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

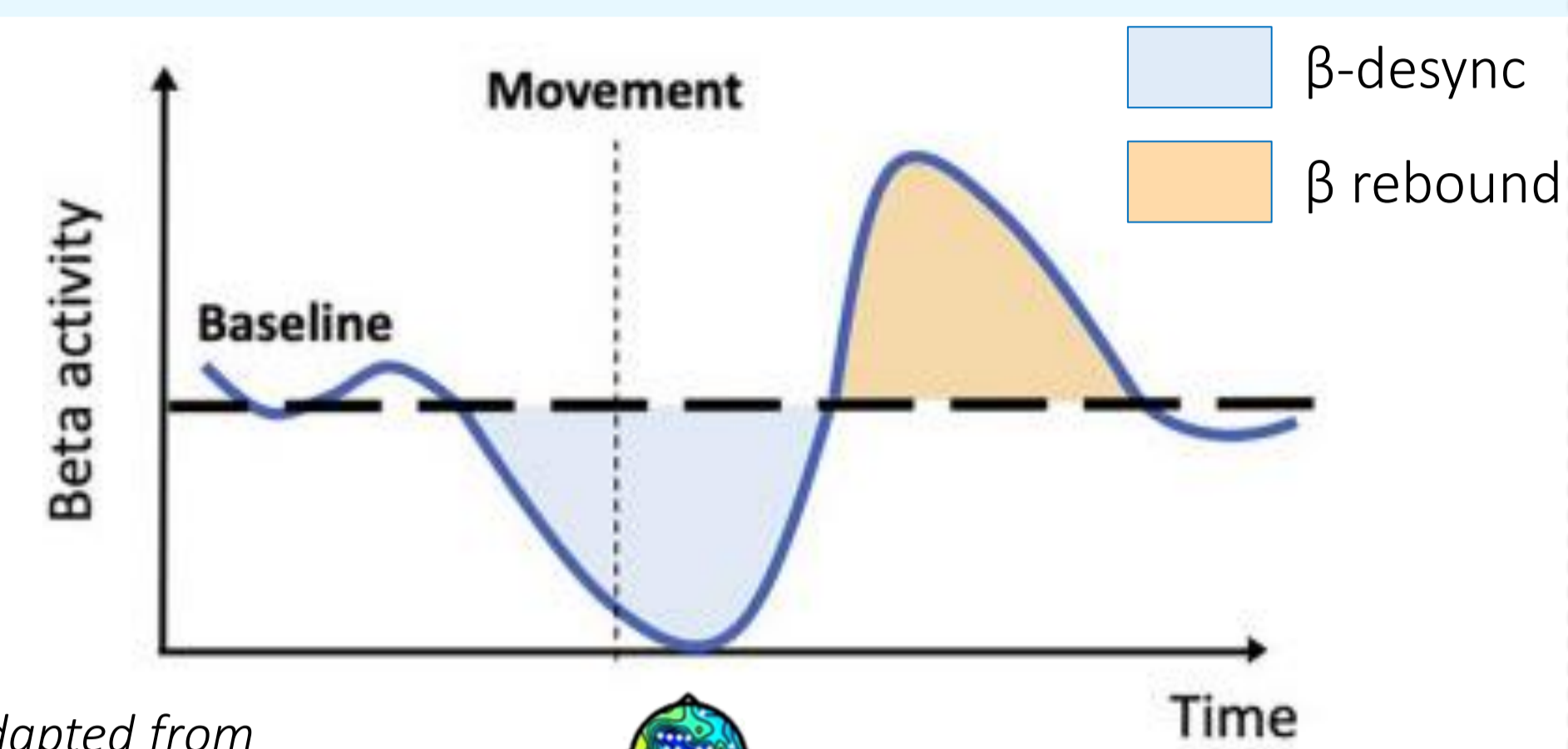
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Introduction - Understanding the role and origin of motor beta-band activity.

- > Movement initiation is associated with a **decrease in the amplitude of beta-band oscillations (β ; 15-25 Hz) over sensorimotor regions**, commonly referred to as β desynchronization (**β -desync**).^[1,2]
- > The magnitude of β -desync has been positively correlated with **movement speed**^[3,4] and **force**.^[5]
- > β -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**.^[6]

However, the functional role of β -desync and its neurophysiological foundation are still unclear.^[7]



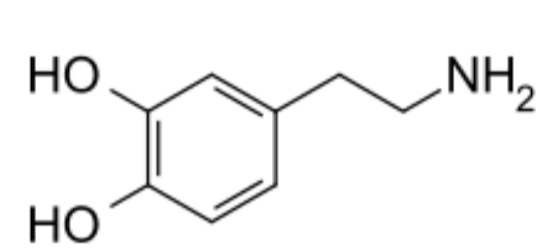
Adapted from Barone & Rossiter (2021).²

Research question - Is β -desync a reflect of motor motivation?

During motor planning, the upcoming action is valuated.



Action value shapes dopaminergic activity...

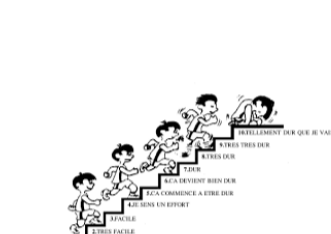


...which in turn modulates motor cortical activity (β -desync)



Therefore, β -desync may be correlated with **motor vigor** (effort)...

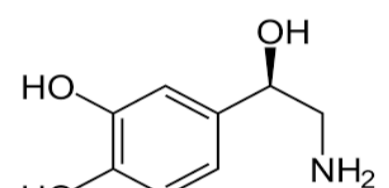
...and potentially with **subjective effort perception**.



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



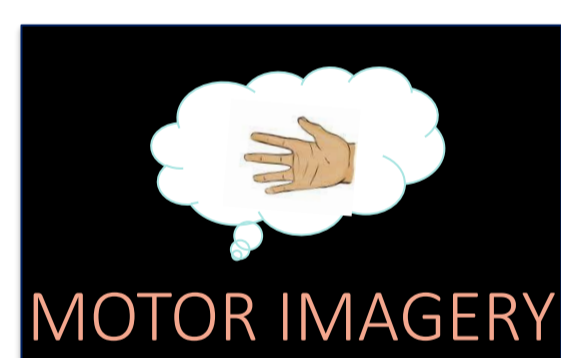
Noradrenaline may also influence β -desync...



Methods - Using neurofeedback to modulate pre-movement β -power and assessing the effects on subsequent movements.

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

1. \searrow β power



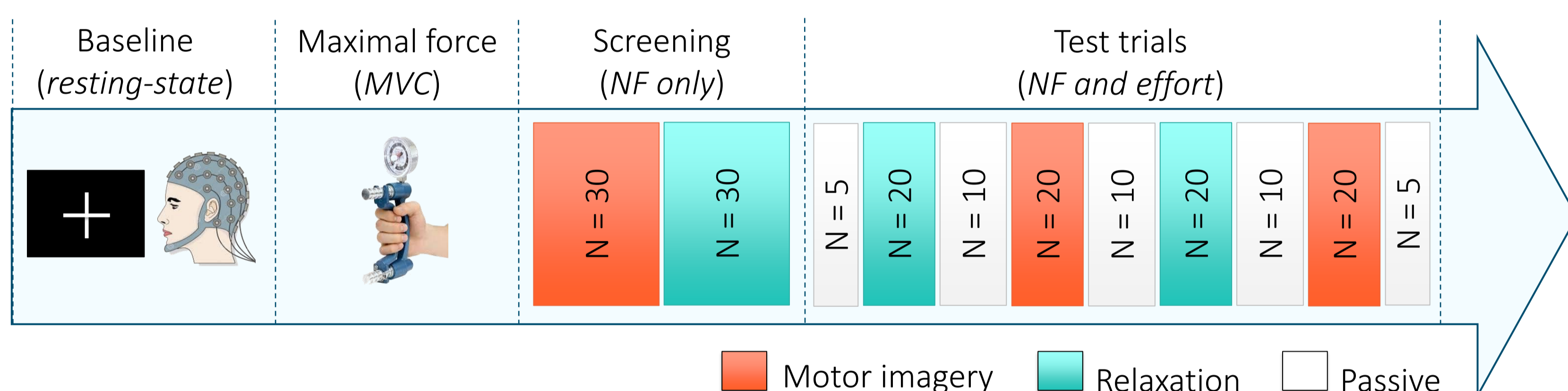
2. \nearrow β power



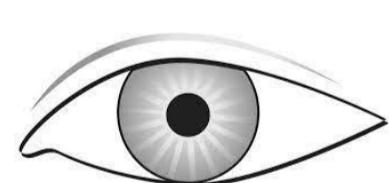
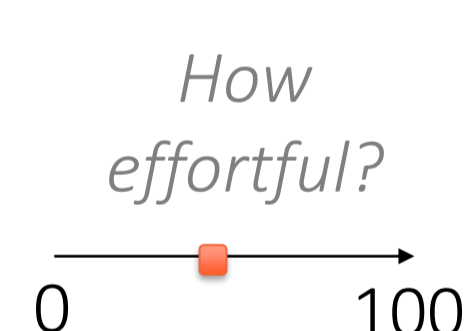
3. Sham



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

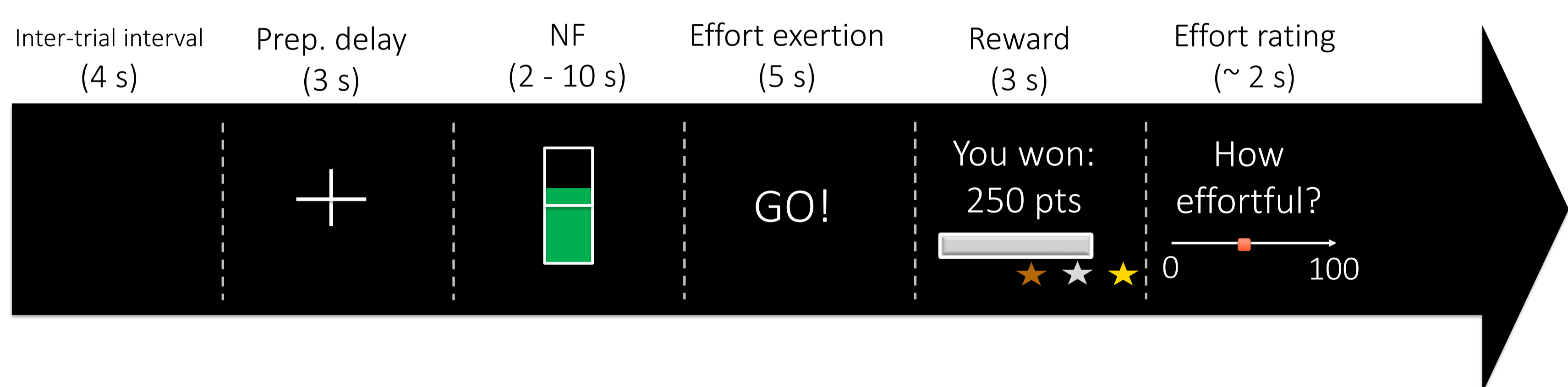
3. Pupil dilation

1a. Time spent above a force threshold

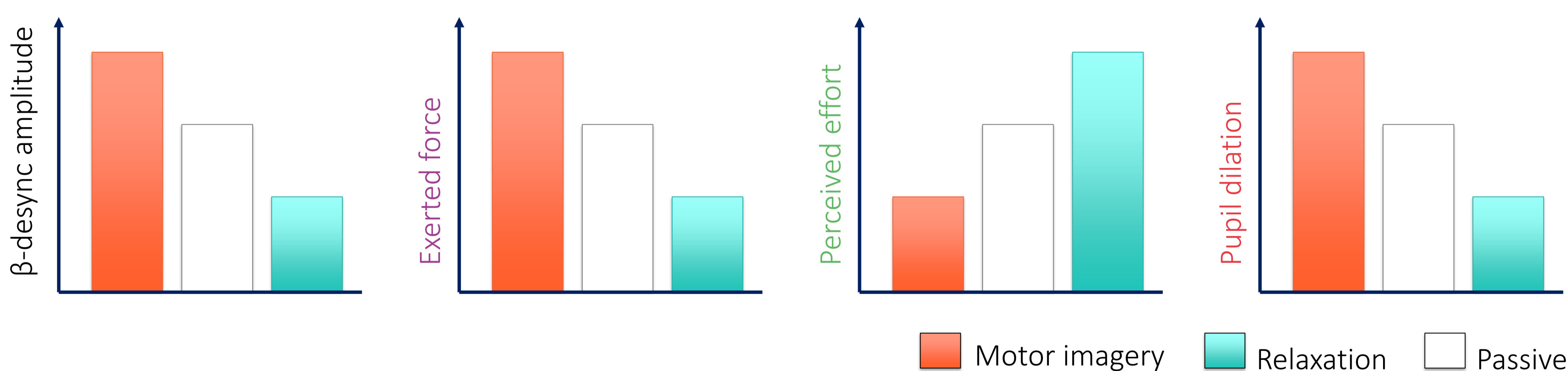
1b. Mean exerted force

1c. Peak force

D. Trial timeline



Expected results



Perspectives

- Clinical applications in motivational disorders (Parkinson's disease, major depression syndrome).
- β -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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