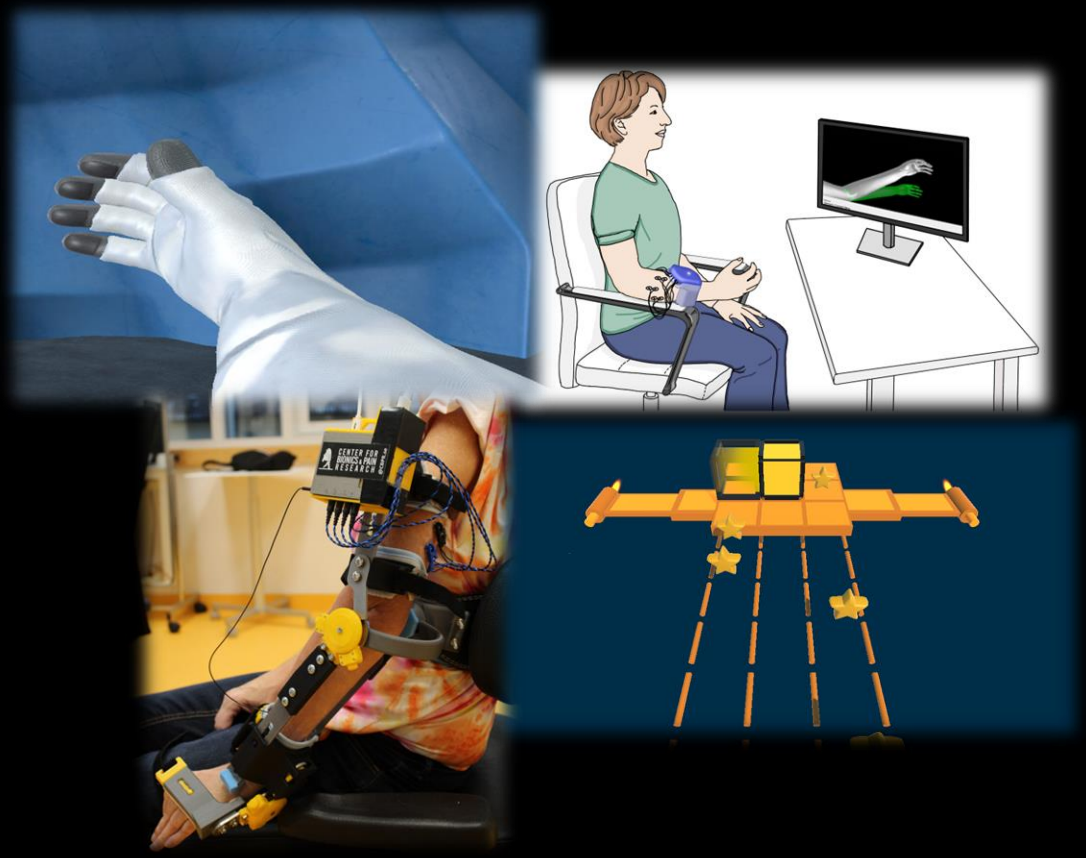
Using bioelectric signals and virtual reality to enable rehabilitation in the highly impaired



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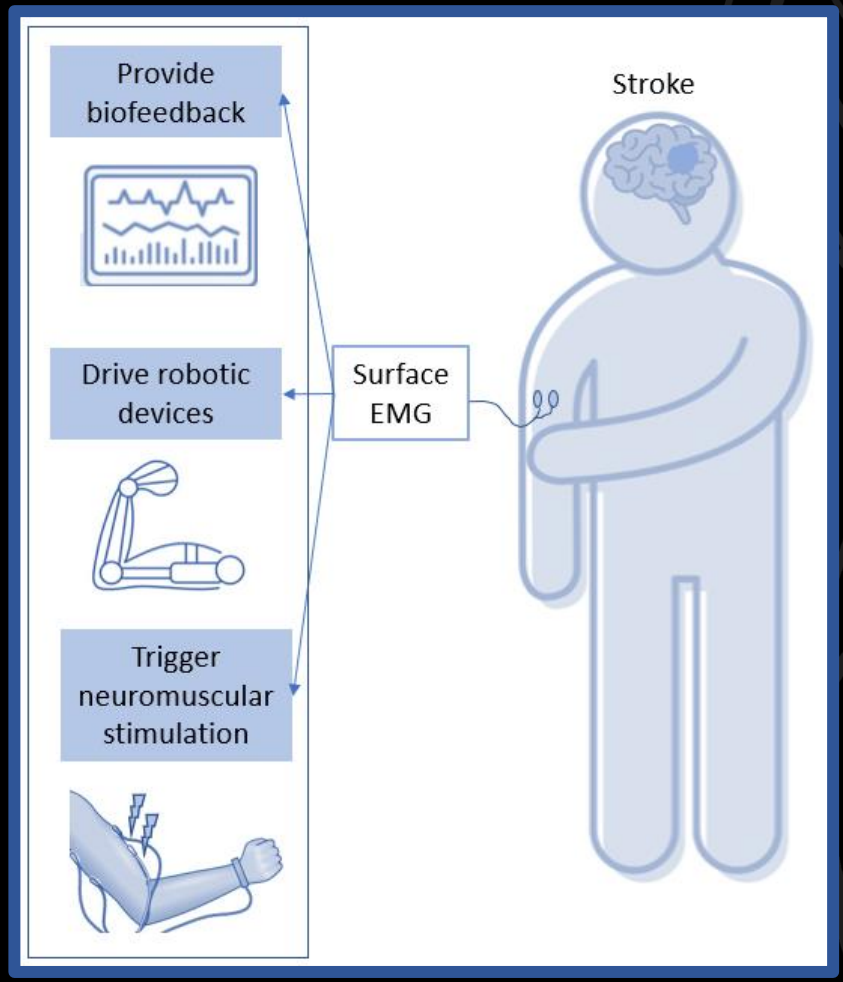
Stroke rehabilitation using Electromyography (EMG)

Maria Munoz-Novoa

- Also known as myoelectric signals
- Use of EMG in stroke rehabilitation
- Systematic review and meta-analysis



Munoz-Novoa *et al.*, Front. In Hum. Neurosci., 2022

Myoelectric Pattern Recognition (MPR)

- Use of pattern recognition (AI) to decode the intended movement from the myoelectric signals
- Used for decades in prosthetics research

Works in the absence of movement

Kristoffersen, 2021

Myoelectric pattern recognition with virtual reality and serious gaming to improve upper limb functioning in chronic stroke: A single case design study

Maria Munoz-Novoa

Six chronic stroke patients
Low upper limb function

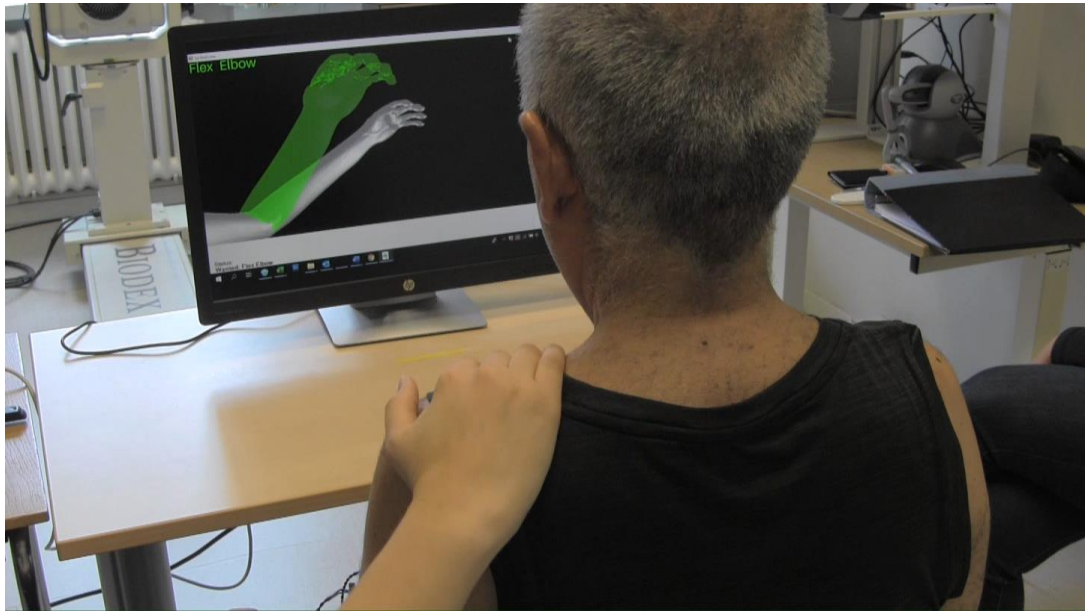
Training:

- 18 sessions (A-B-A study design)
- 3 times per week
- 2 weeks assessments pre-post training

Munoz-Novoa *et al.*, in preparation

Training

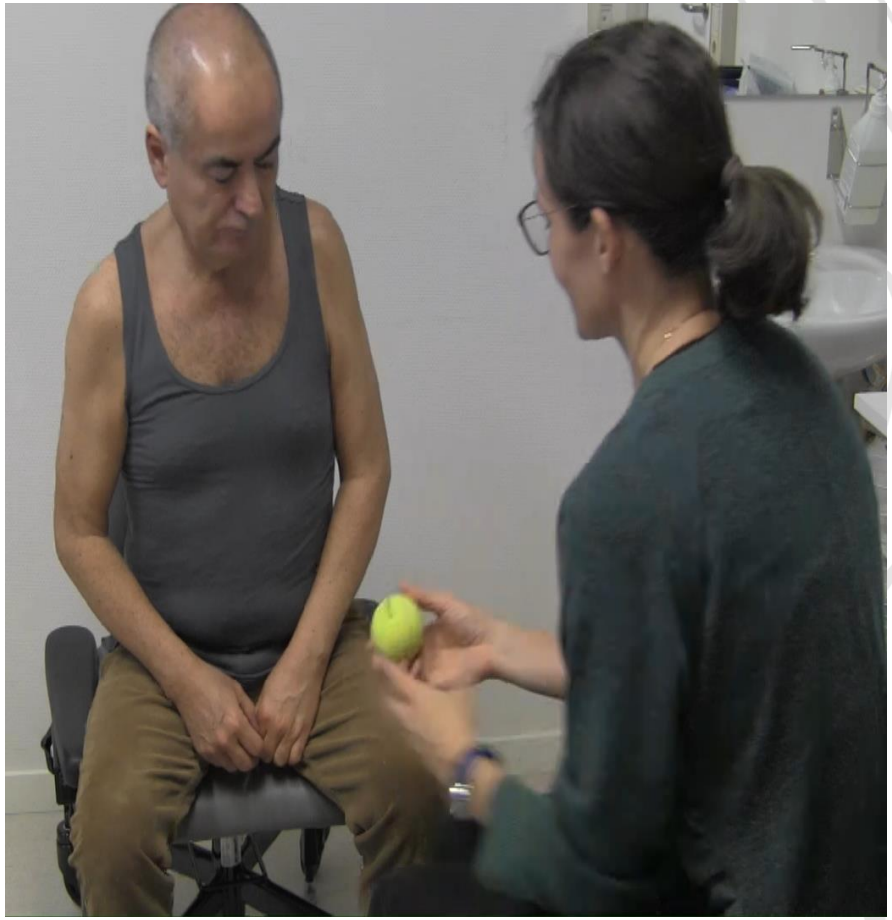
Maria
Munoz-Novoa



Results

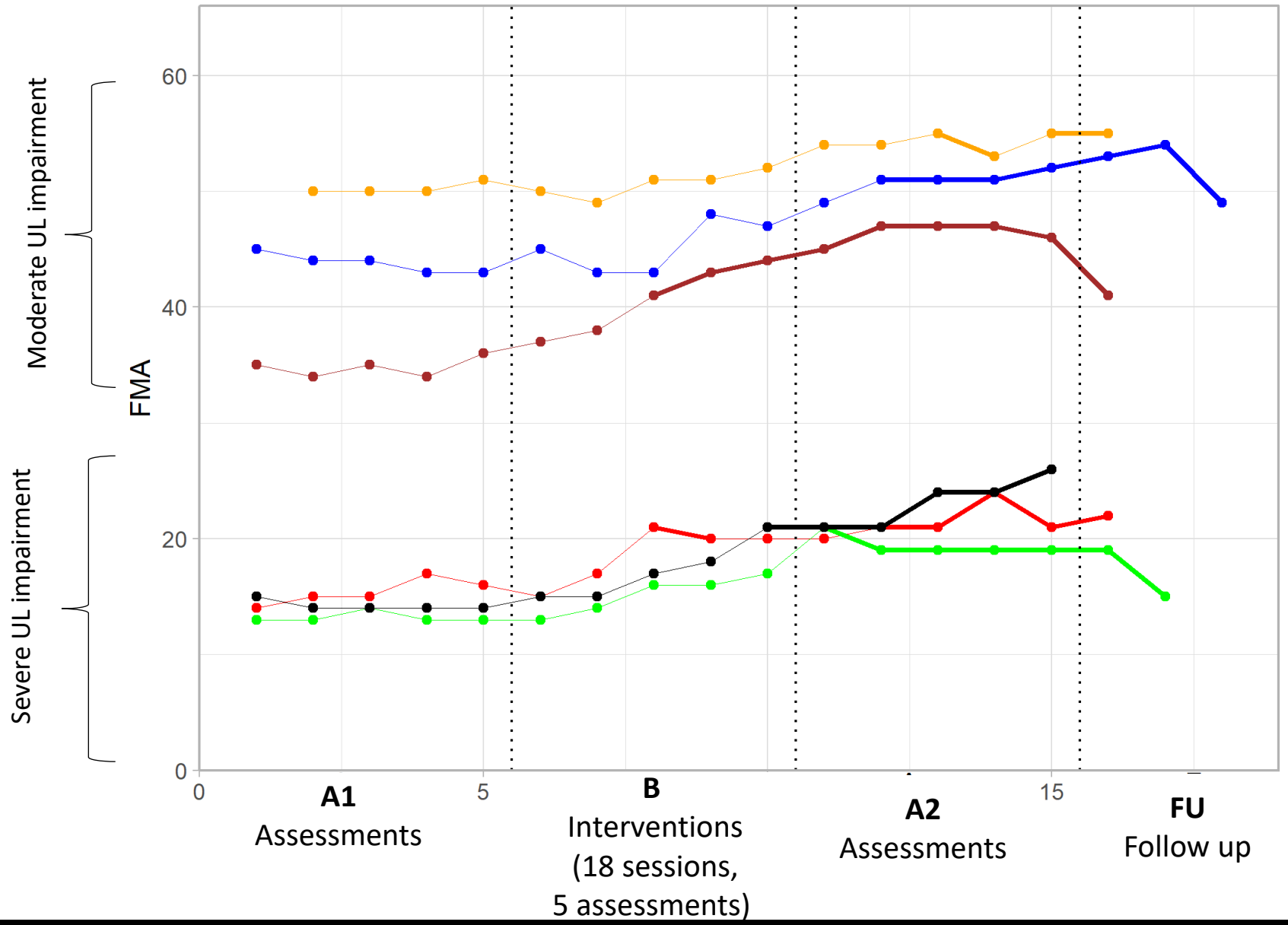
Before training

After training



Results

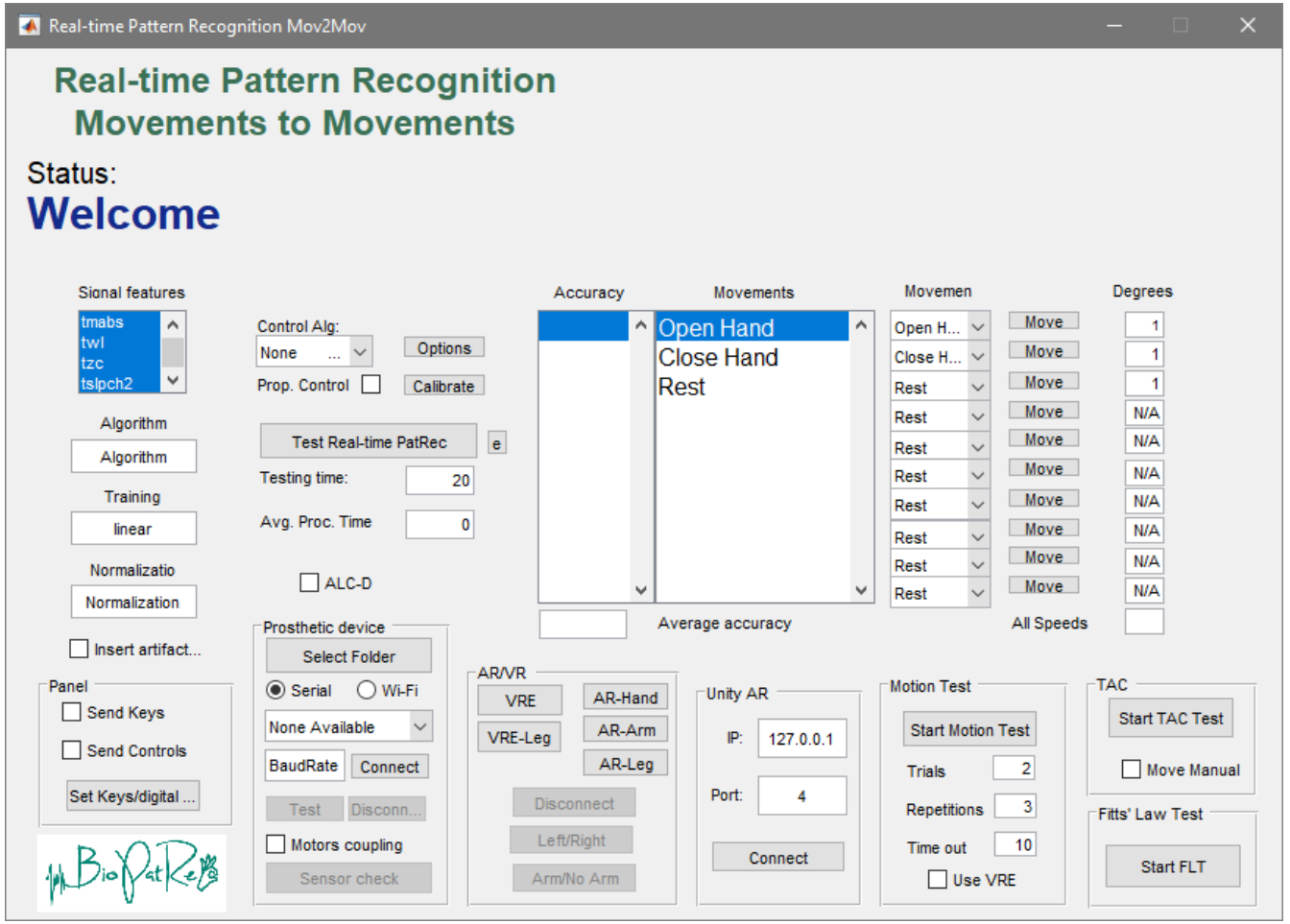
FMA-UE Score



minimal clinical important difference (MCID) 4.25

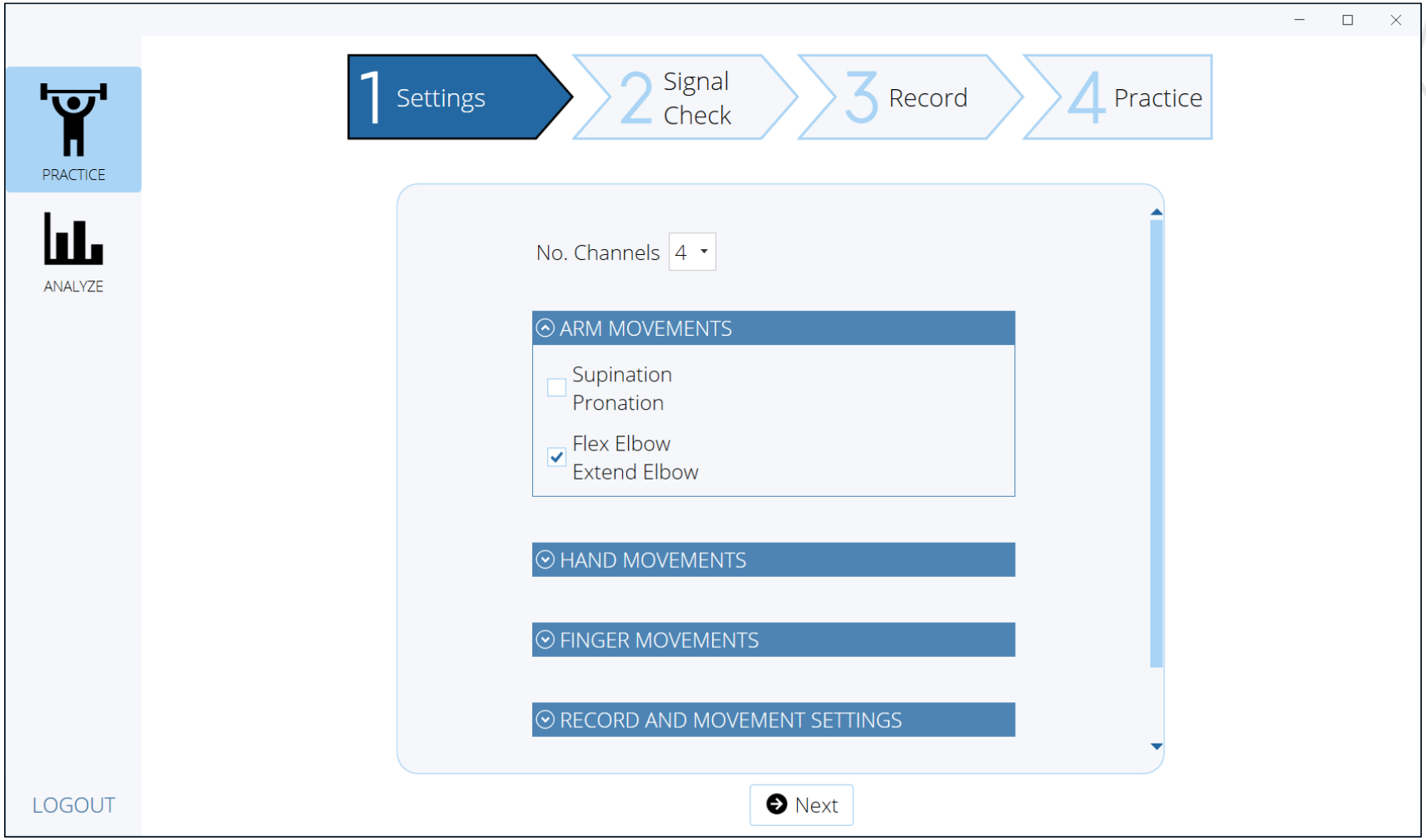
Clinical translation

BioPatRec



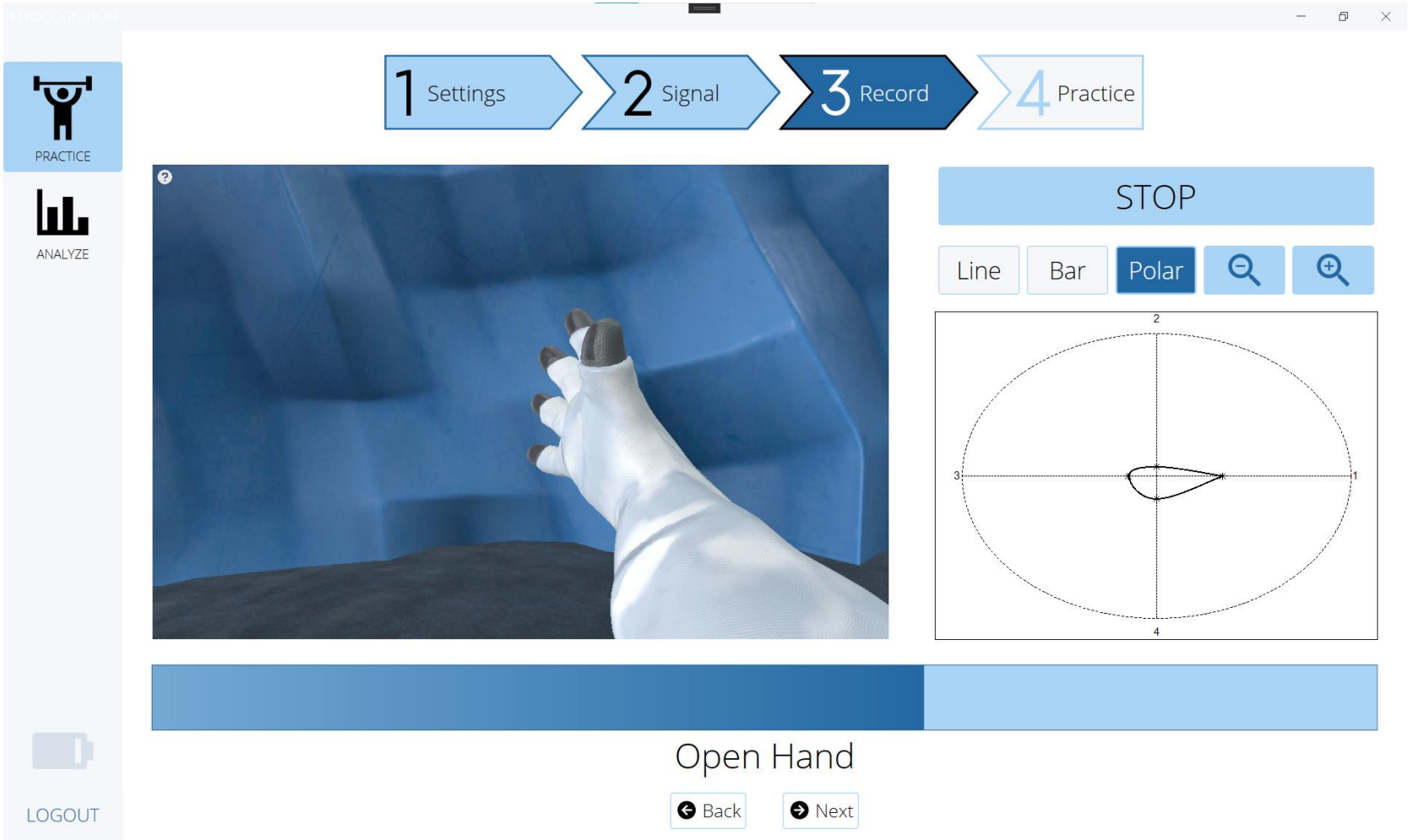
Ortiz-Catalan *et al.*, Source Code Biol Med, 2013

MyoCognition



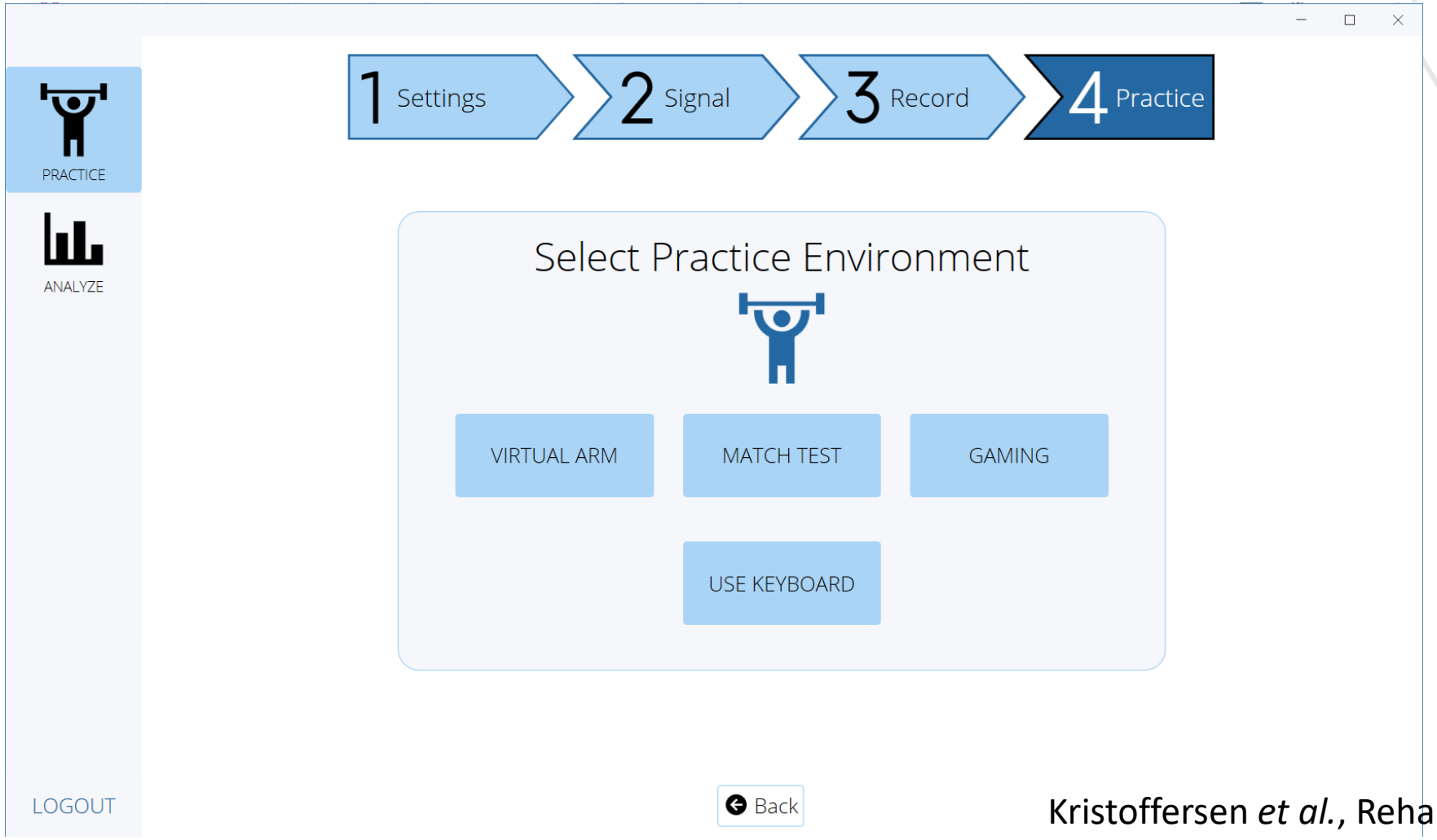
Kristoffersen *et al.*, Rehabweek (ISVR), 2022

MyoCognition



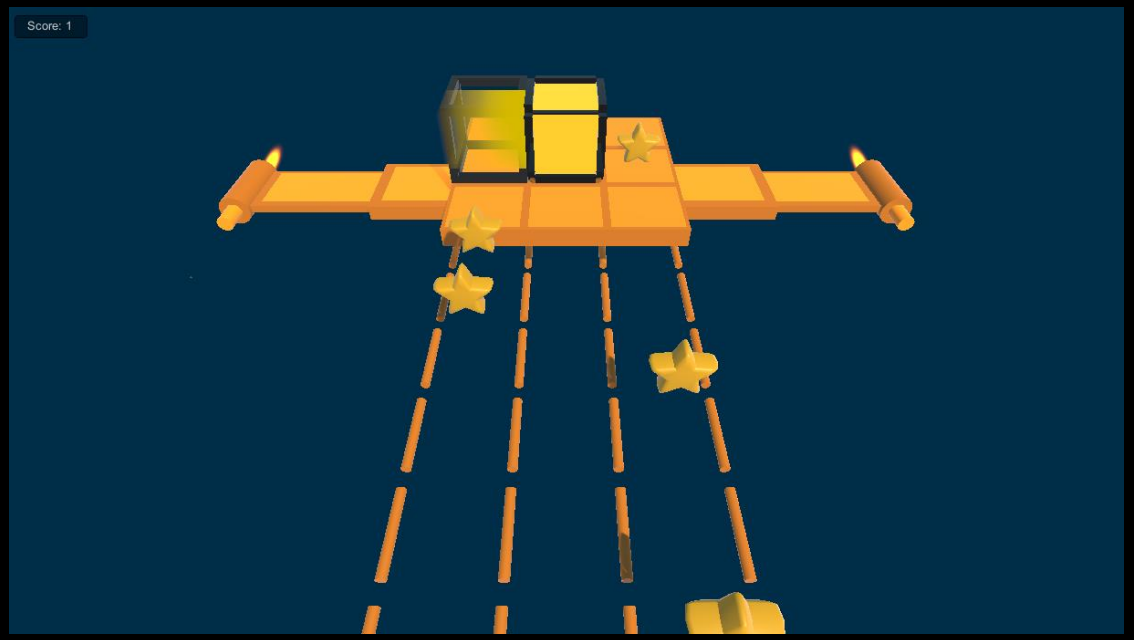
Kristoffersen *et al.*, Rehabweek (ISVR), 2022

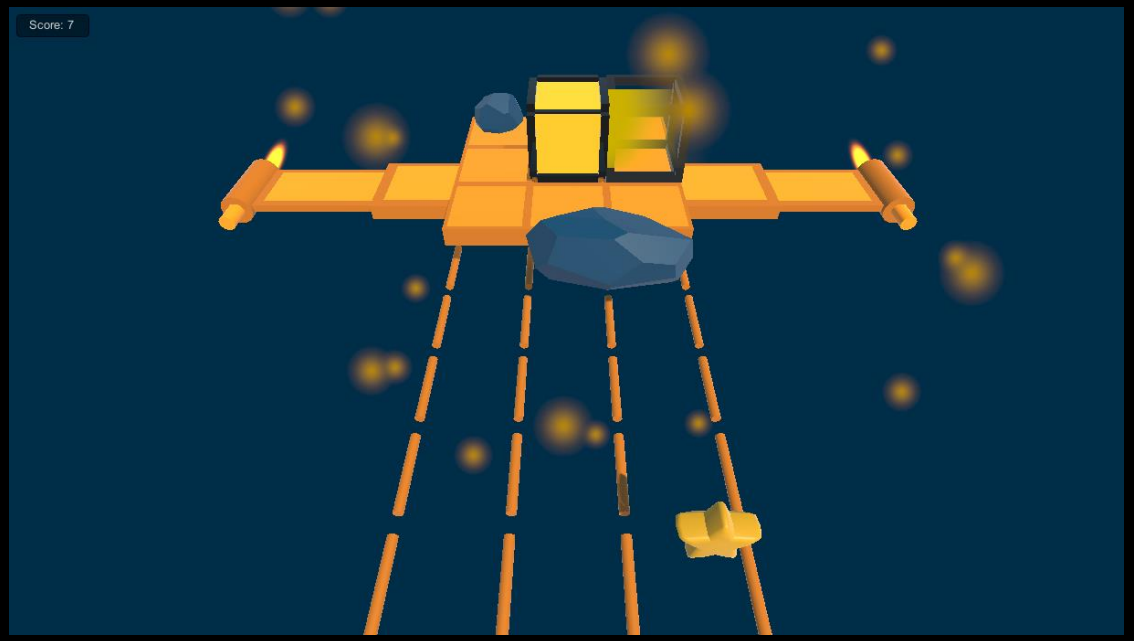
MyoCognition



Kristoffersen *et al.*, Rehabweek (ISVR), 2022

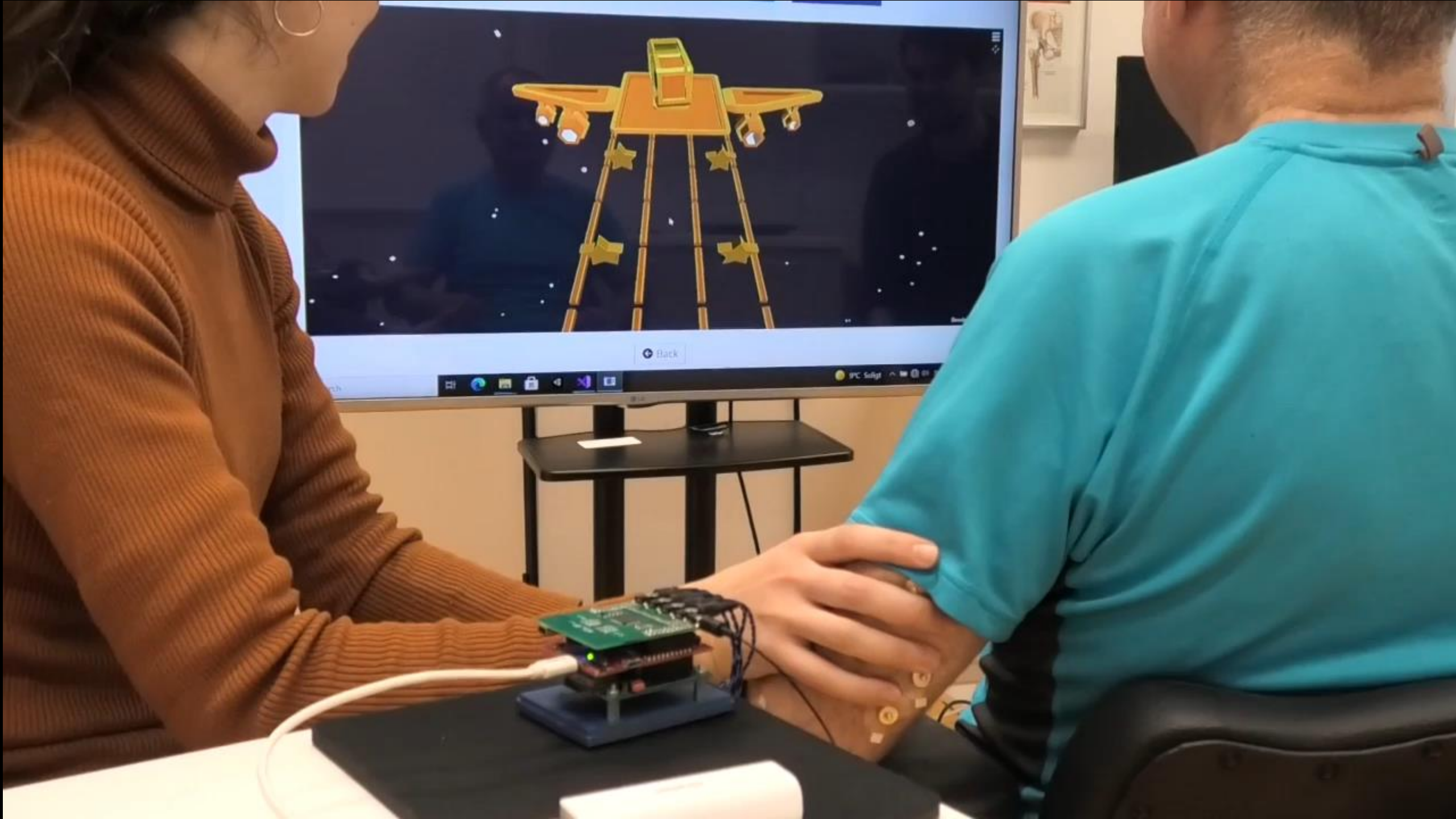
Serious games

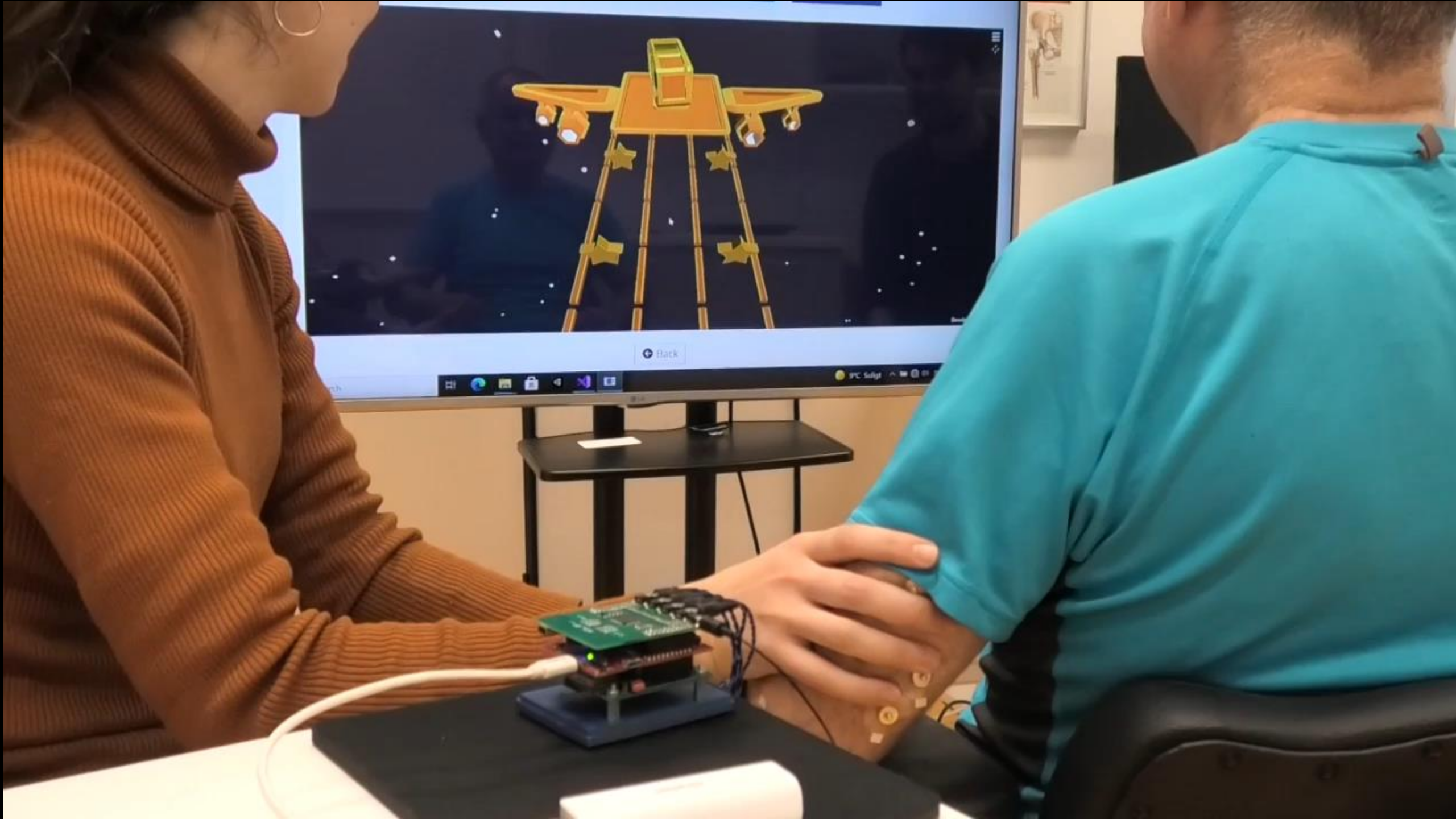




Niklas Möller

Kristoffersen *et al.*, Rehabweek (ISVR), 2022

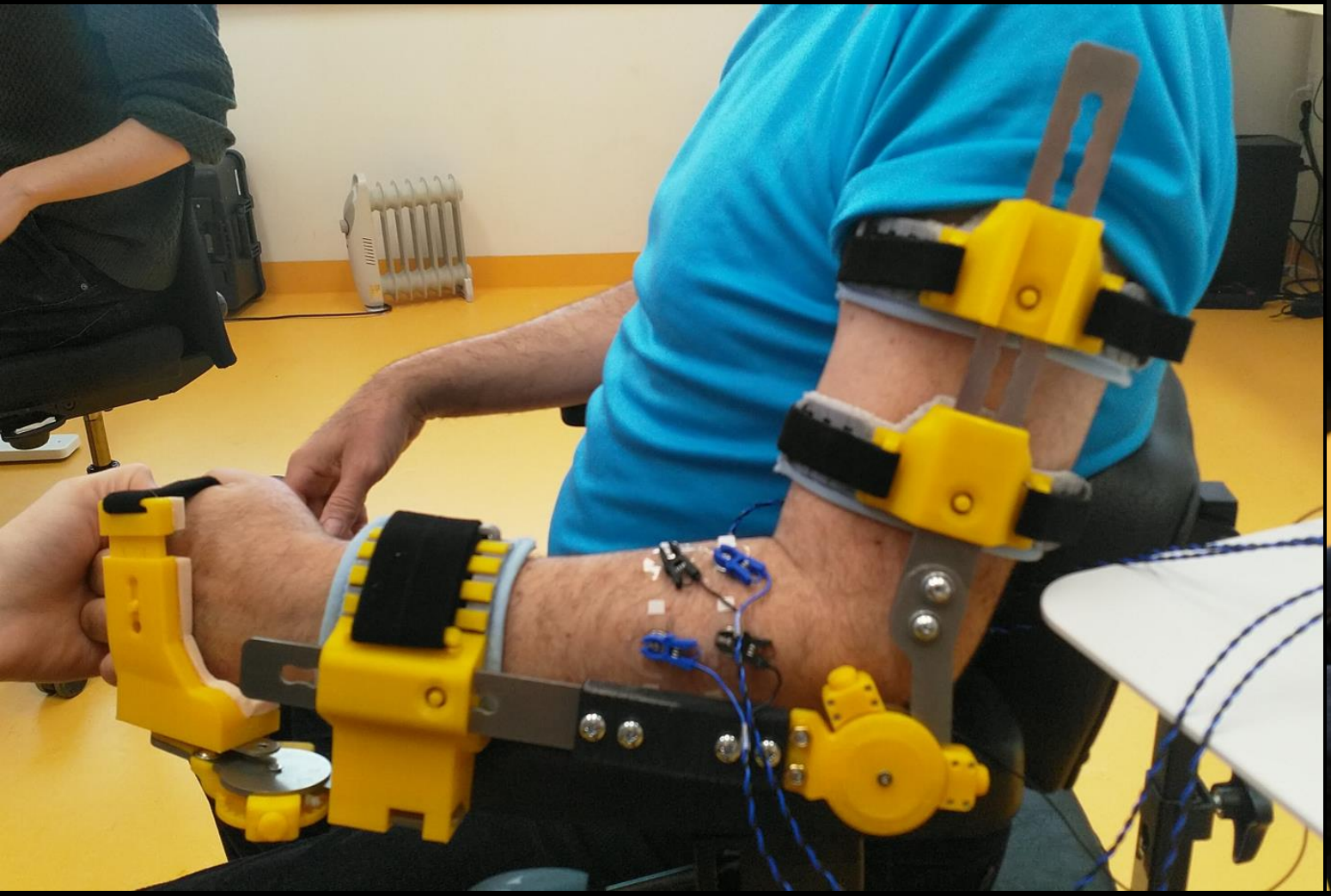


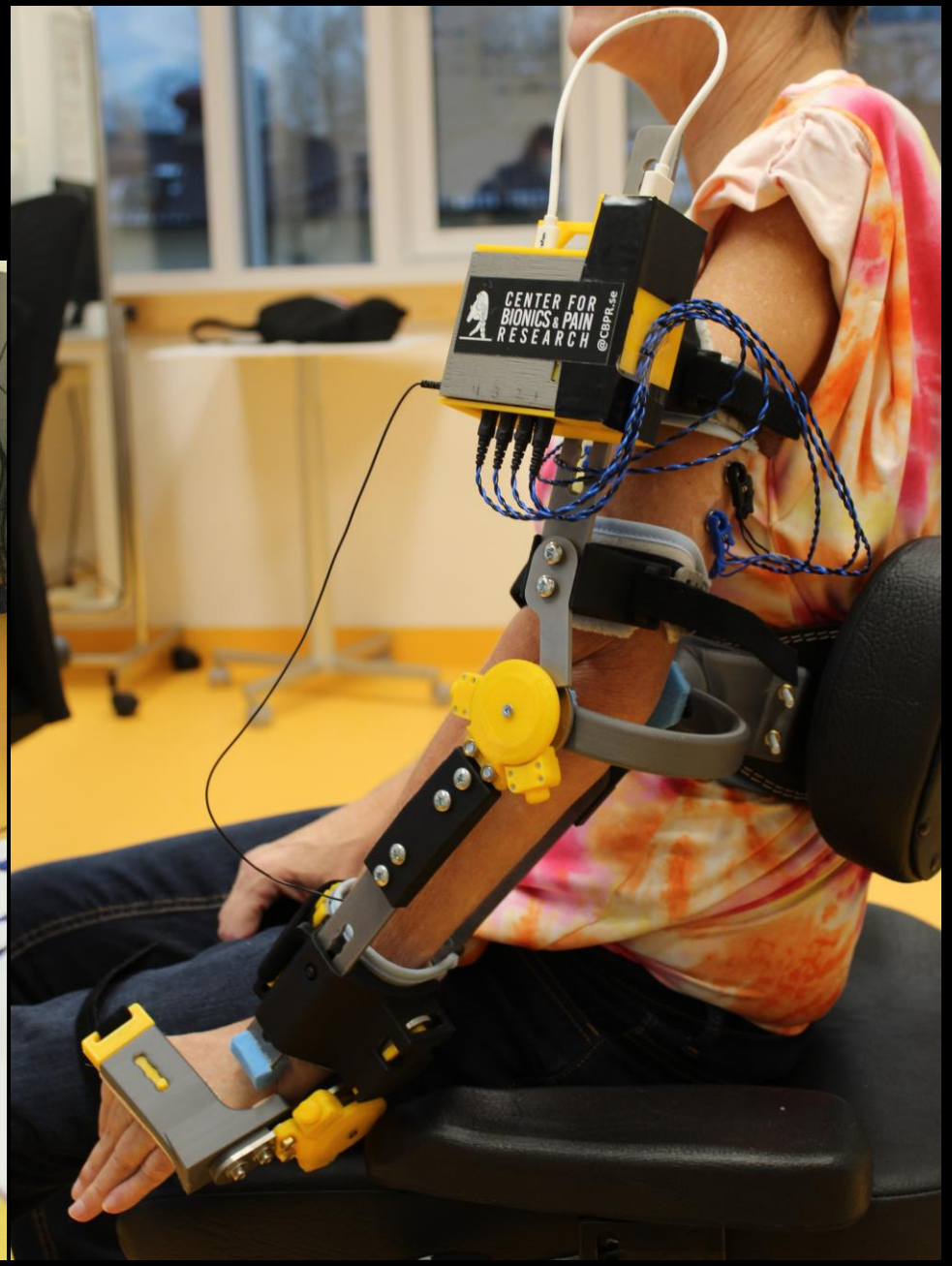


Stefan Schuurbiers

Marnick Joosen

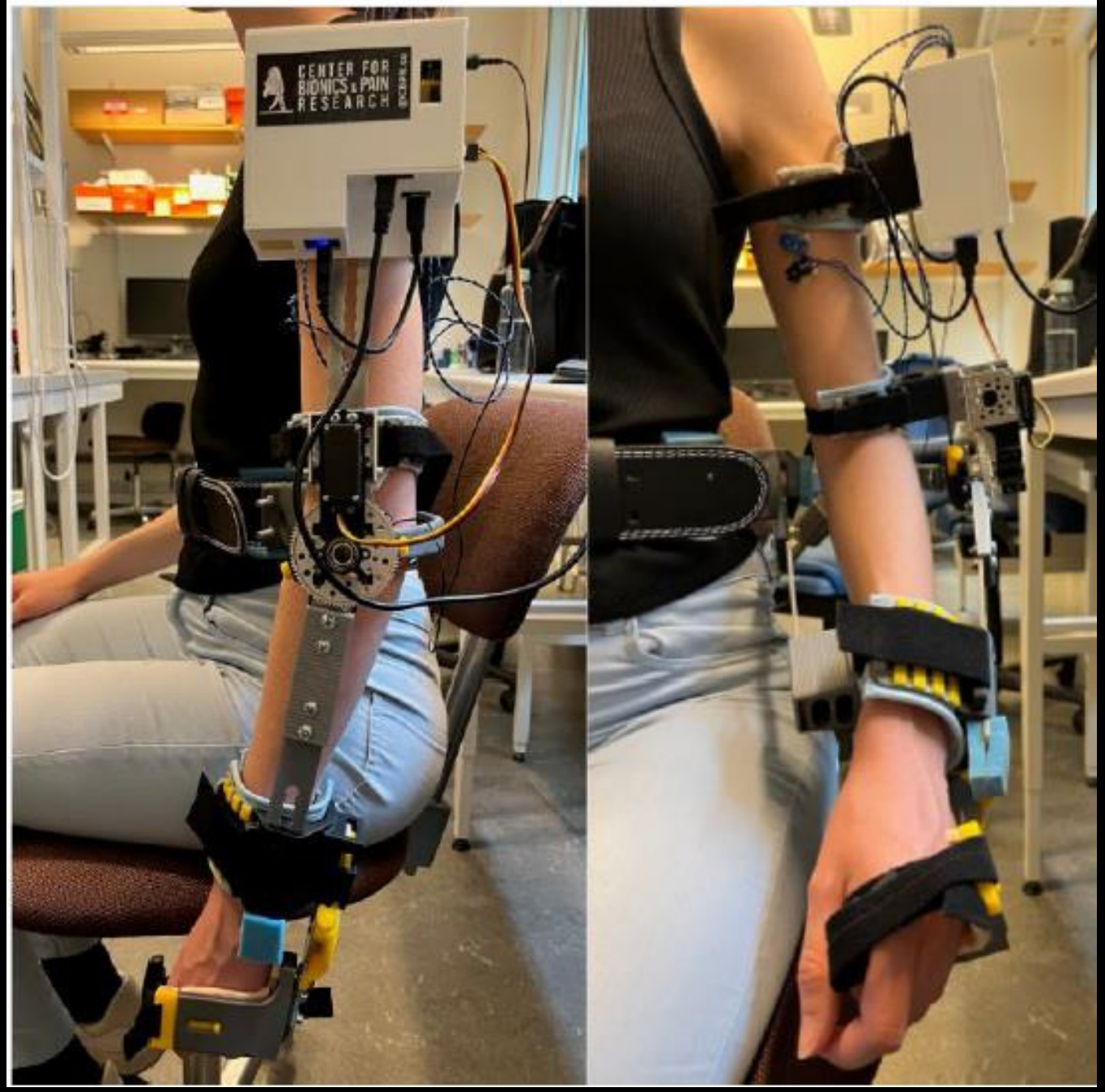
Orthosis





Rebecka Lövgren

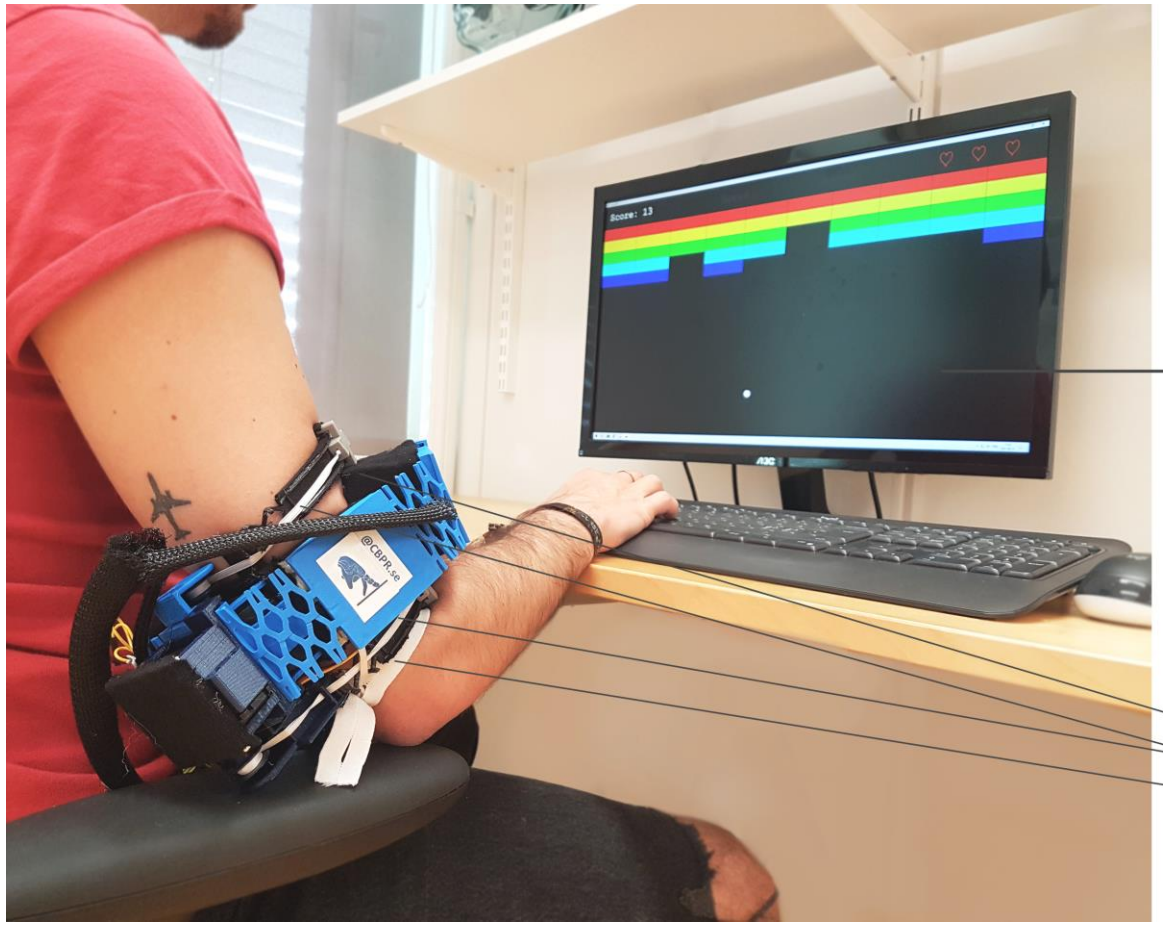
Rebecka Lövgren

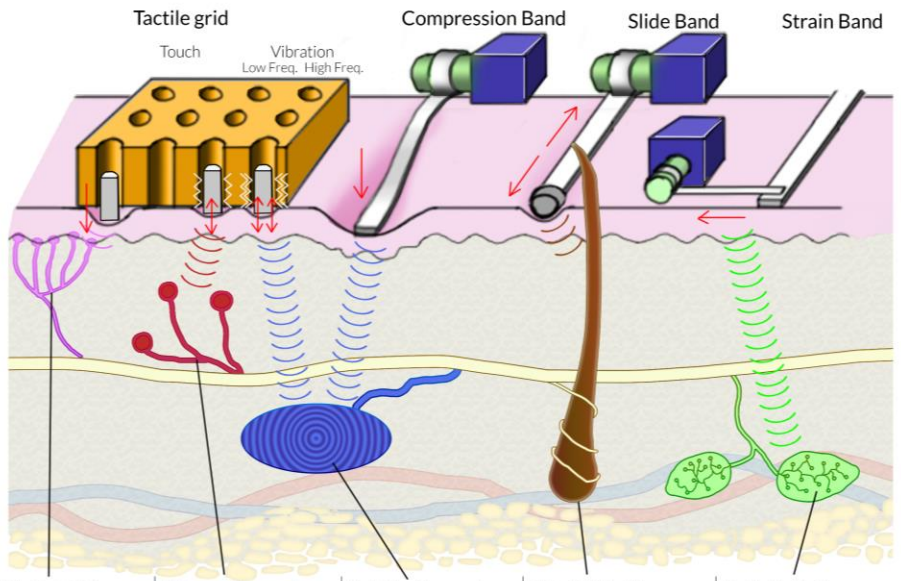


Sensory training

Sensory Training

Mirka Buist

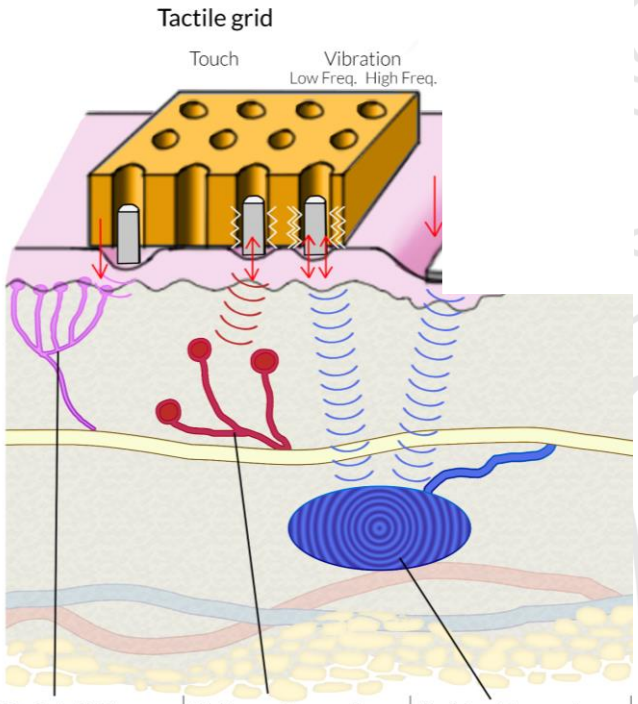


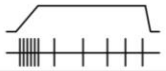


	Merkels Disks	Meisners Corpuscles	Pacinian Corpuscles	Hair Follicle Plexus	Ruffini's Endings
Type	Slow Adapting	Rapid Adapting	Rapid Adapting	Rapid Adapting	Slow Adapting
Response					
Density [/cm2]	High 500	Medium 100	Low 20	Medium 200	Low 10
Fundtion	Light touch and tactile discrimination	Low frequency vibrations and skin motion	High frequency vibrations and deep pressure	Hair movements	Skin Stretch

Myohaptic

Mirka Buist

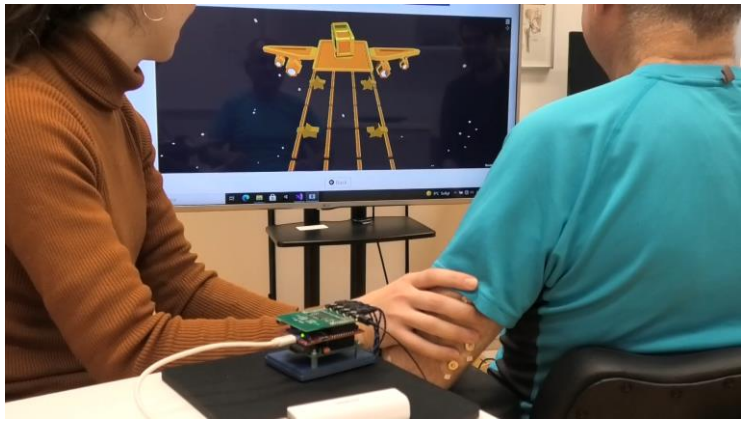


	Merkels Disks	Meisners Corpuscles	Pacinian Corpuscles
Type	Slow Adapting	Rapid Adapting	Rapid Adapting
Response			
Density [/cm2]	High 500	Medium 100	Low 20
Fundtion	Light touch and tactile discrimination	Low frequency vibrations and skin motion	High frequency vibrations and deep pressure

Mirka Buist

Niklas Möller

Sensorimotor training



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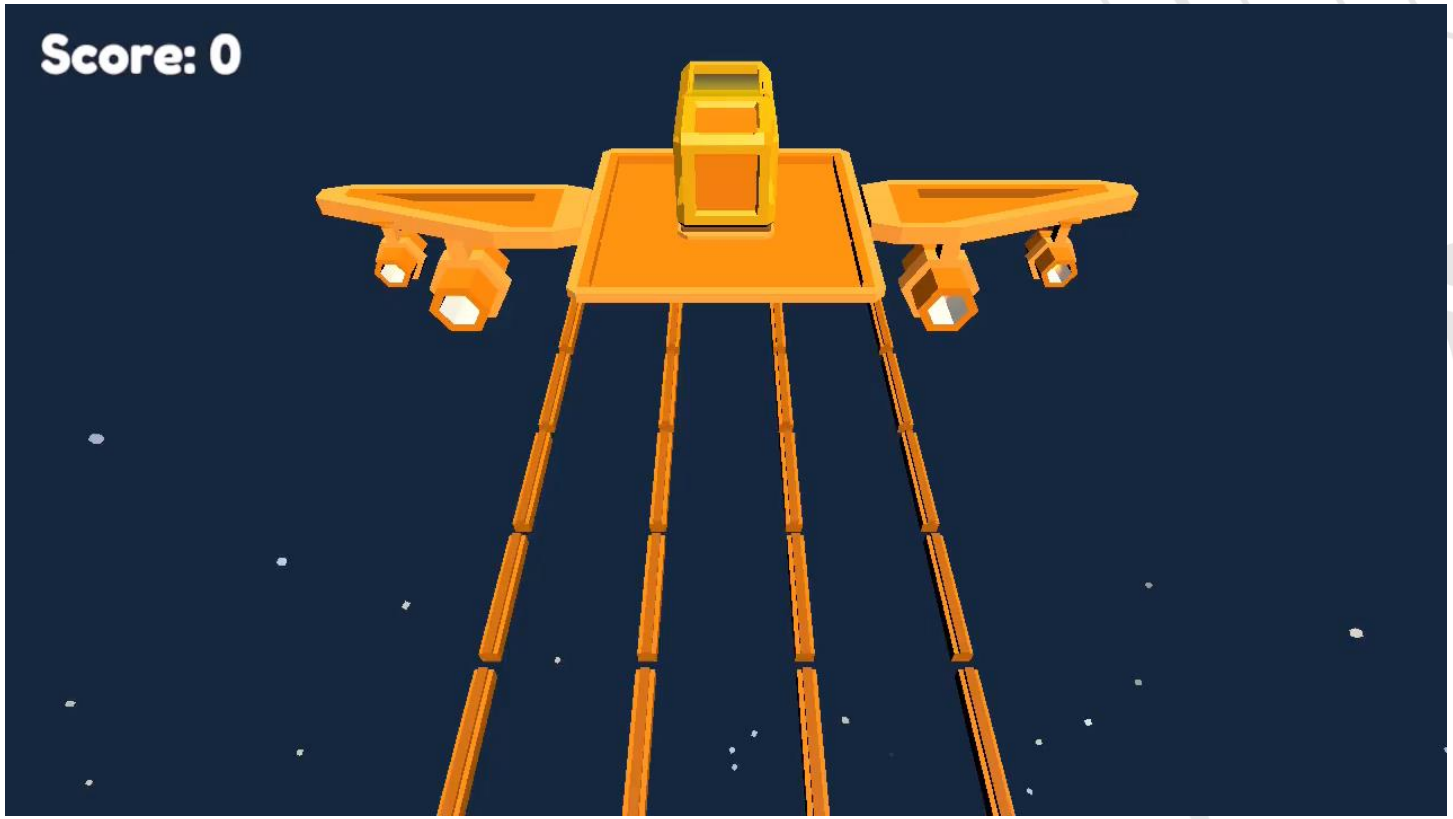


Maria Munoz

Mona Emaldeldin

Case study with minor (chronic case)
Pre-assessment (ARAT)

Maria Munoz

Mona Emaldeldin

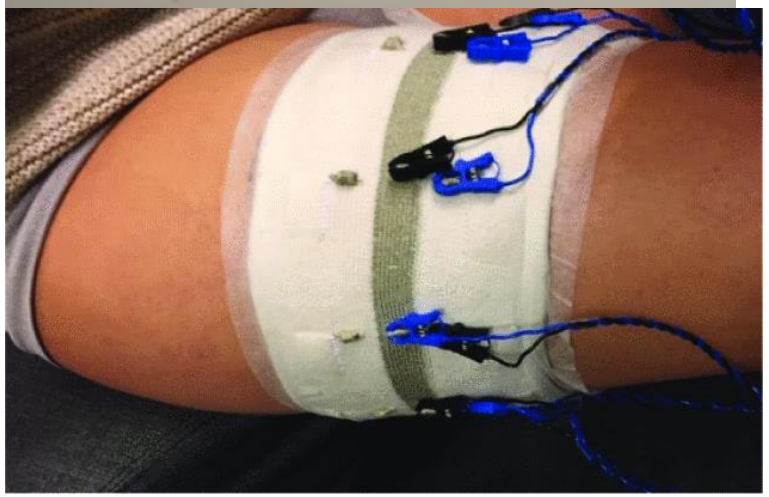
Case study with minor (chronic case) Midterm-assessment (ARAT)

Li Guo

Next steps

Prof. Asplund

Textrode band



Laser Induced Graphene (LIG) electrodes

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Questions?

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