Sensorimotor adaptation in Rehabilitation

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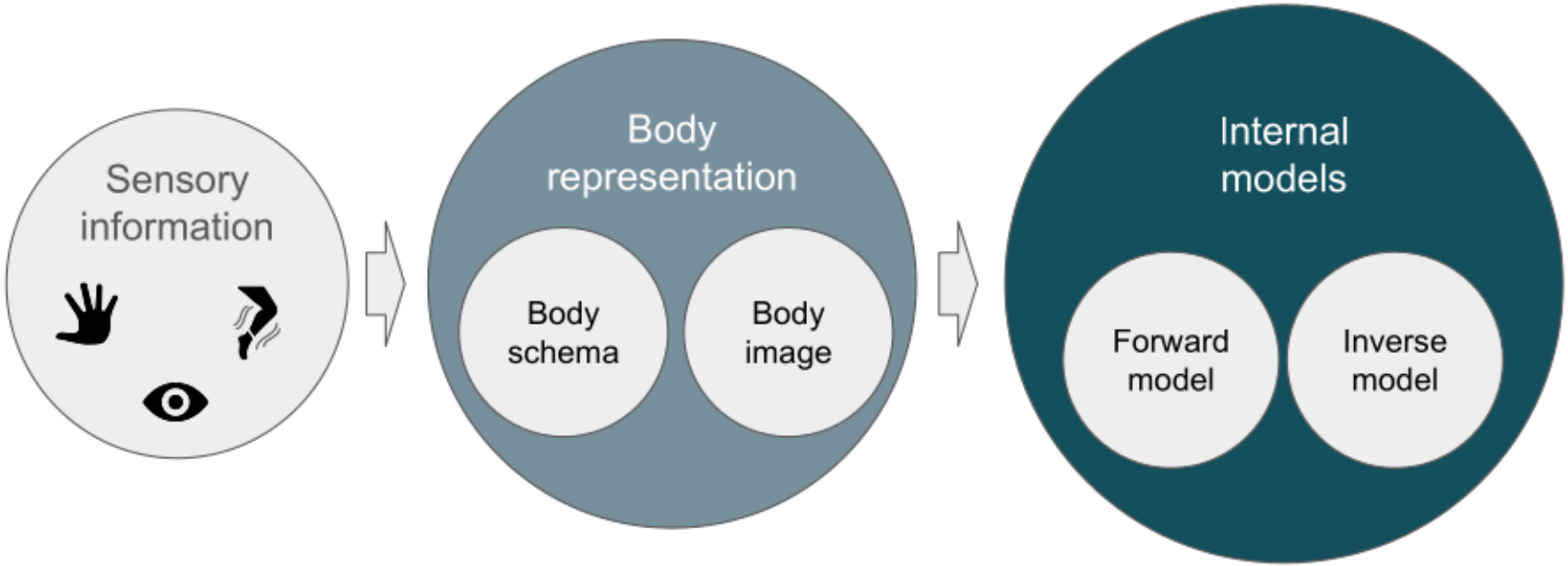
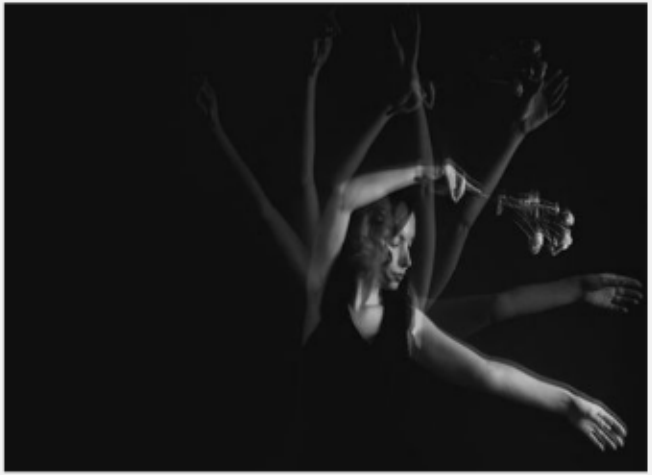
Sensorimotor control



Assaiante et al., Clinical Neurophysiology, 2013

Brain representation of human body

Body schema

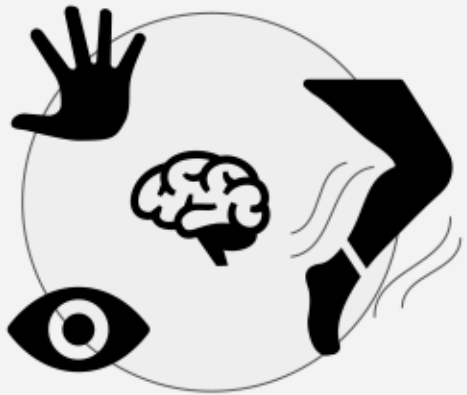


Body image

Assaiante et al., Clinical Neurophysiology, 2013

Brain representation of human body

Body schema



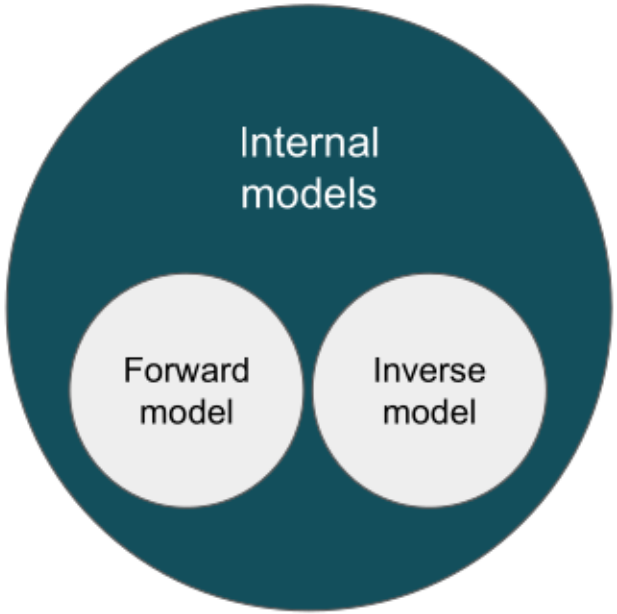
Sensorimotor integration

Body image

Mostly visual information

Pallard, Masson, 1984

Internal models for sensorimotor control



Forward model

"*uses the current state of the motor system to predict its next state*"

movement → outcome

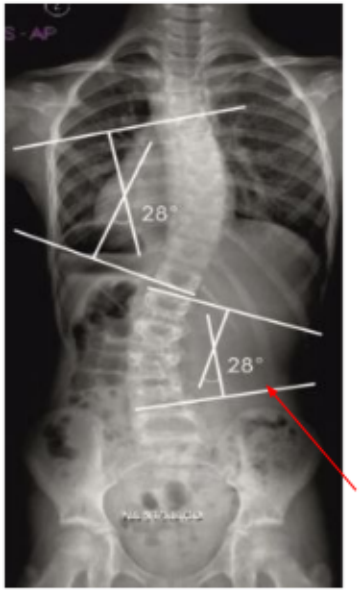
Inverse model

"*determine the motor commands necessary to achieve a desired state*"

outcome → movement

Assaiante et al., Clinical Neurophysiology, 2013; Mial and Wolper, 1996

Adolescent Idiopathic Scoliosis (AIS)



Musculoskeletal disease

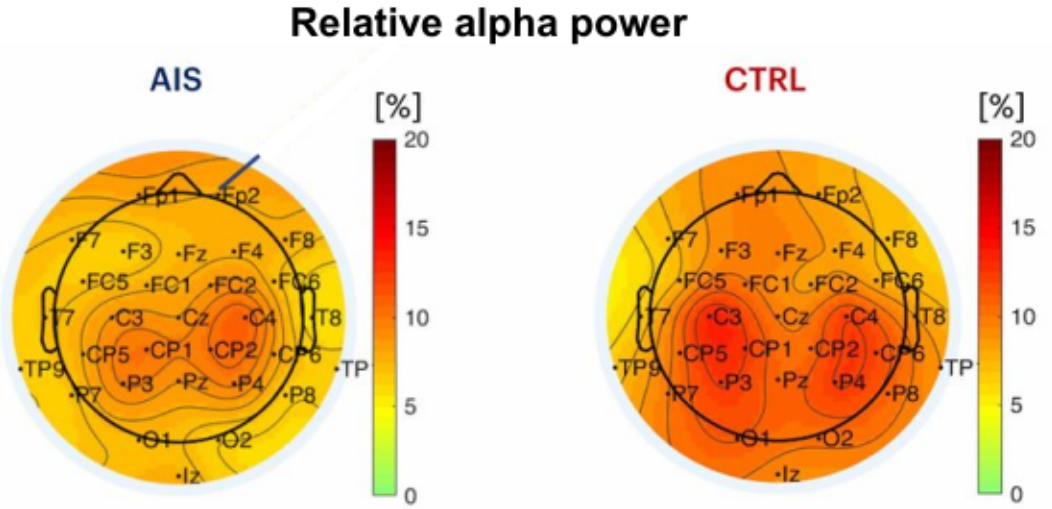
Adolescence

Alterations in body schema and body image

Sensorimotor integration in AIS

Compensatory strategy to overcoming sensorimotor dysfunction mirrored by altered body schema.

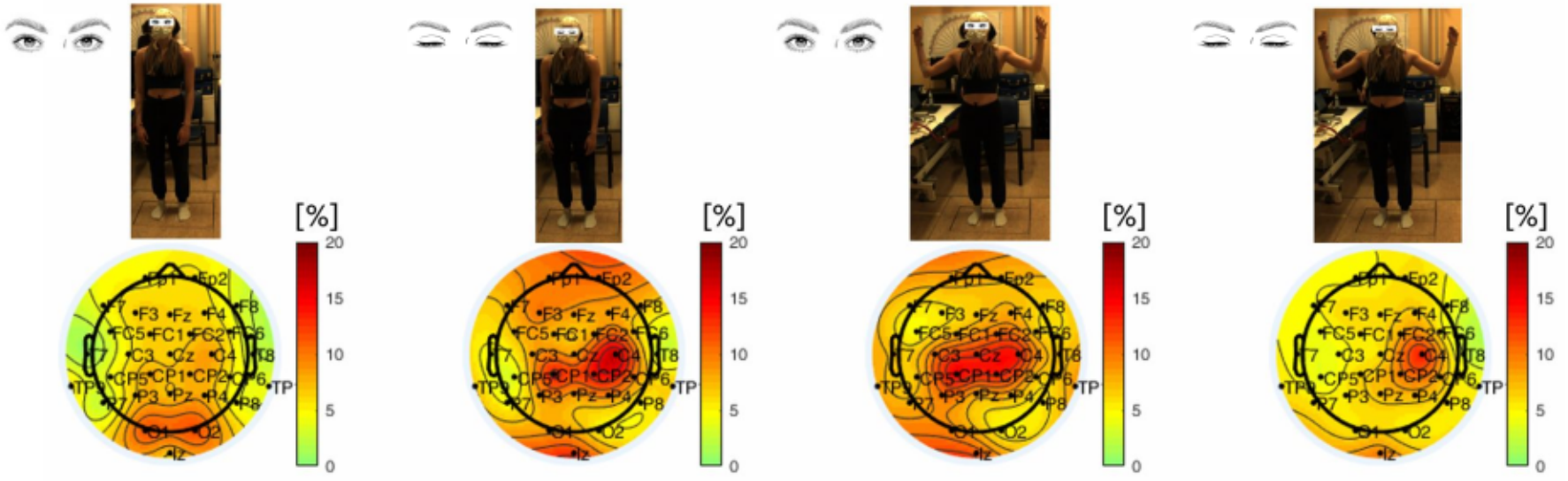
N = 28 (14 AIS, 14 CTRL)



Formaggio et al., Sci Reps, 2022

Sensorimotor integration in AIS

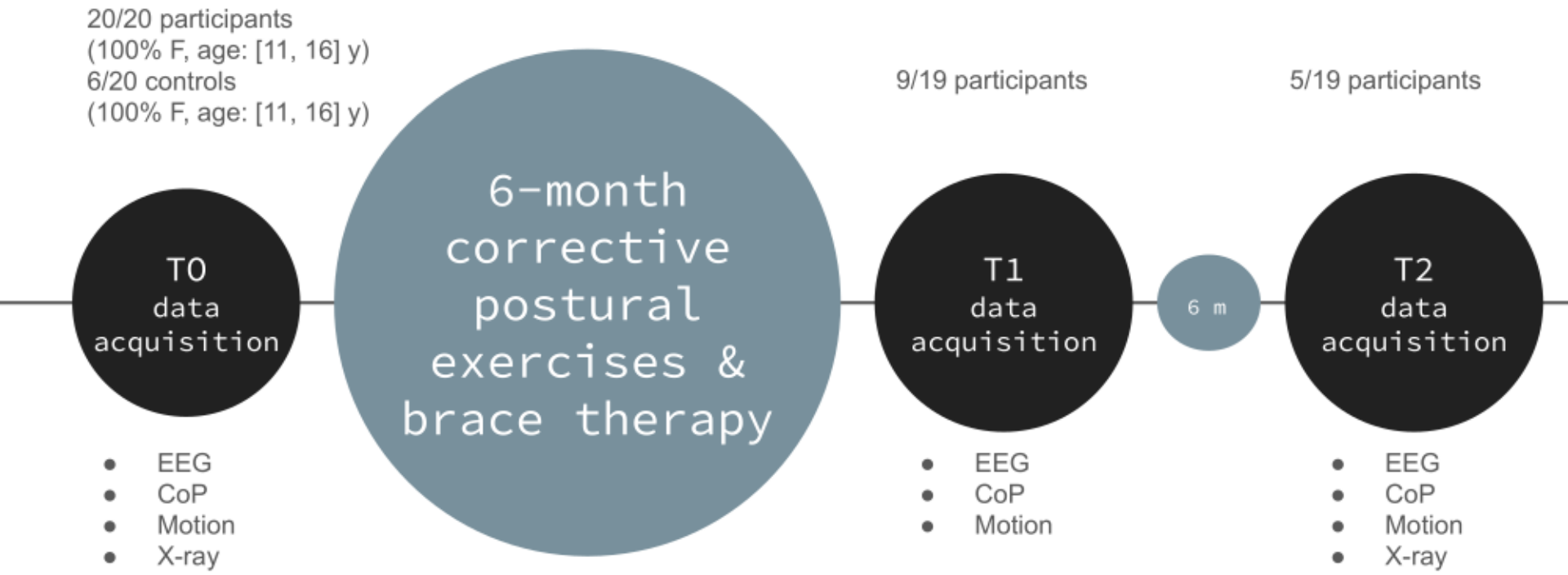
Compensatory strategy to overcoming sensorimotor dysfunction mirrored by altered body schema.



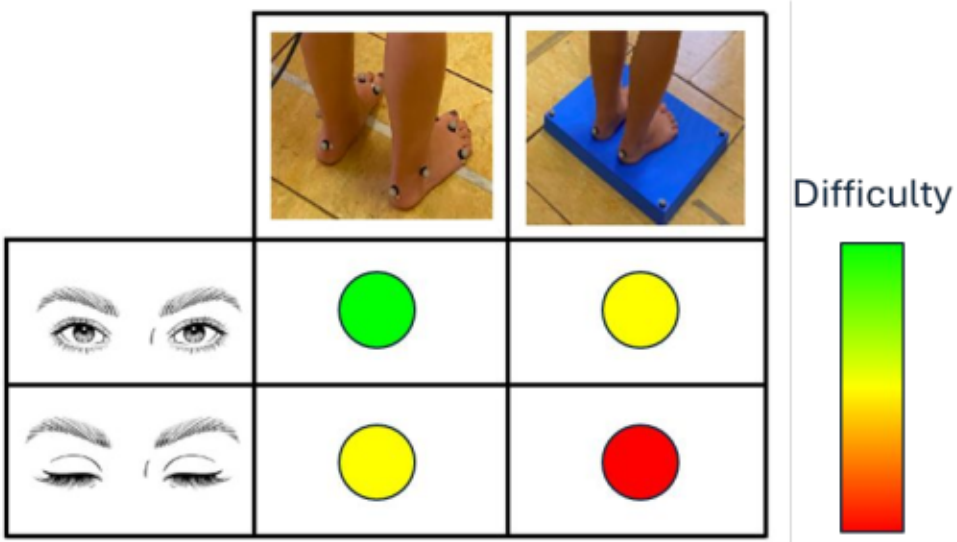
Our open questions

- Are EEG alterations in the alpha rhythm related to AIS pathophysiology or its treatment?
- Is AIS affecting the inverse model, the forward model or both?

Longitudinal assessment of body representation in AIS



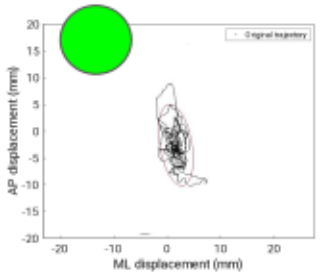
Are EEG alterations in the alpha band related to AIS pathophysiology or its treatment?

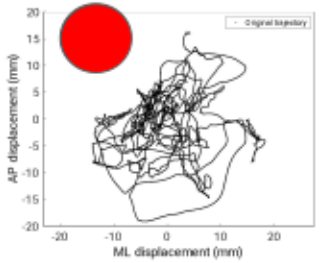


Difficulty

60 seconds per condition

CoP displacement





EEG correlates of *postural* control

frontal brain regions

central brain regions

parietal brain regions

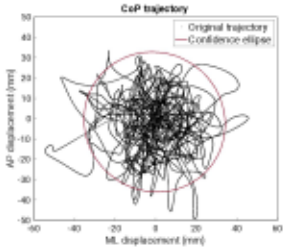
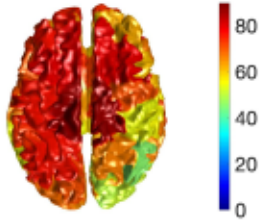
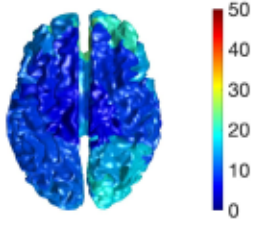
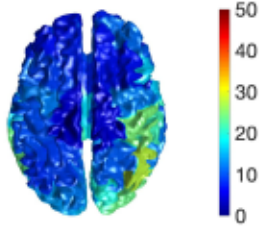
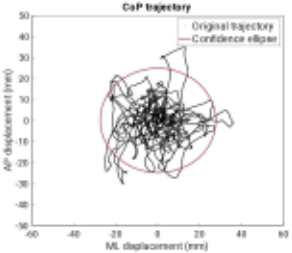
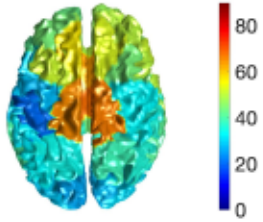
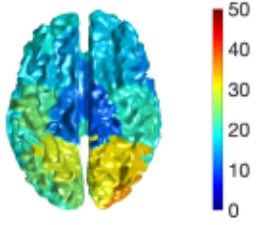
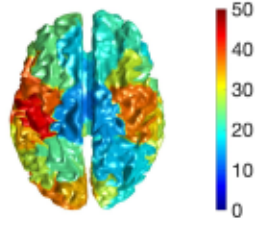
Θ increase as instability/task-difficulty increase

lower α decrease as instability/task-difficulty increase (*information processing*)

higher α decrease as instability/task-difficulty increase (*compensatory strategy*)

Gebel et al, Exp Brain Res, 2020; Edwards et al, Neurosci, 2018

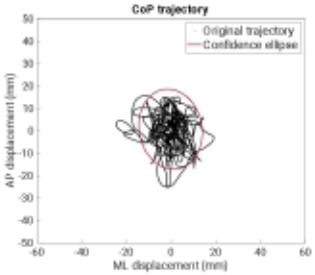
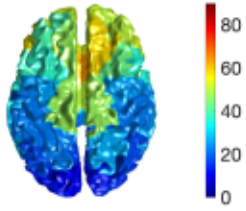
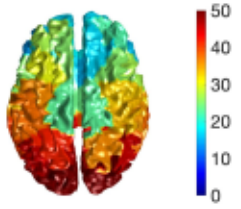
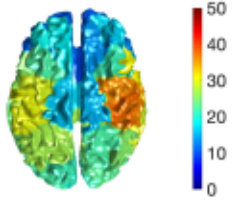
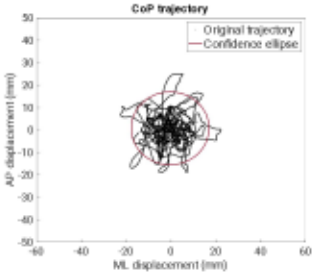
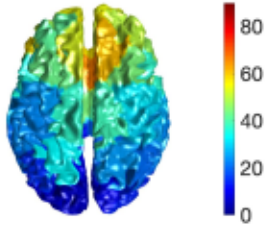
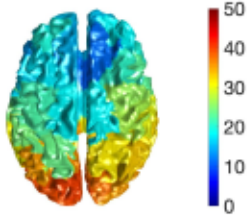
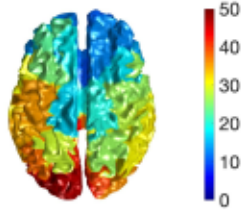
Subject with a large clinical improvement

	Cobb angle (°)	CoP	Theta [4-8 Hz]	Low Alpha [peak - 2 Hz]	High Alpha [peak + 2 Hz]
T0	 35°				
T2	 22°				

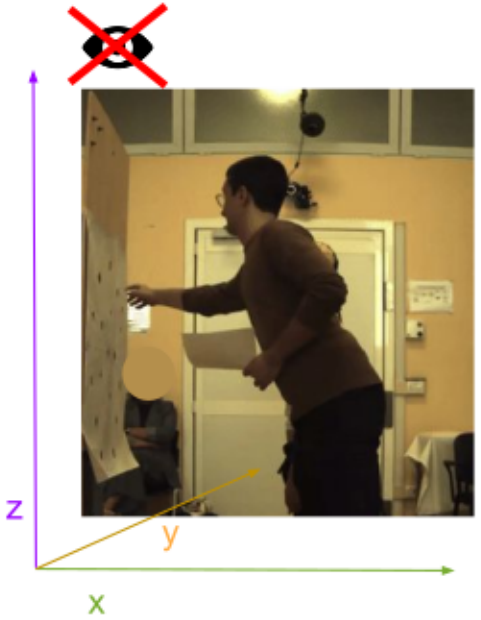
Alpha peak: 10.17 Hz

Alpha peak: 11.68 Hz

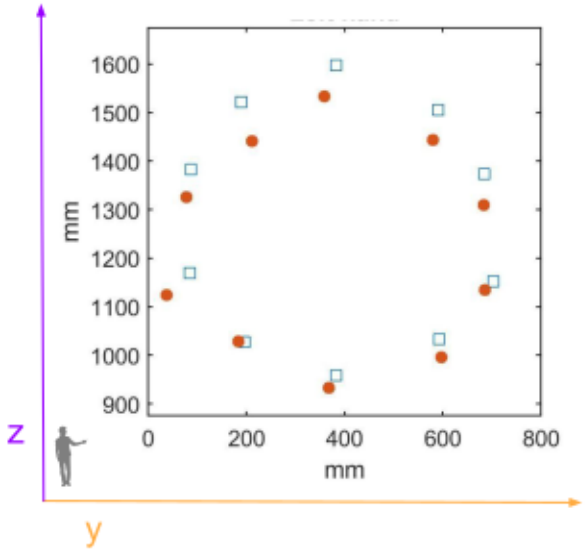
Subject with a minor clinical improvement

	Cobb angle (°)	CoP	Theta [4-8 Hz]	Low Alpha [peak - 2 Hz]	High Alpha [peak + 2 Hz]
T0	16°				
					Alpha peak: 11.66 Hz
T2	13°				
					Alpha peak: 11.50 Hz

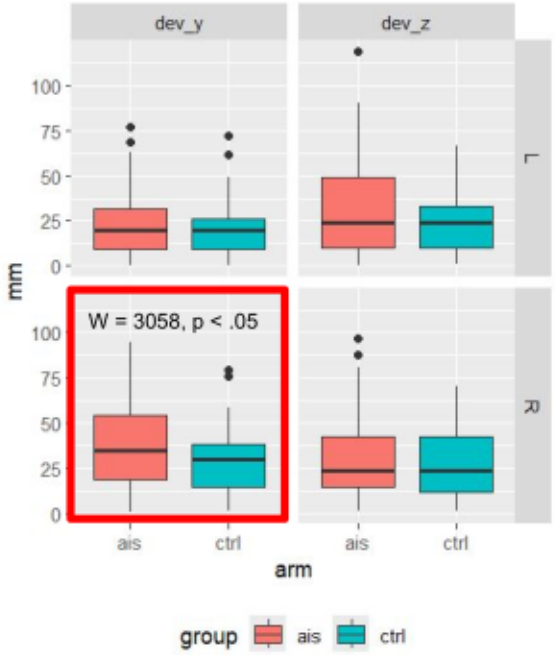
Is AIS affecting the inverse model, the forward model or both?



10 trials for each arm (L and R)

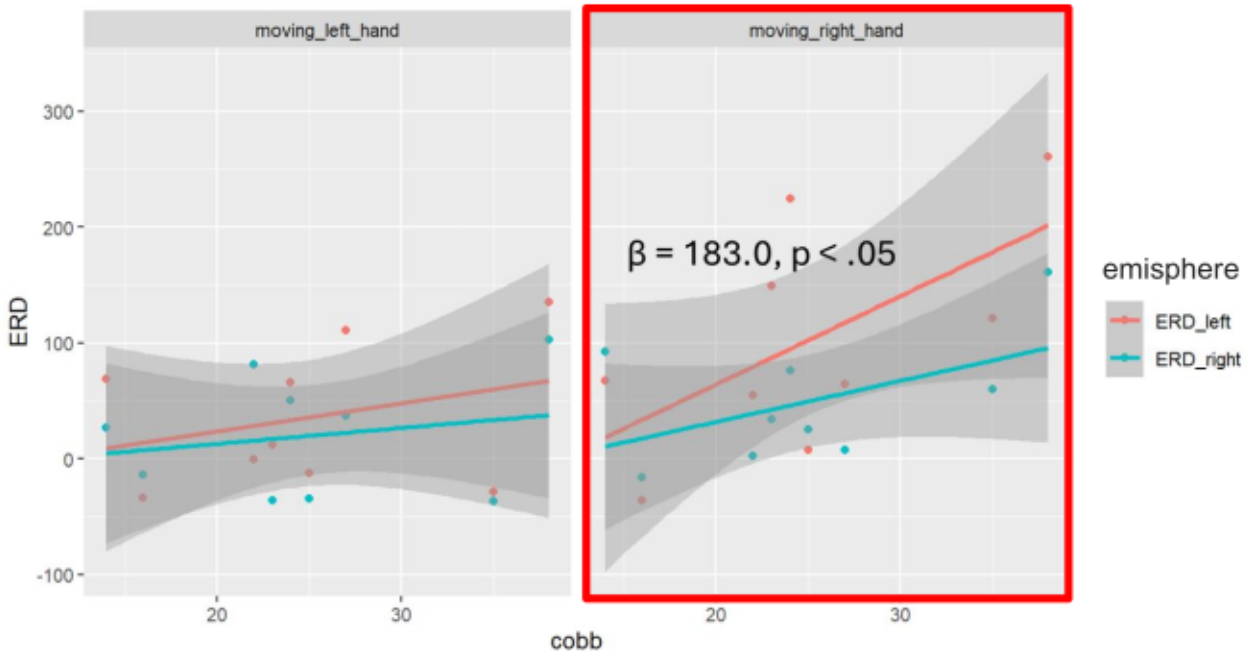


target touch point

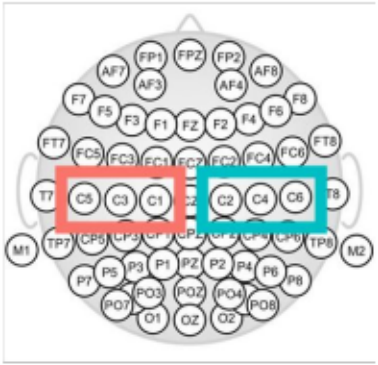


group ais ctrl

Alpha power increase with AIS severity



Spinal curvature modulates brain activity during right arm movements



Preliminary answers

- Are EEG alterations in the alpha rhythm related to AIS pathophysiology or its treatment?

A major clinical improvement is associated with major differences in cortical activity in theta and alpha band as well as postural improvement.

- Is AIS affecting the inverse model, the forward model or both?

It seems to affect in the inverse model. Future research will clarify the effect of AIS on the forward model.

NEURO MOVE REHAB

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