

# Neuroanatomi

## - et kort overblik over nervesystemet

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cand.scient.san, PhD

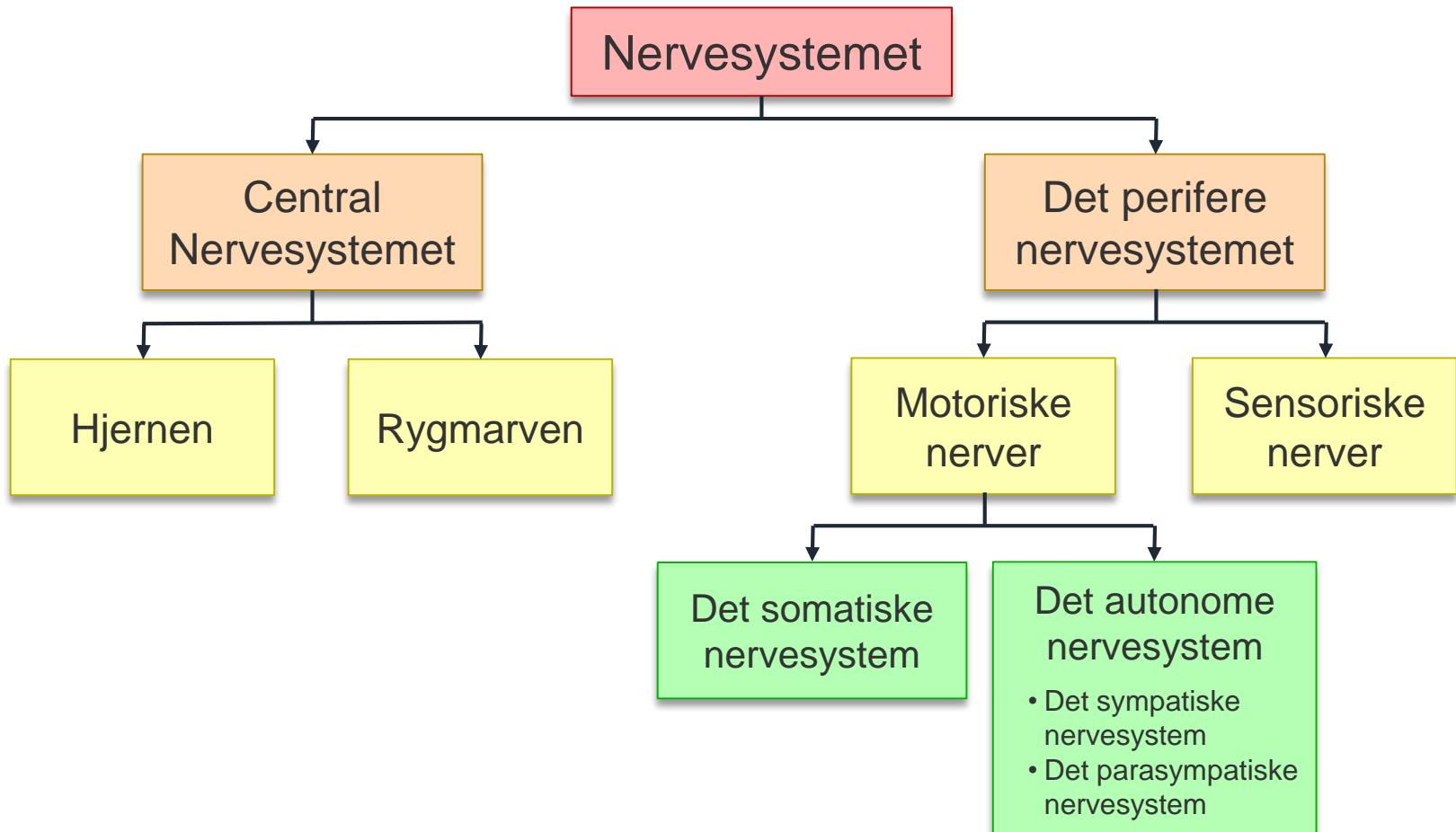
# Trivia om nervesystemet

- Hjernen vejer 1200-1500 g hos mennesker
- Hjernen består af ~60% fedt
- Centralnervesystemet indeholder ~100 milliarder nerveceller
- Storhjernen og lillehjernen indeholder ca. lige mange nerveceller
- Hjernen udgør ~2% af kropsvægten, men bruger ~20% af kroppens ilt

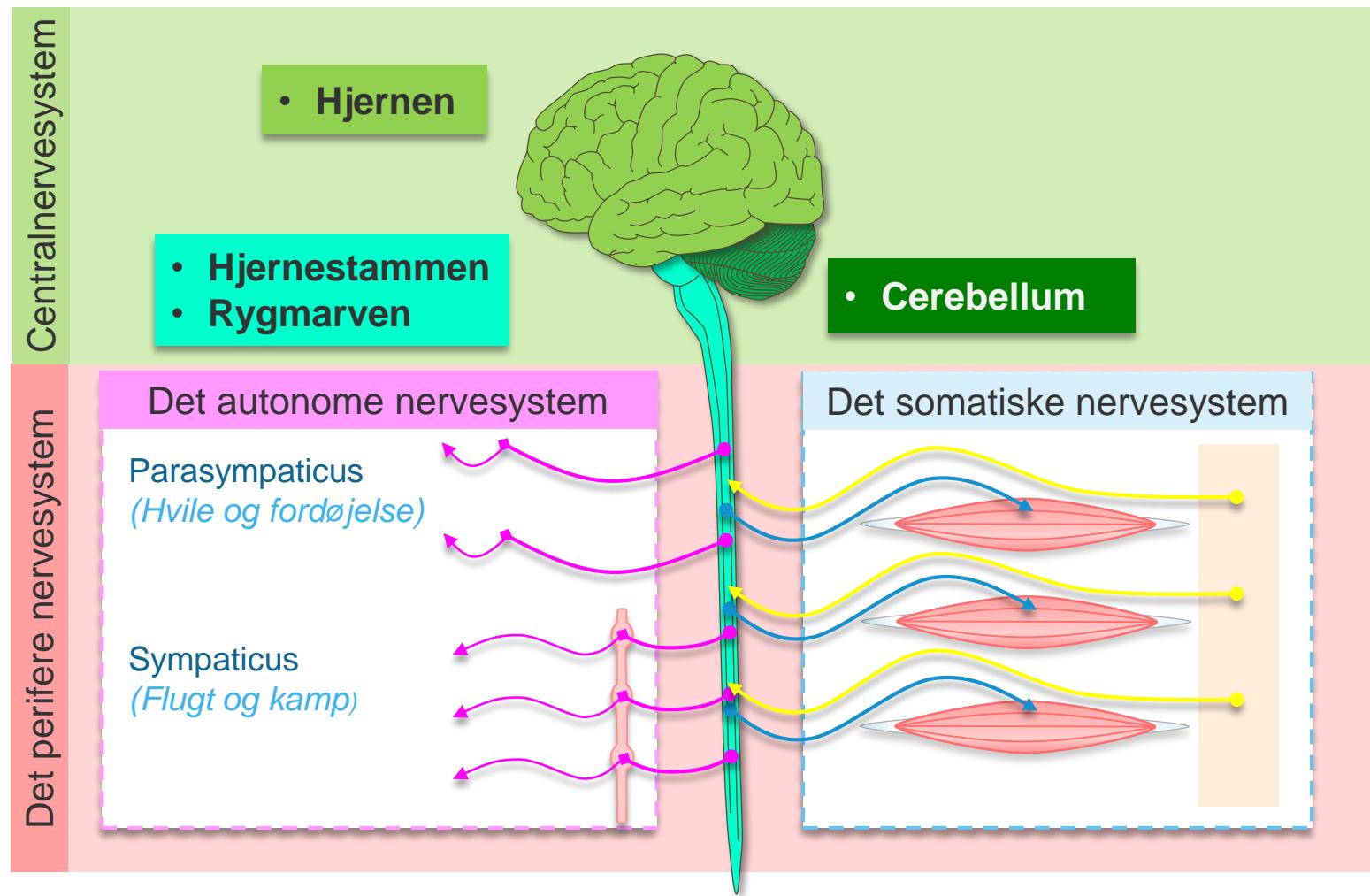


# Overblik

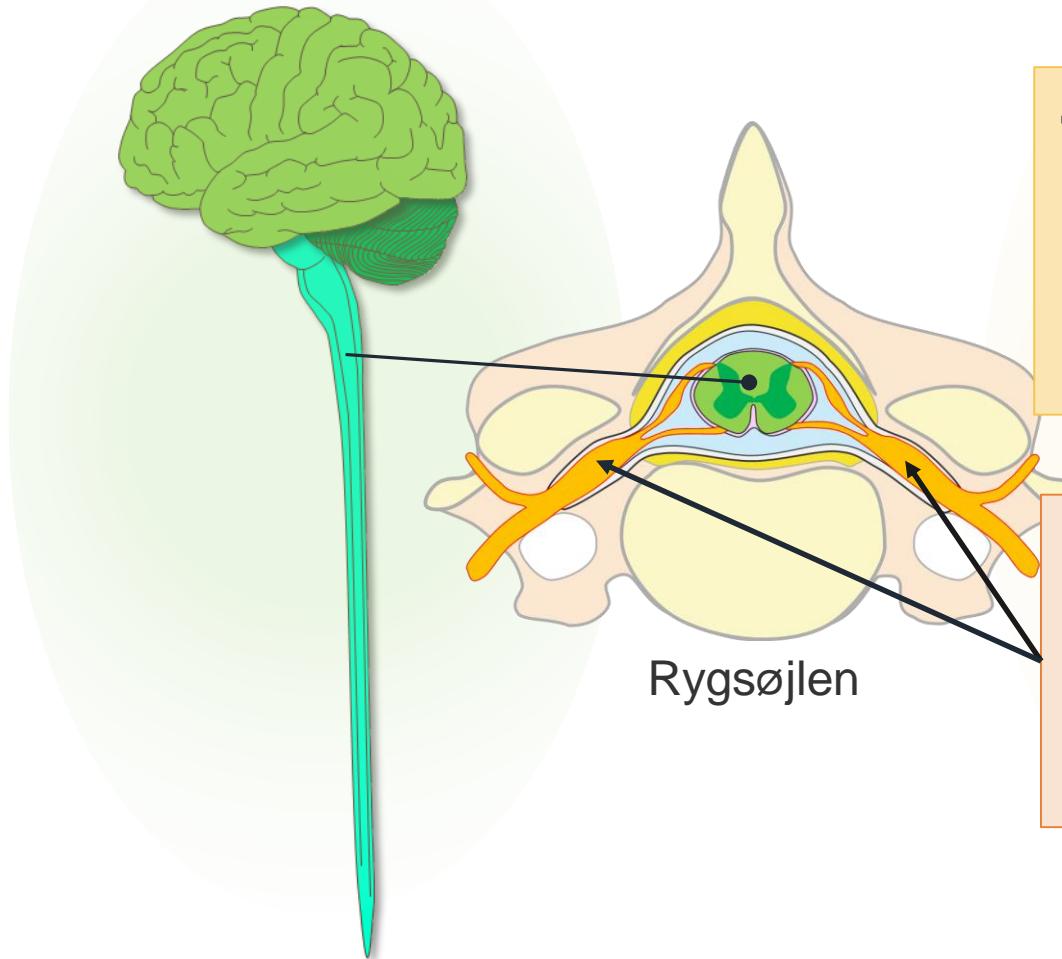
# Kategorisk model



# Model af nervesystemet



Centralt



Perifert

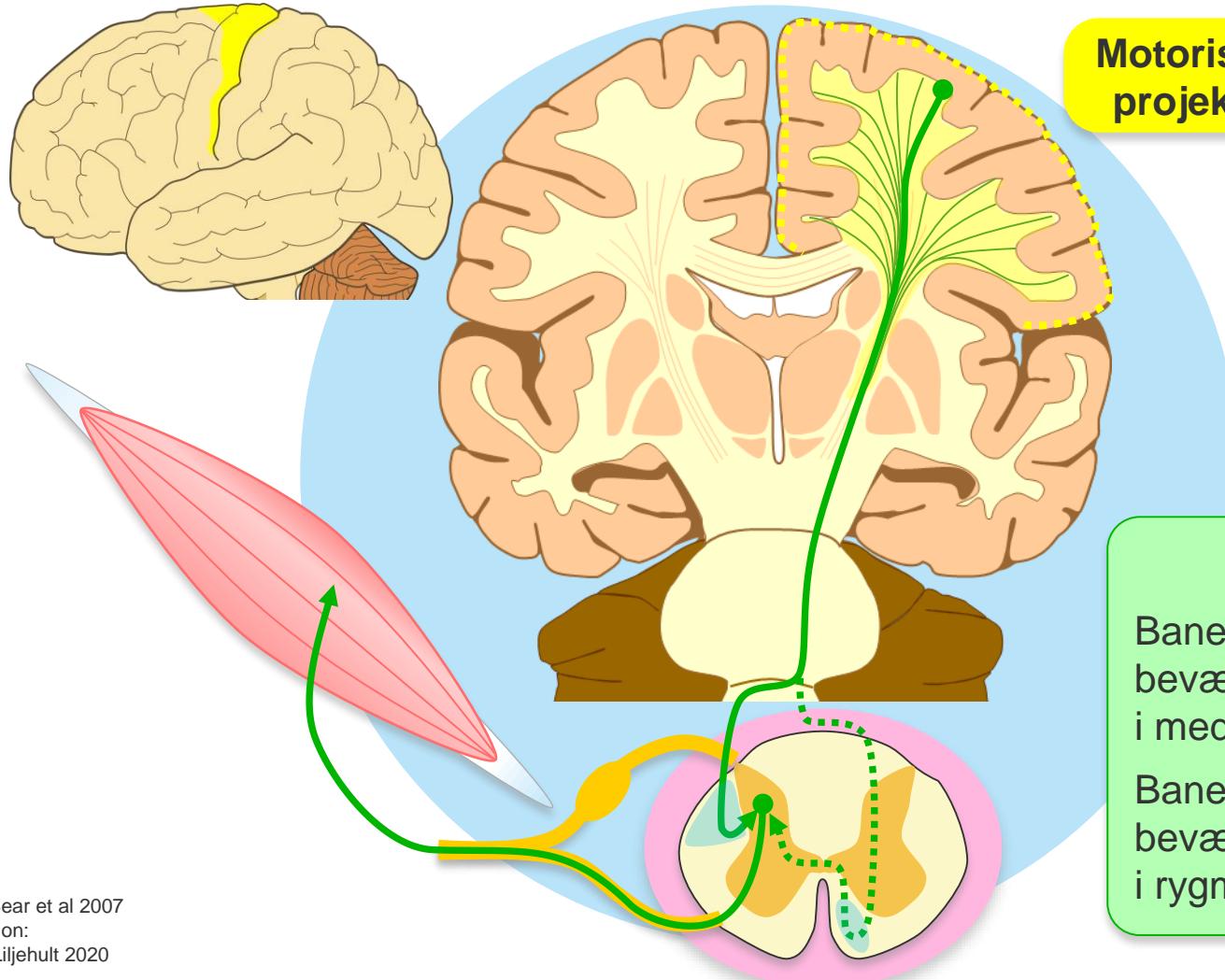
## 12 kranienerve par

- sensorisk
- motorisk
- parasympatisk

## 31 spinalnerves par

- sensorisk
- motorisk
- sympathisk

# De motoriske baner



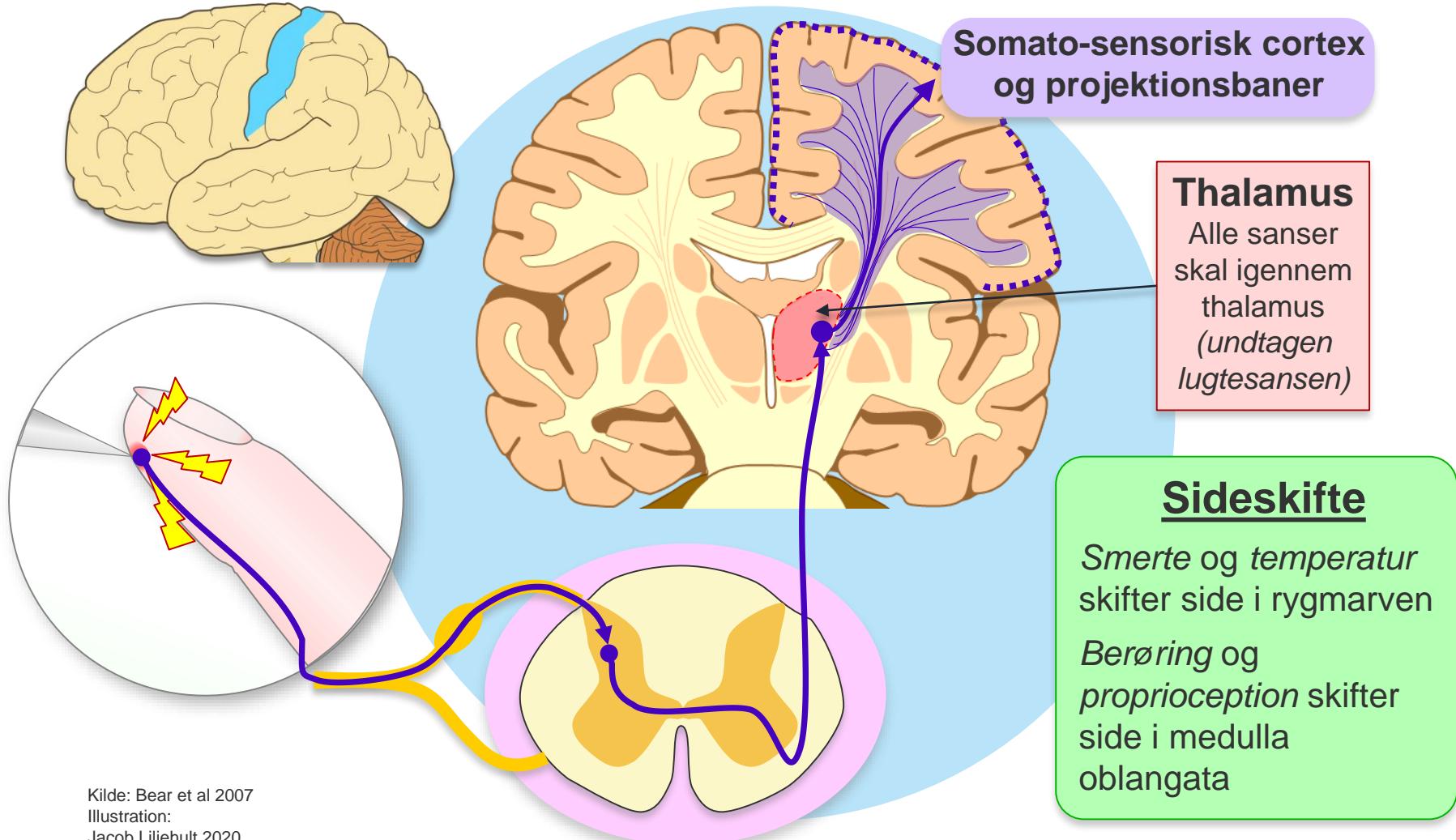
Motorisk cortex og  
projektionsbaner

## Sideskifte

Baner for *voluntære* bevægelser skifter side i medulla oblangata

Baner for *involuntære* bevægelser skifter side i rygmarven

# De somato-sensoriske baner



# Hjernehinderne

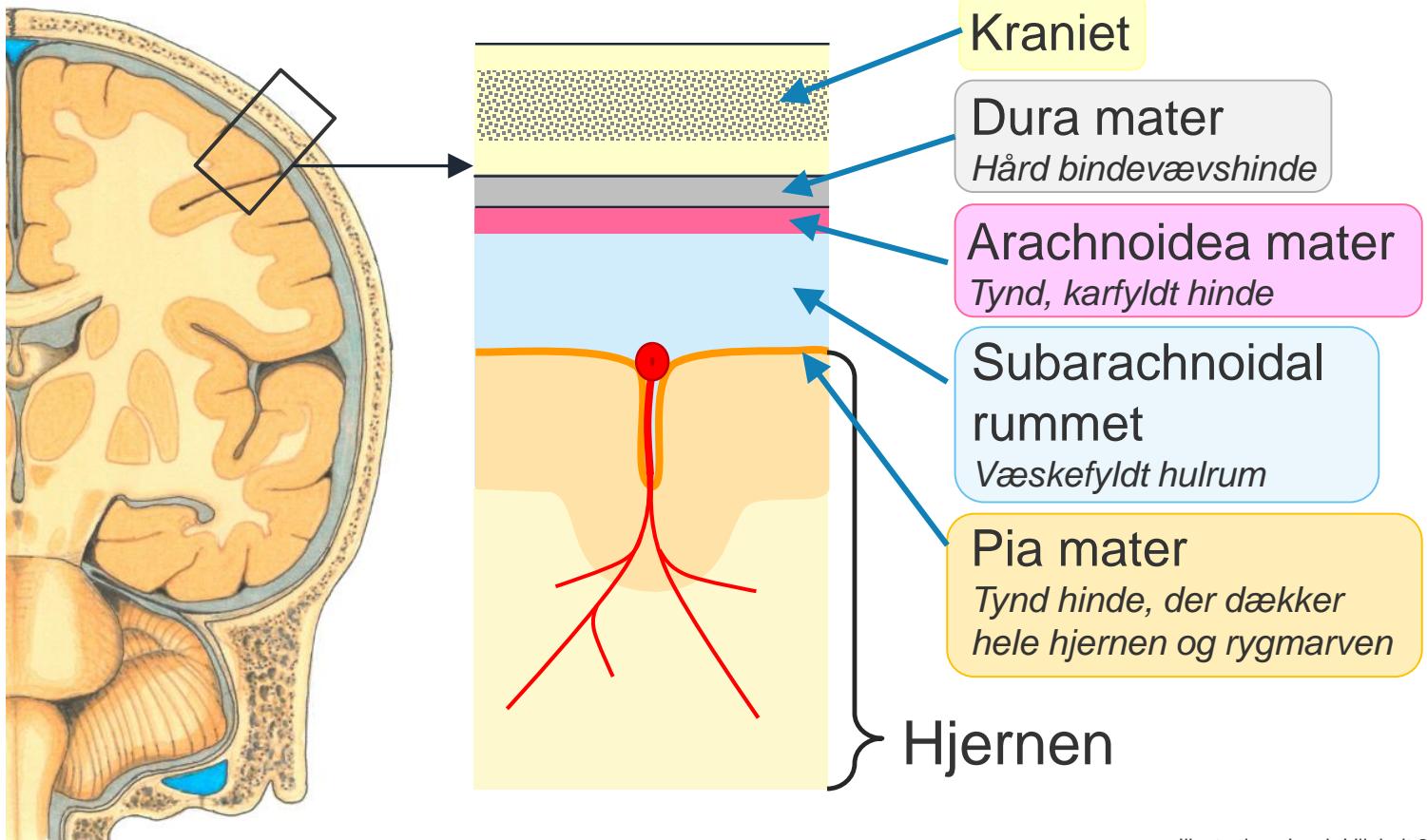
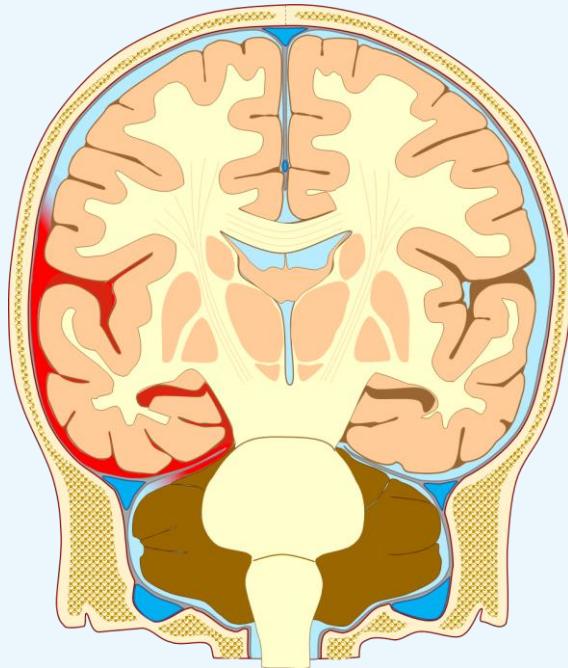
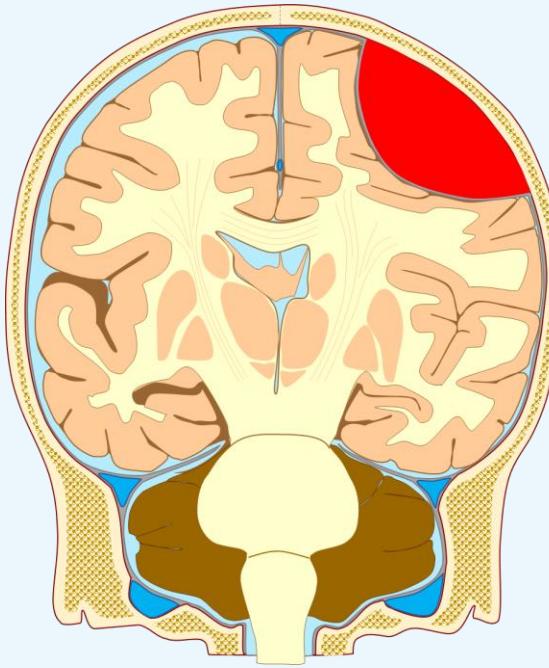
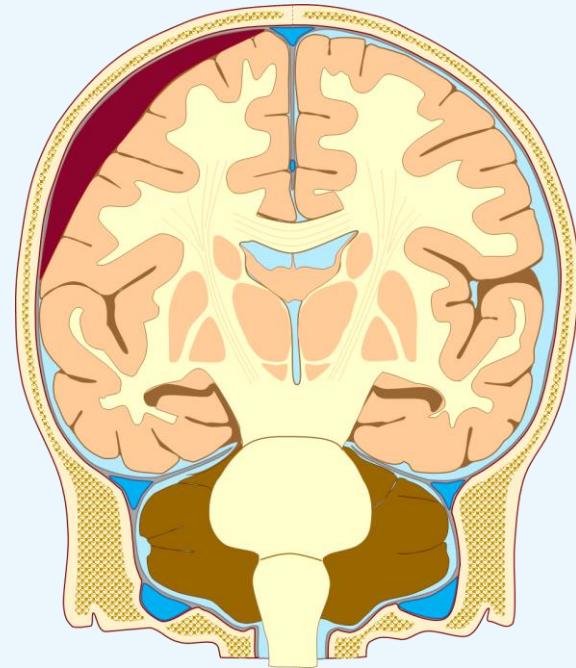
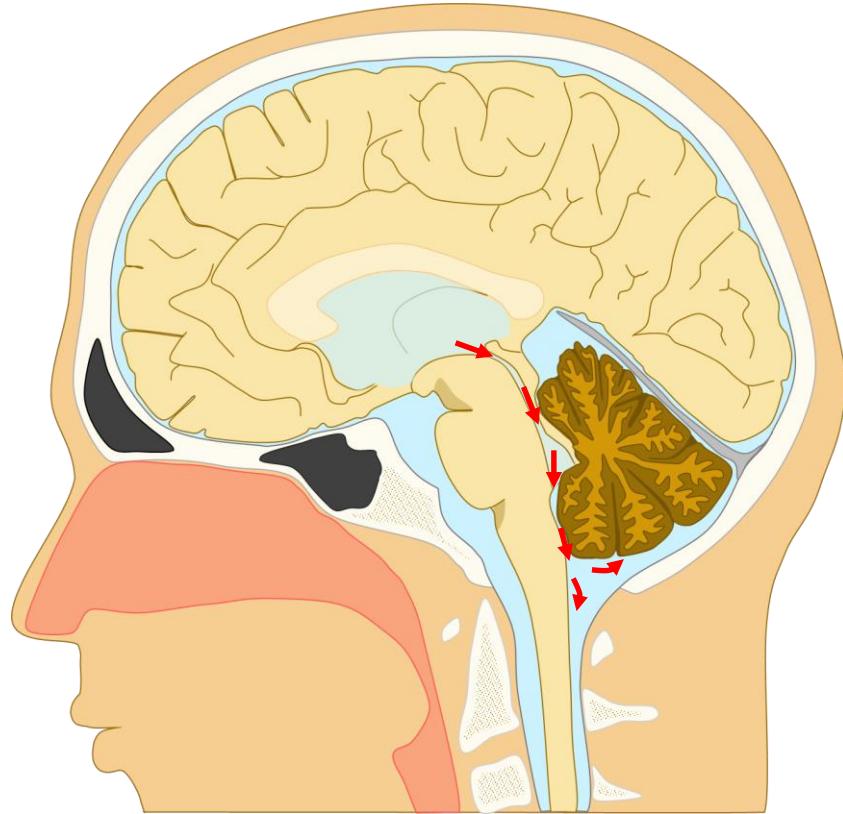
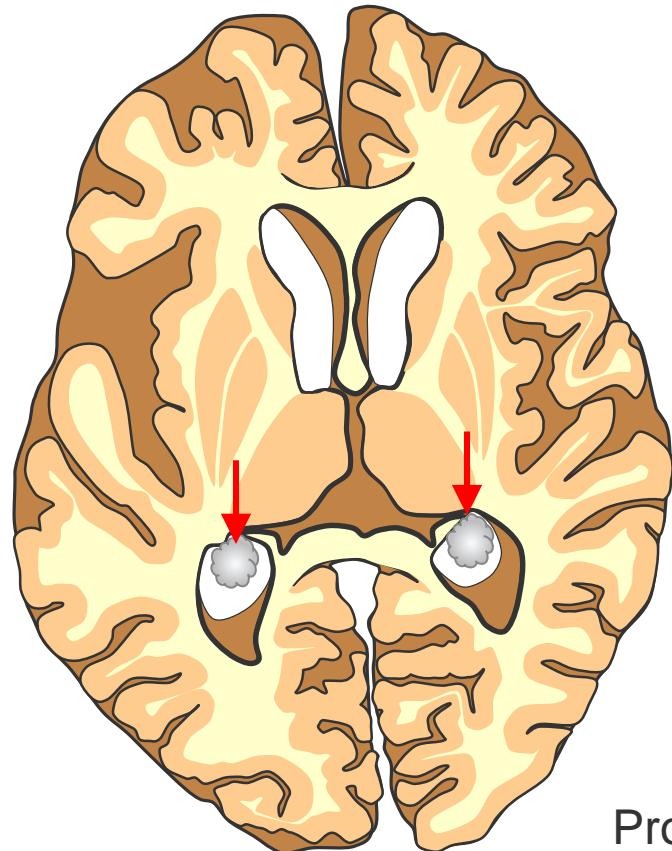


Illustration: Jacob Liljehult 2021

# Blødning mellem hjernehinderne

**SAH**Subarachnoidal  
blødning**EDH**Epidural  
blødning**SDH**Subdural  
blødning

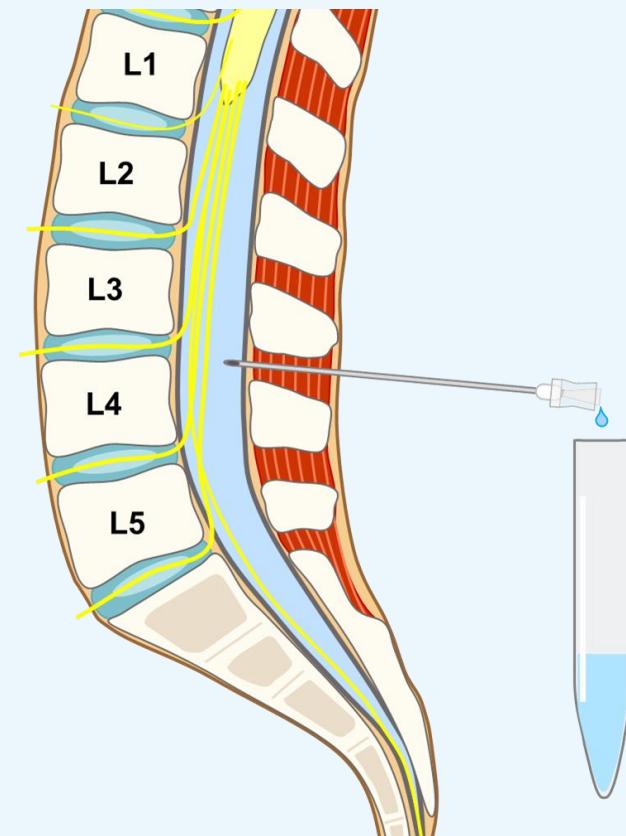
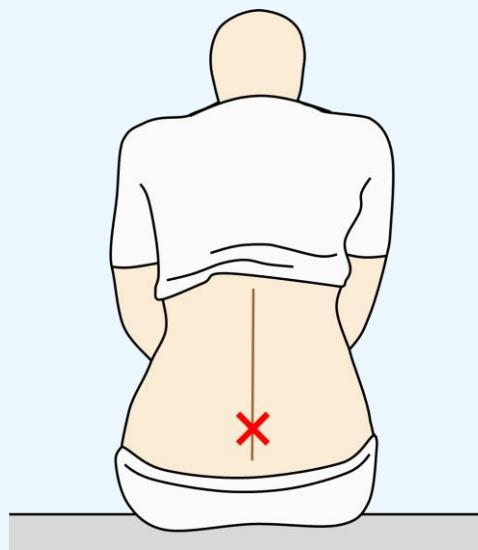
# Cerebro-spinal væske



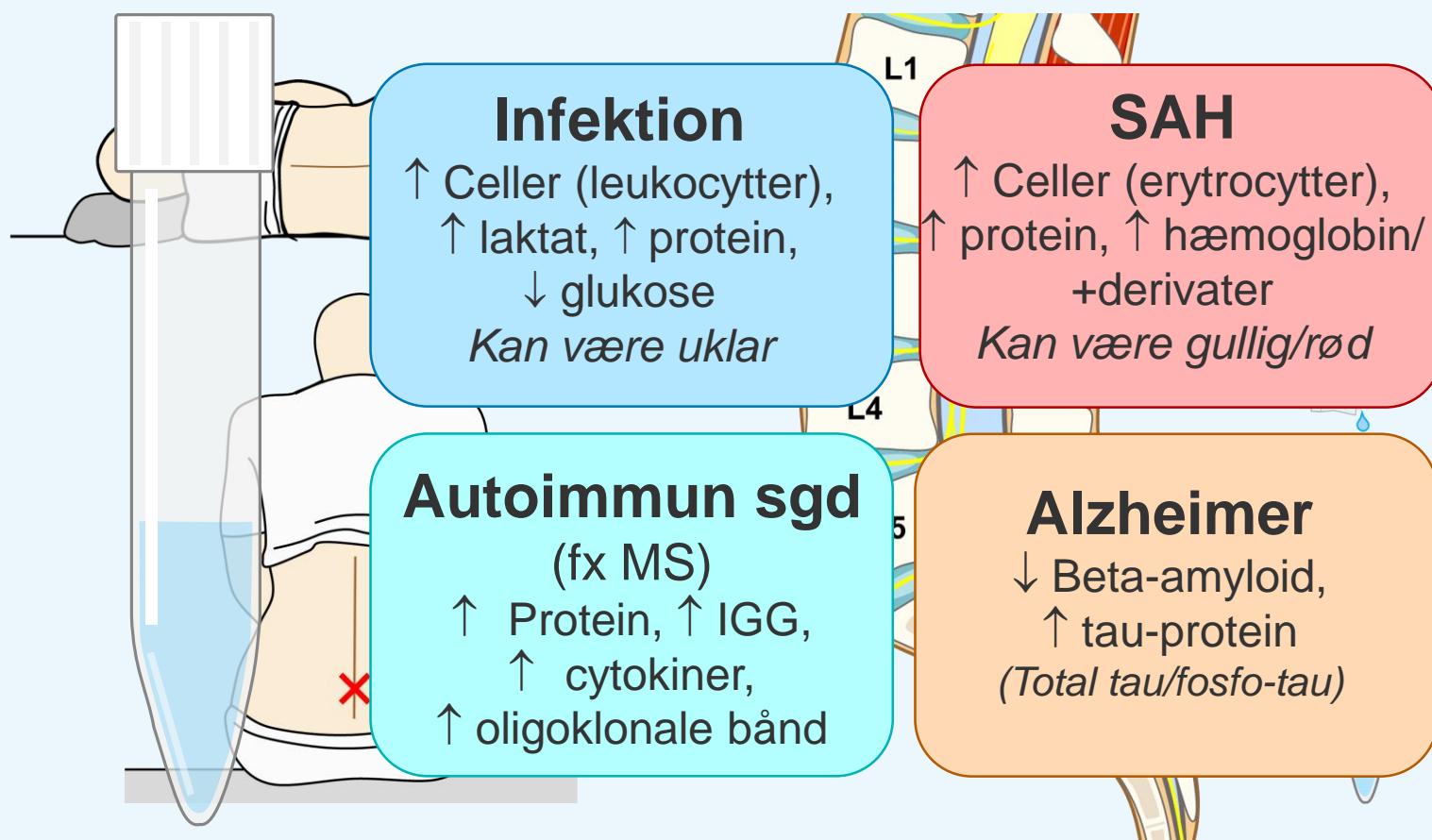
## Produktion

- Aktiv produktion i plexus choroideus
- Passiv udsivning fra hjernens overflade

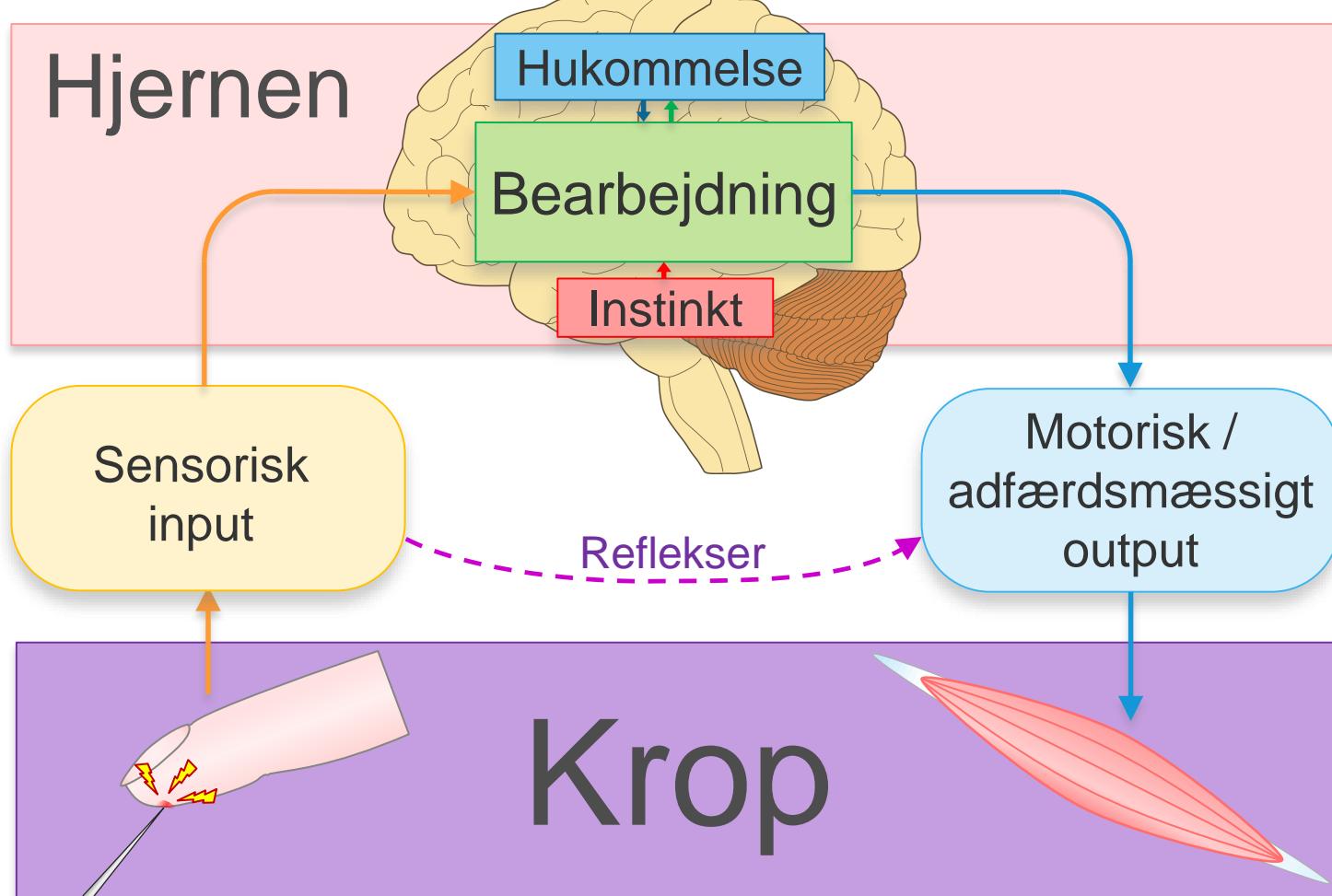
# Lumbalpunktur



# Lumbalpunktur



# Proces-model

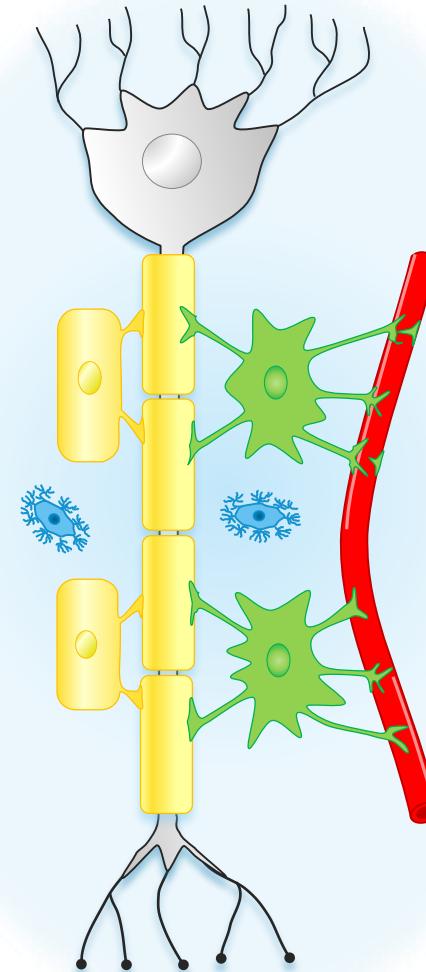


A detailed anatomical illustration of a human brain in lateral view. The brain is colored in a light beige or cream hue. The cerebral cortex is visible with its characteristic gyri (ridges) and sulci (grooves). A prominent feature is the pons, which is shaded in a darker, reddish-brown color with fine horizontal lines, indicating a different tissue type or perhaps a specific anatomical region. The brain is set against a plain white background.

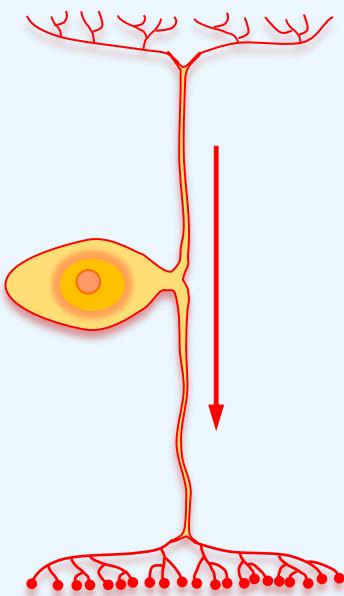
# **Bestanddele**

# Nervesystemets celler

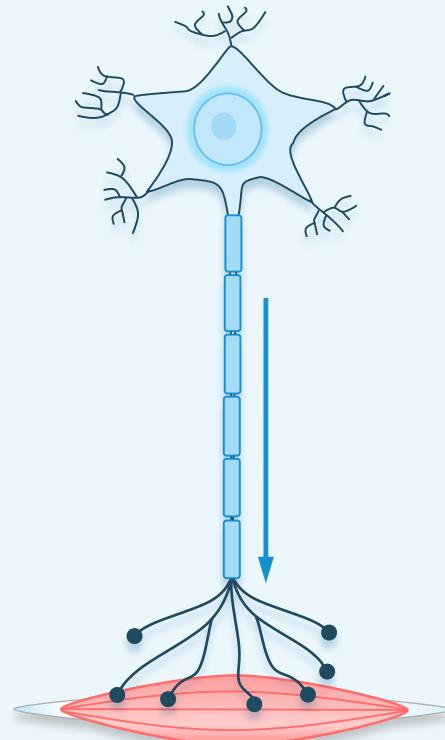
- Nerveceller (Neuroner)
- Støtteceller (Gliaceller)
  - *Astrocytter* ●
  - *Myelinierende celler* ●
    - *Oligodendrocytter (CNS)*
    - *Swann'ske celler (PNS)*
  - *Mikrocytter* ●



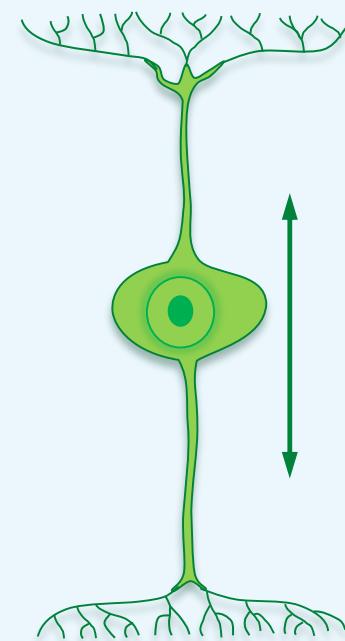
# Neuroner



**Sensorisk neuron  
(Unipolar)**

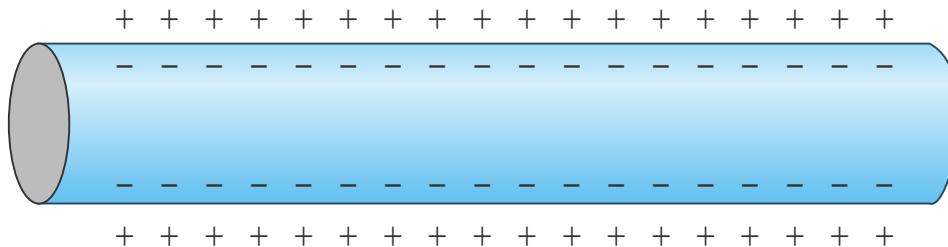


**Motorisk neuron  
(Multipolar)**

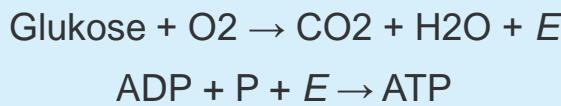
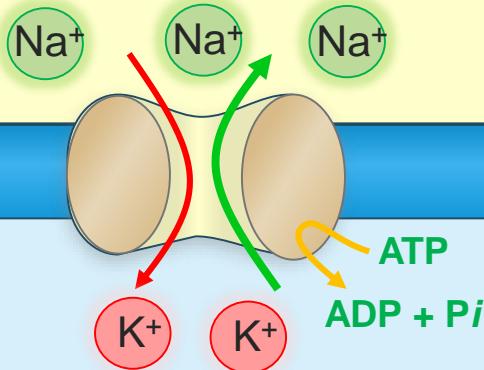


**Interneuron  
(Bipolar)**

# Nervesignalet



## Natrium-Kalium pumpen

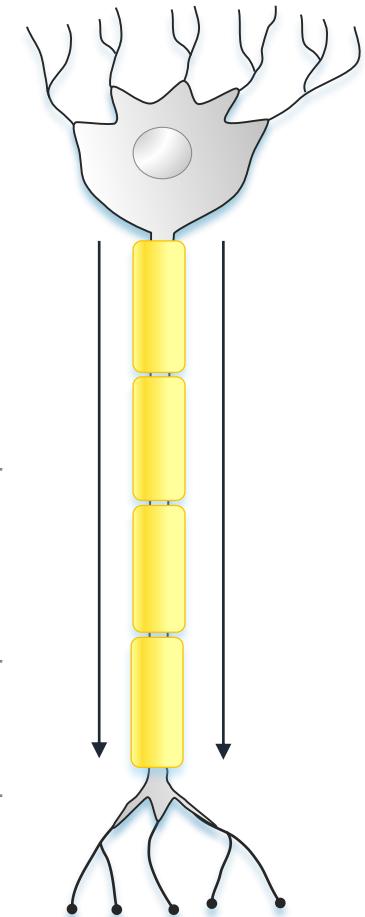


Signalet løber på ydersiden af cellen

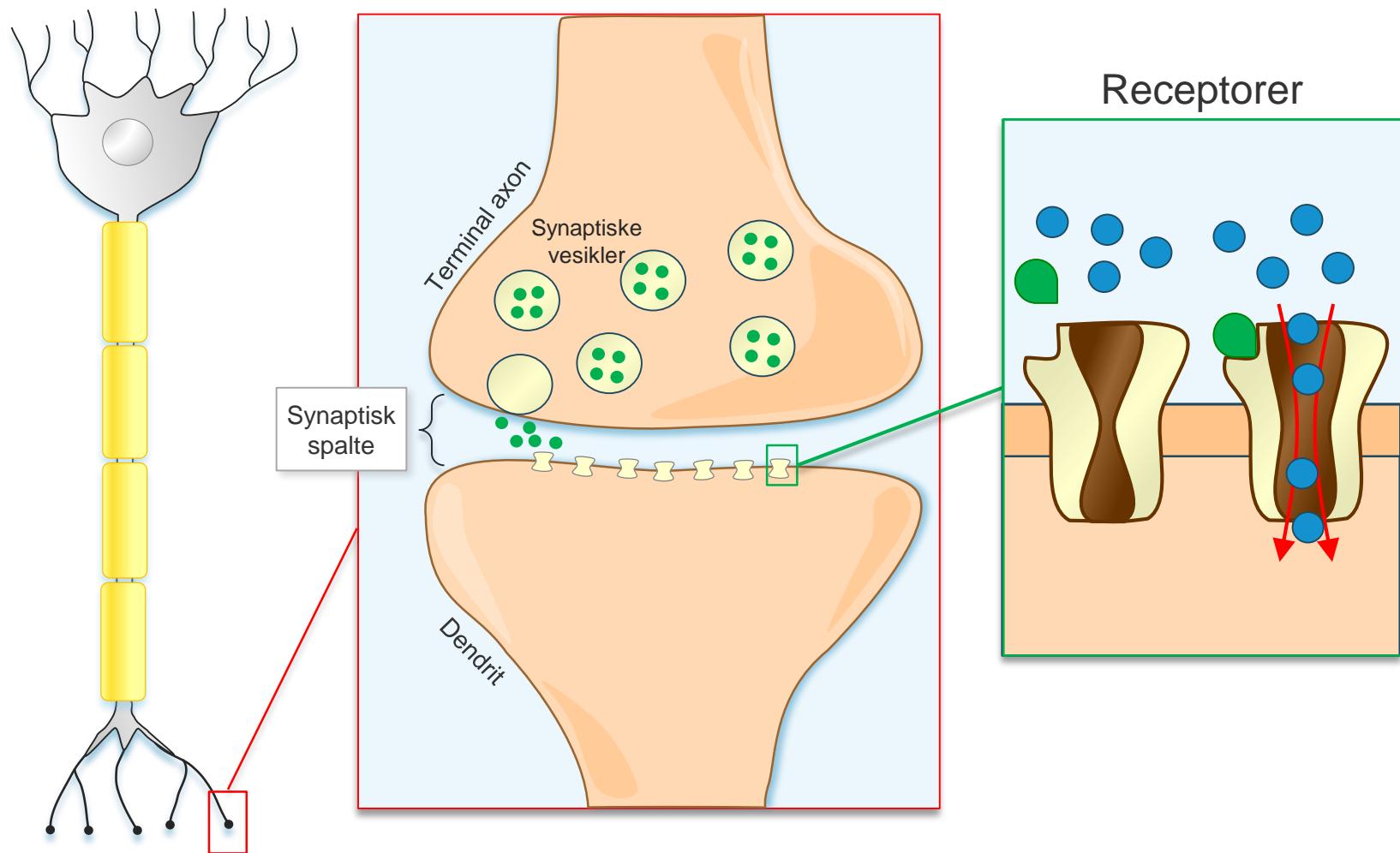
Signalet består i ændringer i spændingsforskellen på inder- og ydersiden

Det kræver energi at opbygge aktionspotentiale

Nerveceller kan kun få energi fra glukose



# Synapser og neurotransmitterer



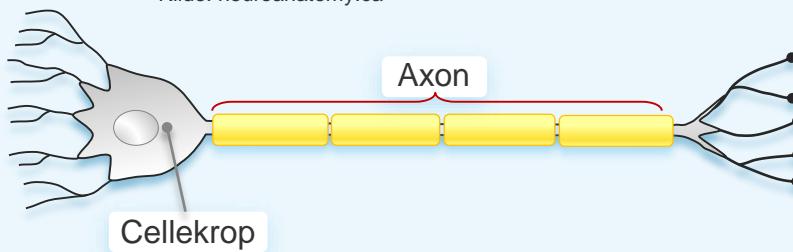
# Neurotransmittere

Neurotransmitter	Sygdomme	Farmakologi
GABA		Benzodiazepiner, barbiturat, alkohol, propofol
Acetylcholin	Myastenia gravis	Botox
Dopamin	Parkinson	Ritalin, L-DOPA
Noradrenalin	Depression	Antidepressiva
Serotonin	Depression	Antidepressiva

# Grå og hvid substans



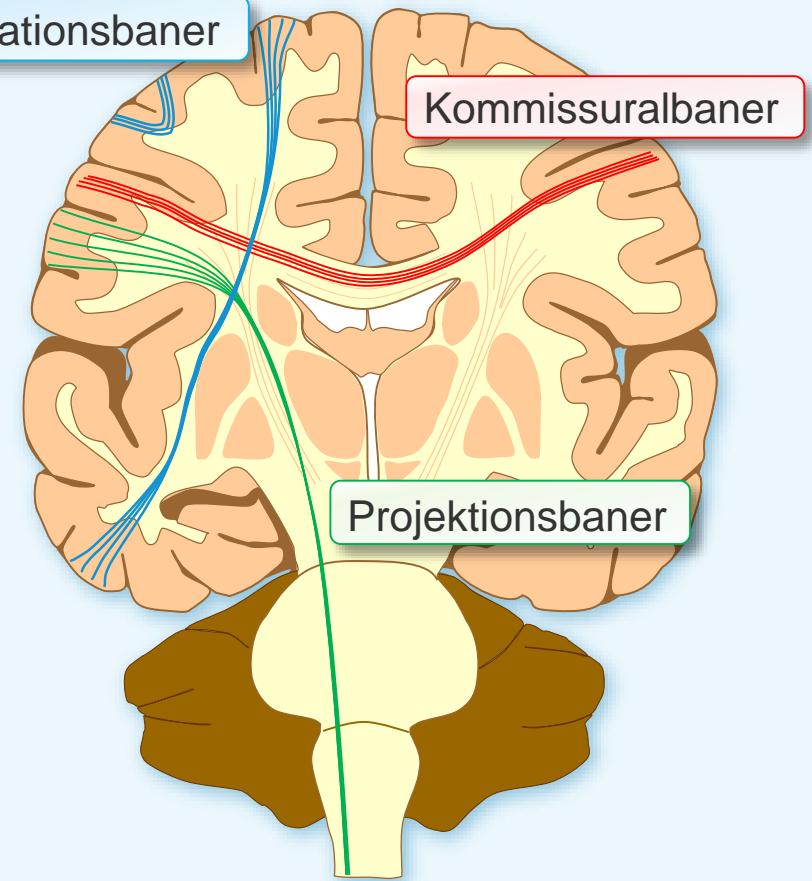
Kilde: neuroanatomy.ca



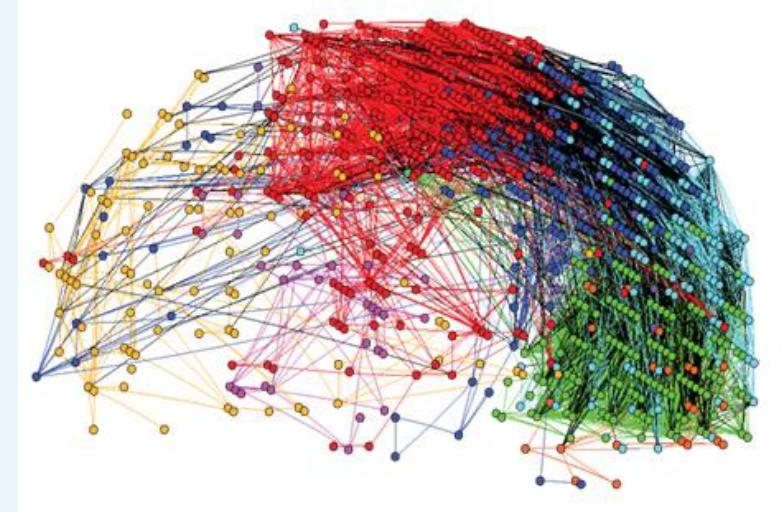
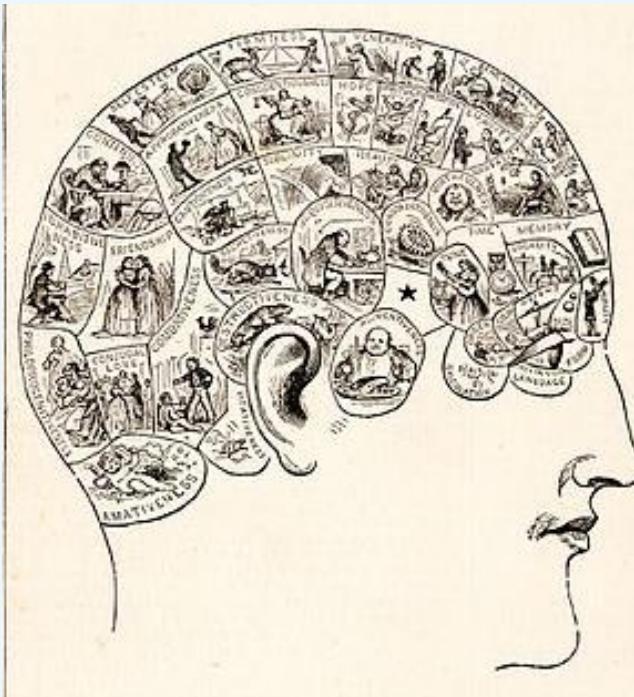
Associationsbaner

Kommissuralbaner

Projektionsbaner



# Hjernens funktioner



## Centre

vs.

# Netværk

# Sammenhæng mellem læsion og symptom?

Prenons d'abord le premier cas, le cas Leborgne ; il s'agit, sans aucune discussion possible, d'une Aphasie de Broca, le malade n'a

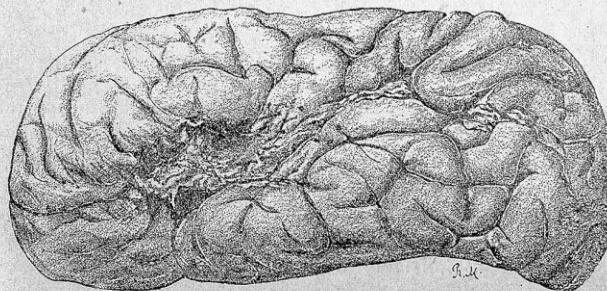
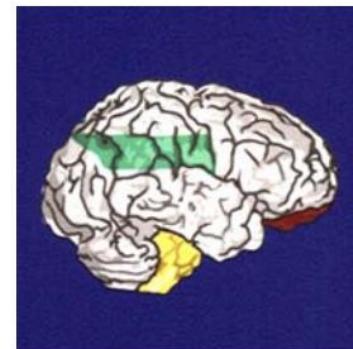


Fig. 1 — Hémisphère gauche du cerveau de Leborgne, première autopsie de Broca. Dessin fait sur la photographie de la pièce actuellement conservée au Musée Dupuytren. On voit que, en outre de la lésion de la troisième frontale, le ramollissement existait tout le long de la scissure de Sylvius et siégeait par conséquent aussi dans la zone de Wernicke.

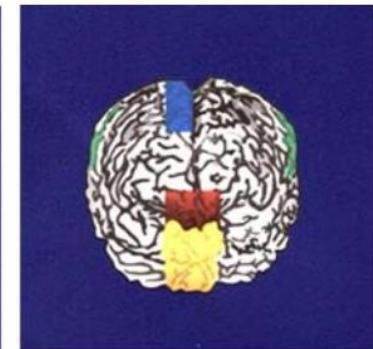
plus à sa disposition que la syllabe *tan*, il est hémiplégique à droite, c'est un aphasique typique.

Voyons les données de l'autopsie :

## Broca's afasi



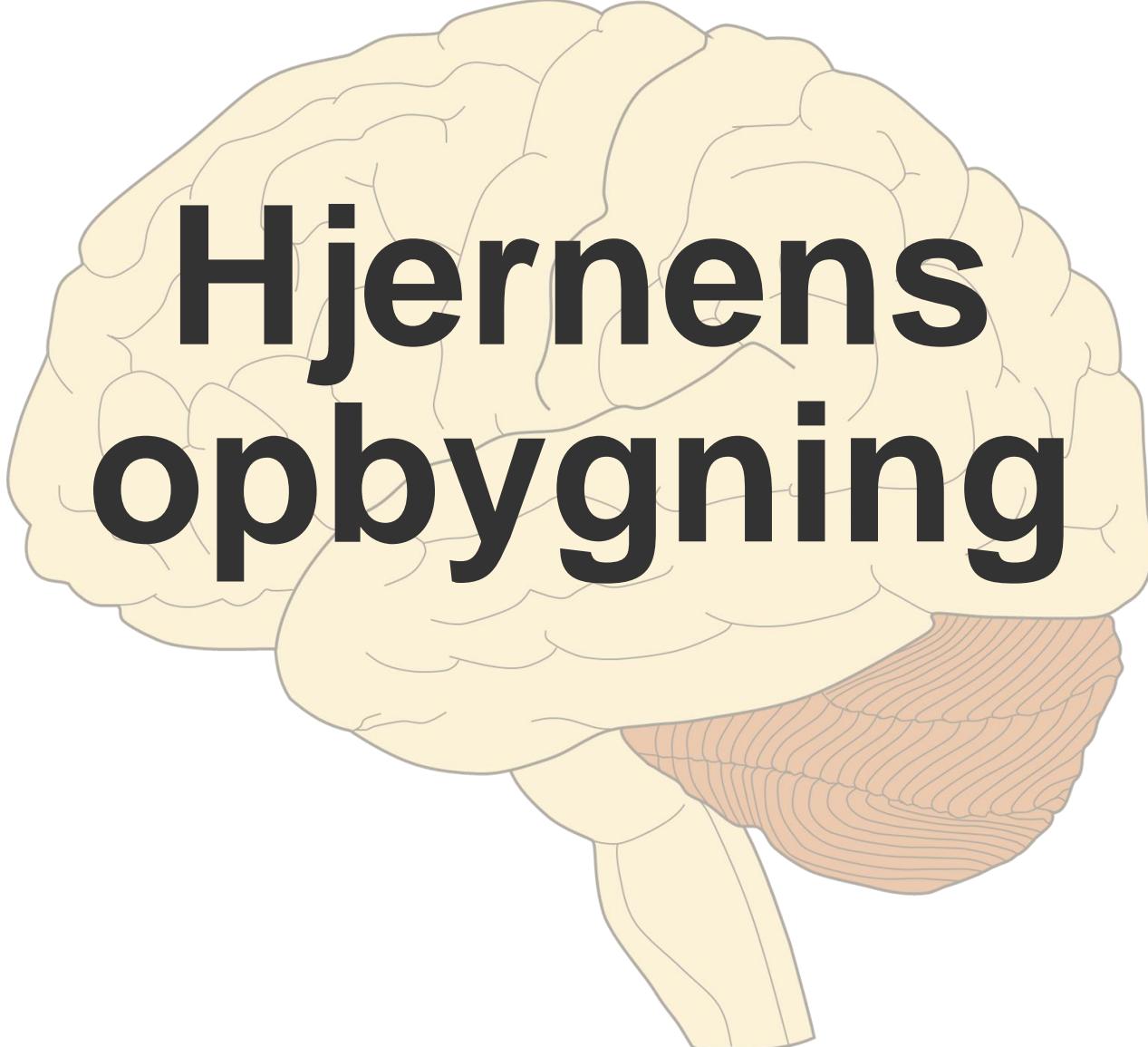
Lateral sagittal view



Anterior coronal view

## Gråd- og latterlabilitet (pseudobulbær affekt)

Ghaffar O, Chamelian L, Feinstein A. Neuroanatomy of pseudobulbar affect : a quantitative MRI study in multiple sclerosis. J Neurol. 2008 Mar;255(3):406-12. PubMed PMID: 18297331.



# Hjernens opbygning

# Hjernen

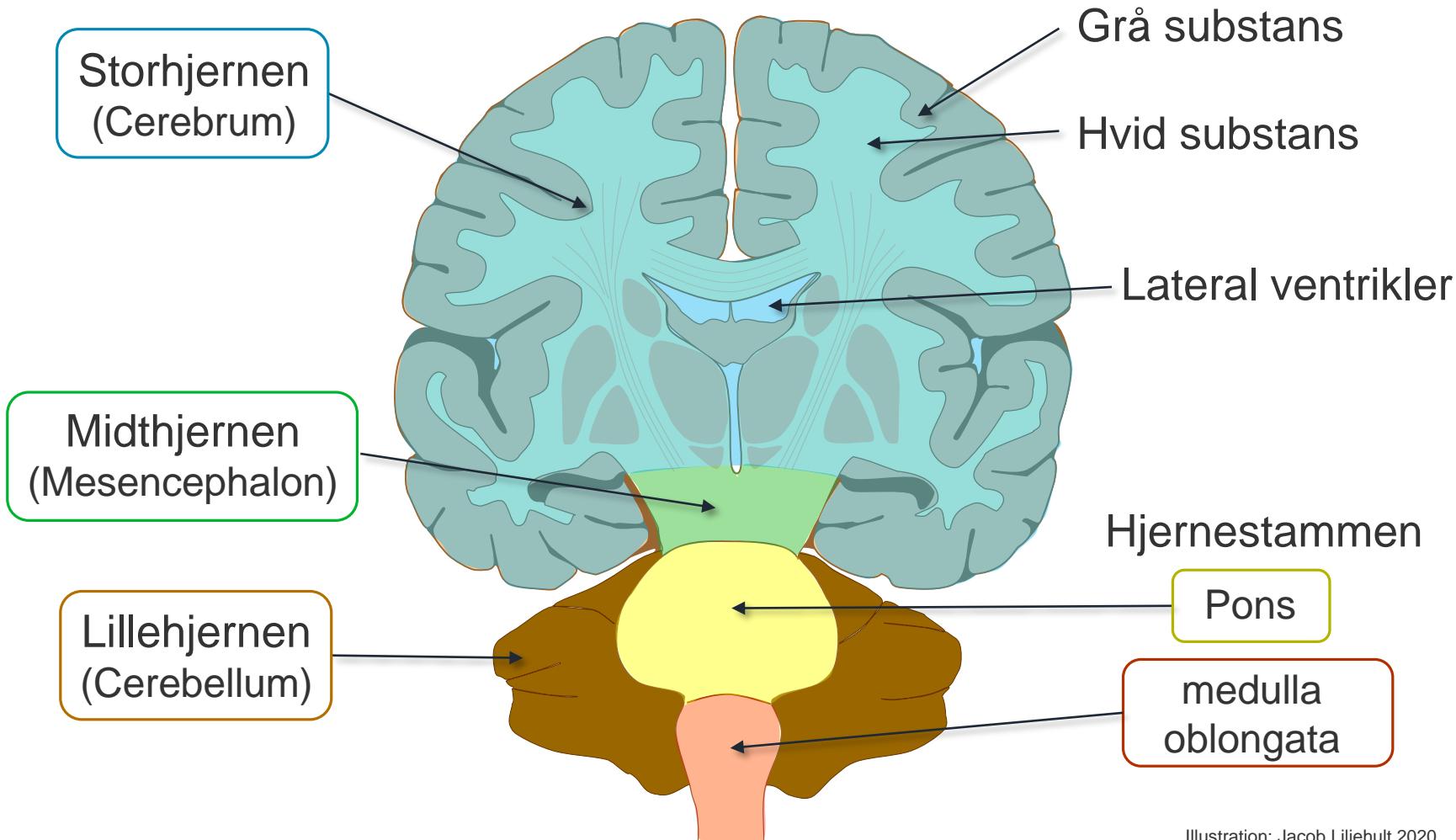


Illustration: Jacob Liljehult 2020

# Hjernens overflade

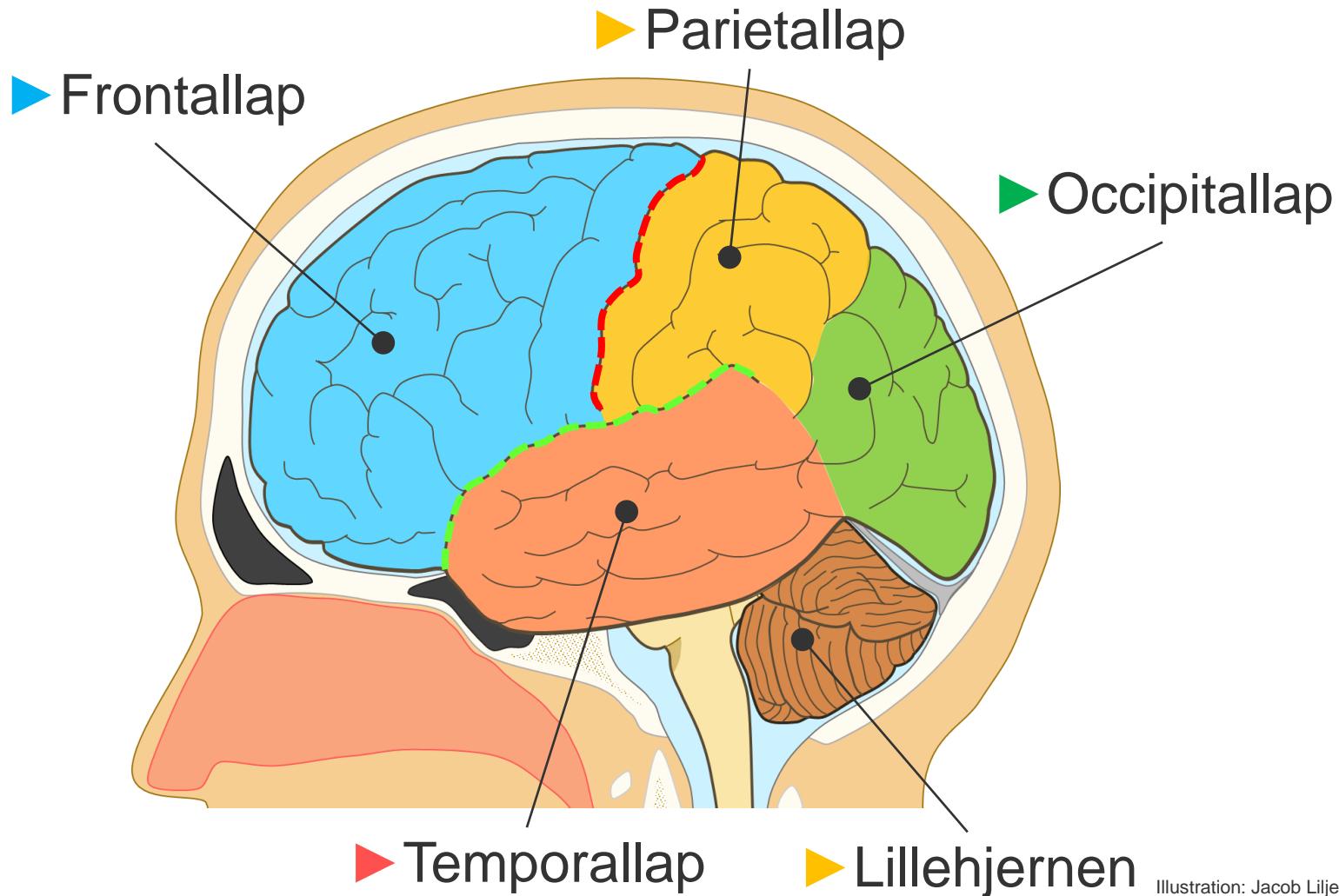


Illustration: Jacob Liljehult 2020

Jacob Mesot Liljehult

# Hjernens overflade

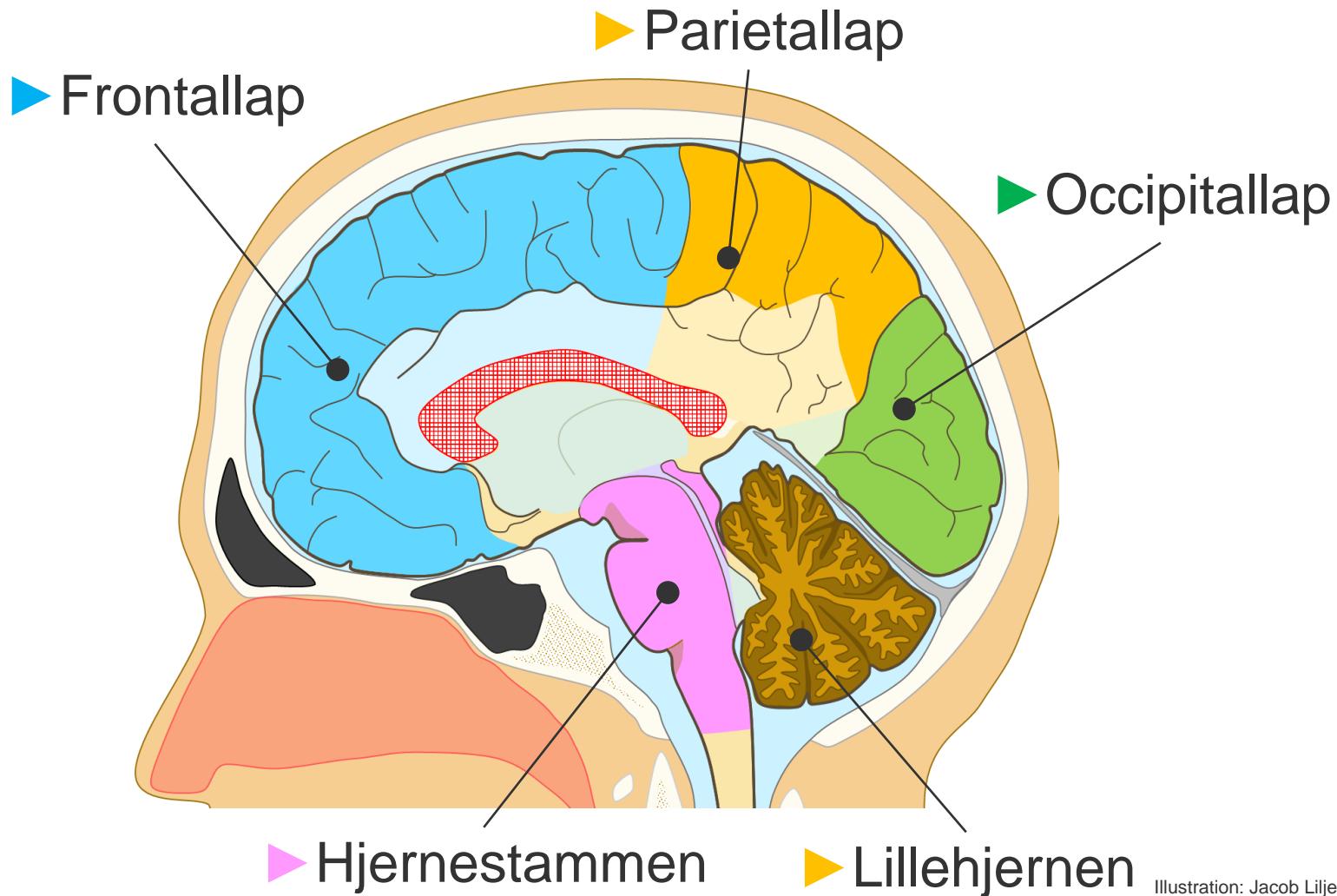
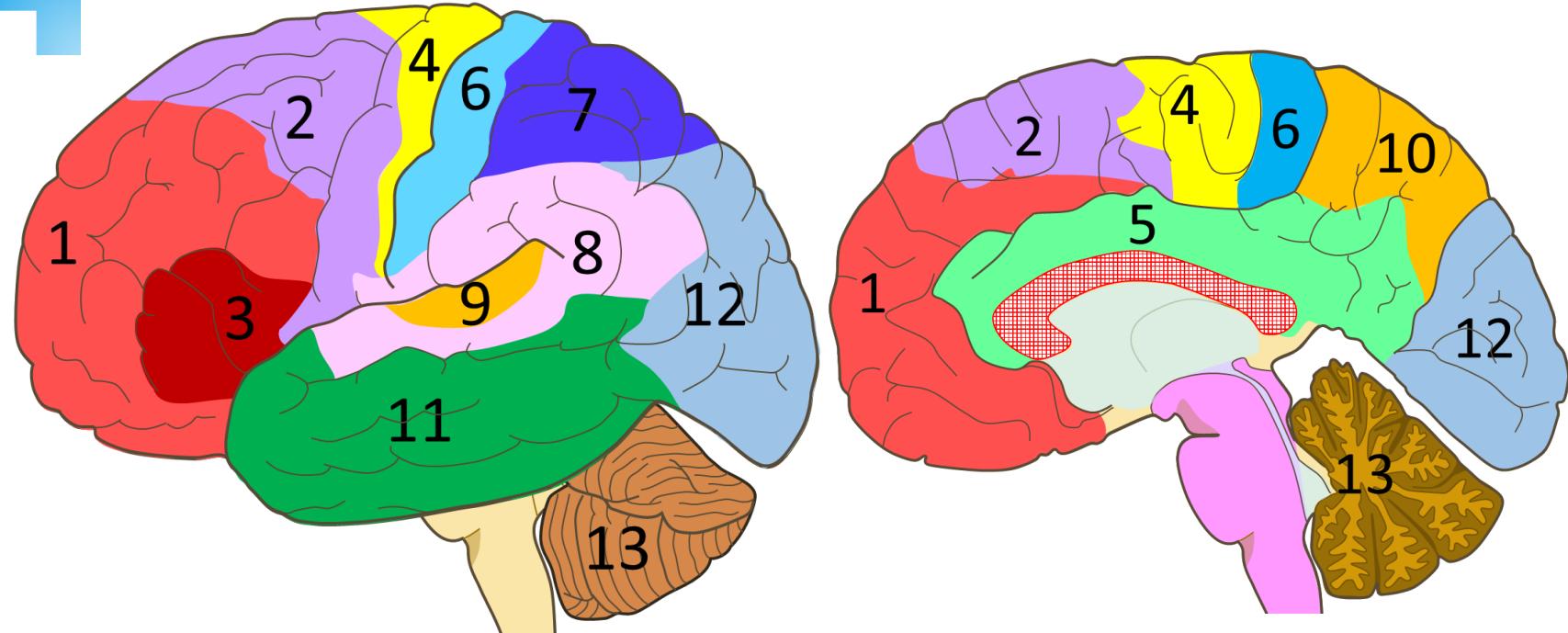


Illustration: Jacob Liljehult 2020



1	<b>Højere mentale funktioner</b> Koncentration, planlægning, dømmekraft, impulshæmning, kreativitet
2	<b>Sekundært motorisk område</b> Øjenbevægelser, orientering, skemaer for bevægelser
3	<b>Broca's område</b> Motorisk del af talen
4	<b>Primært motorisk område</b> Initiering af bevægelser

5	<b>Emotionelt område</b> Smerte, sult, "fight & flight"
6	<b>Primært somato-sensorisk område</b>
7	<b>Sekundært somato-sensorisk område</b> Vurdering af tekstur, vægt etc
8	<b>Wernickes område</b> Sprog forståelse
9	<b>Auditorisk område</b> Hørelse

10	<b>Associativt sensorisk område</b>
11	<b>Associativt område</b> Korttidshukommelse, emtioner
12	<b>Visuelt område</b> Syn, objektgenkendelse
13	<b>Cerebellum</b> Balance, kropsholdning, koordination af bevægelser

Illustration: Jacob Liljhult 2022

# Dybe strukturer

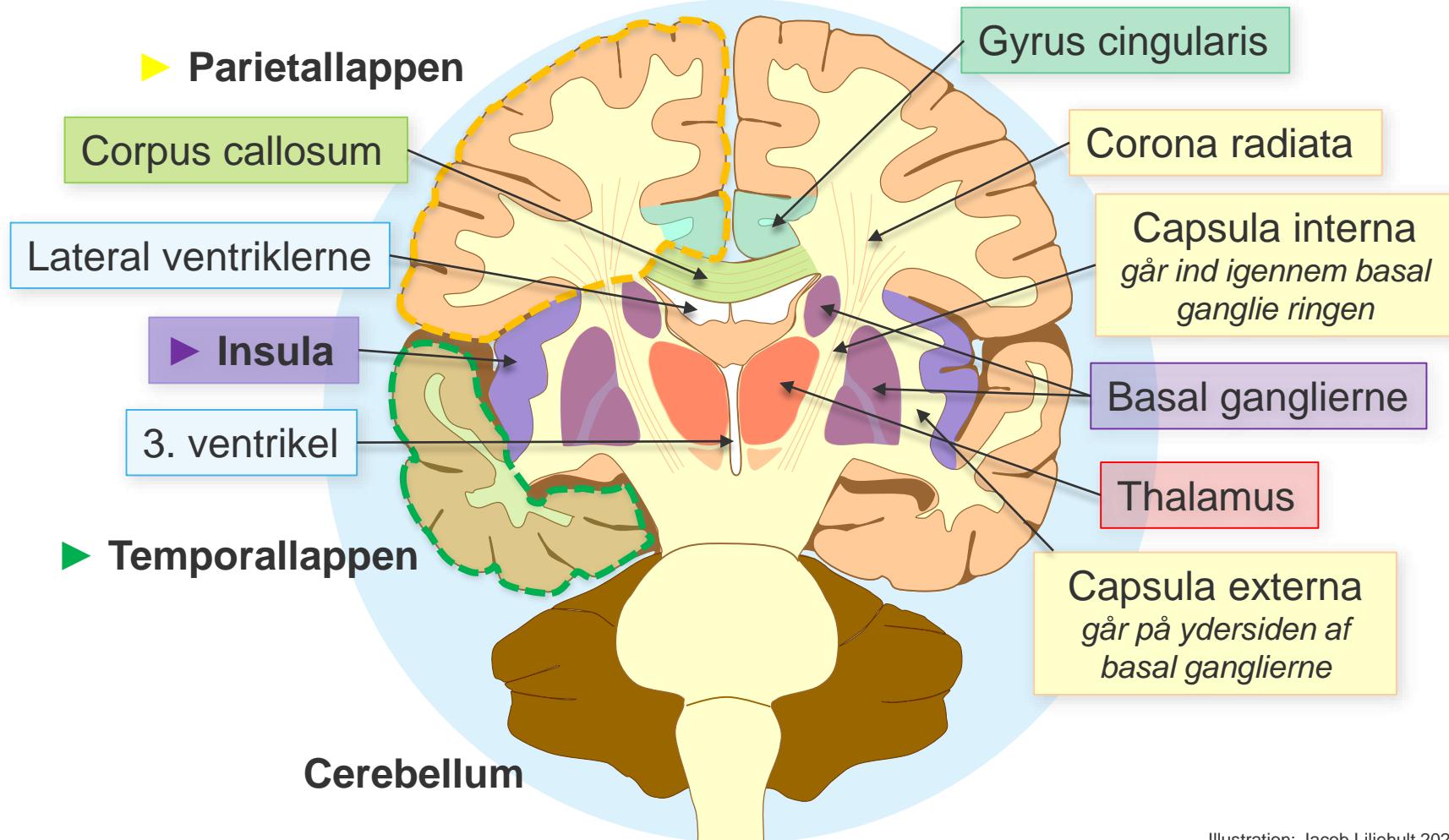


Illustration: Jacob Liljhult 2021

# Hemisfære-lateralisering

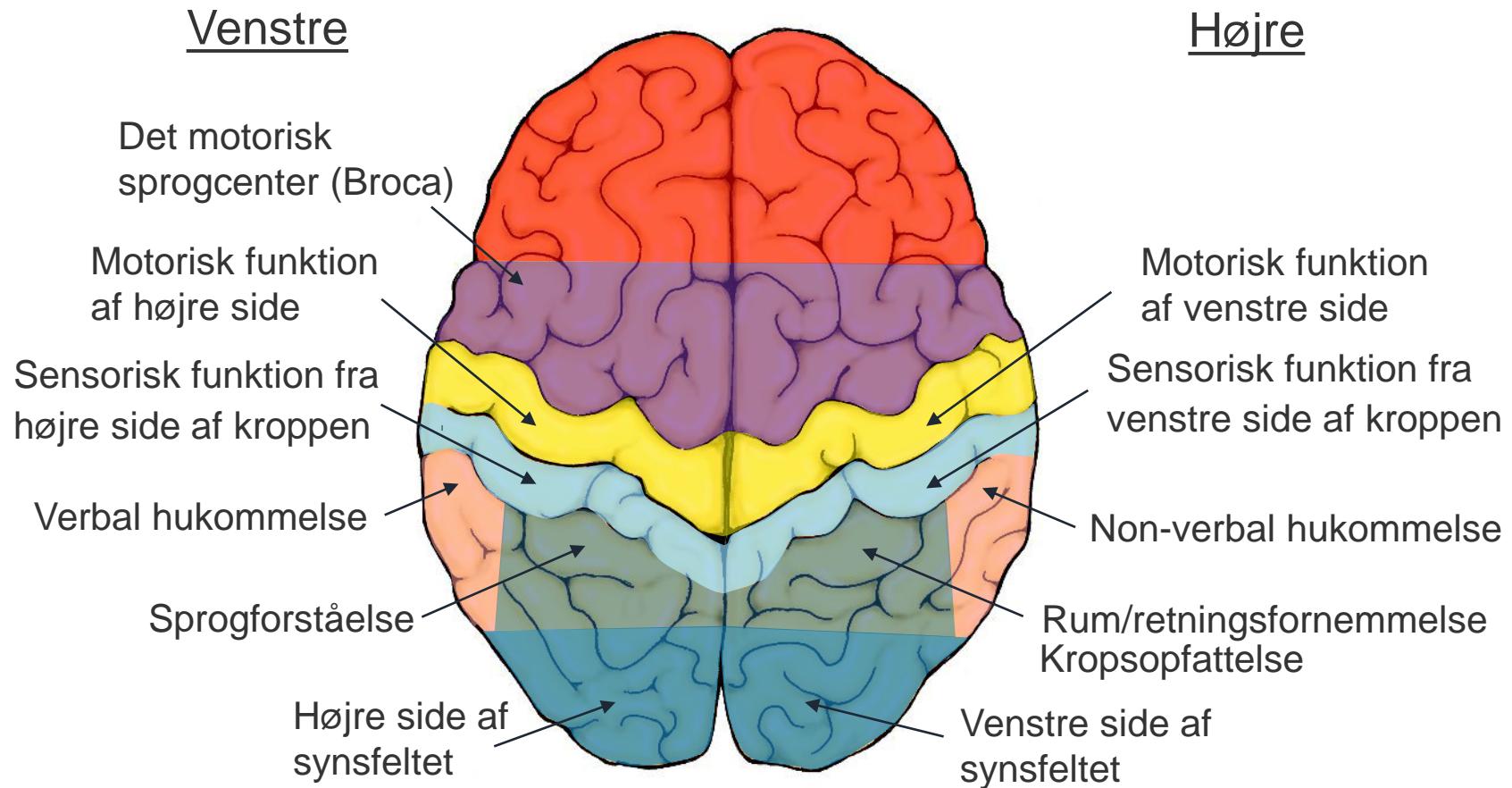
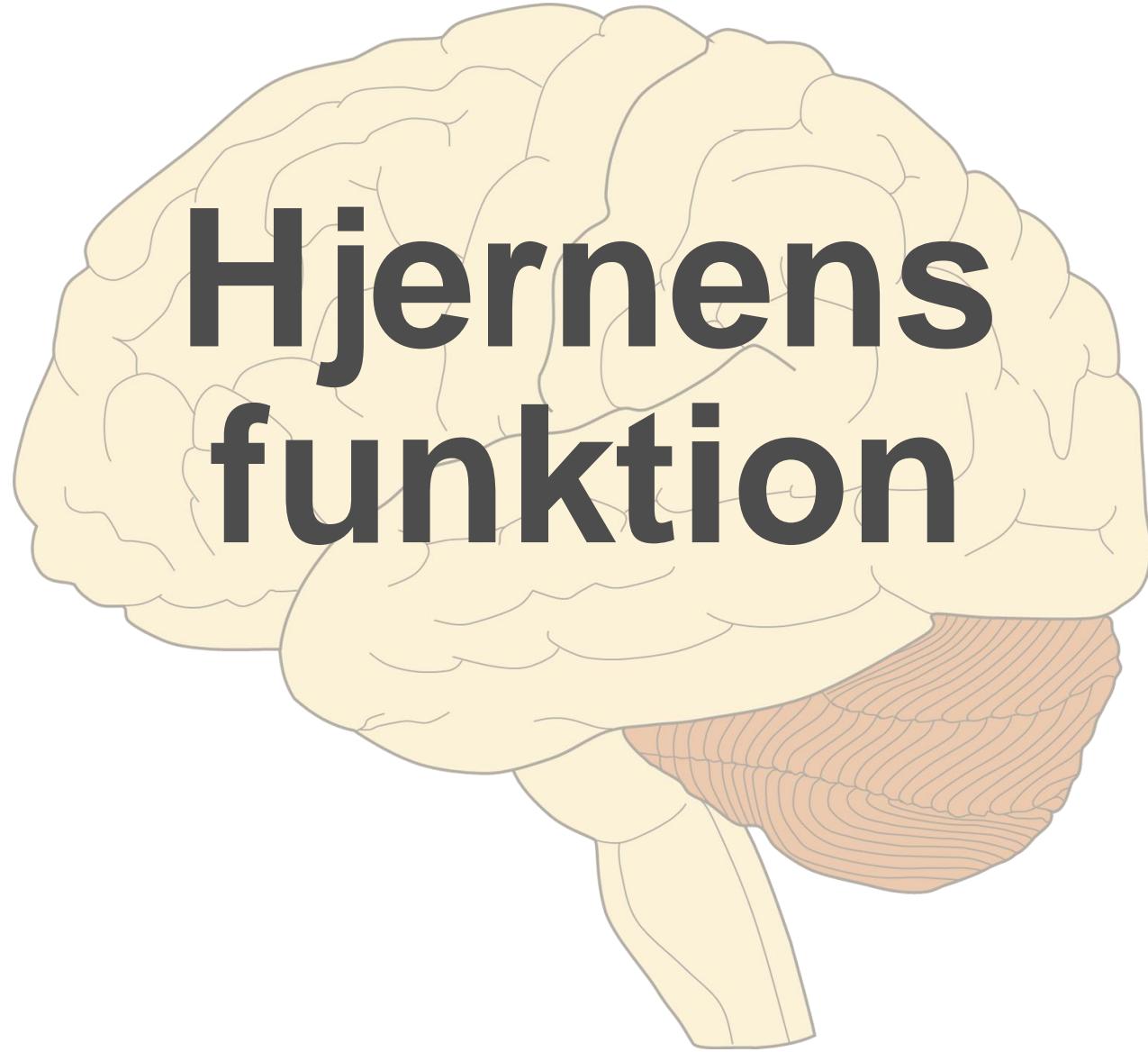
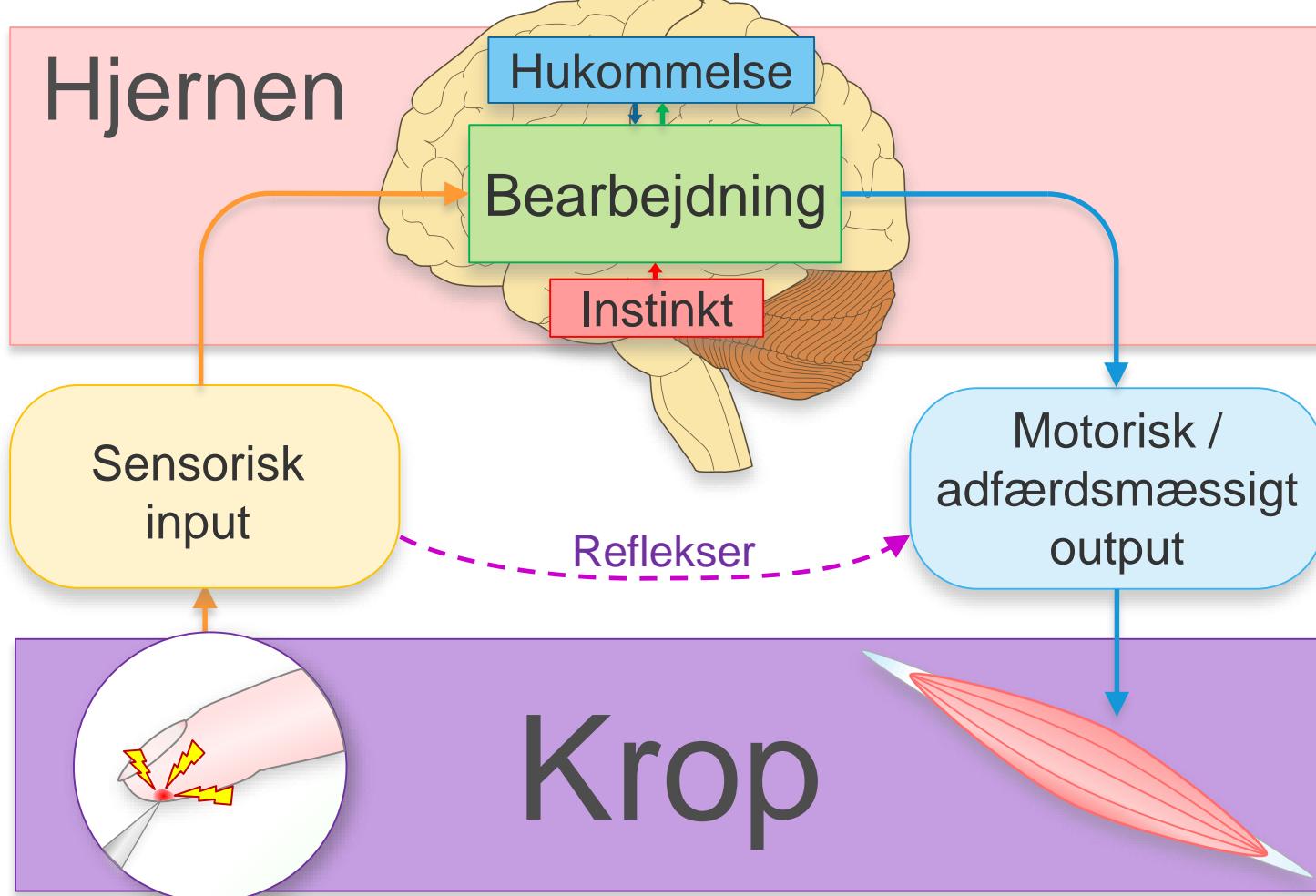


Illustration: Jacob Liljehult 2020

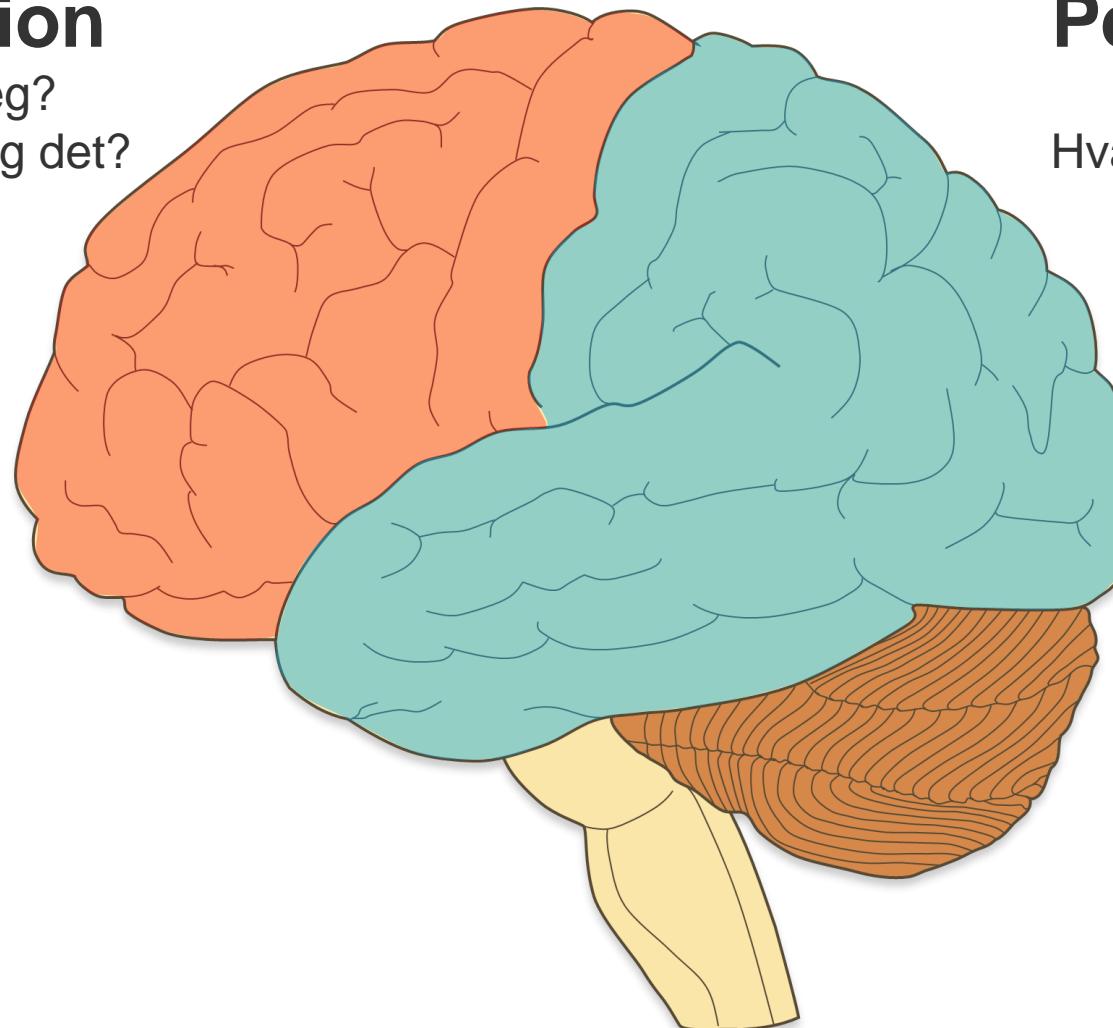


# Funktionel model



# Eksekution

Hvad gør jeg?  
Hvordan gør jeg det?



# Perception

Hvor er jeg?  
Hvad foregår der?

Illustration: Jacob Liljehult 2022

Jacob Mesot Liljehult

# Perception

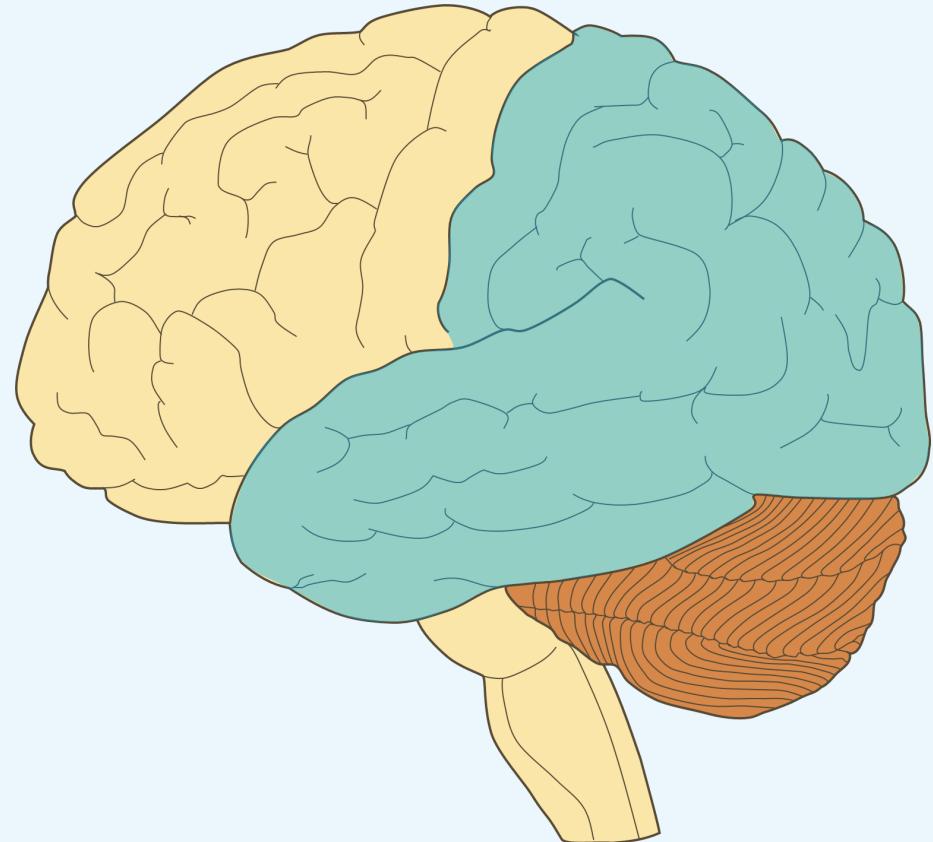
## Sanser

- **Specialiserede sanser**

- Lugt
- Smag
- Syn
- Hørelse
- Balance

- **Somato-sensoriske sanser**

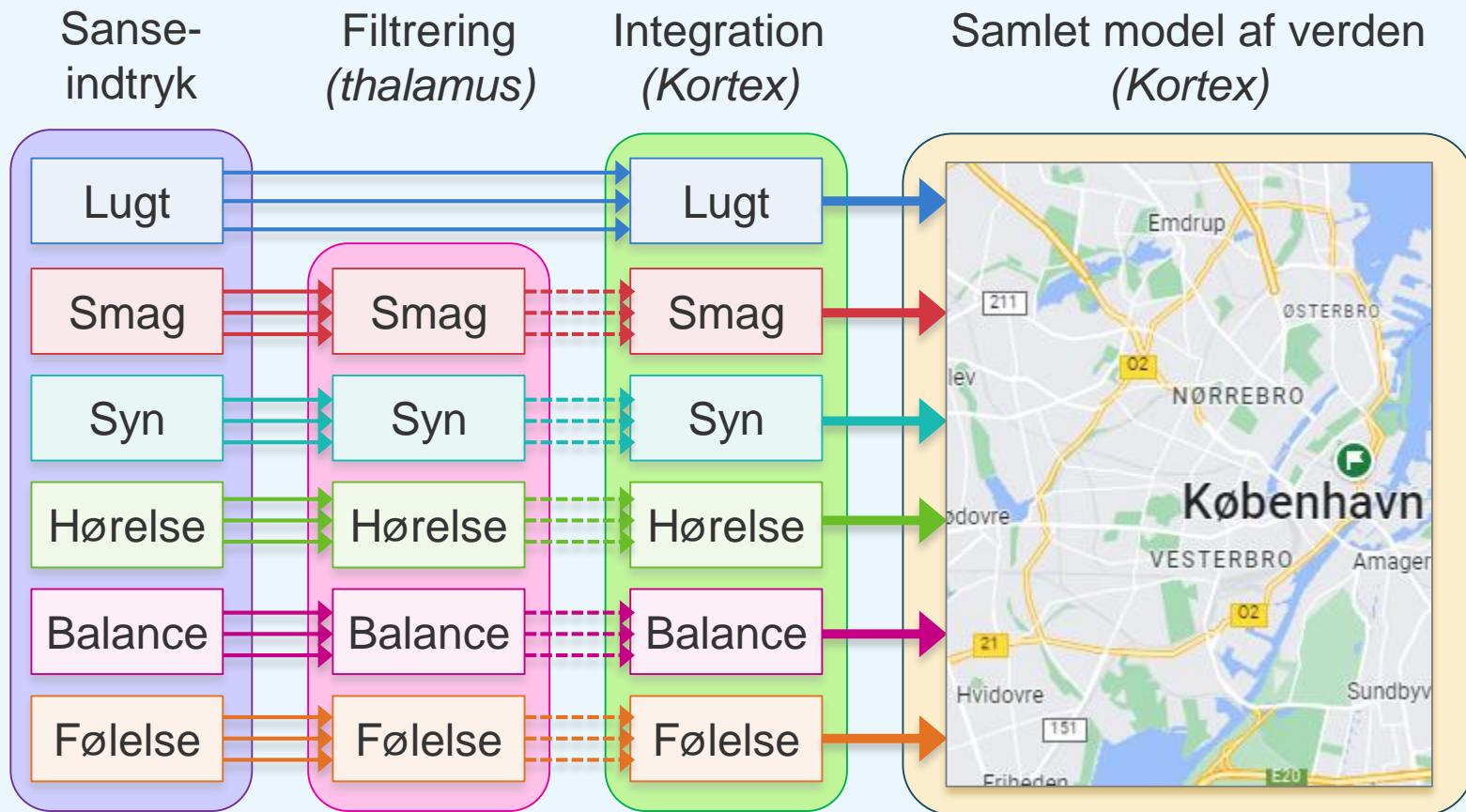
- Berøring
- Smerte/temperatur
- Proprioception

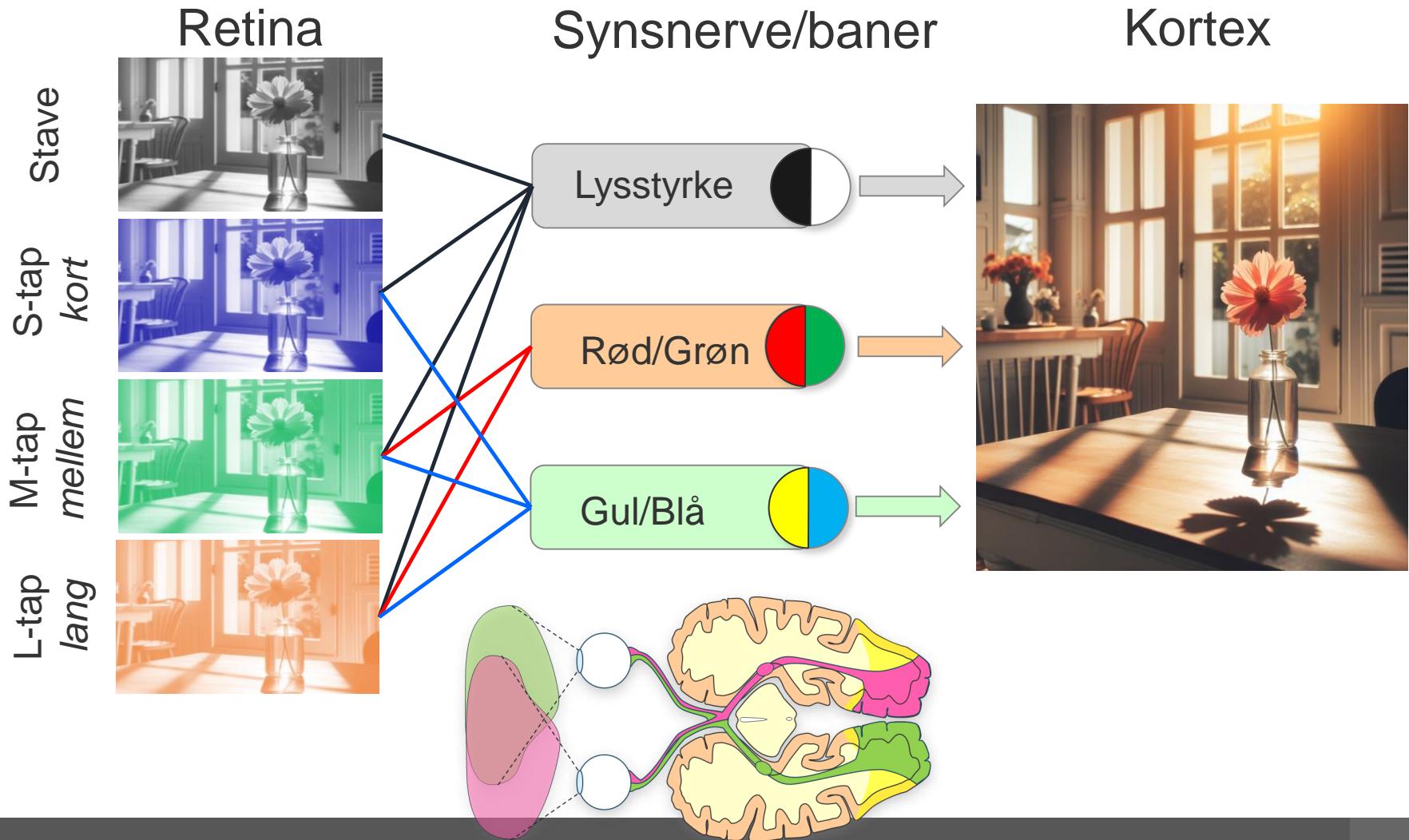


Kilde: Gade 2009; Illustration: Jacob Liljehult 2020

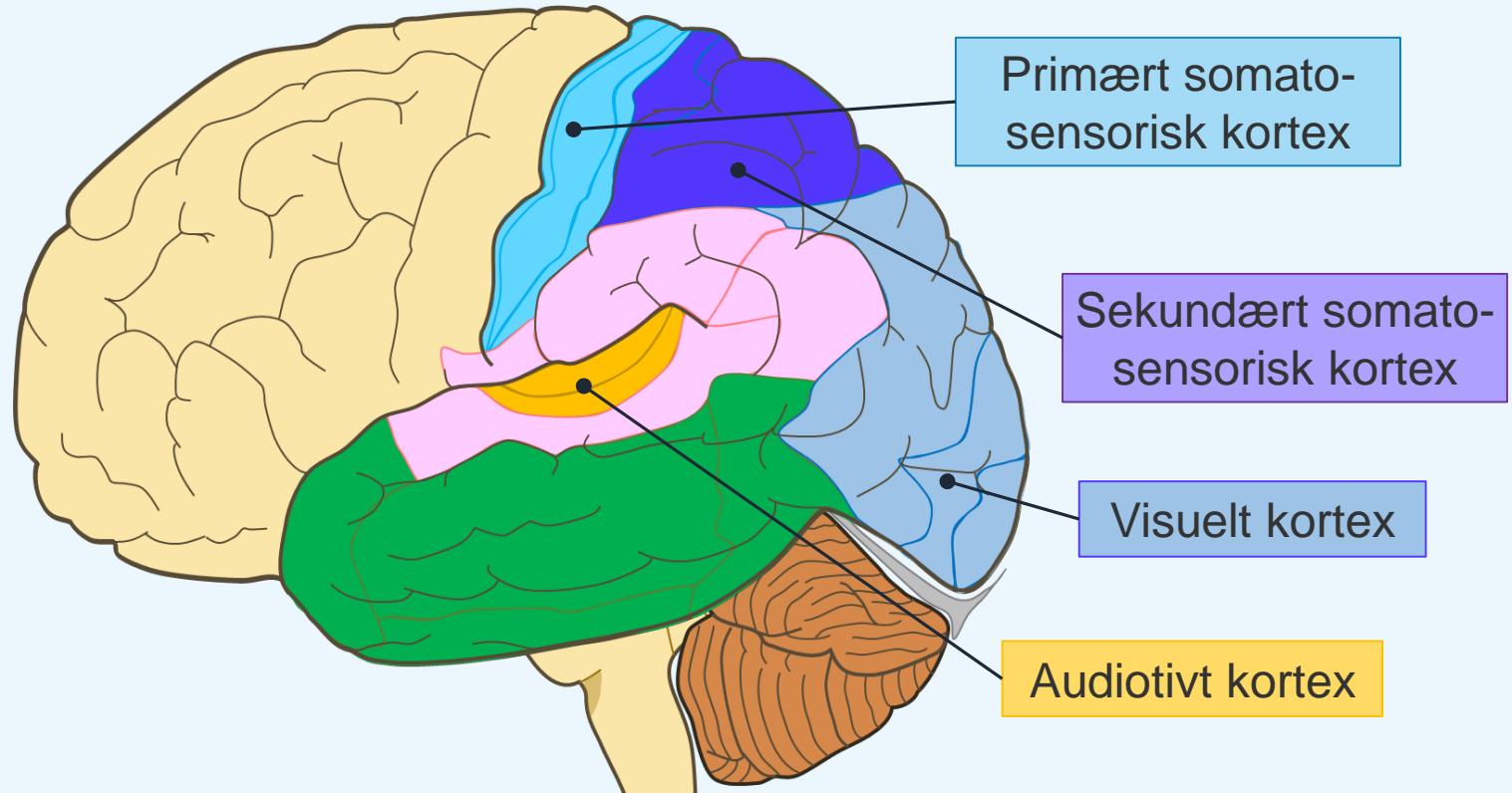
Jacob Mesot Liljehult

# Perception





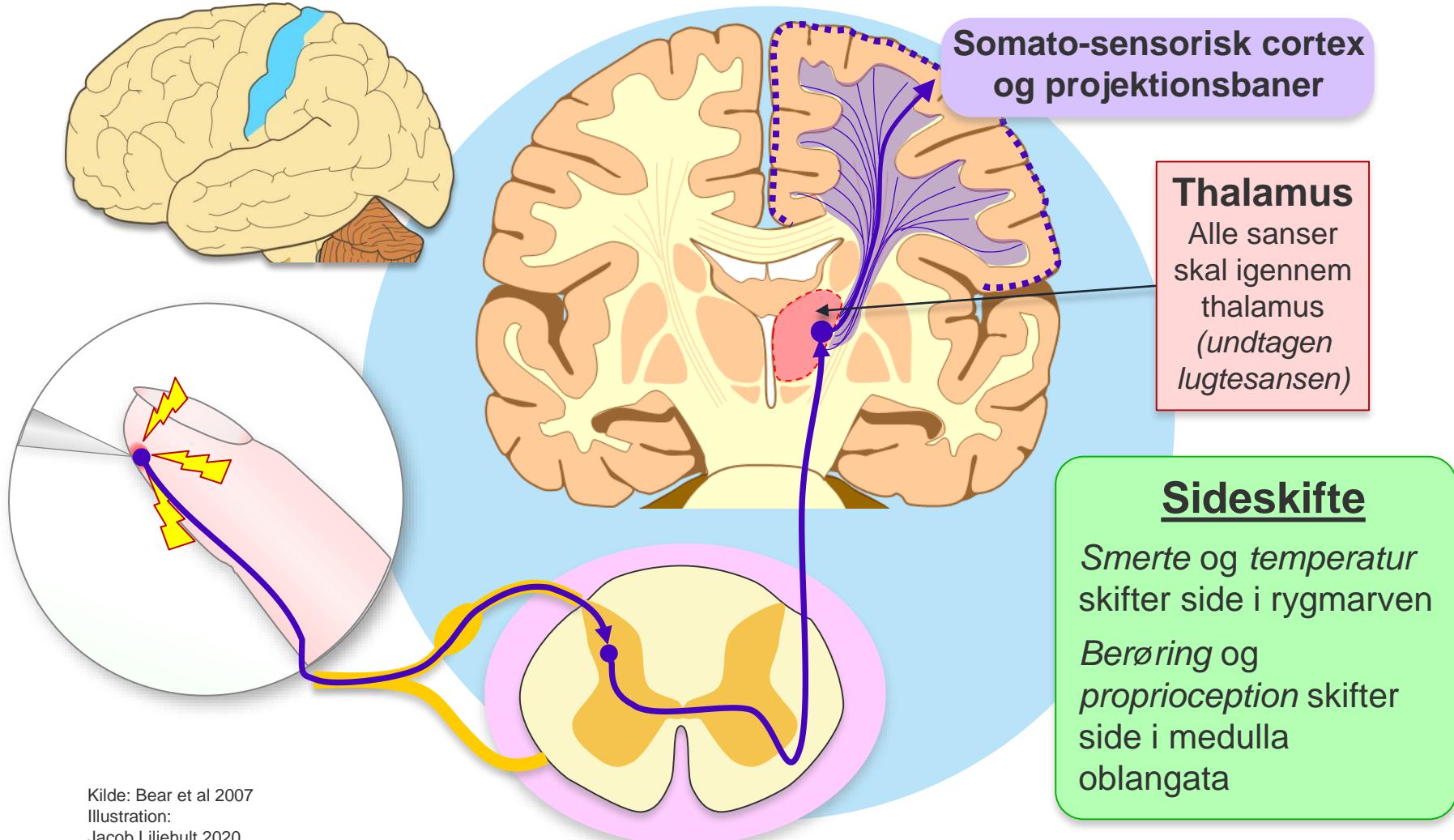
# Perception



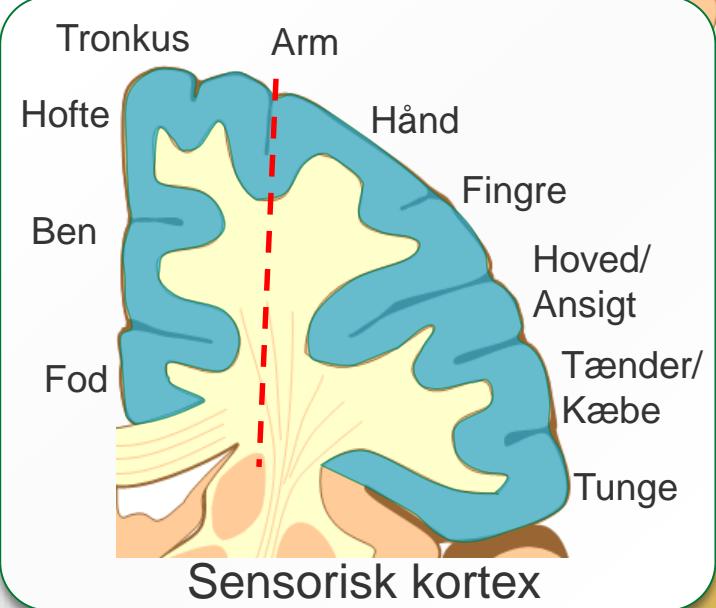
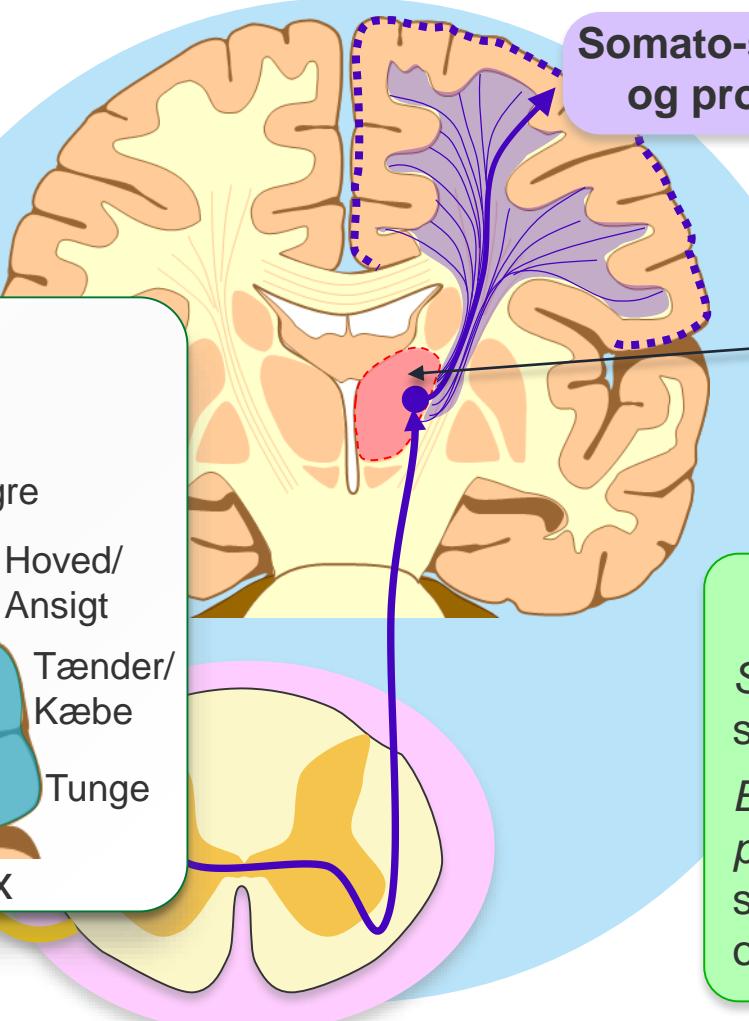
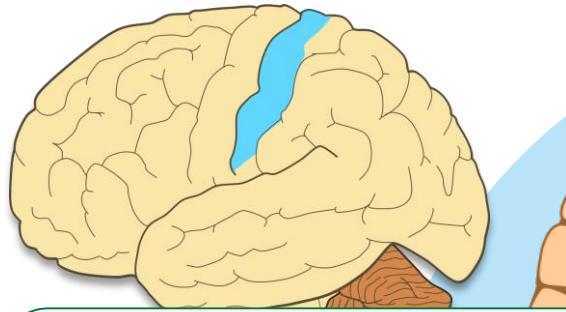
Kilde: Gade 2009

Illustration: Jacob Liljehult 2020

# De somato-sensoriske baner



# De somato-sensoriske baner



Kilde: Bear et al 2007

Illustration:

Jacob Liljehult 2020

# Synet

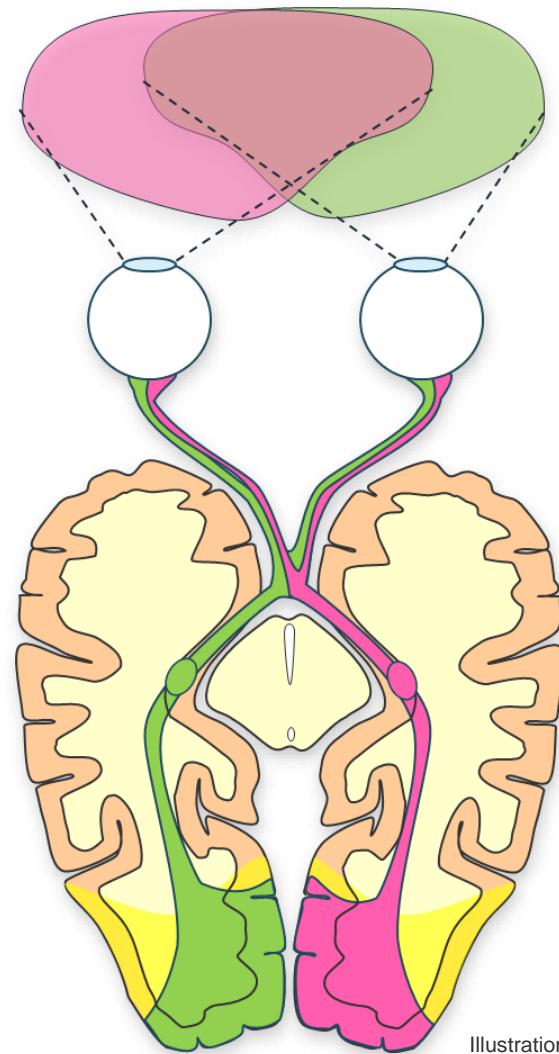
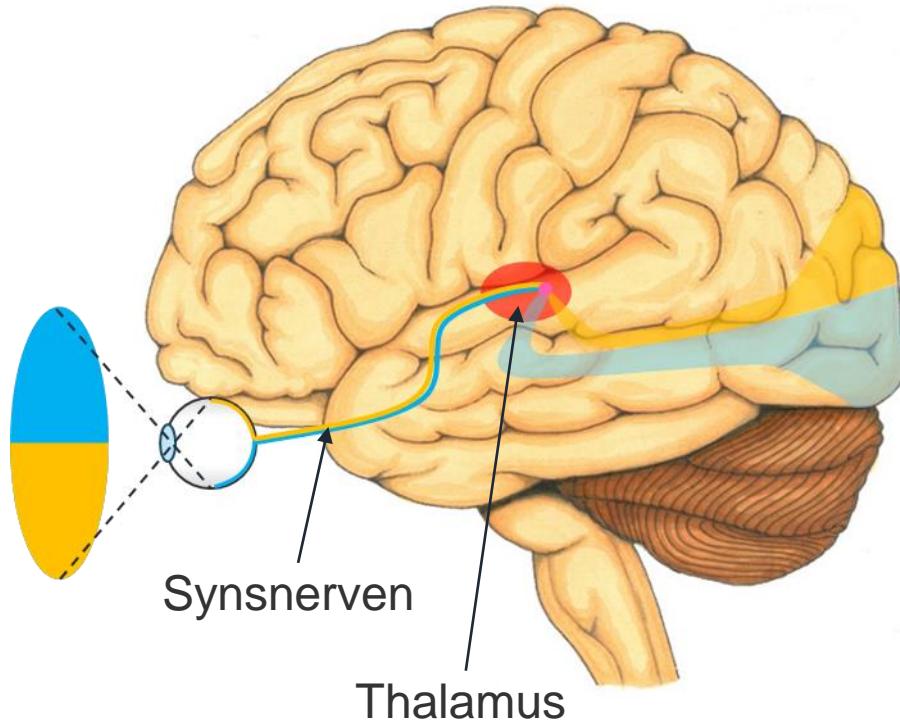
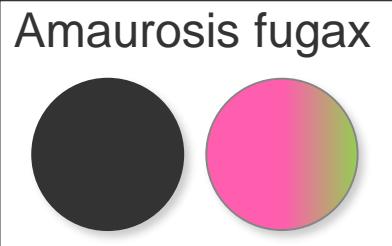


Illustration: Jacob Liljehult 2021

# Visuelle forstyrrelser

Ved apopleksi er  
anopsi altid i  
 modsatte side



Hvis begge  
occipitallapper  
er ramt

Kortikal blindhed +  
anosognosi  
(Anton's syndrom)

Agnosi  
Manglende evne til at  
genkende ting  
(Oftest bilaterale læsioner)

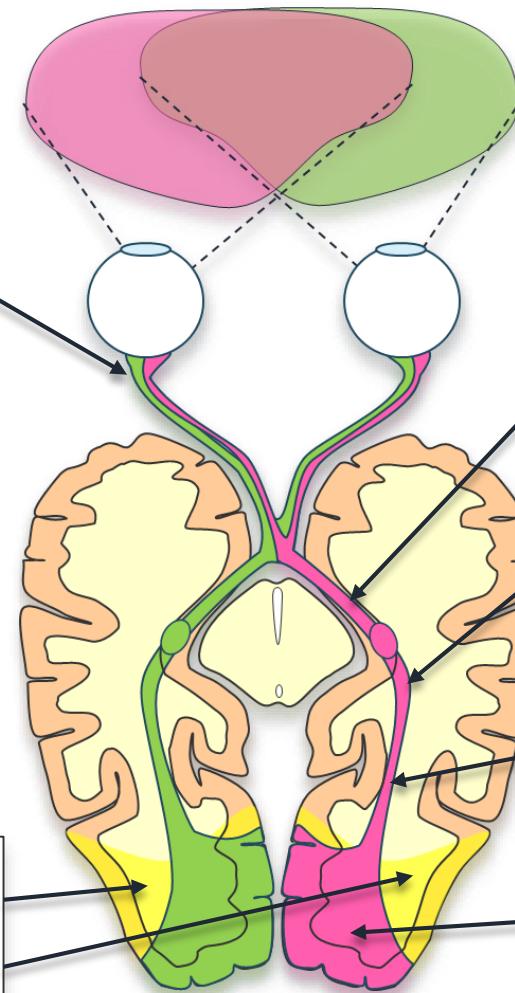


Illustration: Jacob Liljehult 2021



hemianopsi

Øvre kvadrant  
anopsi

Nedre kvadrant  
anopsi

# Visuo-spartielle forstyrrelser

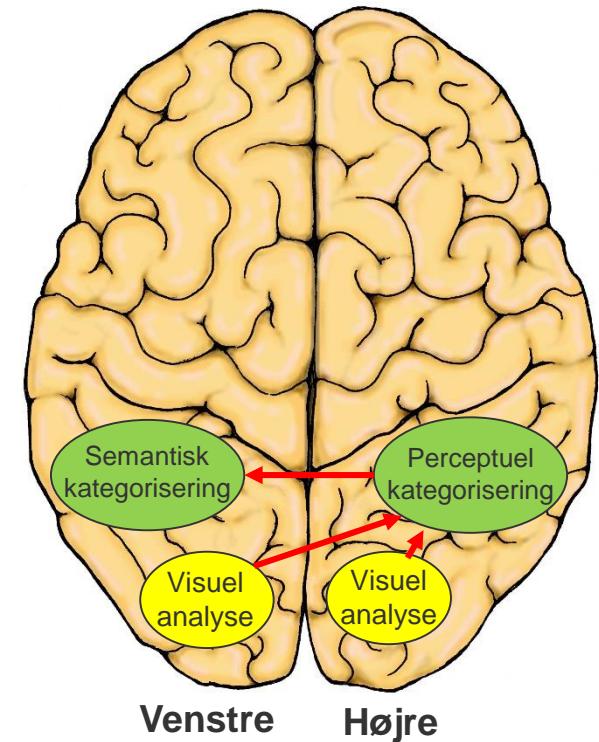
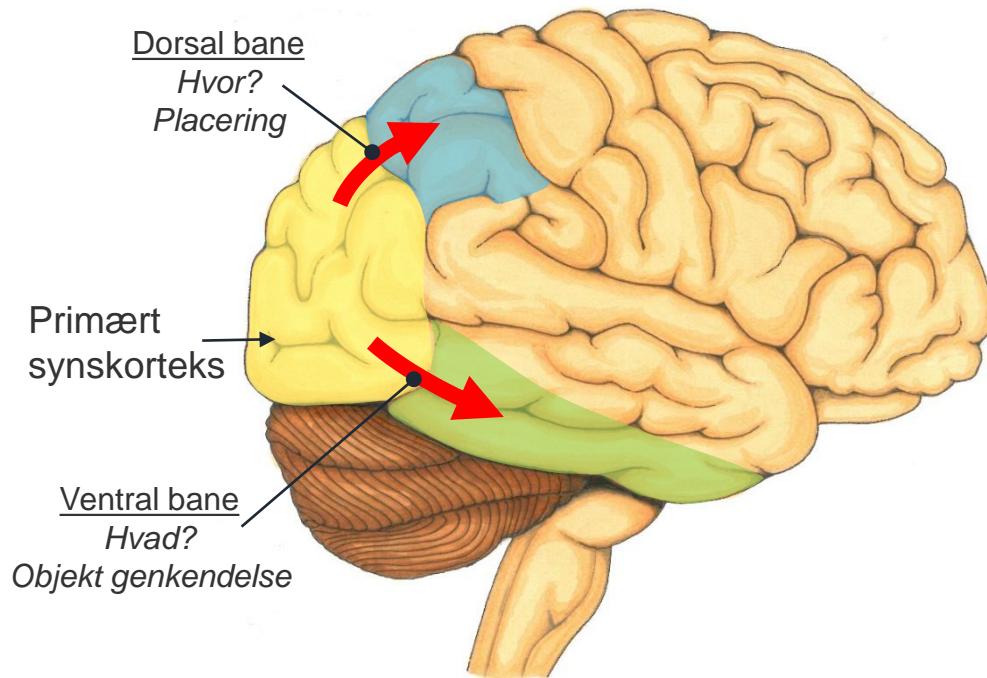


Illustration: Jacob Liljehult 2021

# Visuo-spartielle forstyrrelser

## Visuel agnosi

- Problemer med at genkende/identificere genstande visuelt
- Højre → Apperceptiv agnosi
  - Manglende genkendelse af genstande; kan ofte beskrive detaljer, men ikke helhed
  - Påvirker ofte evnen til at genkende ansigter
- Venstre → Associativ agnosi
  - kan ikke identificere genstande eller deres funktion

## Simultan-agnosi

- Kan kun identificere én ting ad gangen

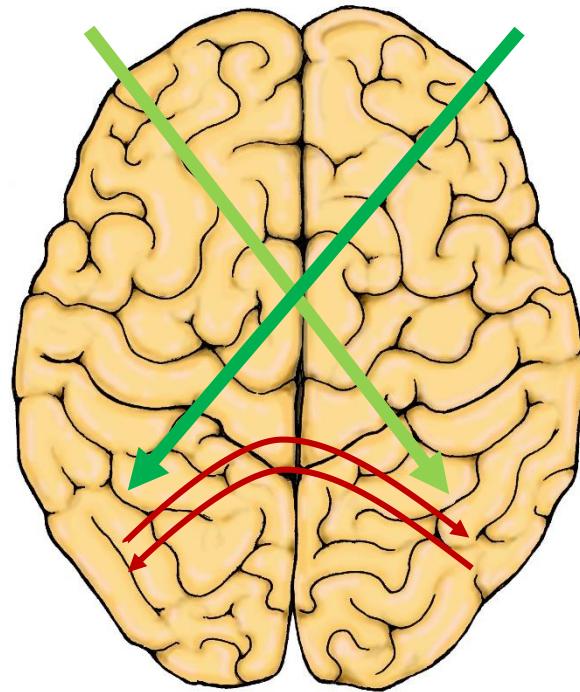
## Visuo-spartiel disorientering

- Problemer med at vurdere genstandes placering i rummet

## Topografisk amnesi/agnosi

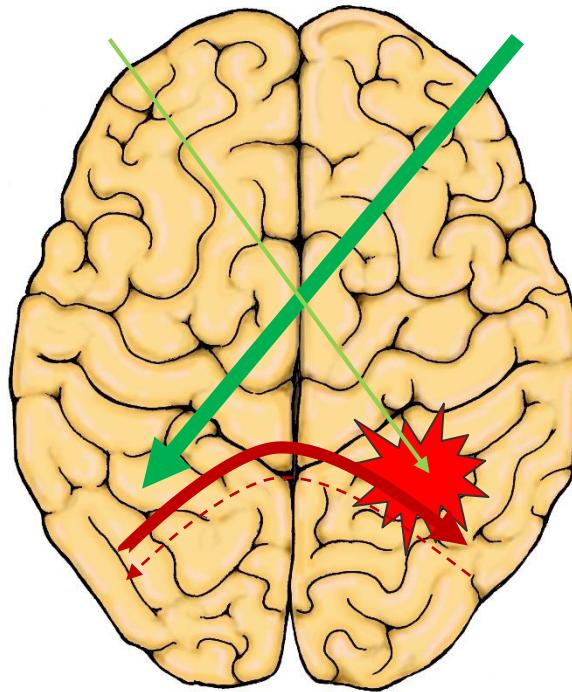
- Problemer med at huske/genkende kendte omgivelser

# Neglekt og inattention



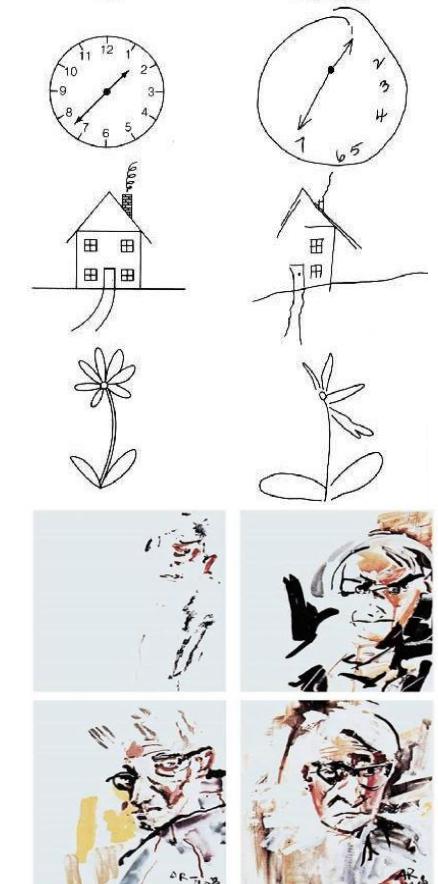
Normal hjerne

Illustration: Jacob Liljehult 2020  
Kilde Gazzaniga et al 2009



Læsion i højre  
parietallap

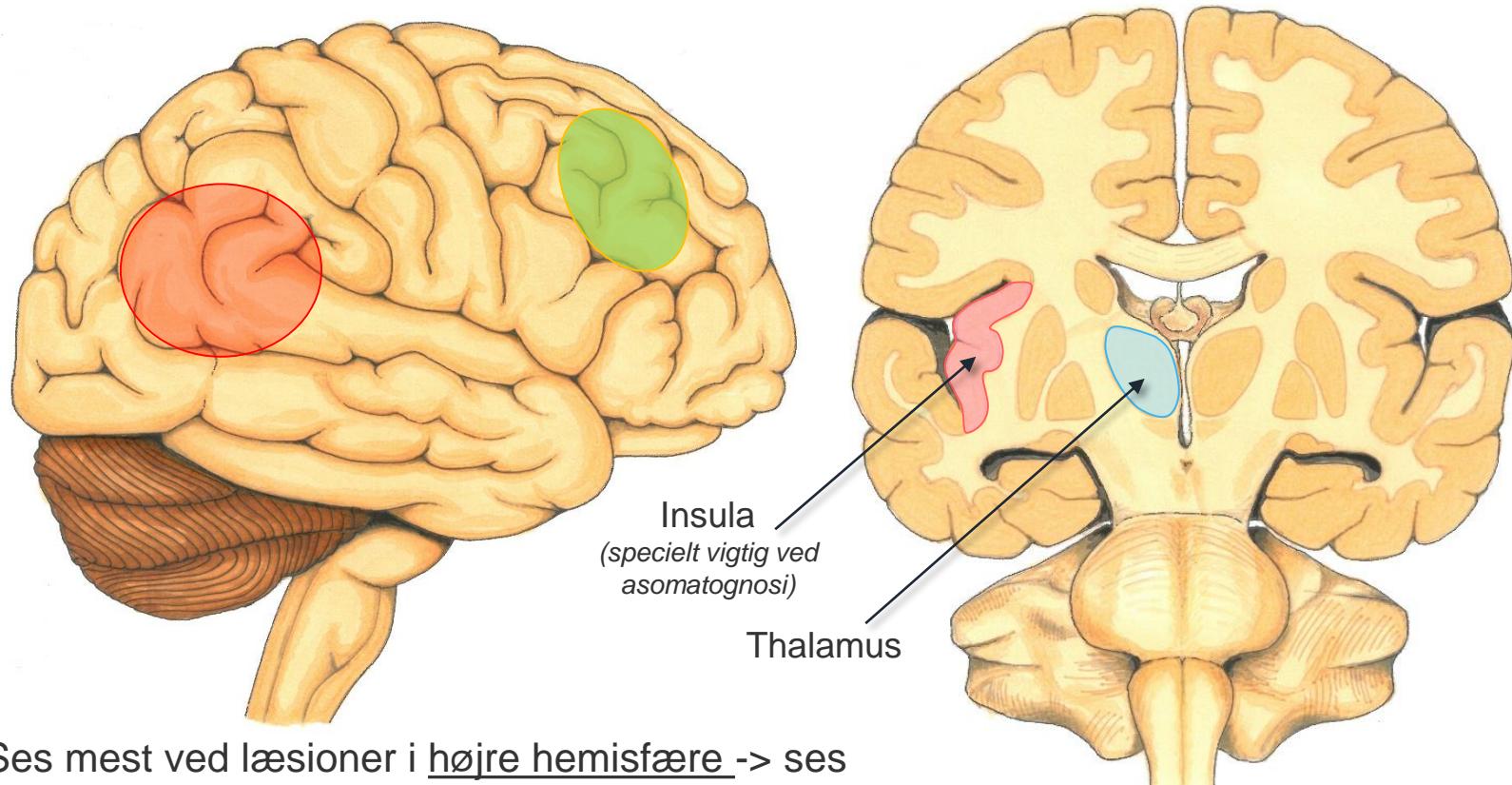
Figure 13. Drawings by a patient with left-side neglect.  
Model  
Patient's copy



# Hvor er gaflen?



# Anosognosi



Ses mest ved læsioner i højre hemisfære -> ses derfor ofte sammen med venstresidig hemiparese

Kilde: Gade 2009

Illustration: Jacob Liljehult 2020

Jacob Mesot Liljehult

# Anosognosi

## Manglende sygdoms- eller symptomerkendelse

### Kategorier

- Global anosognosi: Benægter generelt at være syg (hyppigt ved hovedtraumer og demens)
- Lokal anosognosi: Benægter et specifikt symptom – ofte hemiparese eller hemianopsi (hyppigt ved apopleksi)
- Asomatognosi: Vedkender sig ikke ejerskab over lammet ekstremitet *"Der ligger et fremmed ben i min seng"* (hyppigt ved apopleksi)

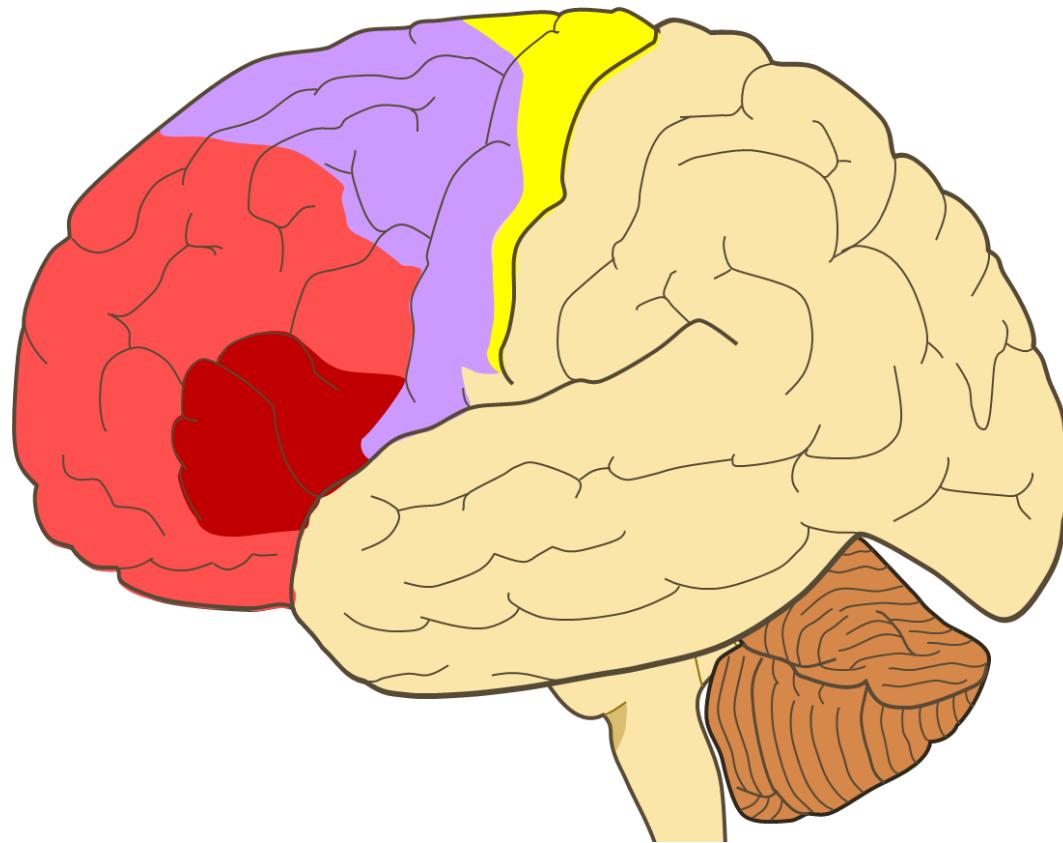
### Karakteristika

- Fortæller ikke spontant om symptomer
- Benægter eksplisit symptomerne
- Konfabulerer om årsagen til symptomerne (udenoms forklaringer)
- Tager ikke højde for symptomerne i sin adfærd
- Reagerer ikke følelsesmæssigt/virker ligeglads (*anosodiafori*)
- Tager ikke højde for symptomerne i sine planer for fremtiden (urealistisk om fremtiden)

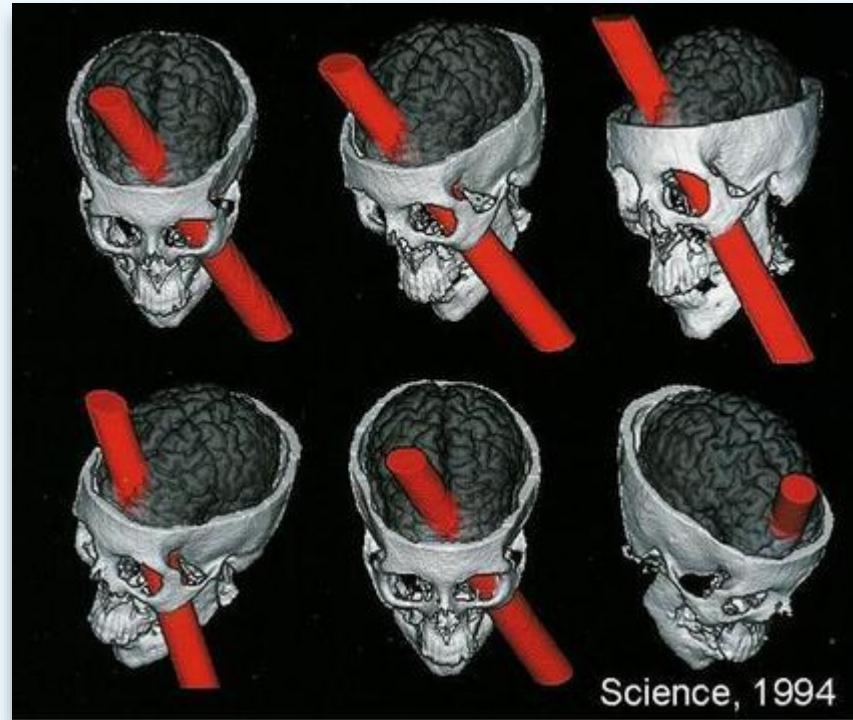
Kilde: Gade 2009

Illustration: Jacob Liljehult 2020

# Eksikution *fra plan til handling*



# Frontallapperne



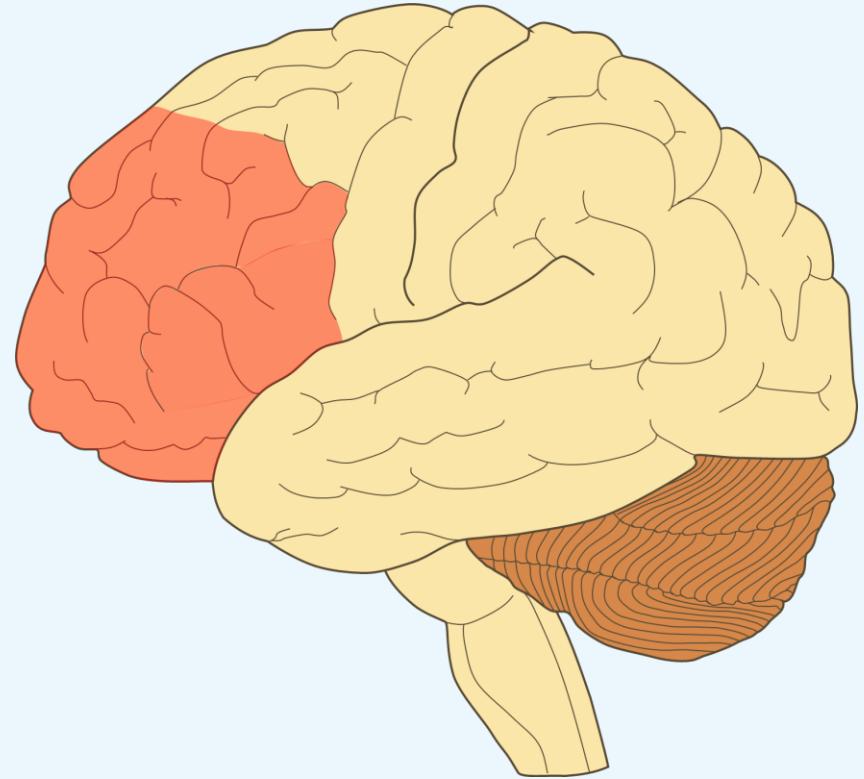
Phineas P Gage (1823-1860)

Billede: Wikipeadia; Damasio et al, 1994

# Præfrontale funktioner

Beslutninger om hvad man skal gøre og hvordan

- Eksiktive funktioner
  - Spontanitet, handlekraft, opmærksomhed, fleksibilitet, motivation, målrettet adfærd
- Responshæmning
- Dømmekraft, selvindsigt
- Personlighed
- Hukommelse



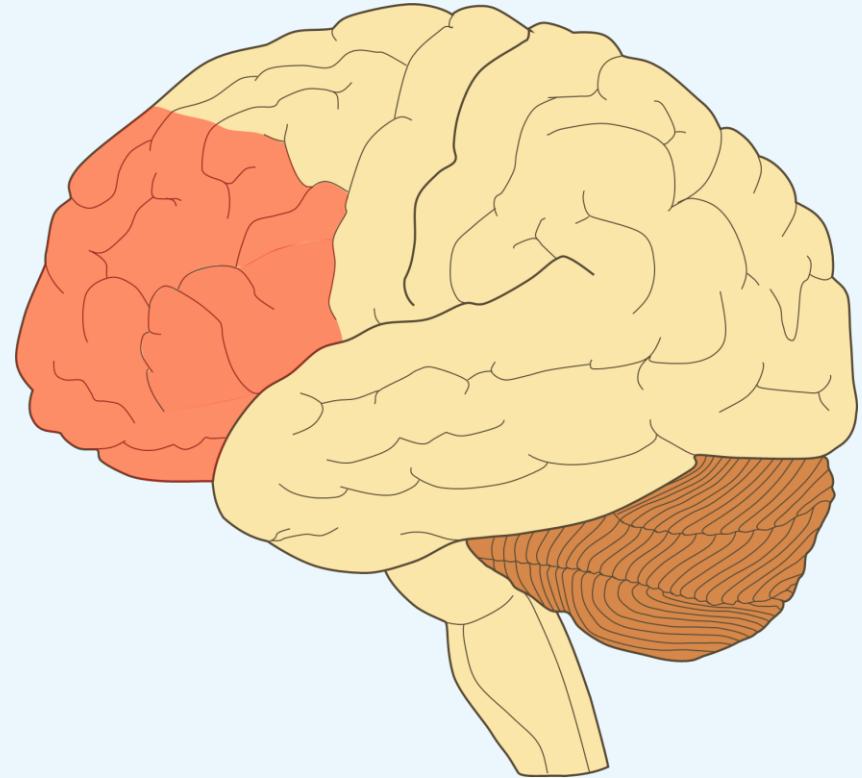
Kilde: Gade 2009

Illustration: Jacob Liljehult 2020

# Præfrontale funktioner

Beslutninger om hvad man skal gøre og hvordan

- Apati, rigiditet, springende opmærksomhed
- Perseveration og stereotyp adfærd
- Manglende hæmning
- Nedsat dømmekraft, selvindsigt
- Ændret personlighed



Kilde: Gade 2009

Illustration: Jacob Lilje hult 2020

# Præfrontale funktioner

## Dorso-lateralt

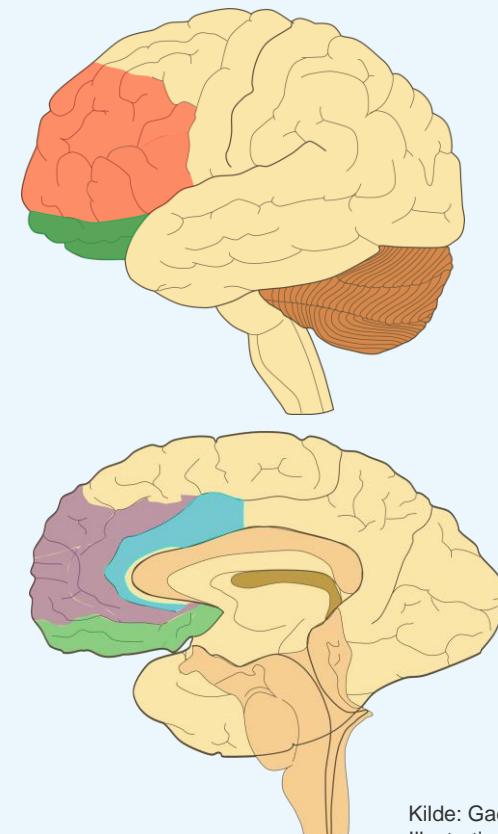
Nedsat energi, initiativløshed, nedsat evne til planlægning, ligegyldig

## Orbitalt

Opstemt, rastløs, mangler hæmninger, ansvarsløse handlinger, hensynsløs, selvoptaget

## Medialt

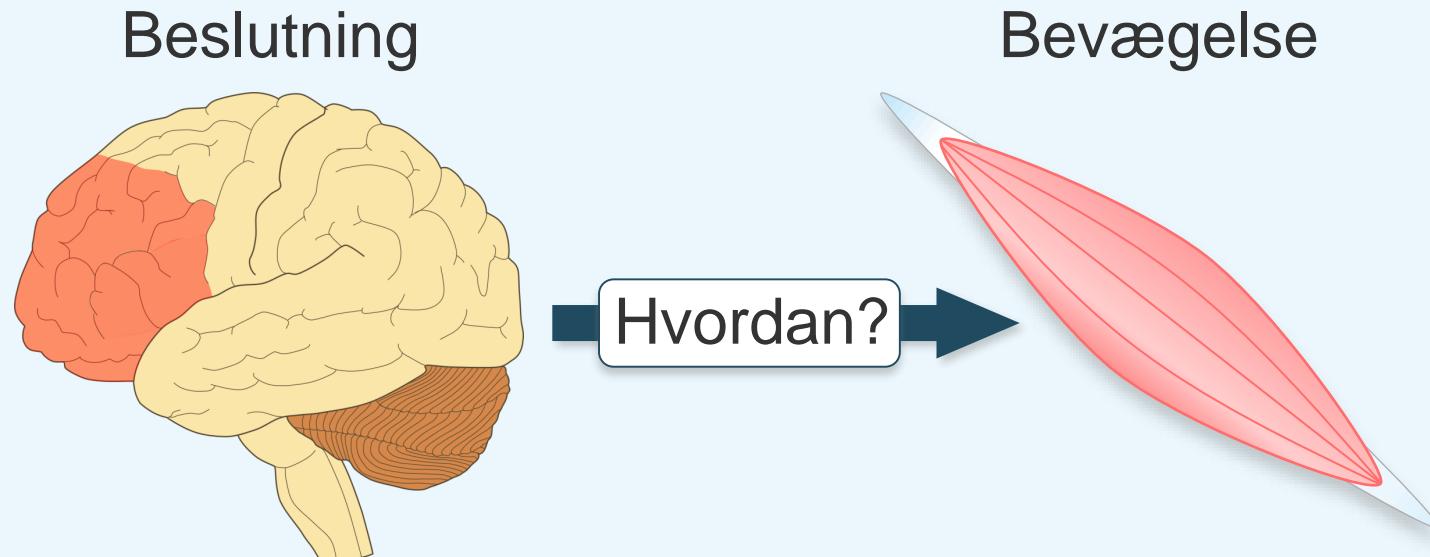
Nedsat opmærksomhed, nedsat bevidsthed, desorienteret, konfabulerende



Kilde: Gade 2009

Illustration: Jacob Liljehult 2020

# Det motoriske system



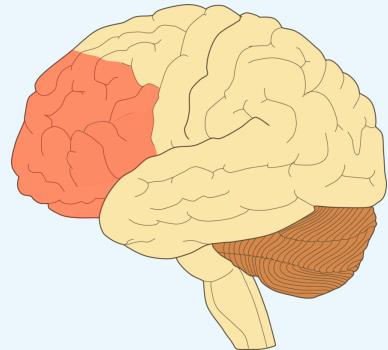
Kilde: Bear et al 2007 Illustration: Jacob Liljehult 2020

Jacob Mesot Liljehult

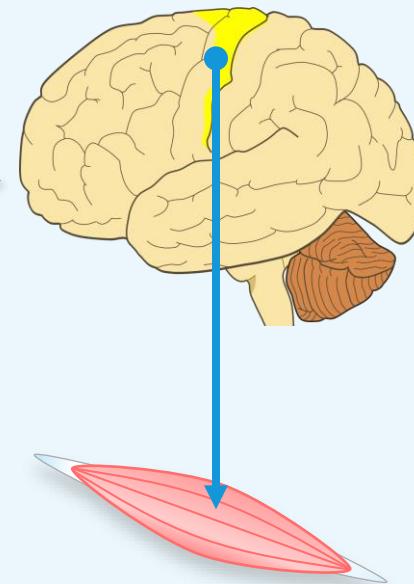
70

# Det motoriske system

Beslutning



Primært  
motorisk kortex



*Hver muskel skal  
have besked på  
hvad den skal gøre*

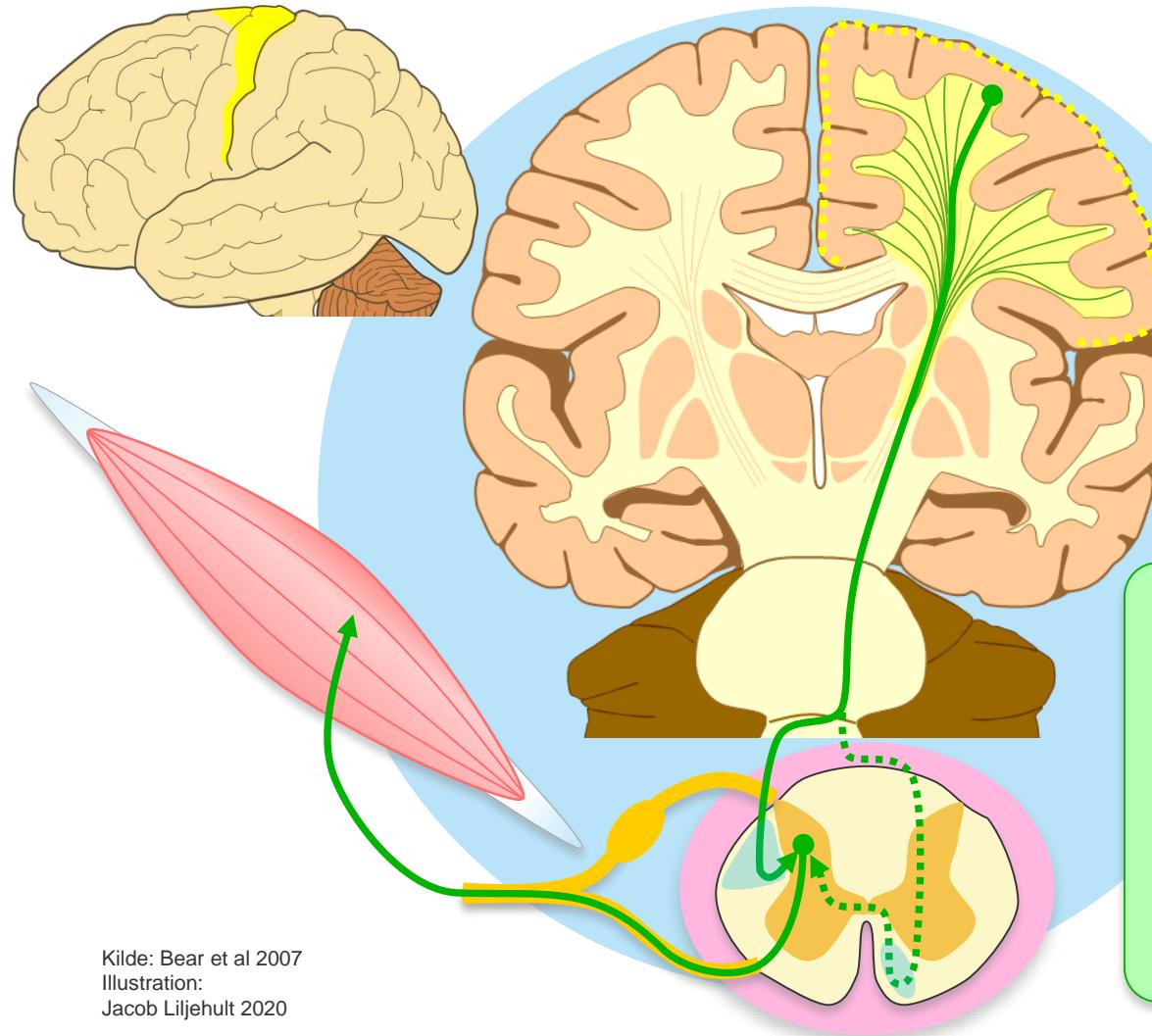
Bevægelse

Kilde: Bear et al 2007 Illustration: Jacob Liljehult 2020

Jacob Mesot Liljehult

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# De motoriske baner



Motorisk cortex og  
projektionsbaner

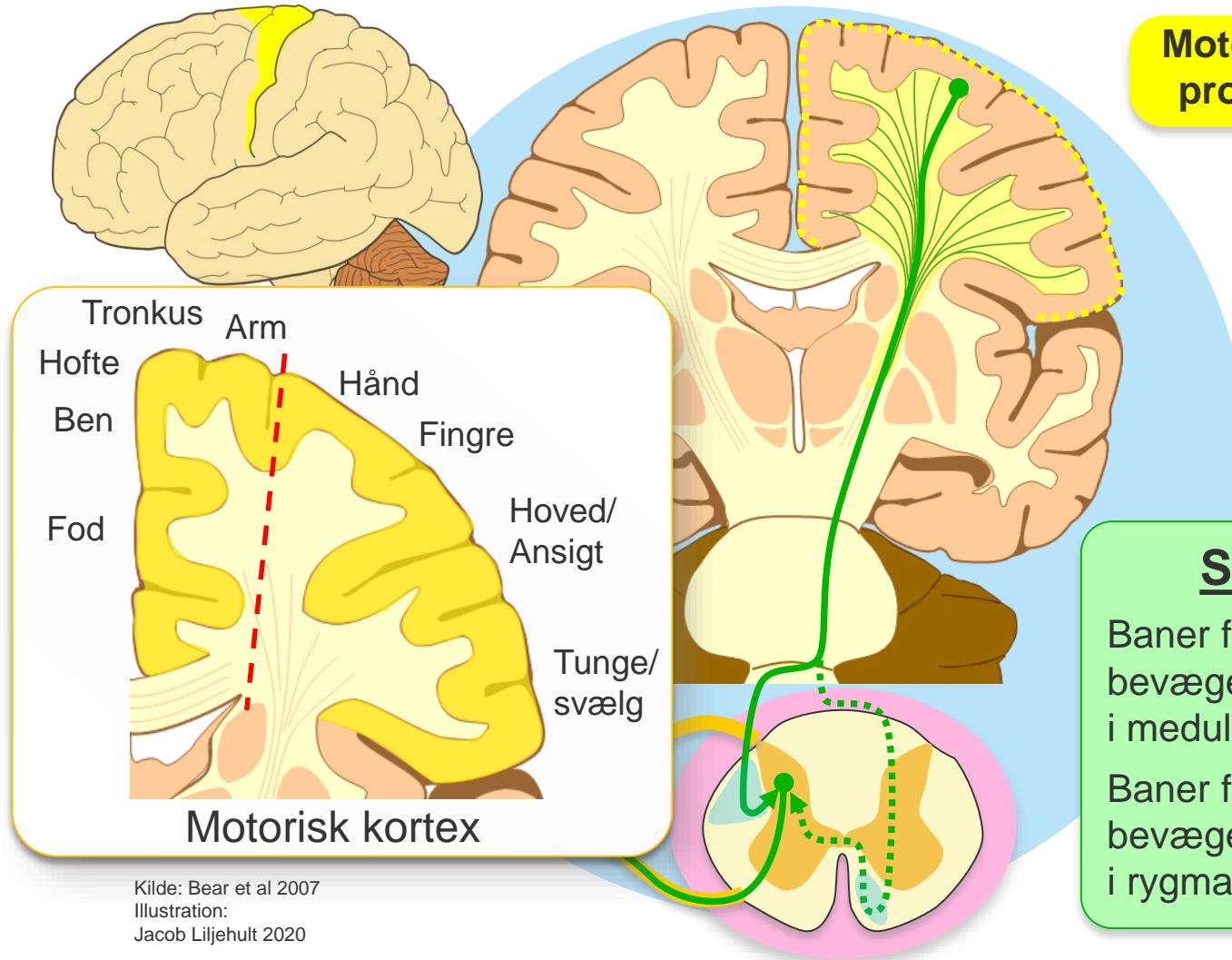
## Sideskifte

Baner for *voluntære* bevægelser skifter side i medulla oblangata

Baner for *involuntære* bevægelser skifter side i rygmarven

Kilde: Bear et al 2007  
Illustration:  
Jacob Liljehult 2020

# De motoriske baner



Kilde: Bear et al 2007  
Illustration:  
Jacob Liljehult 2020

Motorisk cortex og  
projekionsbaner

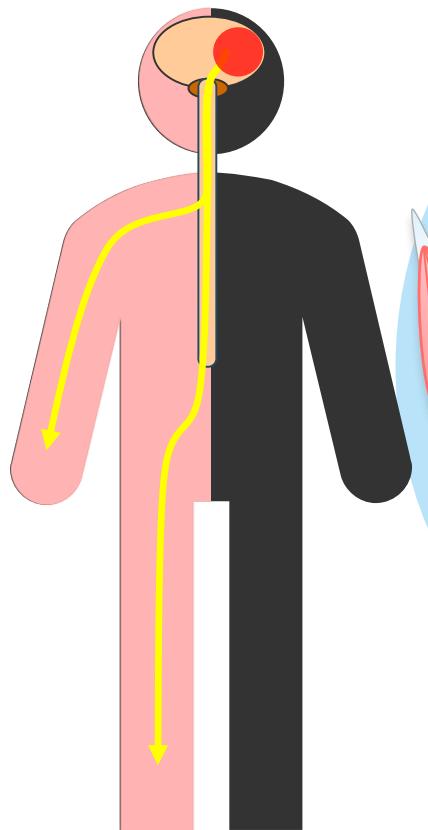
## Sideskifte

Baner for *voluntære* bevægelser skifter side i medulla oblangata

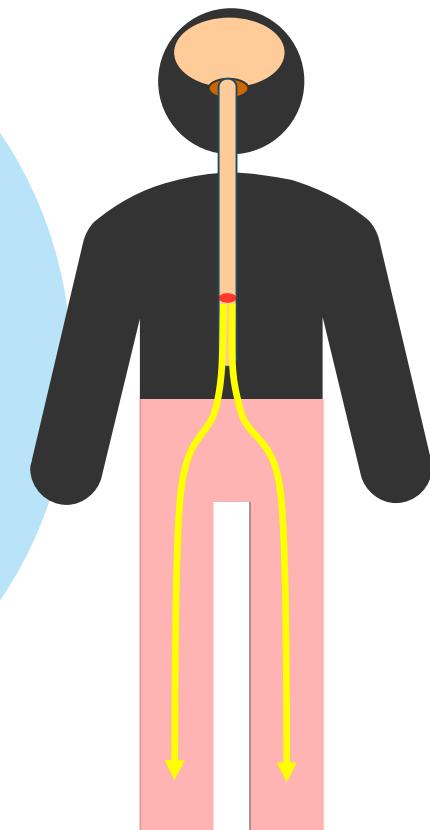
Baner for *involuntære* bevægelser skifter side i rygmarven

# Pareser

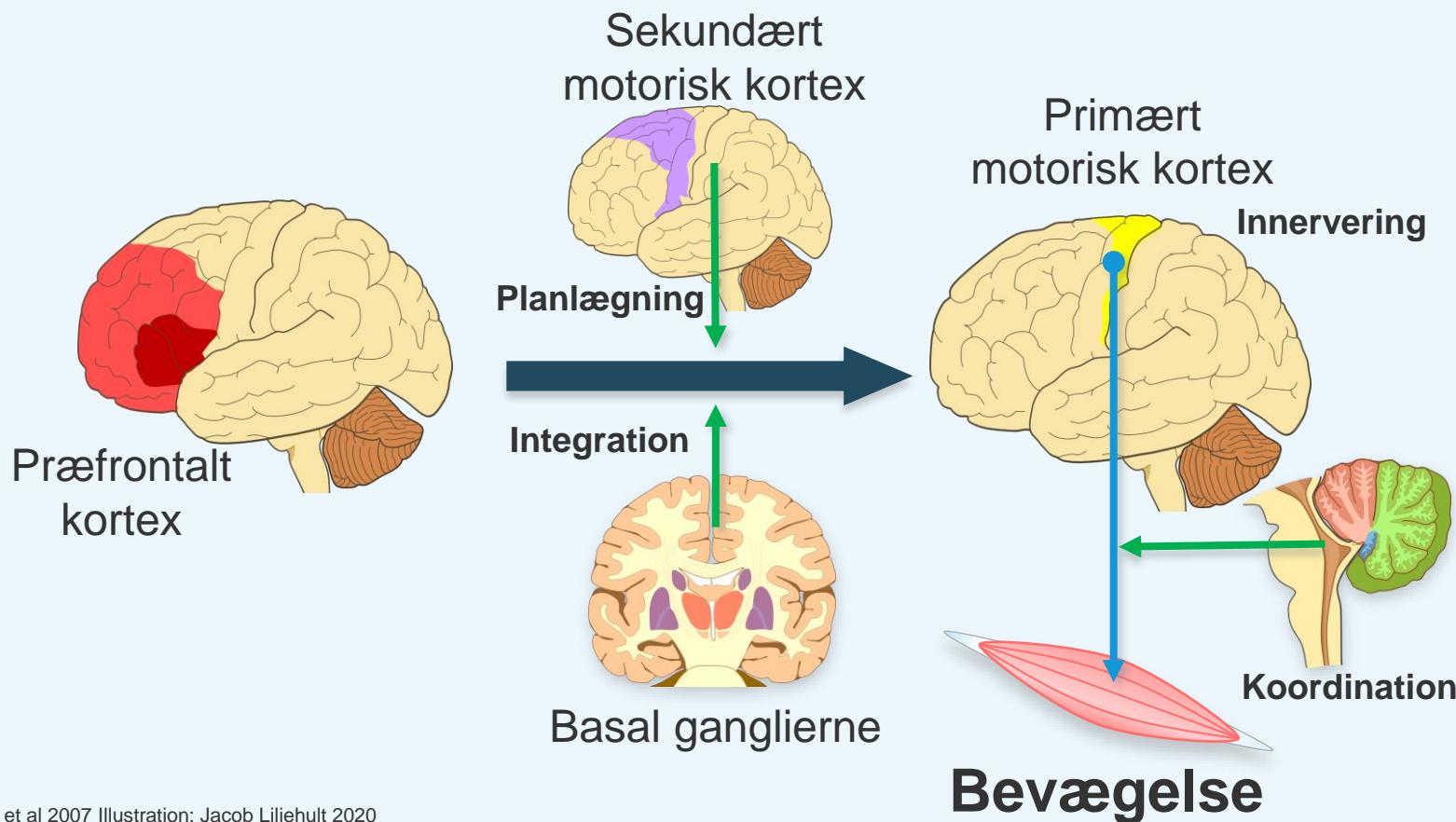
## Hemiparese *Supranuklær*



## Paraparesse *Medulær*

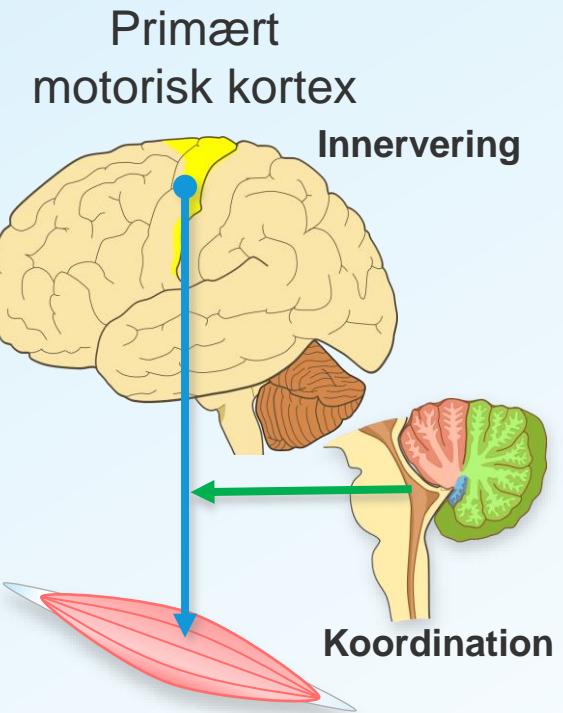
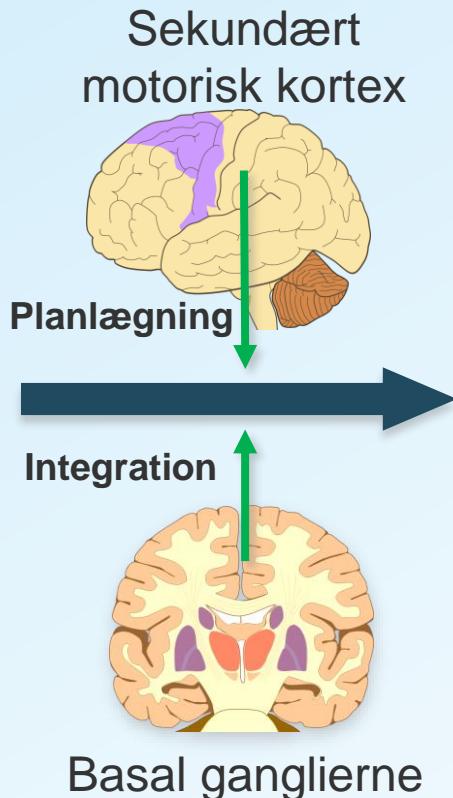
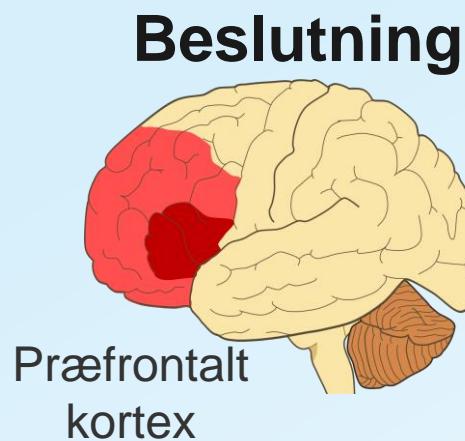


# Det motoriske system



Kilde: Bear et al 2007 Illustration: Jacob Liljehult 2020

# Det motorisk system



Kilde: Bear et al 2007 Illustration: Jacob Liljhult 2020

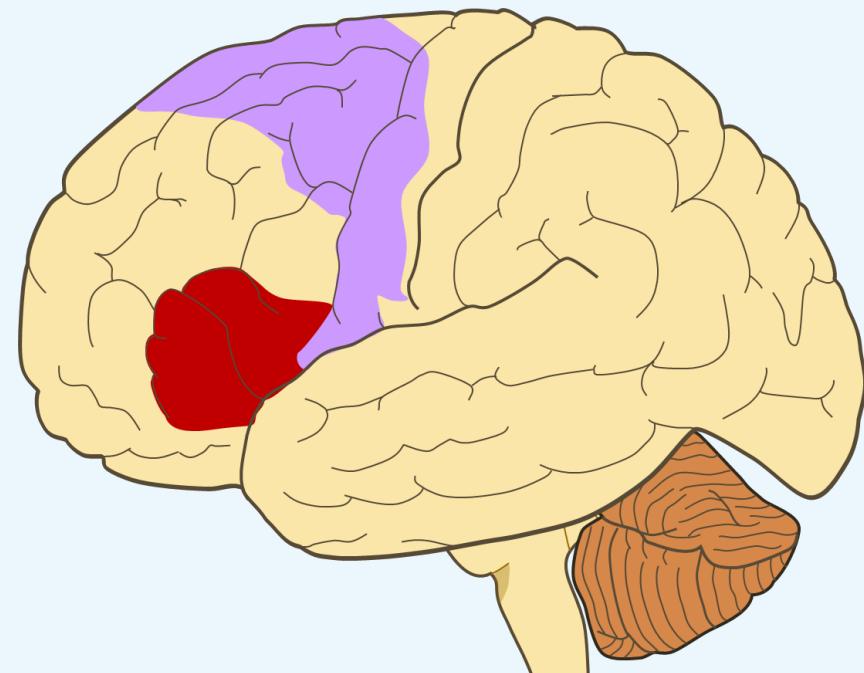
Jacob Mesot Liljhult

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# Sekundært motorisk kortex

- Planlægning af adfærd og bevægelse
- Skemaer for hvordan bevægelser skal laves

- Tale-motorik
- Non-verbal kommunikation (ansigtsudtryk, gestik)



Kilde: Gade 2009

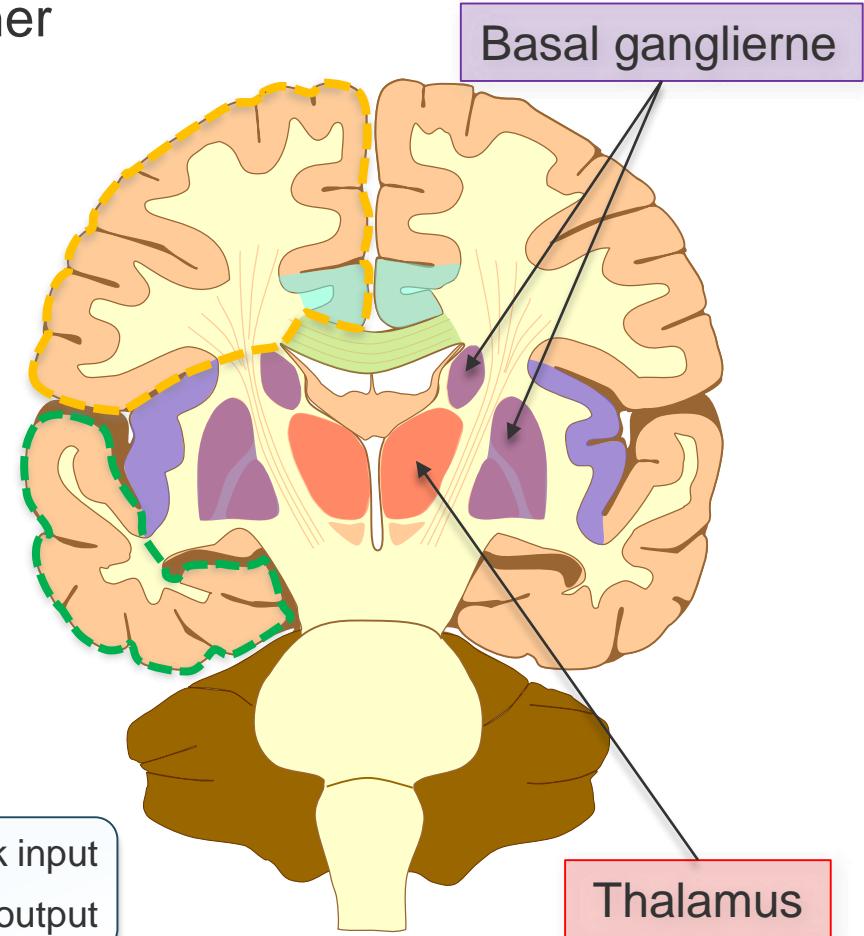
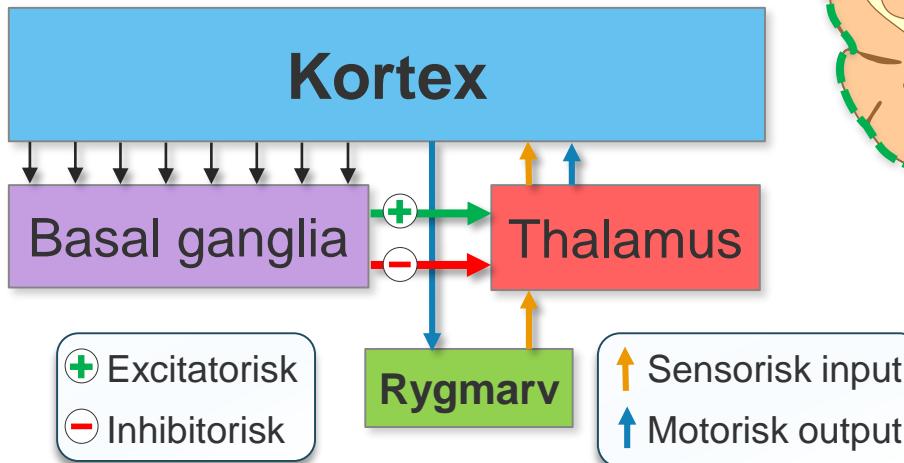
Illustration: Jacob Liljehult 2020

# Basal ganglerne

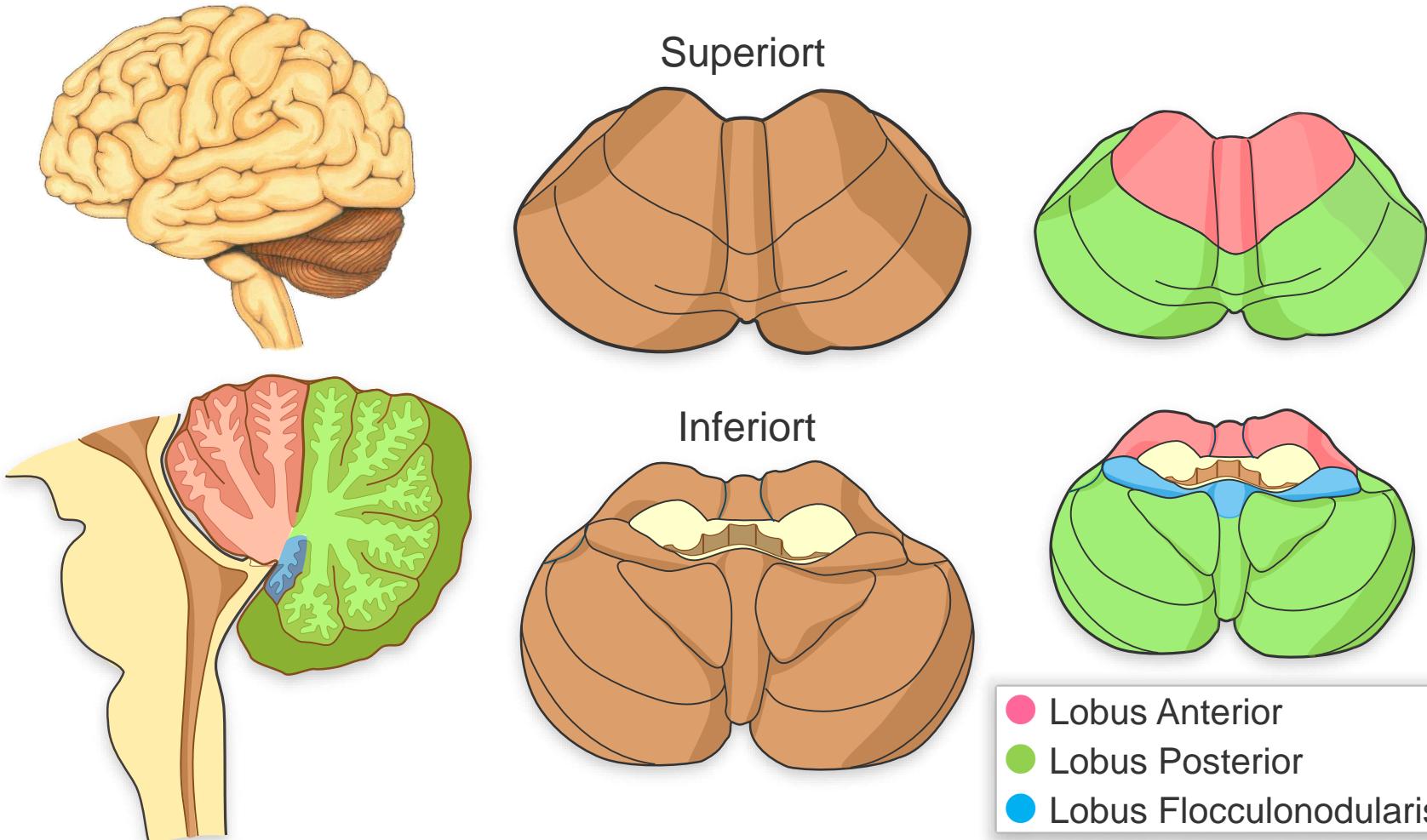
Tager input fra kortex og samordner det til et samlet adfærds-output

Tre kredsløb:

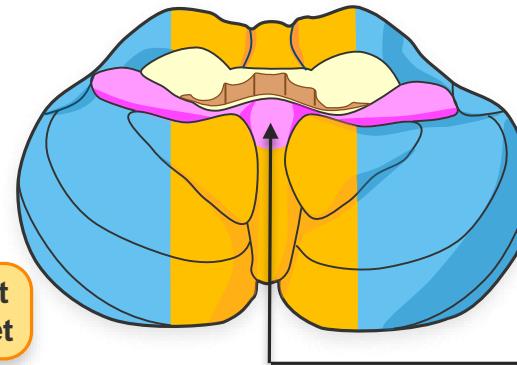
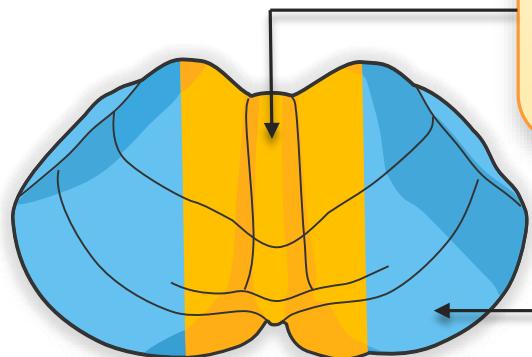
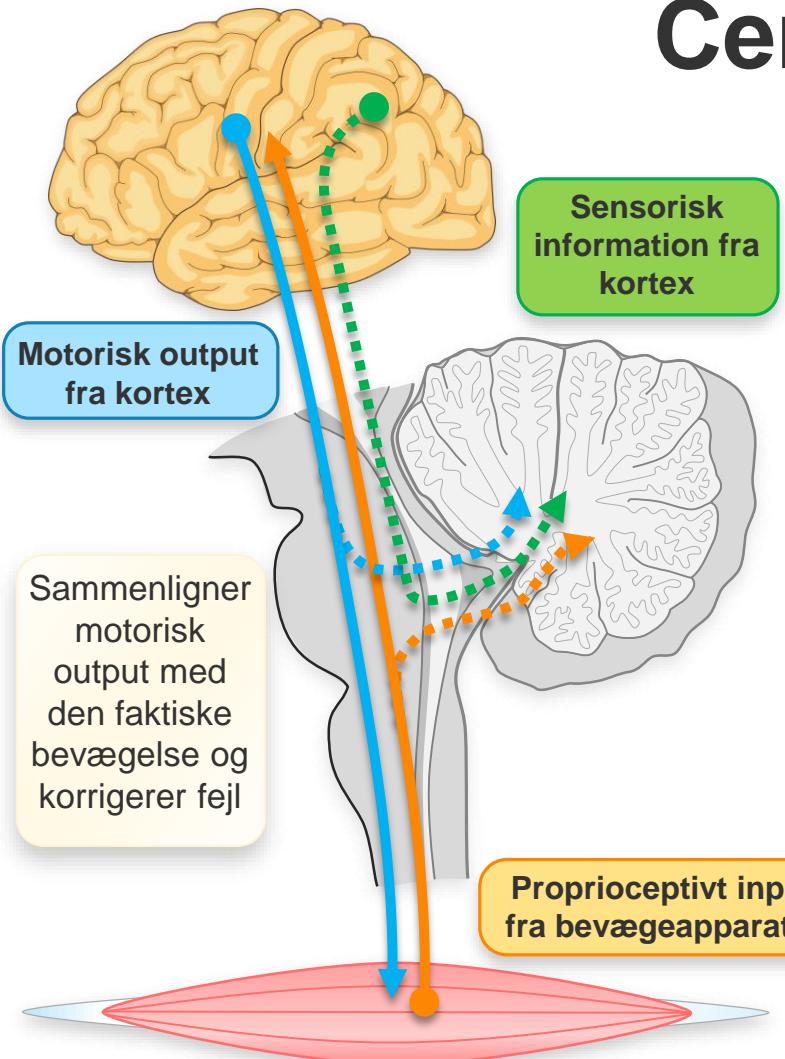
1. Integration af motorisk output
2. Læring og kognition
3. Regulering af emotionelle aspekter af adfærd



# Cerebellum



# Cerebellum



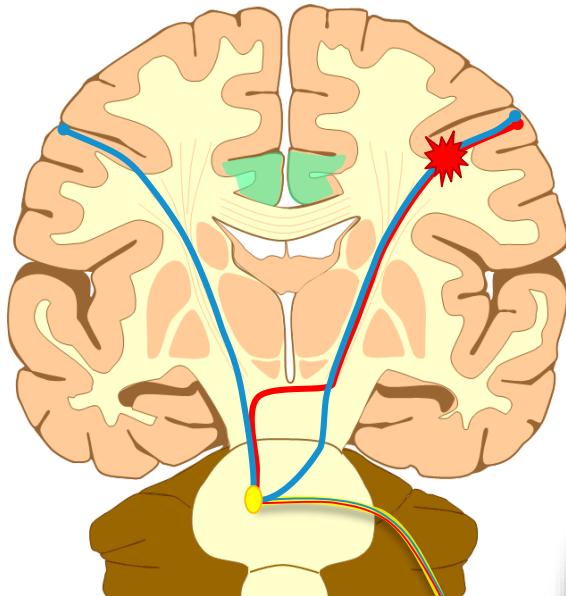
- Propriotion
- Tonus
  - Truncus instabilitet
  - Gang-ataksi

- Koordination
  - Koordinations problemer
  - Ataksi (ekstremitet)
  - Intentions-tremor
  - Dysmetri
  - Dysartri

- Balance
  - Balance-problemer

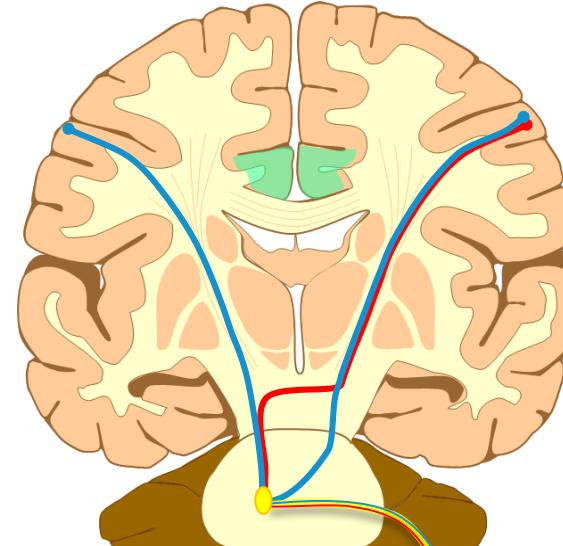
# Faciales parese

Central  
(Supranuklear)



- Asymmetri omkring munden
  - Problemer med at smile og puste kinderne op

Perifer  
(Infranuklear)



- Asymmetri omkring munden
  - Problemer med at smile og puste kinderne op
  - Ptose
  - Problemer med at rynke panden

Illustration: Jacob Liljehult 2020

# Apraksi

Generelt: Latenstid, tøvende og klodset, perseveration

Ideomotorisk

- Problemer med at lave de rigtige bevægelser der er knyttet til en handling
  - *Patienten kan ikke finde ud af at vinke på opfordring*

Ideatorisk

- Problemer med sekvensen af delelementer i en aktivitet
  - *Patienten begynder at bruse sig før han har taget tøjet af*

Konceptuel

- Problemer med at udvælge de rigtige genstande til handlingen
  - *Patienten prøver at børste tænder med tandpastatuben*

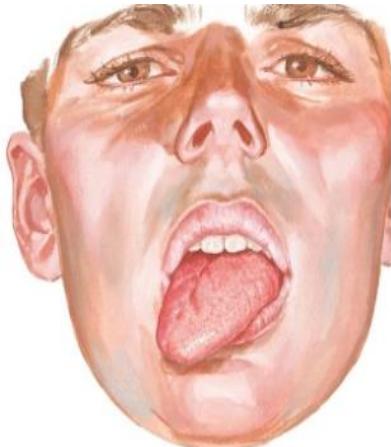
# Ideomotorisk apraksi



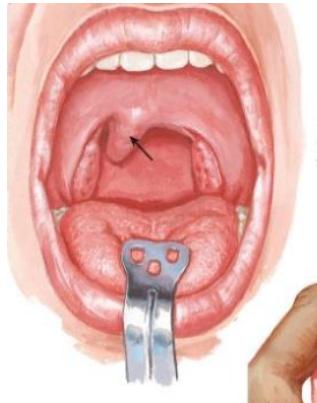
<https://youtu.be/vTFdNk7Jloo>

# Mund og svælg

Tungedeviation



Ganesejlsparese



Dysfagi (*Synkeproblemer*)

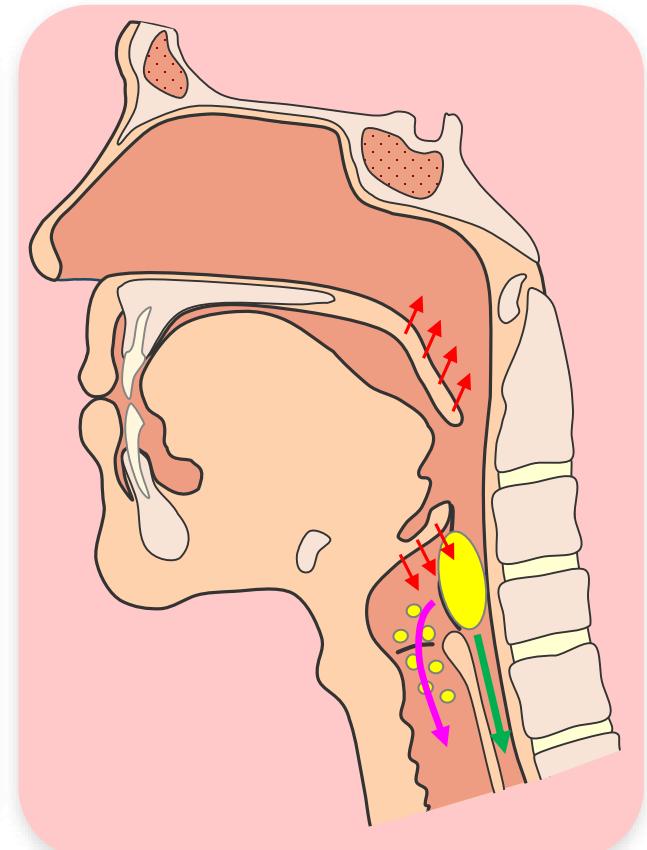
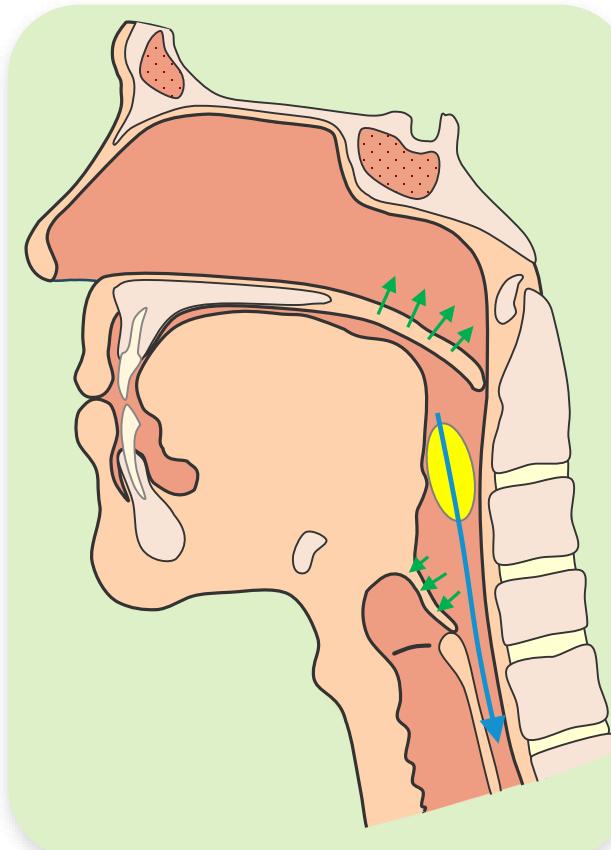
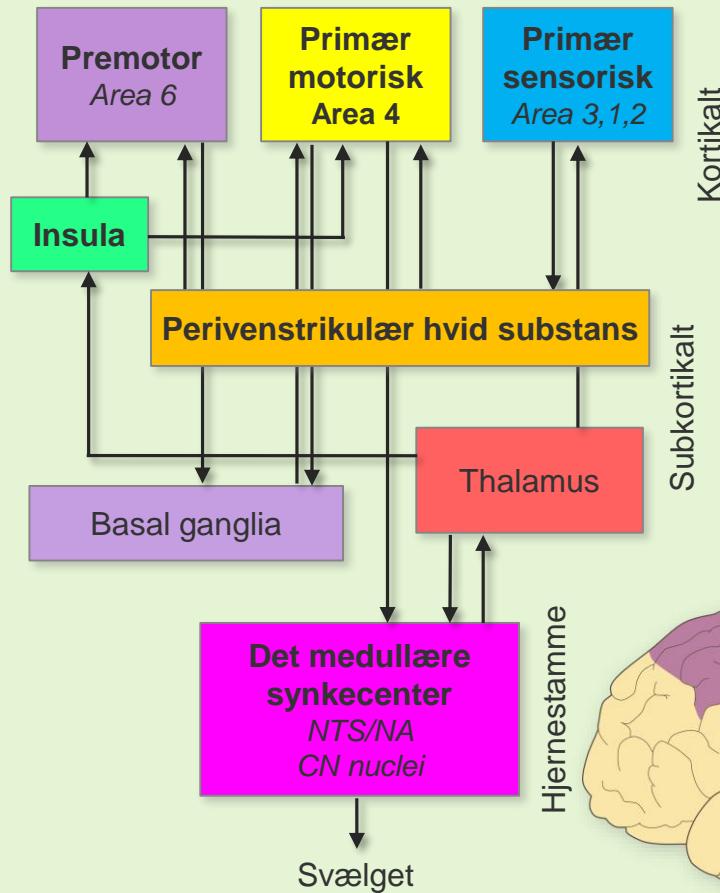


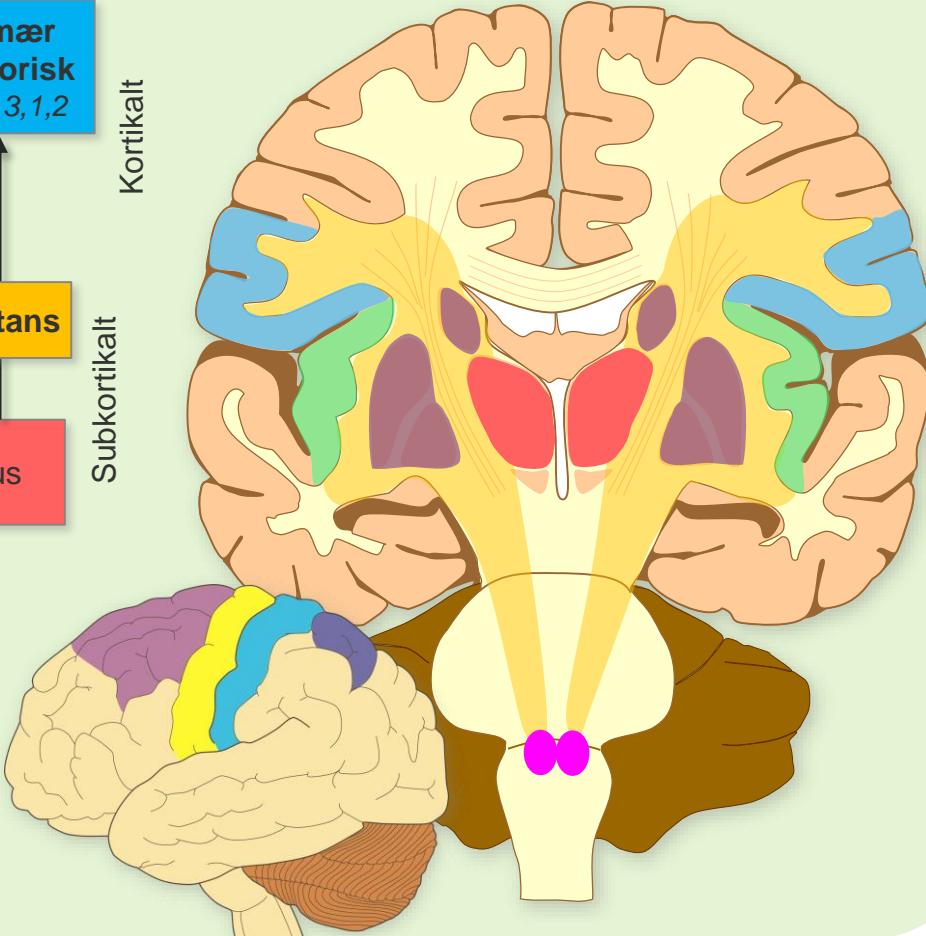
Illustration: Jones et al 2011 & Jacob Liljehult 2022

Jacob Mesot Liljehult

# Fysiologisk synkning



Efter Daniels et al. 1999



# Sprog og kommunikation

## Venstre side

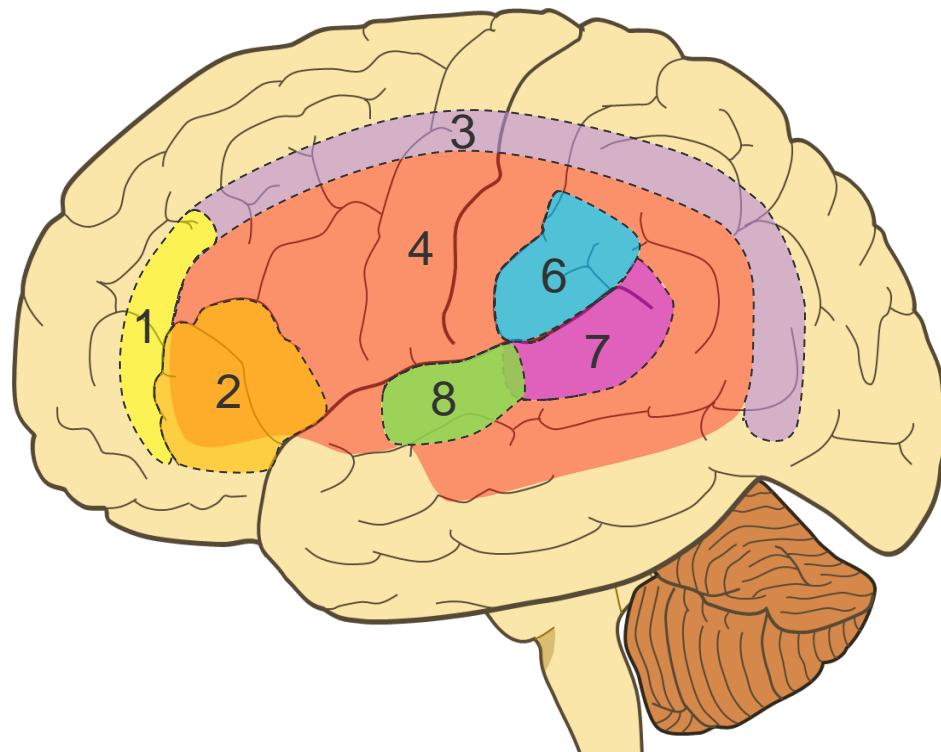
- Afasi (Produktion, forståelse)
  - Flydende
  - Ikke-flydende
  - Global
- Agraphi (Skrivning)
- Alexi (Læsning)

## Højre side

- Intonation af sproget
- Giver sproget affekt
- Sproglig struktur

## Begge sider

- Dysartri (Eksikution)



## Ikke-flydende afasi

	Forståelse	Gentagelse	Afasitype
1	God	God	Transkortikal motorisk afasi
2	God	Dårlig	<b>Broca-afasi</b>
3	Dårlig	God	Blandet transkortikal afasi
4	Dårlig	Dårlig	<b>Global afasi</b>

## Flydende afasi

	Forståelse	Gentagelse	Afasitype
5	God	God	Anomisk afasi
6	God	Dårlig	Konduktionsafasi
7	Dårlig	God	Transkortikal sensorisk afasi
8	Dårlig	Dårlig	<b>Wernicke-afasi</b>

Tekst efter Gade et al 2009; Illustration: Jacob Liljehult 2020

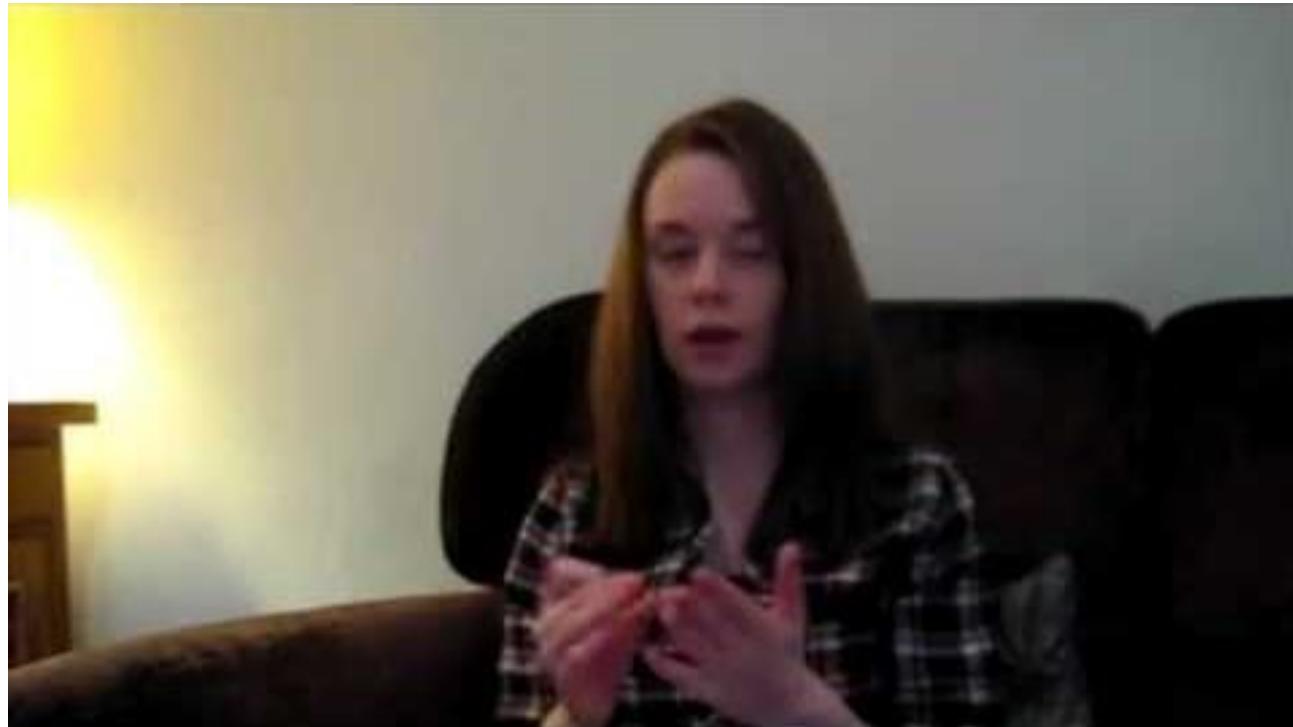
# Flydende afasi



Manglende forståelse; flydende talestrøm uden relevant indhold

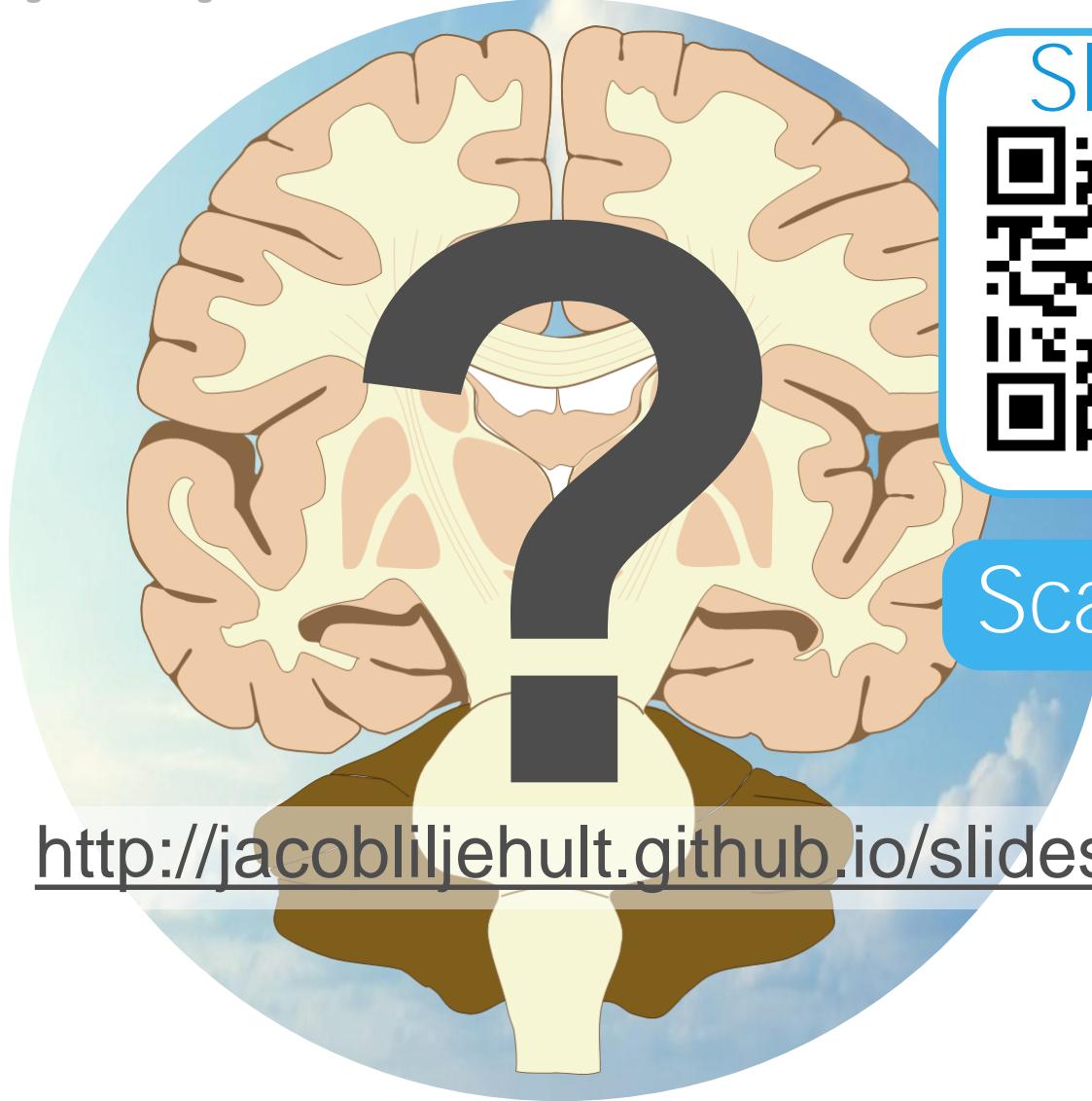
<https://youtu.be/3oef68YabD0>

# Ikke-flydende afasi



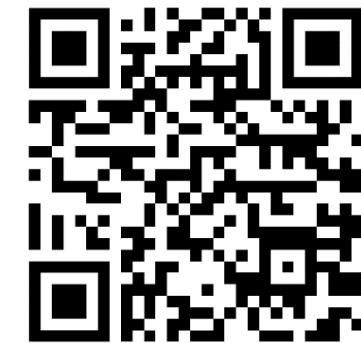
God forståelse  
Svarene er opbrudte og indeholder kun  
meningsbærende enheder

<https://youtu.be/lP8hkopObvs>



<http://jacobliljehult.github.io/slides>

Slides



Scan mig

# Referencer

- Bear et al. Neuroscience: Exploring the brain (3rd ed). Lippincott Williams and Wilkins 2007.
- Gade et al. Klinisk neuropsykologi. Frydenlund 2009.
- Gazzaniga et al. Cognitive neuroscience (3rd ed). WW Norton & Company 2009.
- Hickey. Clinical practice of Neurological and Neurosurgical nursing (6th ed). Wolters Kluwer Health 2009.
- Jones et al. Netter's neurology. Elsevier 2011.
- Paulsen et al. Klinisk Neurologi og Neurokirurgi (5. udg.). FADLs forlag 2011.