**Positron-emission-tomography (PET) applications in neuroscience**

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**Functional imaging: space, time and interference**

Functional imaging: physiology

- PET
- (f)MRT
- MEG
- EEG
- (r)TMS

Functional imaging: history

- recordings of pulse waves in traumatic brain injury
- arm
- skull
- clock
- listening to a question
- calculating

Angelo Mosso (1881)

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**Functional imaging: physiology**

rest  activity

CBF (+29%)

Blood Flow & Glucose Utilization (+23%)

O₂-concentration ↑ in active areas

⇒ uncoupling of CBF and CMRO₂
Apraxias are disorders of higher motor cognition, which cannot be (fully) explained by elementary motor deficits (like paresis), by disturbances of communication (e.g. aphasia) or by general cognitive deficits (as in dementia).

Typical clinical neuropsychological symptoms of apraxia are disturbed imitation of (abstract and/or symbolic) movements, deficits in the goal-directed use of objects and tools, and impaired dexterity during movement execution.

Ideo-motor apraxia
Disturbed movement planning ("How to do").
Main symptom is the deficient imitation of abstract (> symbolic) movements.
Cognitive model of movement imitation

- Movement
  - Visual analysis
  - Semantic memory
  - Working memory
  - Motor system
  - Imitation

**Abstract movements**

- (0%MF > 100%MF)

**Symbolic movements**

- (100%MF > 0%MF)

- Right parieto-occipital cortex
- Superior parietal cortex bilaterally
- Right V5/MT
- Left superior temporal gyrus
- Left angular gyrus
- Left parahippocampal gyrus

p=0.001, uncorrected

Rumiati RI, Weiss PH et al. (2005) J of Cognitive Neuroscience

**Ideo-motor apraxia: Dissociation between the imitation of abstract and symbolic movements**

- Imitation of abstract movements
  - Visual analysis
  - Semantic memory
  - Working memory
  - Motor system
  - Imitation

- Imitation of symbolic movements
  - Inferior temporal cortex (+68, +58, -50)

p=0.001, uncorrected
**Ideational apraxia**

Disturbed movement concept ("What to do").

Main clinical symptom is the deficient object use (with preserved pantomime)


Fink et al. (2000) Neurology

Seitz et al. (1998) Archives Neurology
Neglect

**Incidence** of cognitive deficits after stroke: 48% of patients with right-hemispheric stroke suffer from neglect, after 3 months still present in 17% of the patients

**Relevance** for rehabilitation: neglect is an independent negative predictor for rehabilitation outcome

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**Monitoring changes in the motor system after stroke**

Seitz et al. (1998) Archives Neurology

**Spatial cognition: neglect**

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**Neglect: clock drawing**

Halligan et al. (2003) TICS; Binkofski & Fink (2005) Nervenarzt
Neglect: clinical picture

Spatial neglect: patients are impaired in actively orienting to the contralesional space and acting on stimuli in contralesional space.

Neglect in near space

Neglect in far space

Neglect: Deficits in line bisection

Neglect in near space

Neglect in far space

Neglect: clinical dissociations

Neglect in near space

No neglect in far space

Neglect: clinical dissociations

No neglect in near space

Neglect in far space


Neglect in near vs. far space

Main effect Task
Line bisection in near and far space

Main effect Space
Far space > Near space

PET-study

Weiss PH et al.
Brain (2000)

Patient

Vuilleumier P et al.

Neurodegeneration

PET-imaging in Parkinson’s disease: diagnosis

Heiss (1999) Nervenarzt

PET-imaging in Parkinson’s disease: diagnosis

Heiss (1999) Nervenarzt
PET-imaging in Parkinson’s disease: diagnosis

Heiss (1999) Nervenarzt

PET-imaging of the dopaminergic system


PET-imaging in Dementia: diagnosis of AD

PET-imaging in Dementia: diagnosis of AD

Heiss (1999) Nervenarzt

PET-imaging in Dementia: diagnosis of AD

ß-Amyloid-PET-marker: Pittsburgh compound B (PIB)

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