

# Understanding Fatigue in Long COVID

Agostina Casamento-Moran  
Vikram S. Chib



JOHNS HOPKINS  
BIOMEDICAL ENGINEERING



# A multidisciplinary team



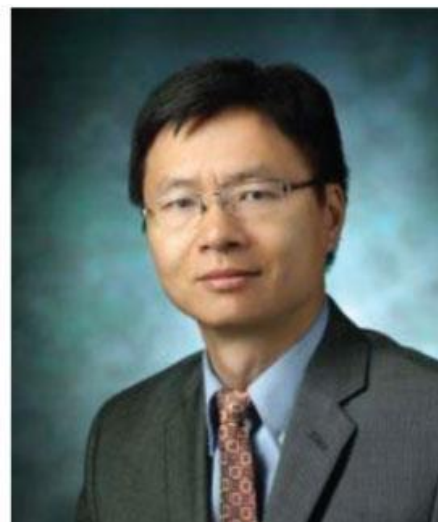
Joonhee Leo Lee, M.S.



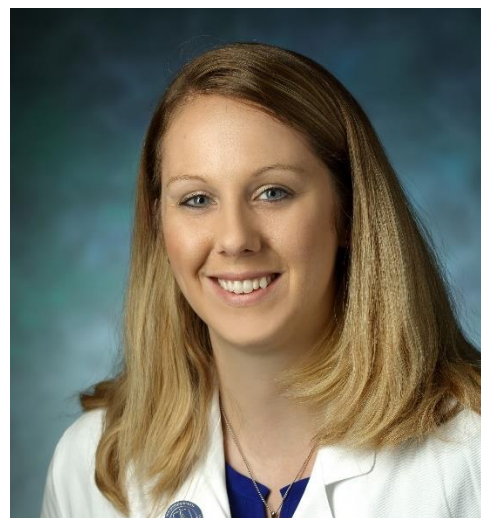
Aram Kim, Ph.D.



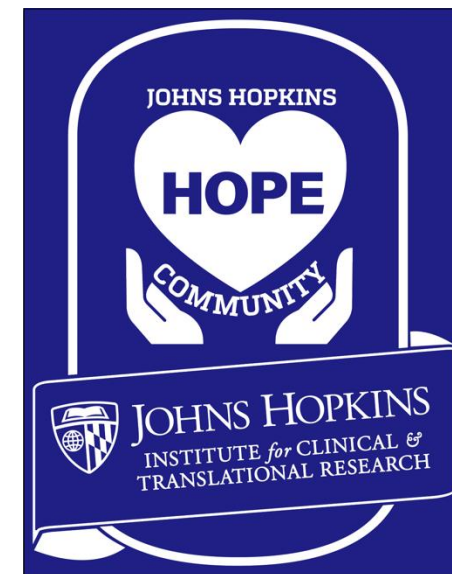
Alba Azola, M.D.



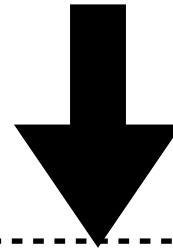
Hanzhang Lu, Ph.D.



Laura A. Malone, M.D.,  
Ph.D.



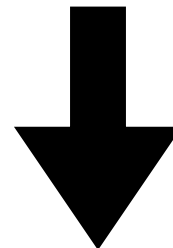
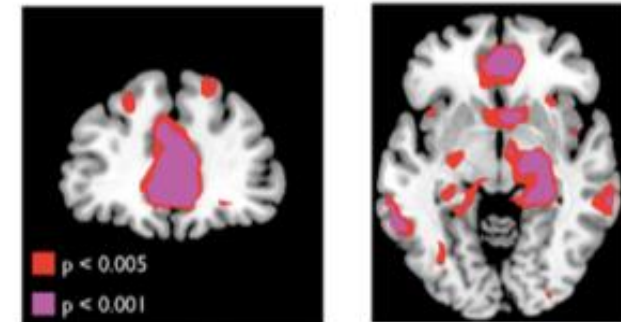
# How do different factors influence feelings of fatigue and decisions to exert effort?



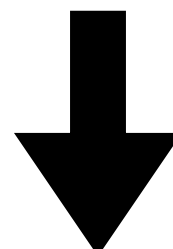
Behavioral Experiments



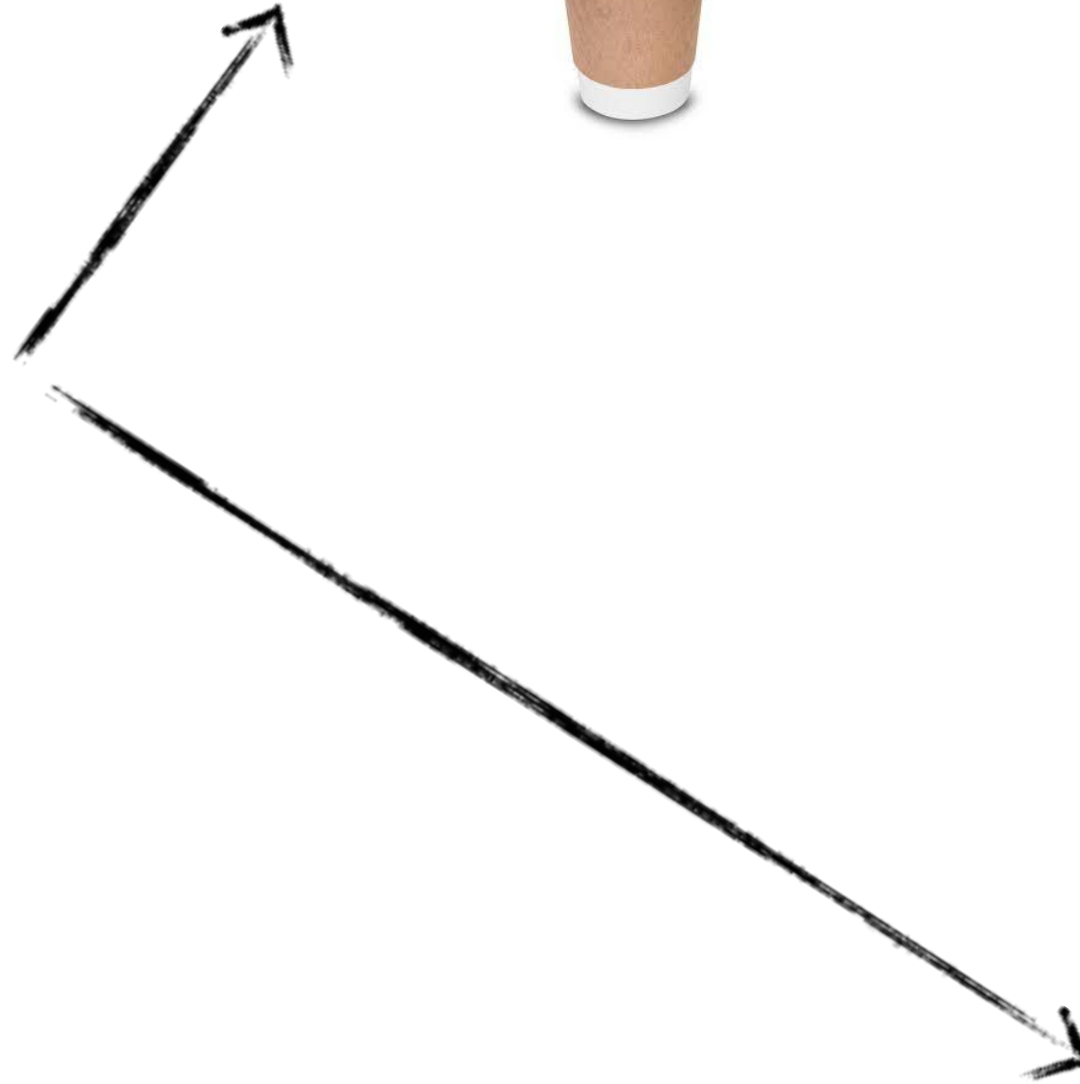
Functional Brain Imaging



Mathematical Modeling of  
Behavior and Neural Activity



Mechanism / Diagnosis / Treatments



What happens in your brain and body  
with long COVID fatigue?

# Demographics

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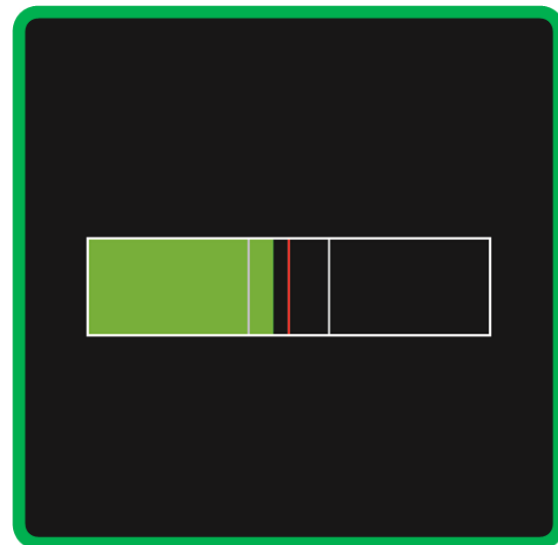
	<b>Long COVID</b>	<b>HC</b>
N (F)	34 (26)	34 (26)
Age (Min – Max)	46 yrs (23 – 73)	45 yrs (25 – 73)

# Experimental tasks

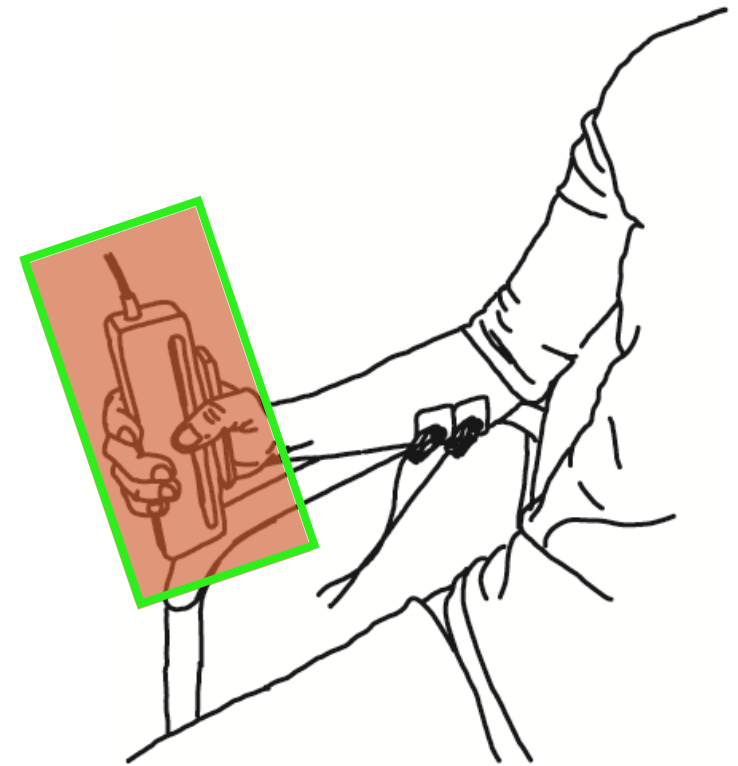
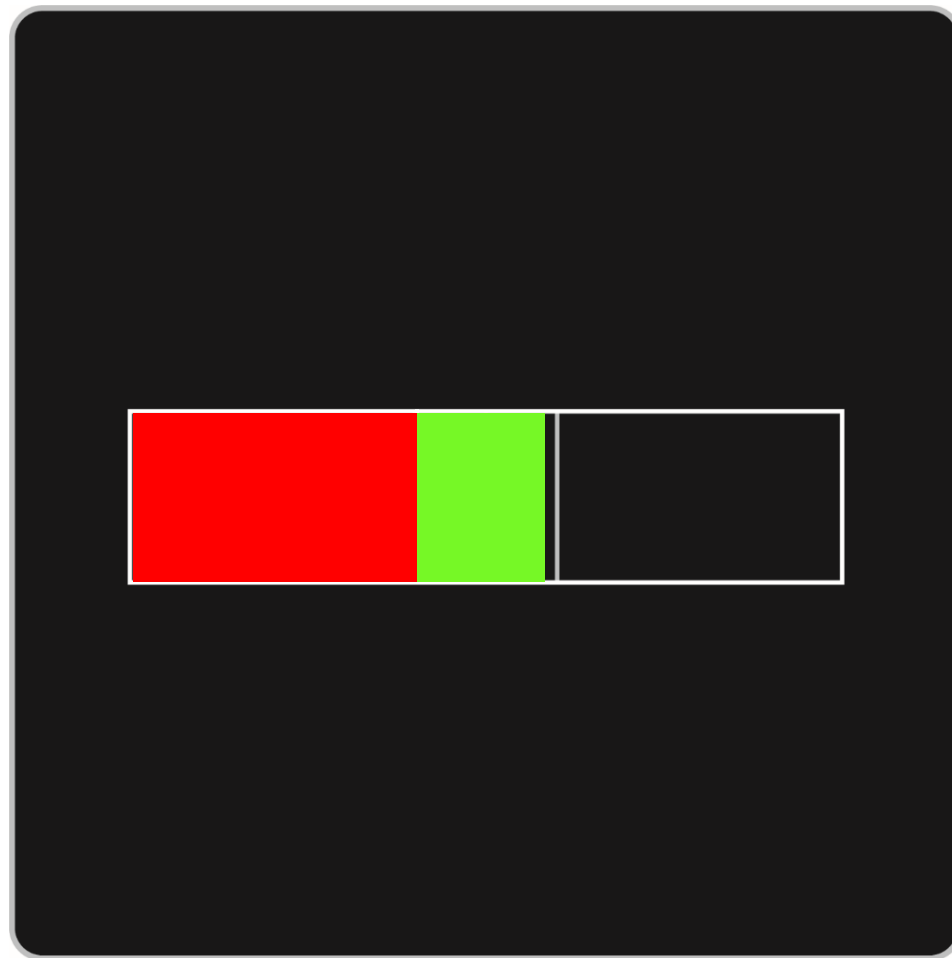
## Feelings of tiredness



## Performance



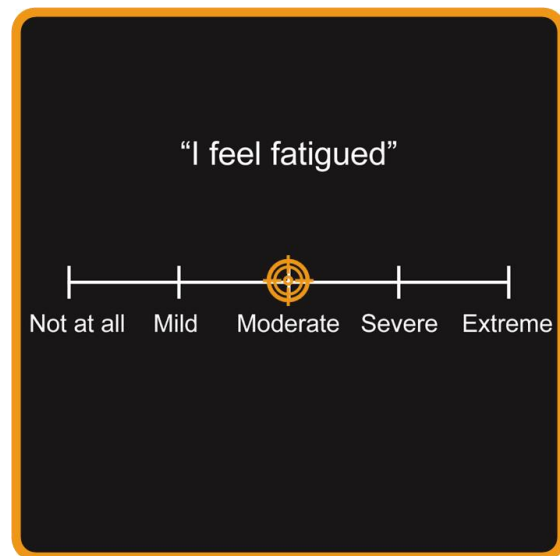
# Motor performance



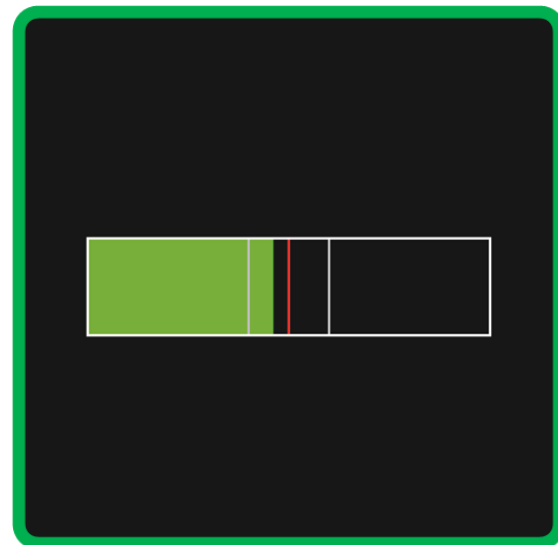


# Experimental tasks

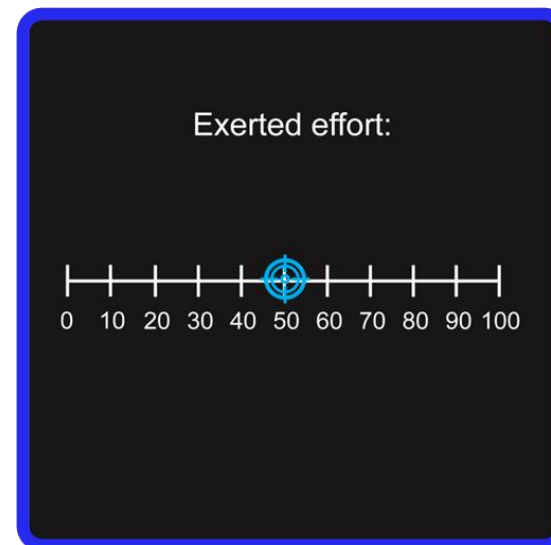
Feelings of tiredness



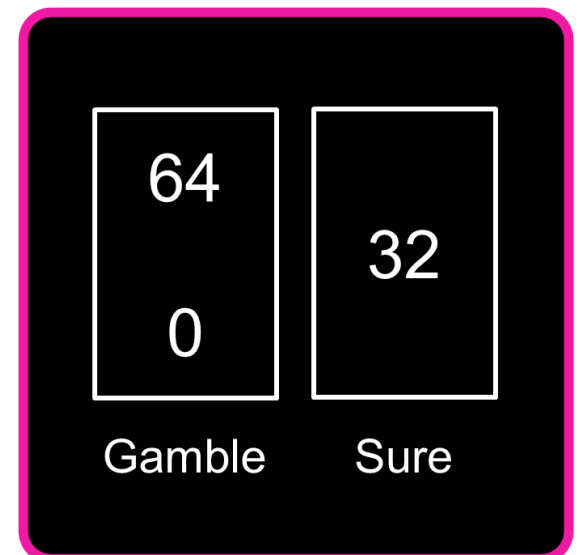
Performance



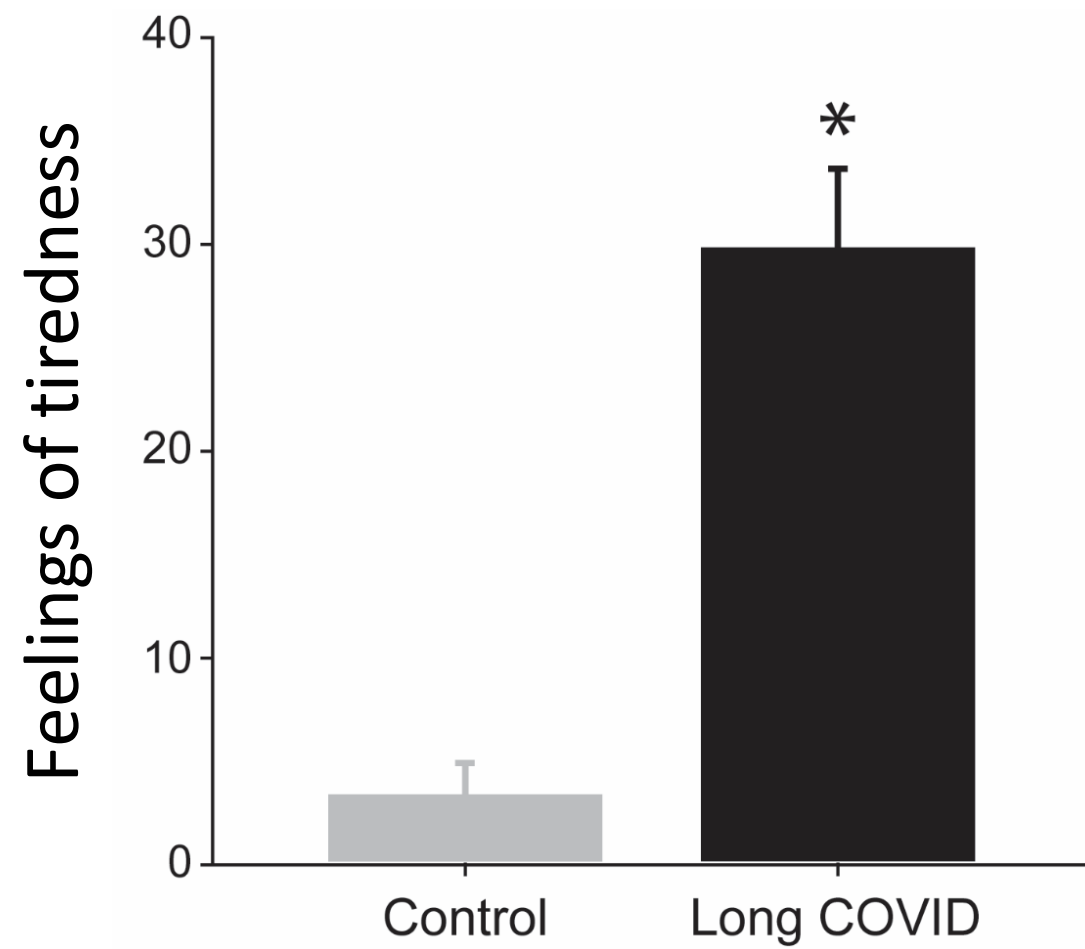
Effort Assessment



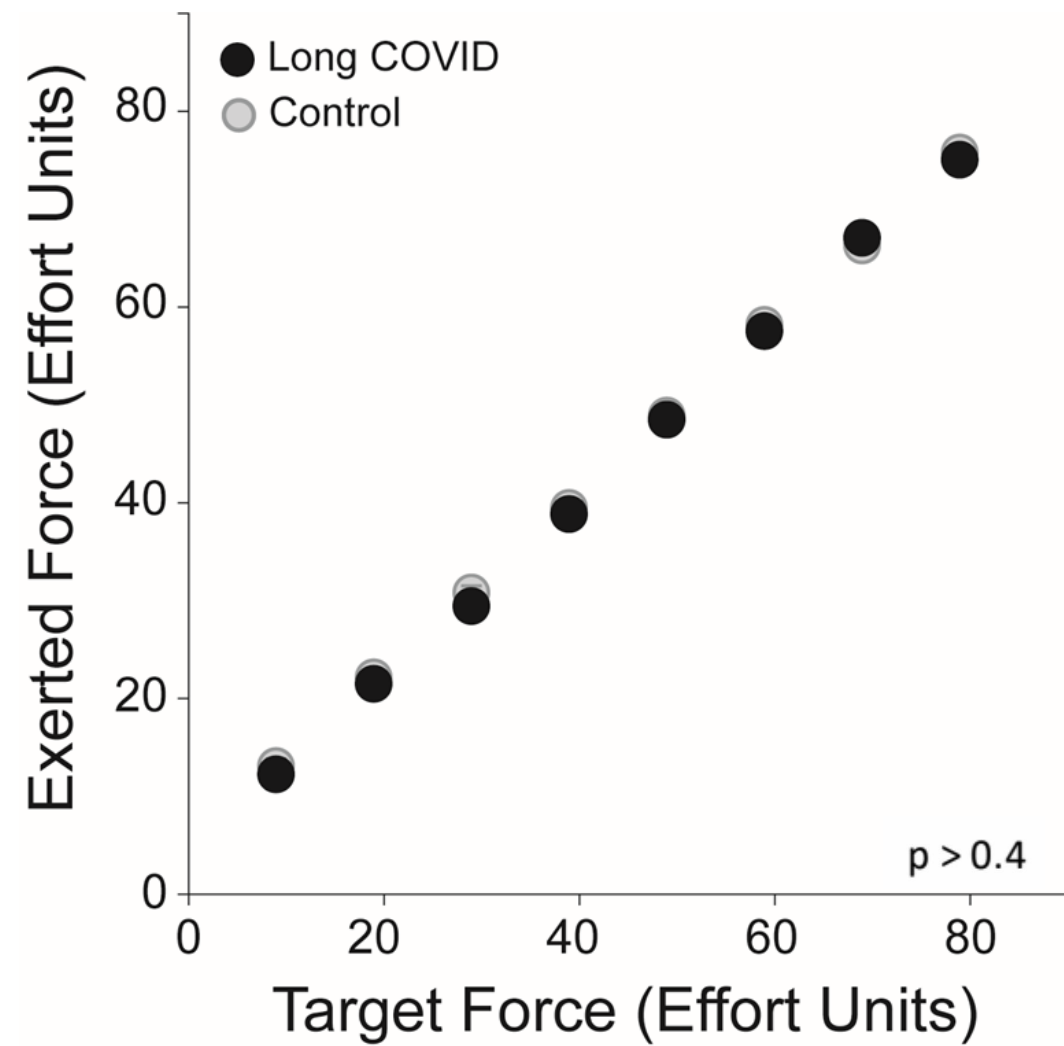
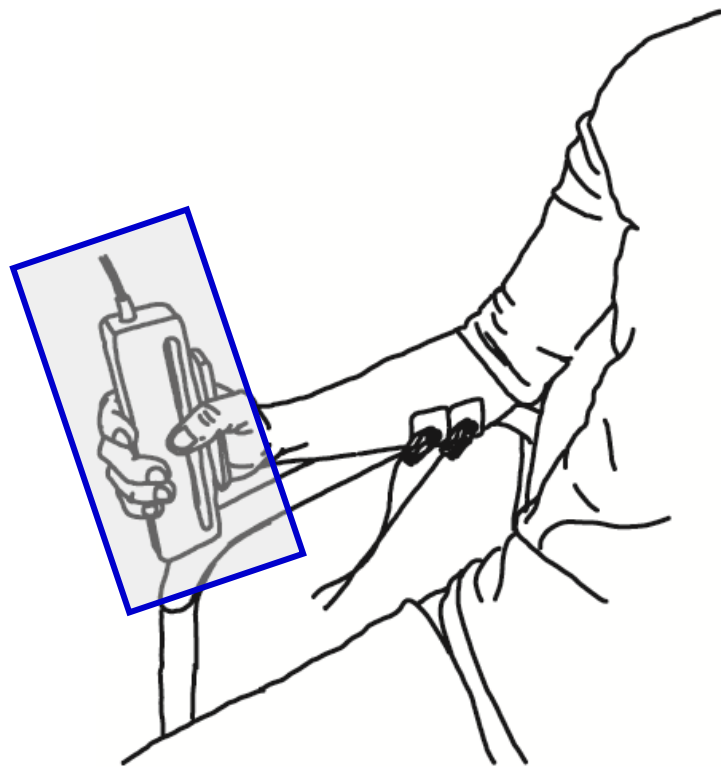
Effort-based decision-making



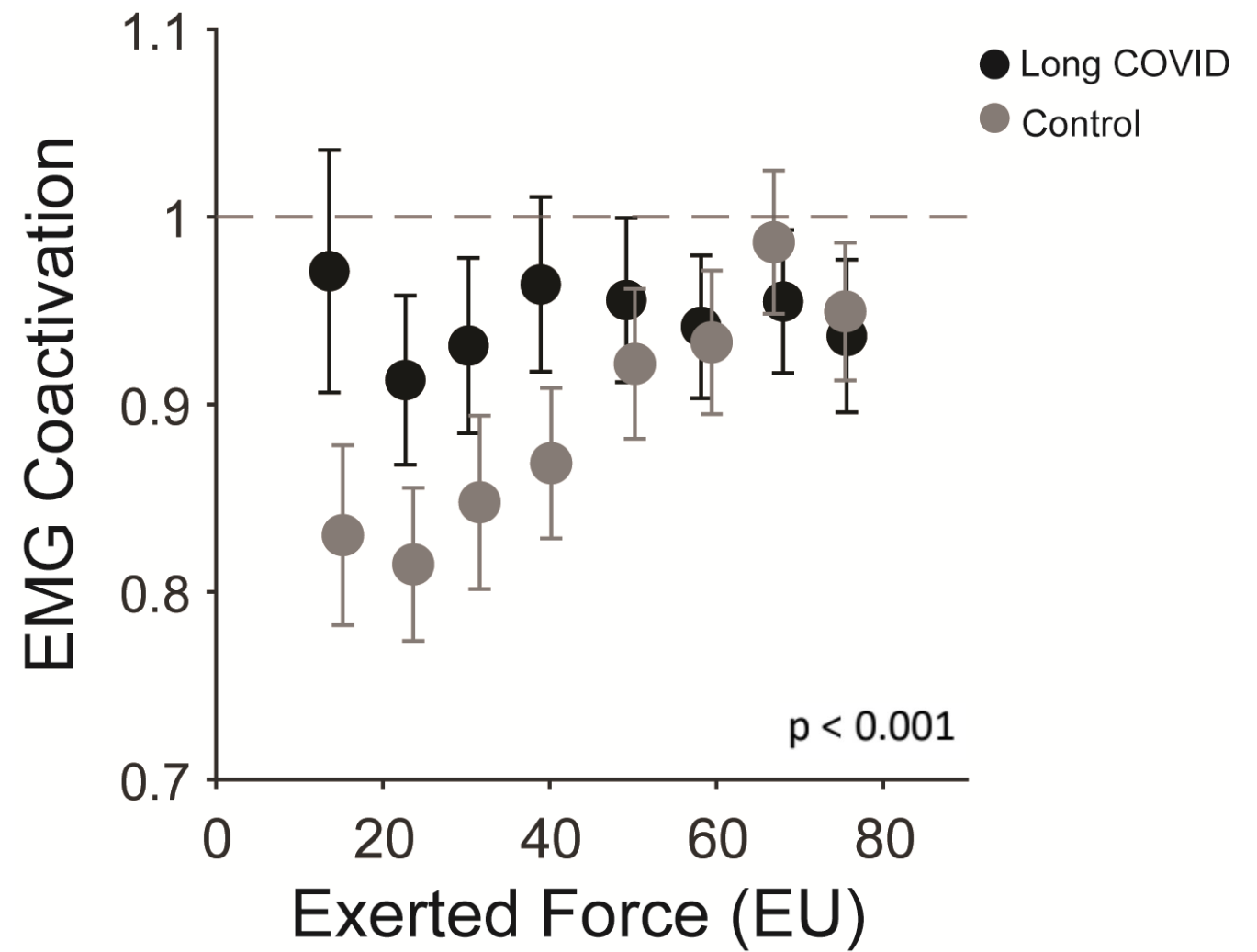
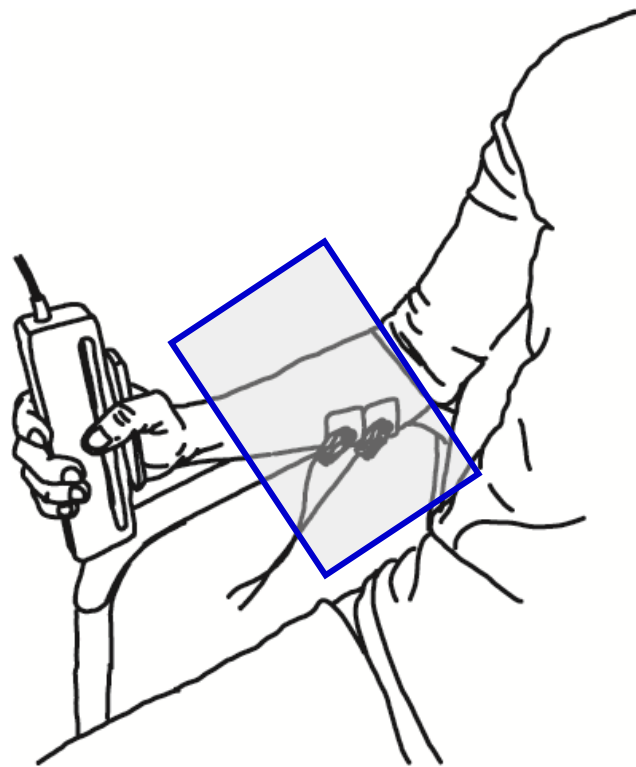
# Stronger feelings of tiredness in Long COVID



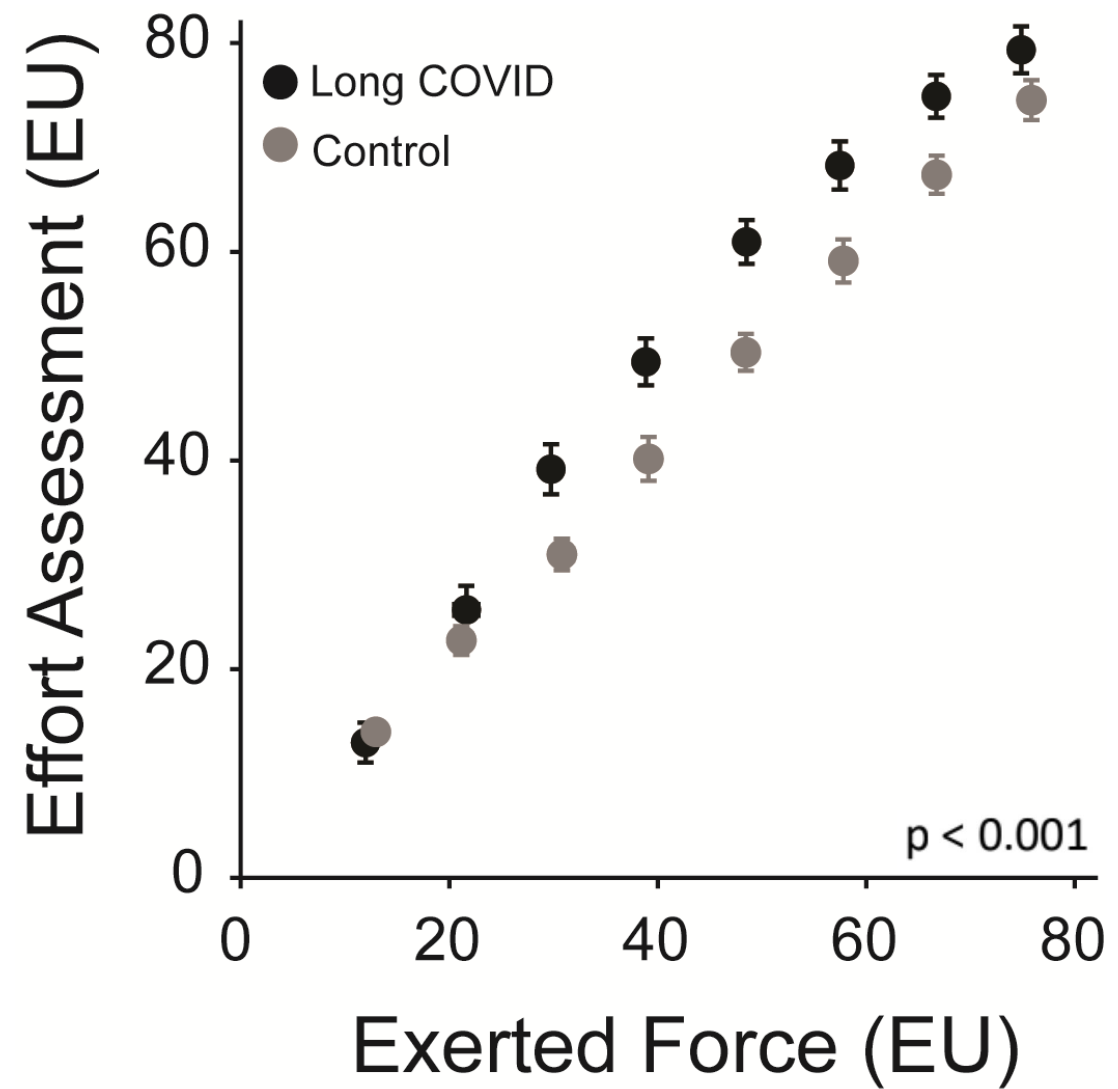
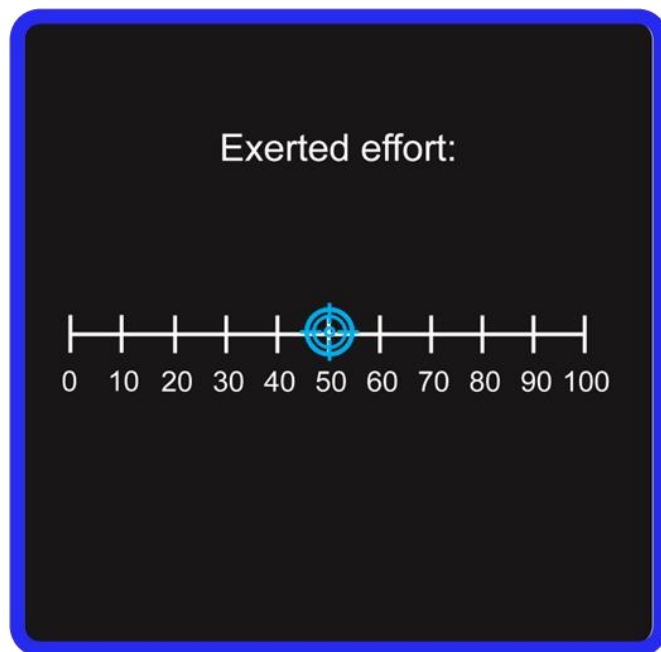
# Similar motor performance



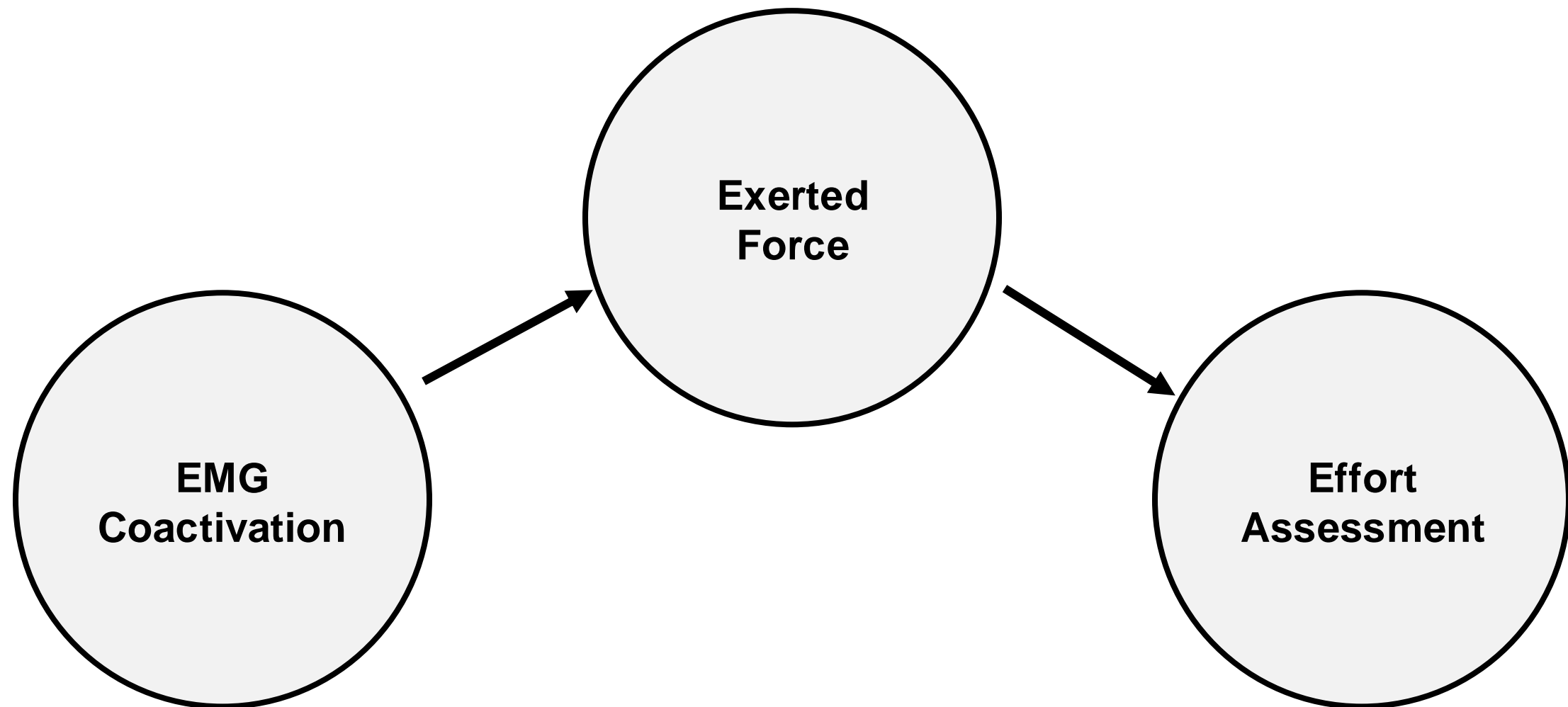
# Higher neuromuscular coactivation in Long COVID



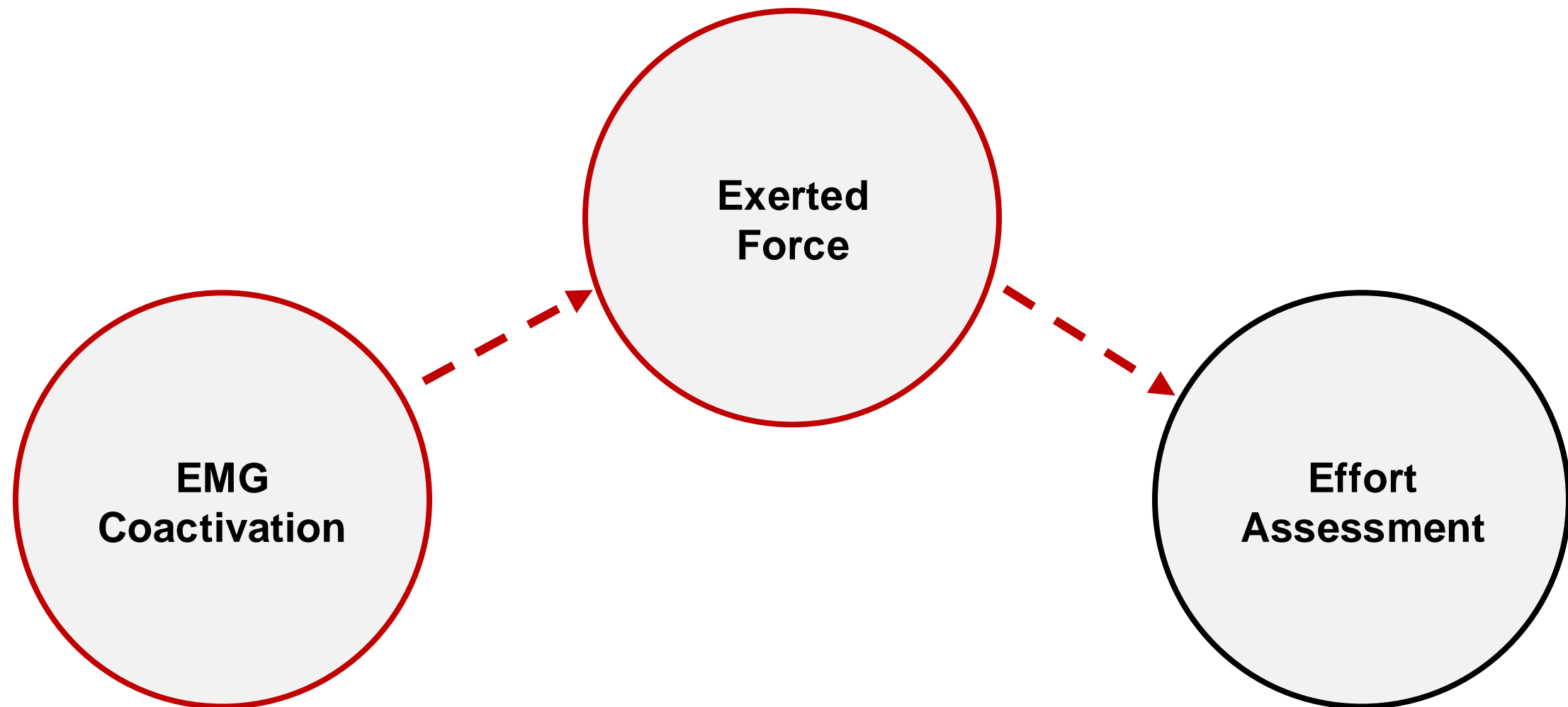
# Heightened effort assessment in Long COVID



# Relationship between neuromuscular performance and effort assessment

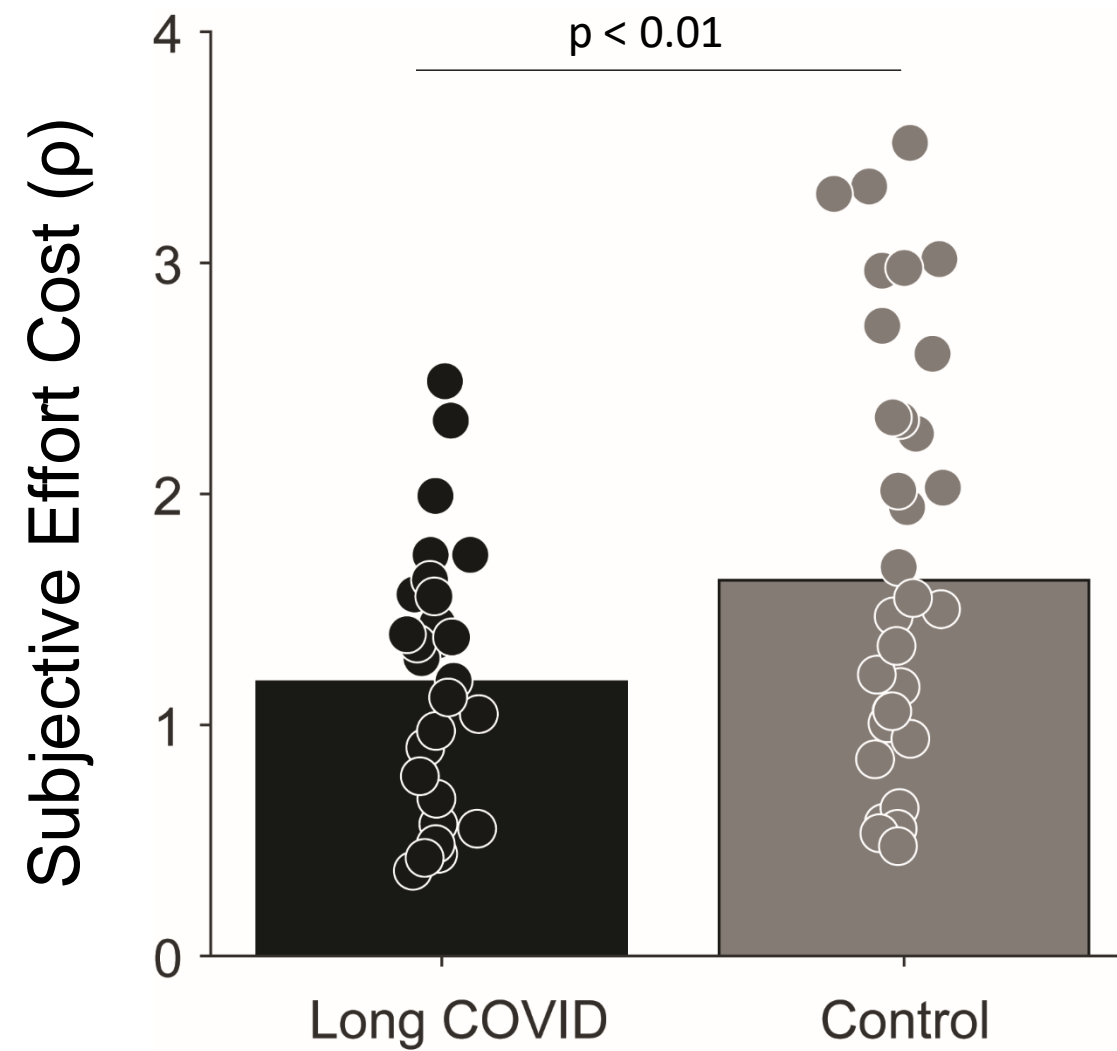
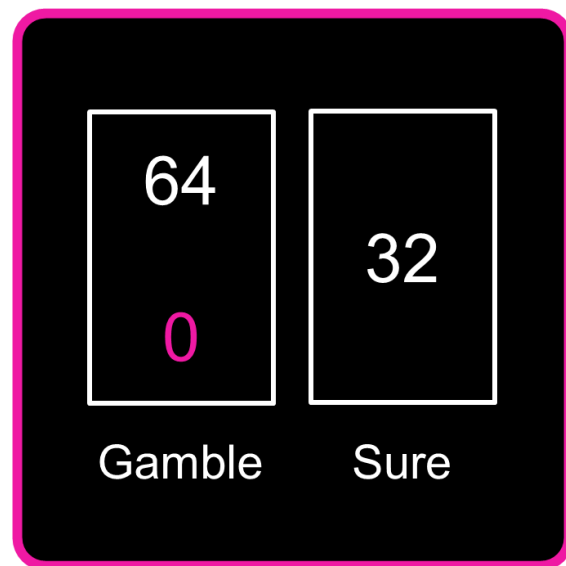


# Impaired relationship between neuromuscular performance and effort assessment in Long COVID



$p < 0.001$

# Riskier effort-based decision-making in Long COVID





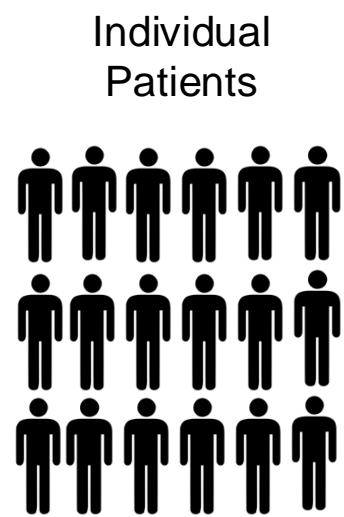
# Neural Mechanisms of Fatigue in Post-Acute Sequela of SARS-CoV-2

## R01NS140610

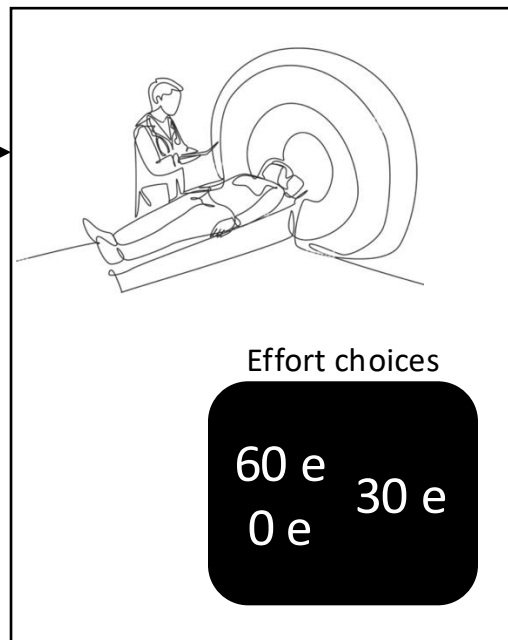
Aim 1: Determine the relationship between blood-brain barrier (BBB) permeability and neural and behavioral representations of effort assessment in individuals with long COVID suffering from fatigue.

Aim 2: Investigate how BBB permeability influences individuals with long COVID's immediate response to bouts of fatiguing exertion and the underlying neural processes.

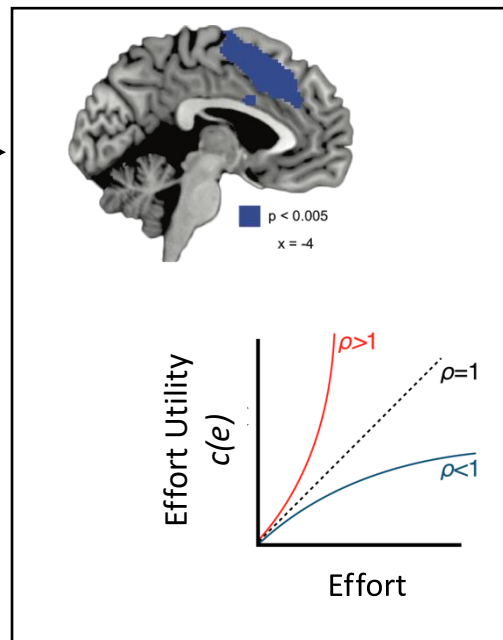
Aim 3: Evaluate how BBB permeability changes through the time course of long COVID and how these changes are related to behavioral and neural representations of fatigue.



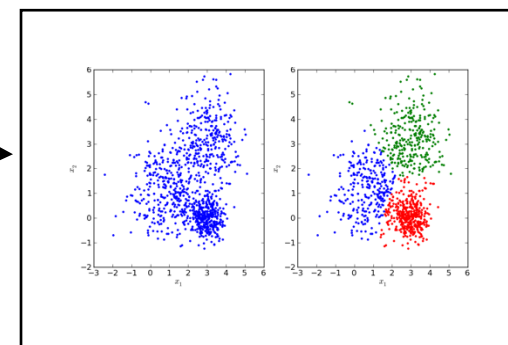
Level 1:  
Cognitive/Physiological  
battery



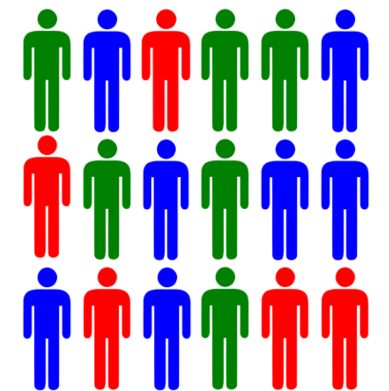
Level 2:  
Computational Modeling

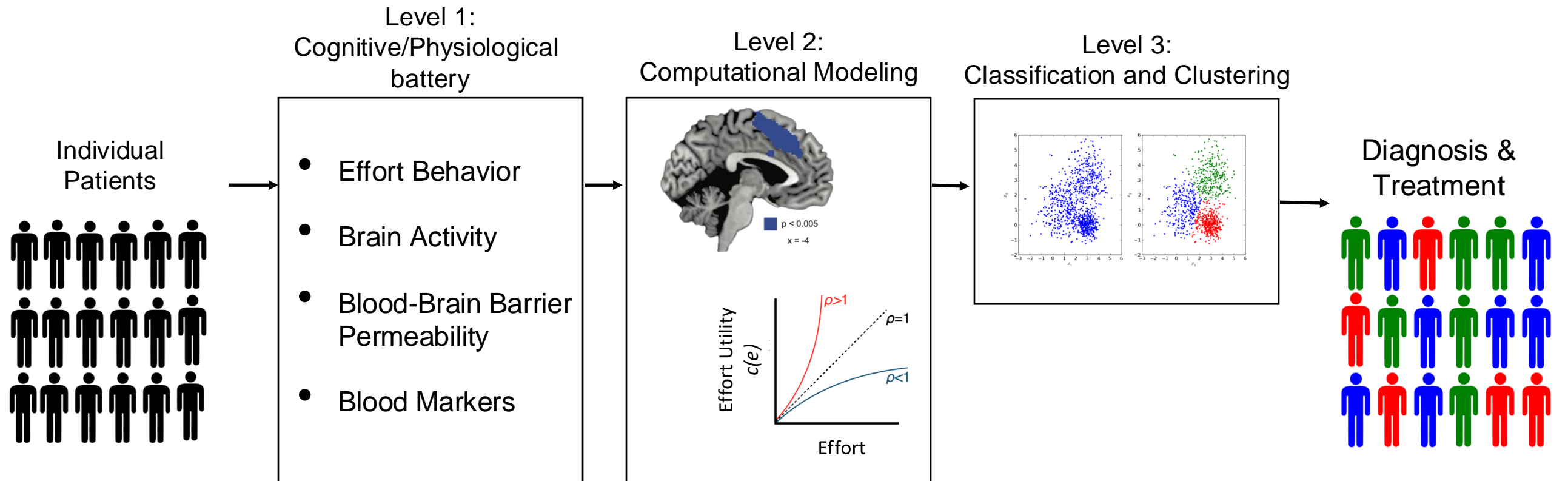


Level 3:  
Classification and Clustering



Diagnosis &  
Treatment





Questions?