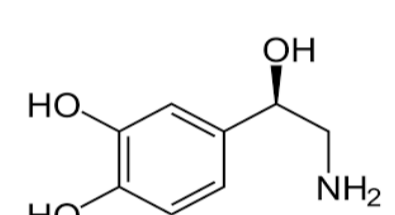


...which in turn modulates motor cortical activity ( $\beta$ -desync)



Therefore,  $\beta$ -desync may be correlated with **motor vigor** (effort)...

...and potentially with **subjective effort perception**.



Noradrenaline may also influence  $\beta$ -desync...

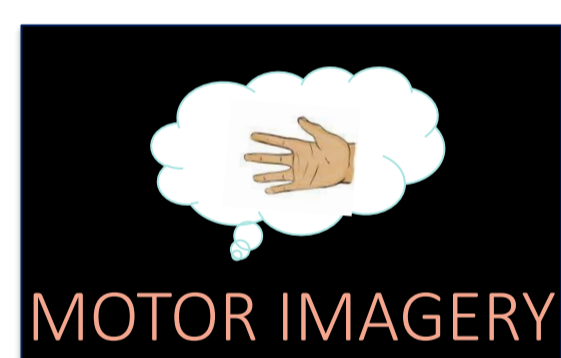


...and its activity can be quantified with **pupil dilation**, which is also correlated with effort.

## Methods - Using neurofeedback to modulate pre-movement $\beta$ -power and assessing the effects on subsequent movements.

### A. 3 experimental conditions with 3 types of neurofeedback (NF)

1.  $\searrow$   $\beta$  power



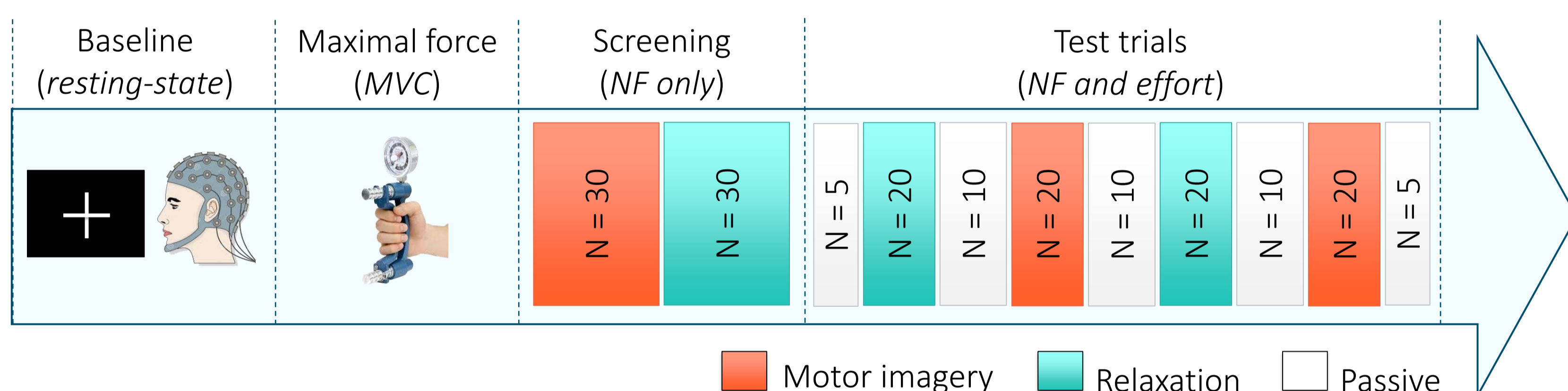
2.  $\nearrow$   $\beta$  power



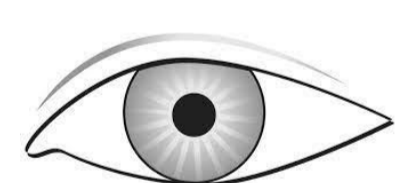
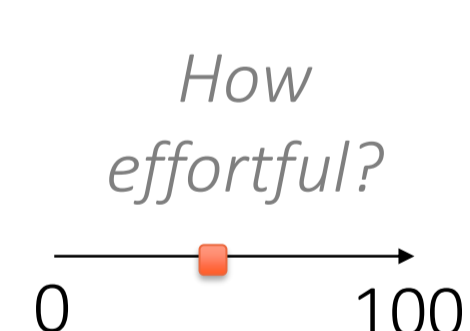
3. Sham



### C. Session timeline (motor imagery and relaxation blocks will be counterbalanced)



### B. Assessment of motor motivation with different variables



1. Exerted force

2. Perceived effort

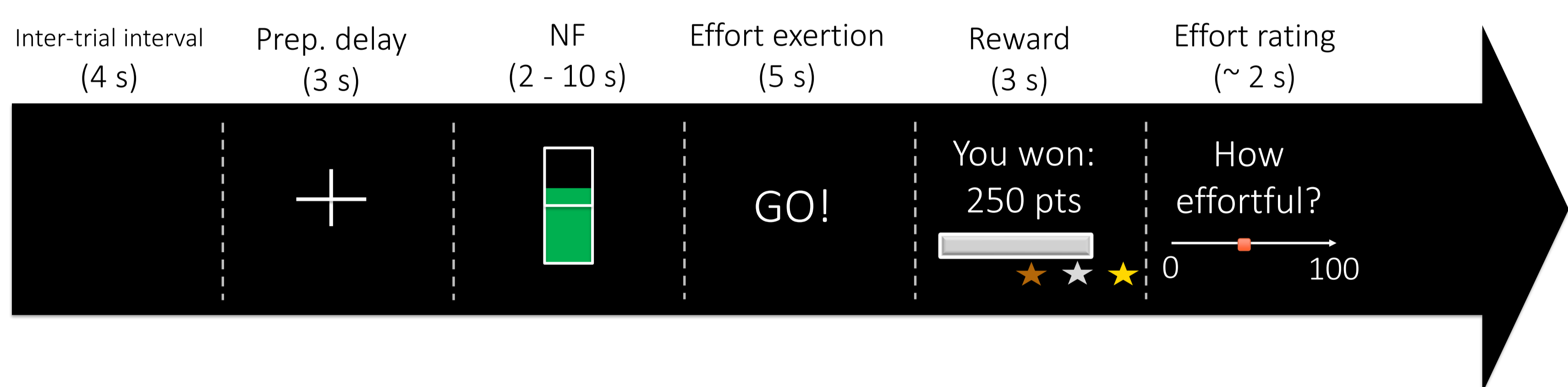
3. Pupil dilation

1a. Time spent above a force threshold

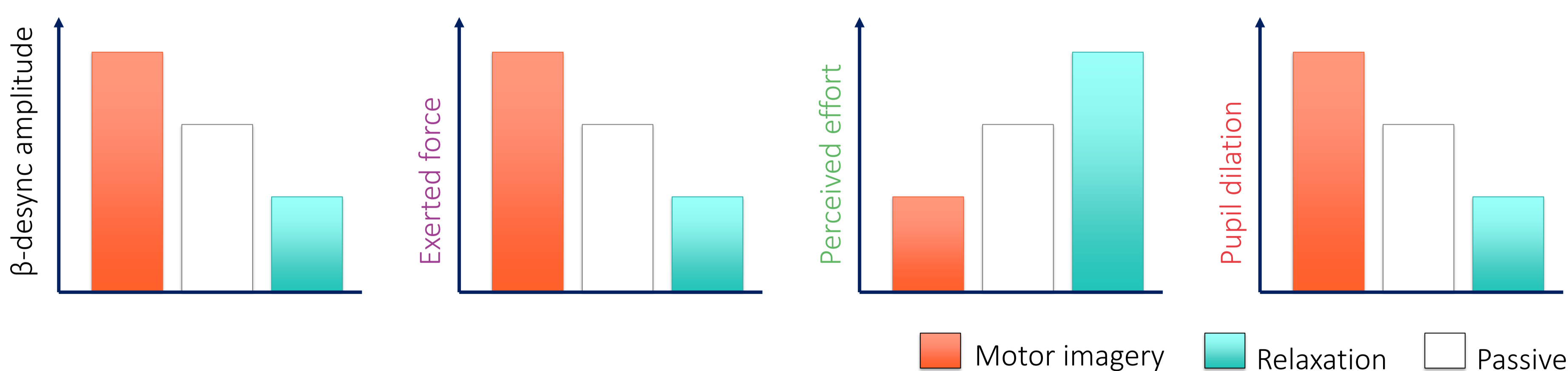
1b. Mean exerted force

1c. Peak force

### D. Trial timeline



## Expected results



## Perspectives

- Clinical applications in motivational disorders (Parkinson's disease, major depression syndrome).
- $\beta$ -desync as a proxy for motor motivation.
- Pharmacological studies (dopamine, noradrenaline).
- Association with inter-individual variability in motor motivation.

### En savoir +

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### References

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