An attempt to catch the hand in the brain

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If walking is a series of falls,
then reaching and grasping
is a dance of adjustments.

Harbourne, 2015

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Aim of the lecture

- To understand the ‘system’ (neurophysiological background) of grasping

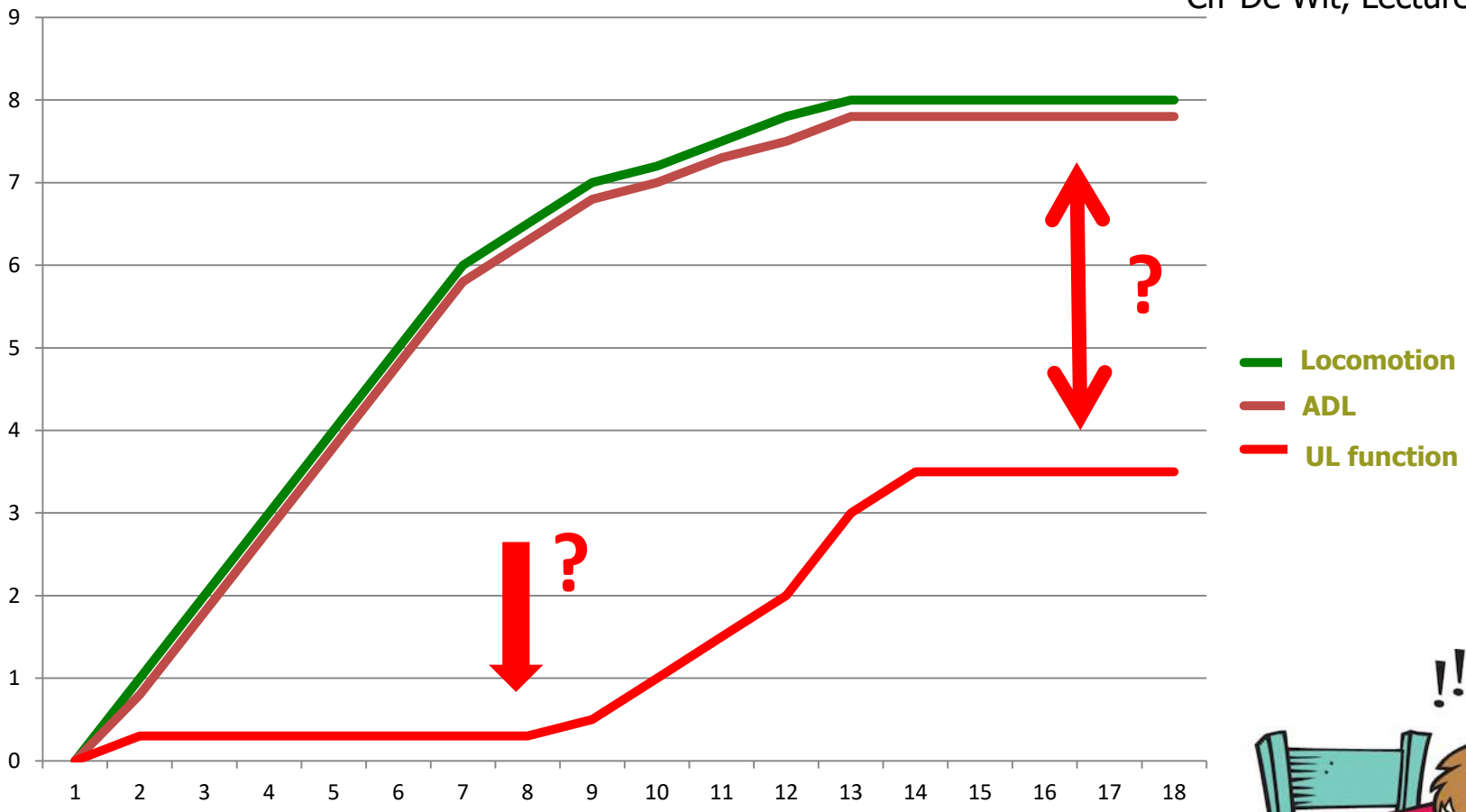
- To understand how we can influence this system with complex technology (smart hand orthosis)

Core activity of the rehabilitation centre(s)

- Treatment of patients with acquired brain lesions
  - Stroke
  - Traumatic brain injury
  - Minimal responsiveness
  - …

Functional recovery (Locomotion, ADL, UL function)

Cfr De Wit, Lecture 2011



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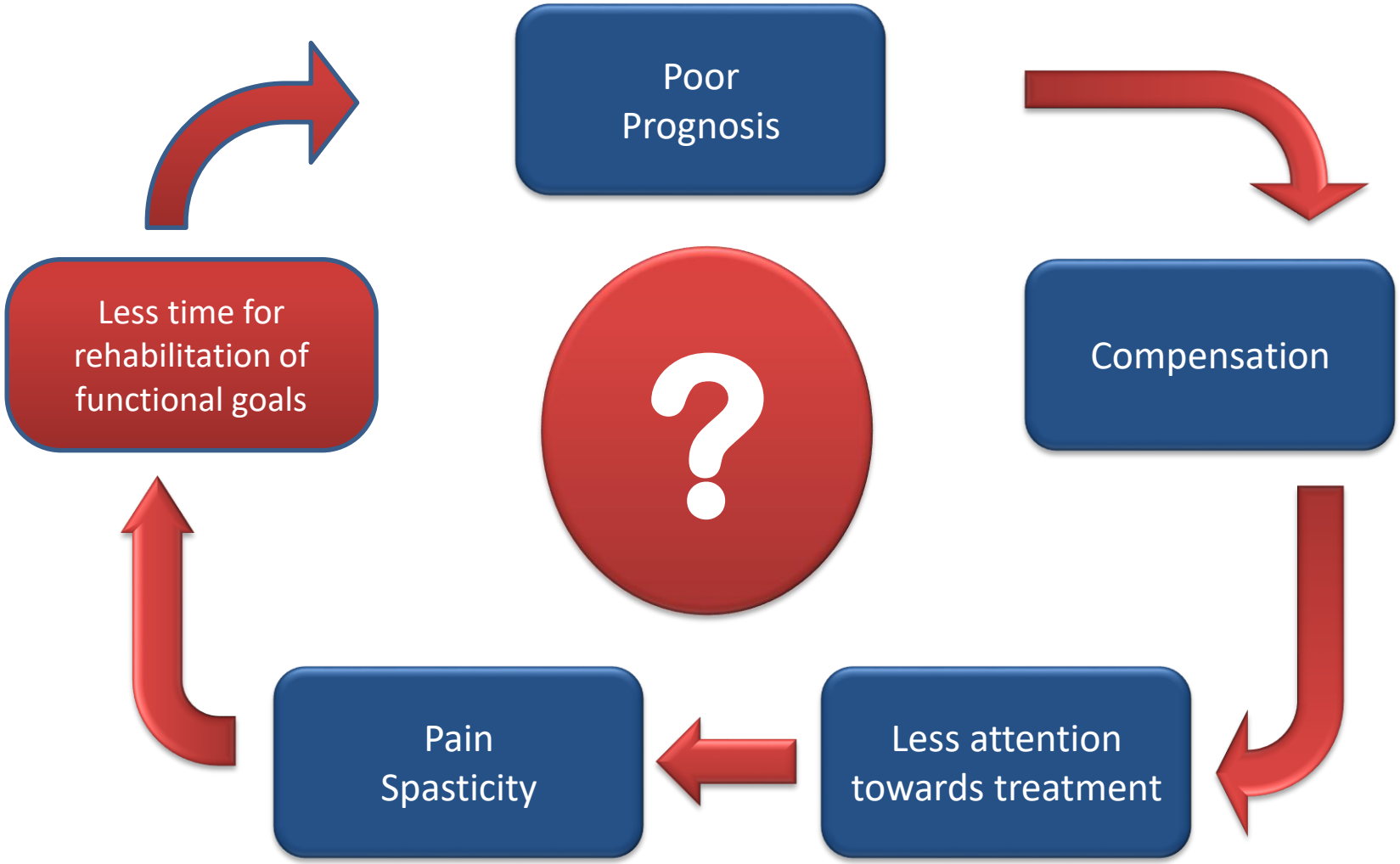
Functional recovery (UL function)

- 30-66% has **no** functional use of the UL (6m after stroke).

(Parker et al, 1986; Kwakkel et al, 2003)

- Reduced arm function contributes to decreased quality of life in stroke patients

(Nichols-Larsen, 2005)



Naar Werner, 2008

Key aspects in knowledge on upper limb training

- Neurophysiology: understand the system … search for the potential
- Sequences of reaching and grasping: from core to hand … and back
- Brain perceives the arm has heavy….. and acts as such
- Orientation of the hand towards an object …..defines the movement of the arm

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Grasp

- Grasping is the most important skilled motor act of primates.

- It is based on a series of sensorimotor transformations through which the affordances of the objects to be grasped are transformed into appropriate hand movements.

Grasp

- The loss of functional reach and grasp is a brain problem ….. ‘speak’ to the brain

- Make it happen: preserve the ‘tools’ you are able to work with as a therapist

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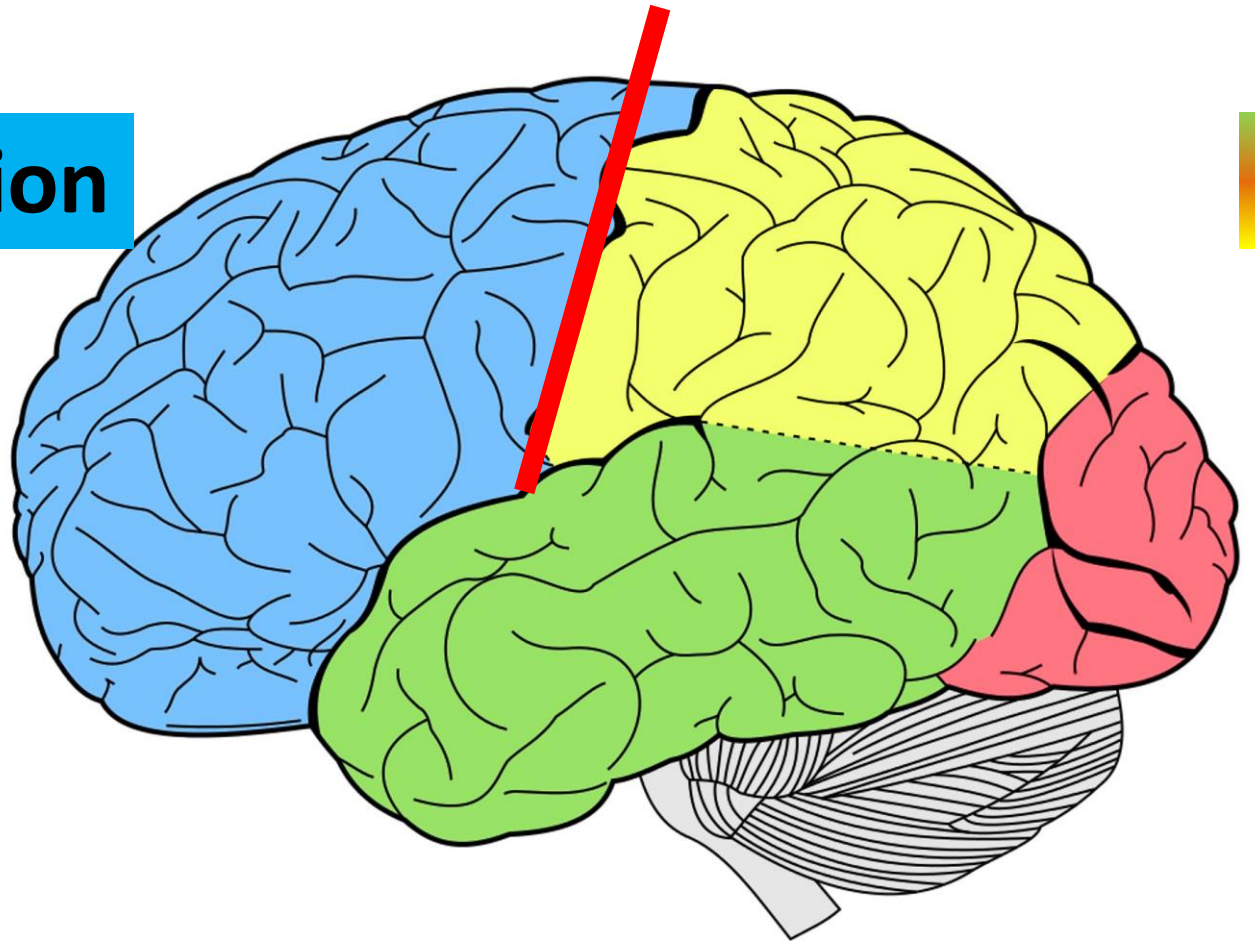
The magic is in the brain

Action / Cognition



Perception

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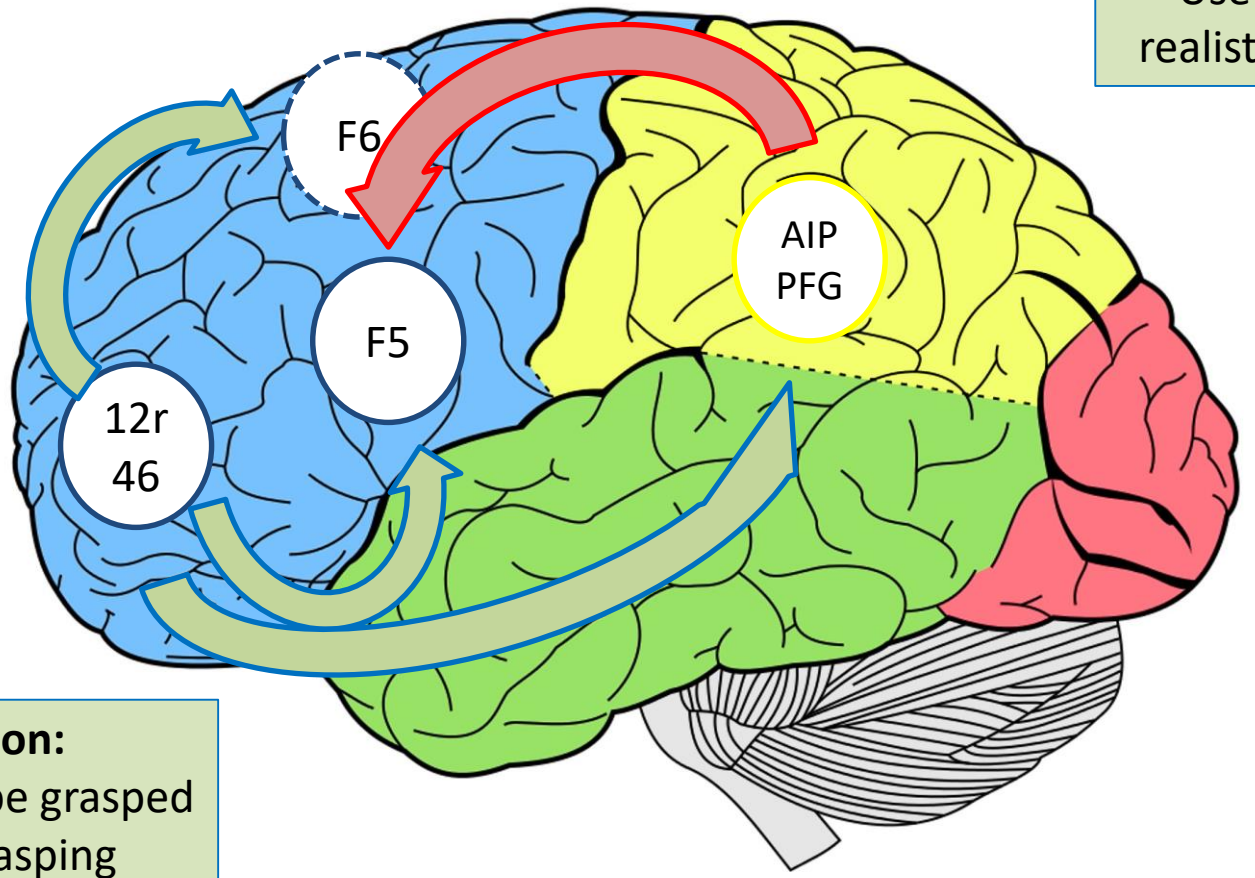
The magic is in the brain

Therapeutic relevance
- Use of daily objects in an as realistic situation as possible.



Higher order information:
- Meaning of the object to be grasped
- Overarching goal of grasping

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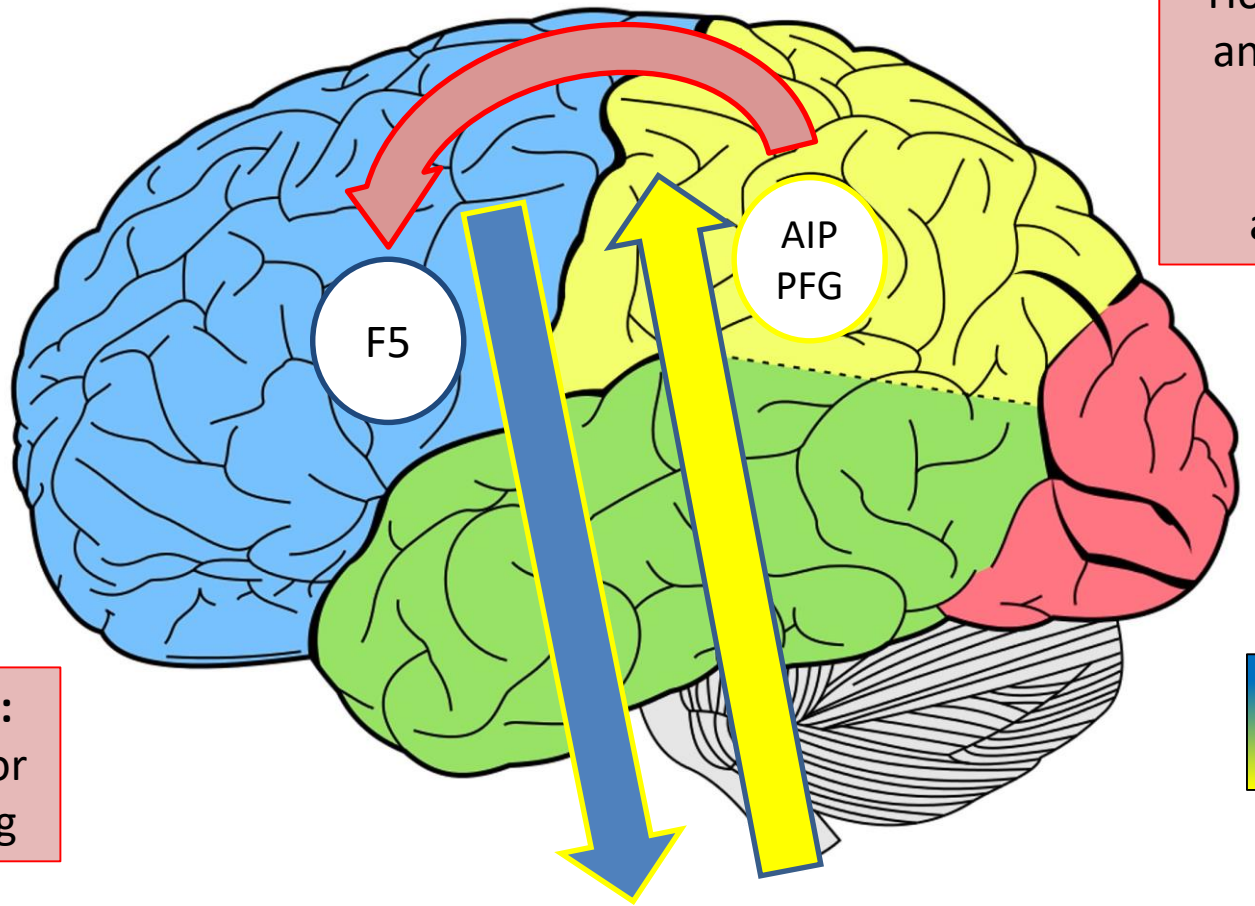
Gerbella et al, 2017

The magic is in the brain

Therapeutic relevance:
- How to send appropriate sensory and proprioceptive information to the parietal cortex
- How to facilitate appropriate motor response



Parieto-frontal connection:
core circuit for sensorimotor transformation for grasping

Use of Intelligent Hand orthosis?

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Gerbella et al, 2017

Grasp

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- Make it happen: preserve the ‘tools’ you are able to work with as a therapist

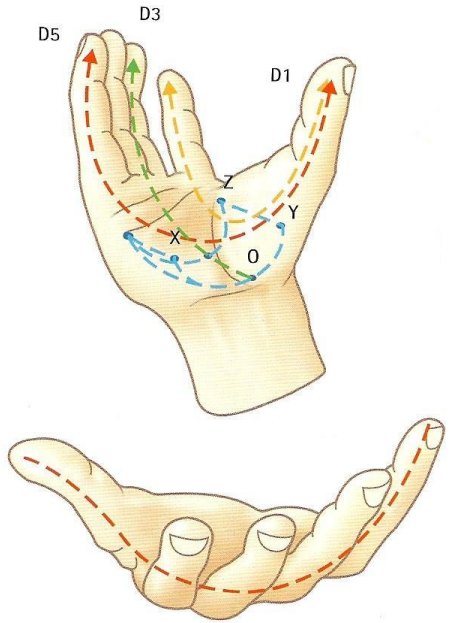
Arches of the hand

The palmar concavity:

- plays an essential role in hand shape modulation to ensure a secure and stable grasp conforming to the intended use of the object

Sangola et al, 2009

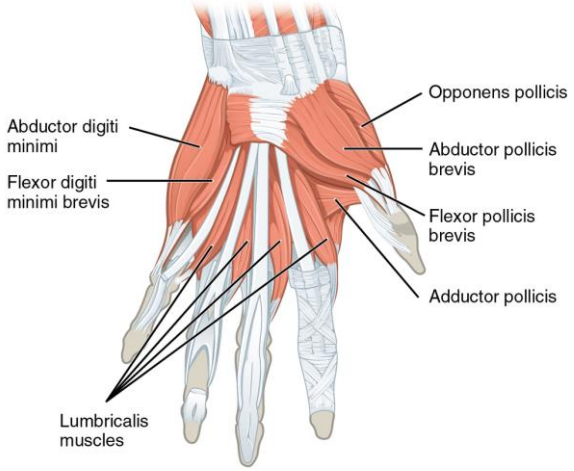
- Is a prerequisite to increase the probability of activating the intrinsic muscles of the hand in patients with acquired brain injury

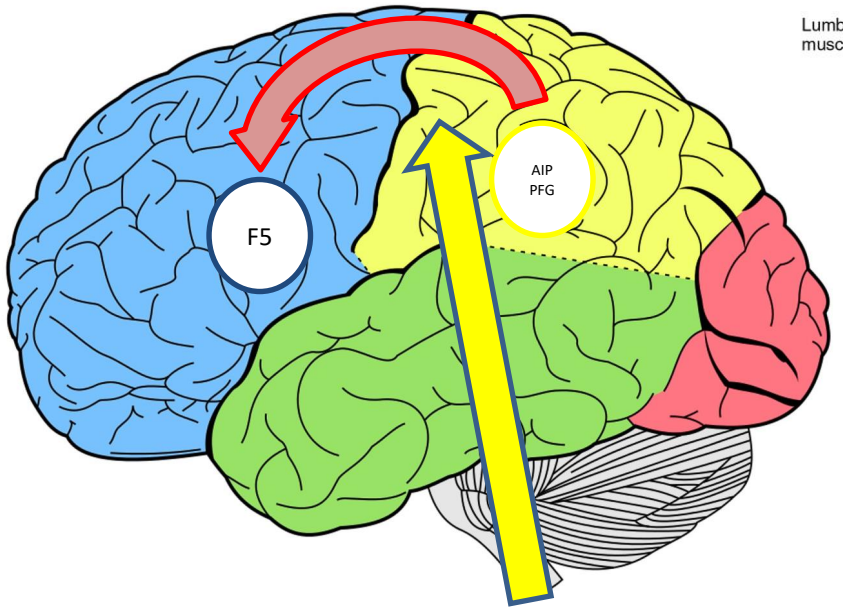


Kapandji AI, 2007

Intrinsic muscles of the hand

- Give a lot of proprioceptive input (muscle spindles)





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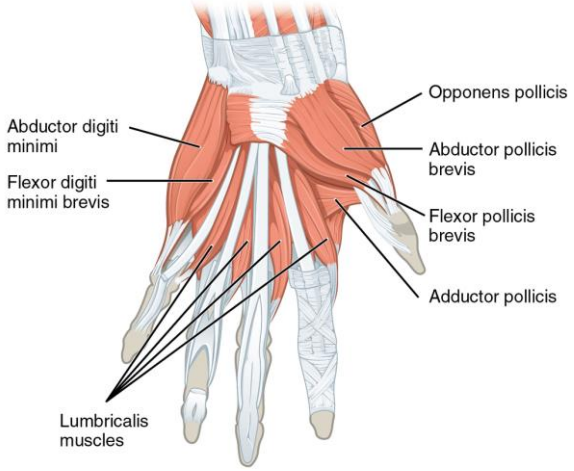
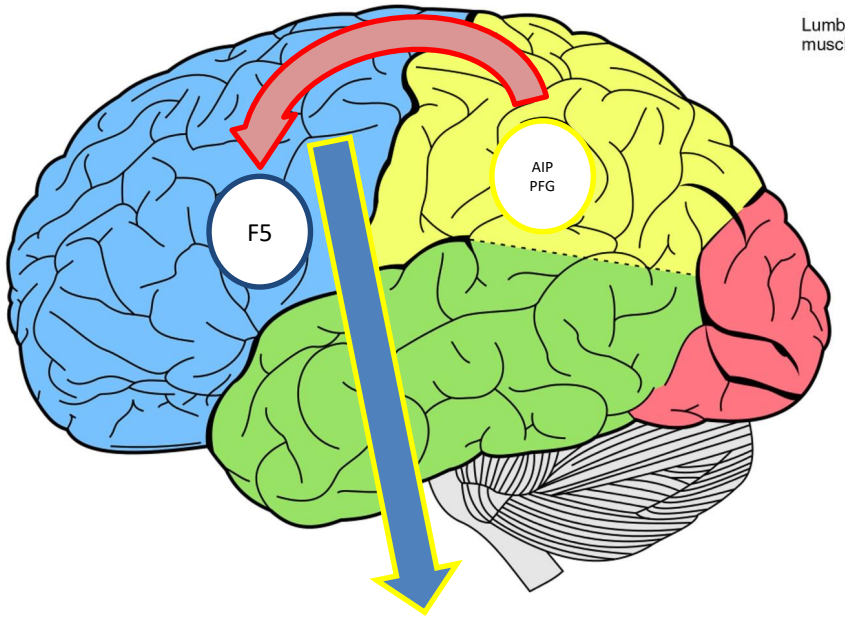
Intrinsic muscles of the hand

- Core system of the hand – part of building the arches
- Basis on which selective movement is build





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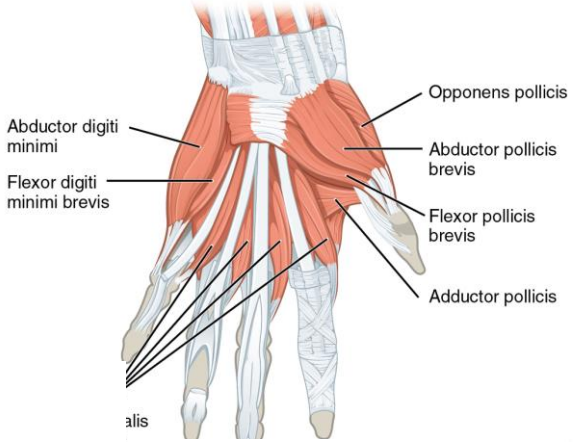
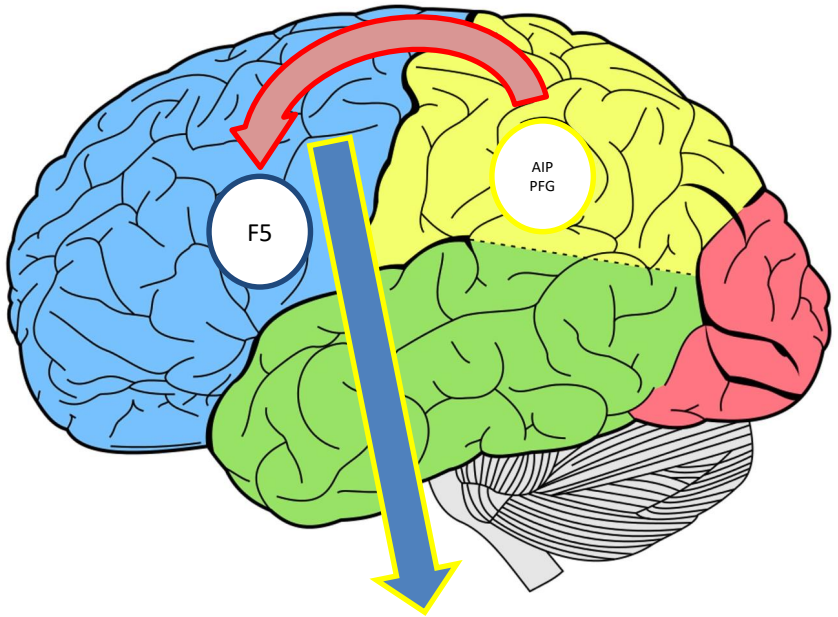
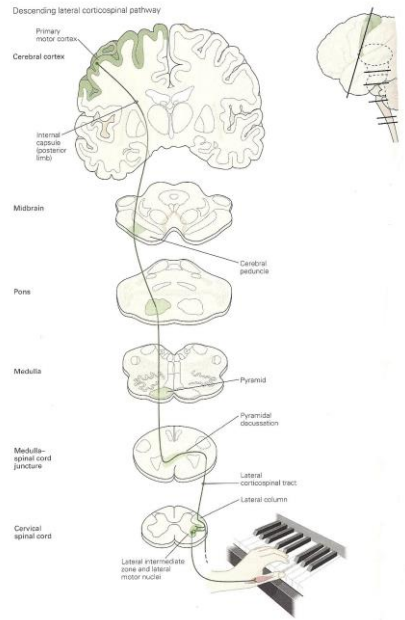
Intrinsics of the hand

- Mainly innervated by the corticospinal system through mono-synaptical connections.







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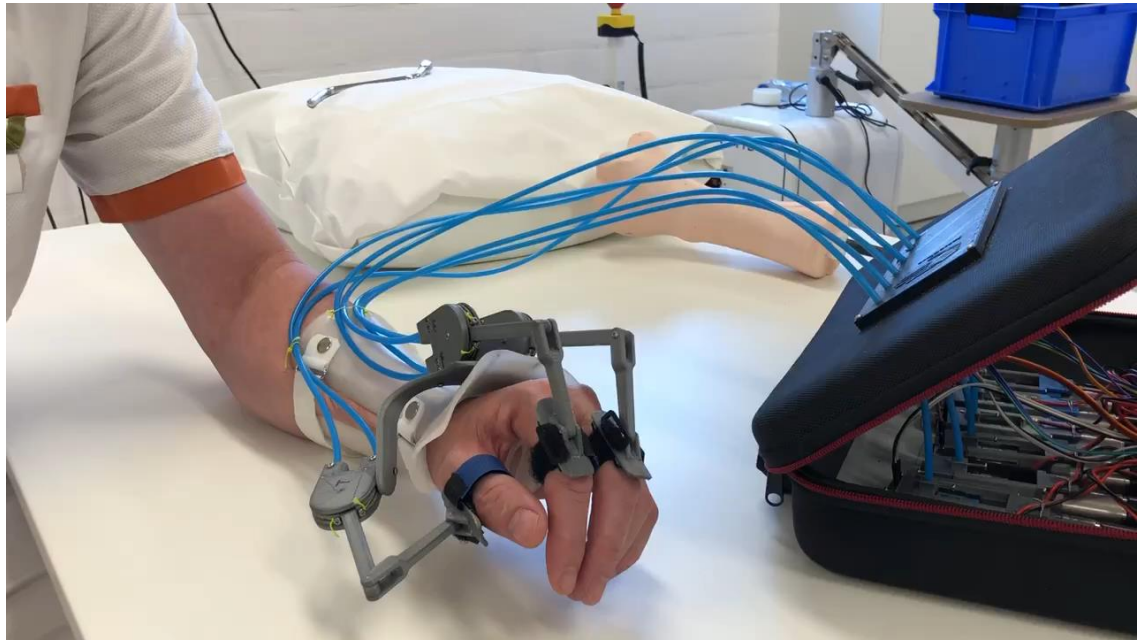
Intrinsic muscles of the hand

- Search for potential of the intrinsics and activate them before extrinsics (if possible).
- Increase intensity and repetition



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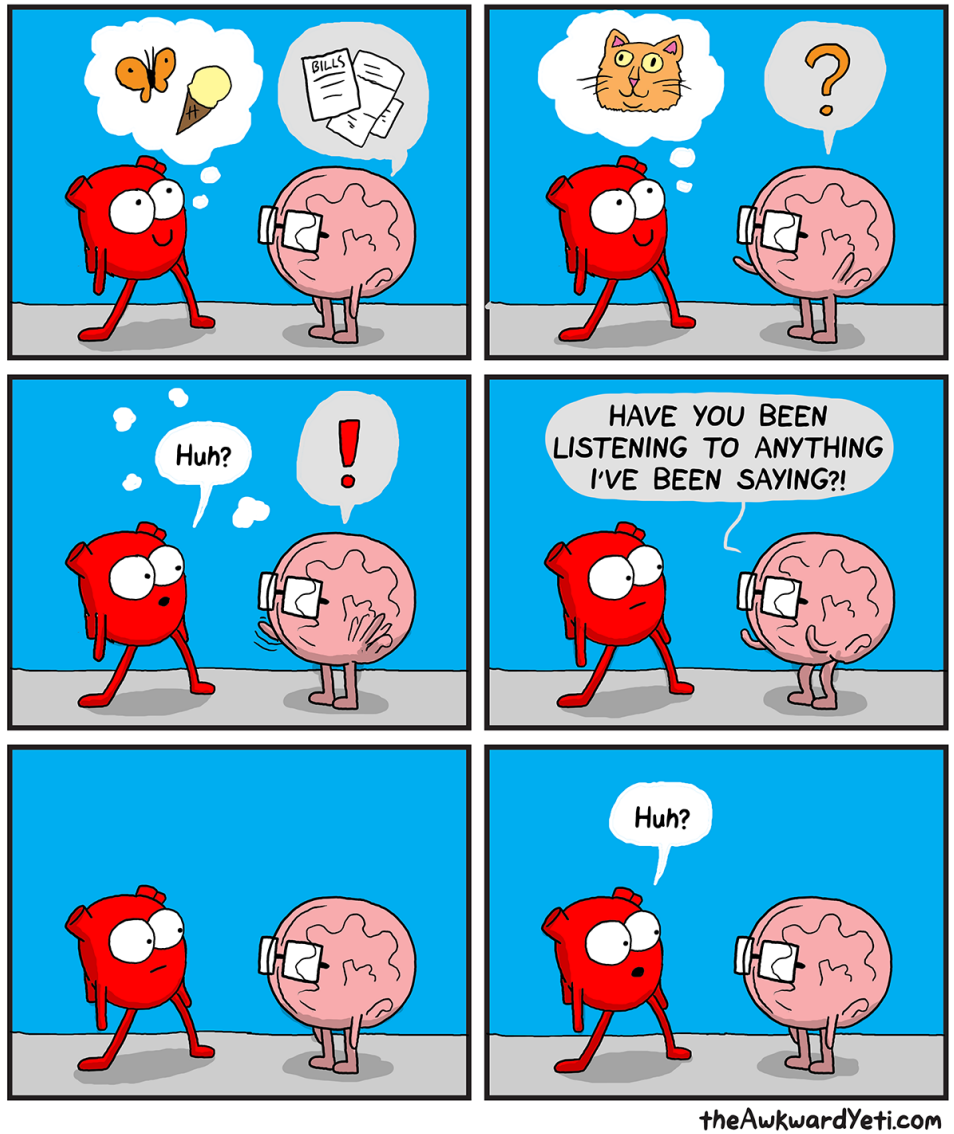
Sense Glove

LIVIT orthopedie

Conclusion

- Treating the (arm-) hand is:
  - Understanding how the brain is organised
  - Understanding how the brain is informed
  - Understanding how the brain can activate in an appropriate way
  - Understanding that repetition and intensity is needed



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