

Neuroanatomi

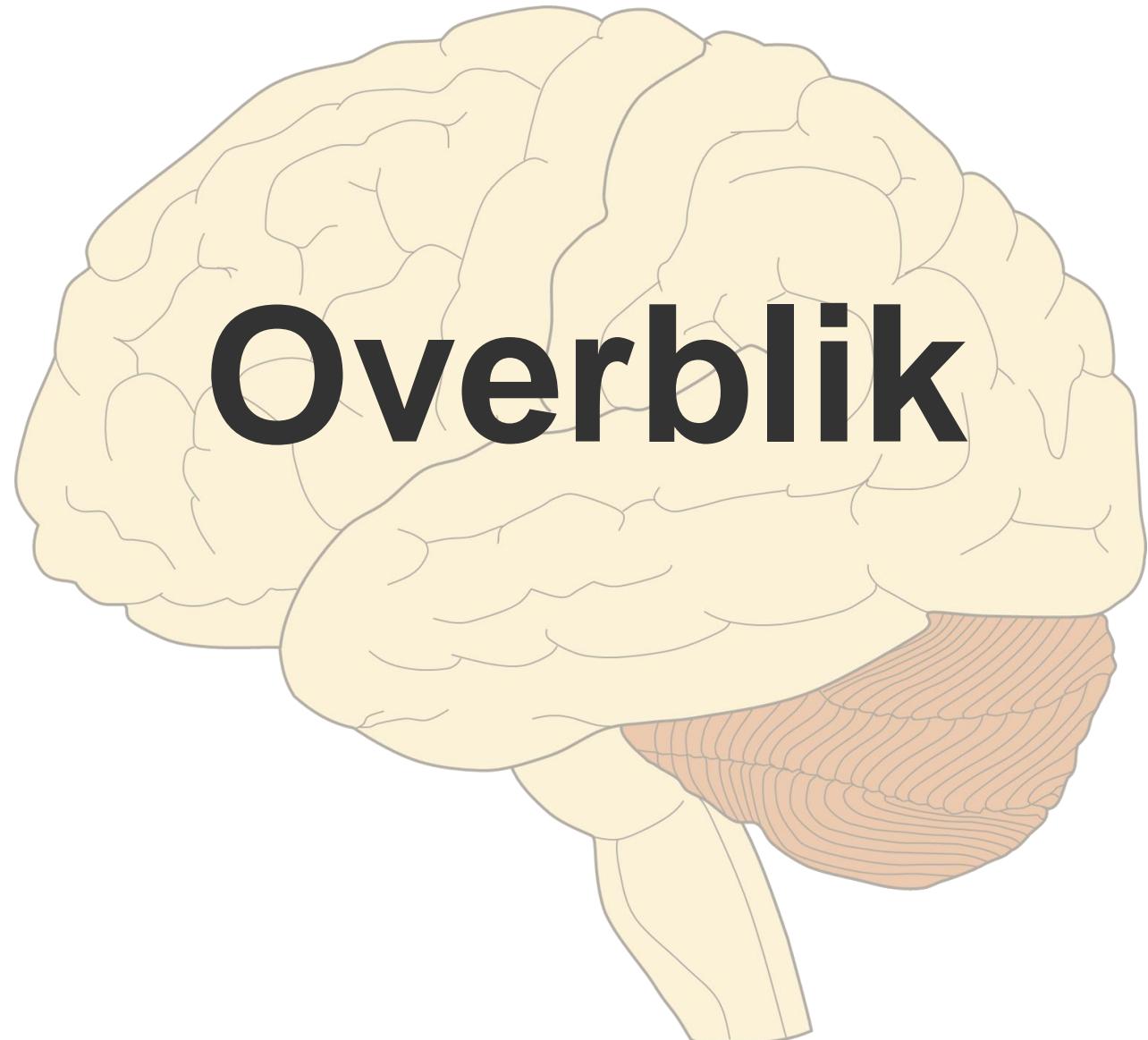
- et kort overblik over nervesystemet

Jacob Mesot Liljehult
Klinisk sygeplejespecialist
cand.scient.san, PhD

Jacob Mesot Liljehult

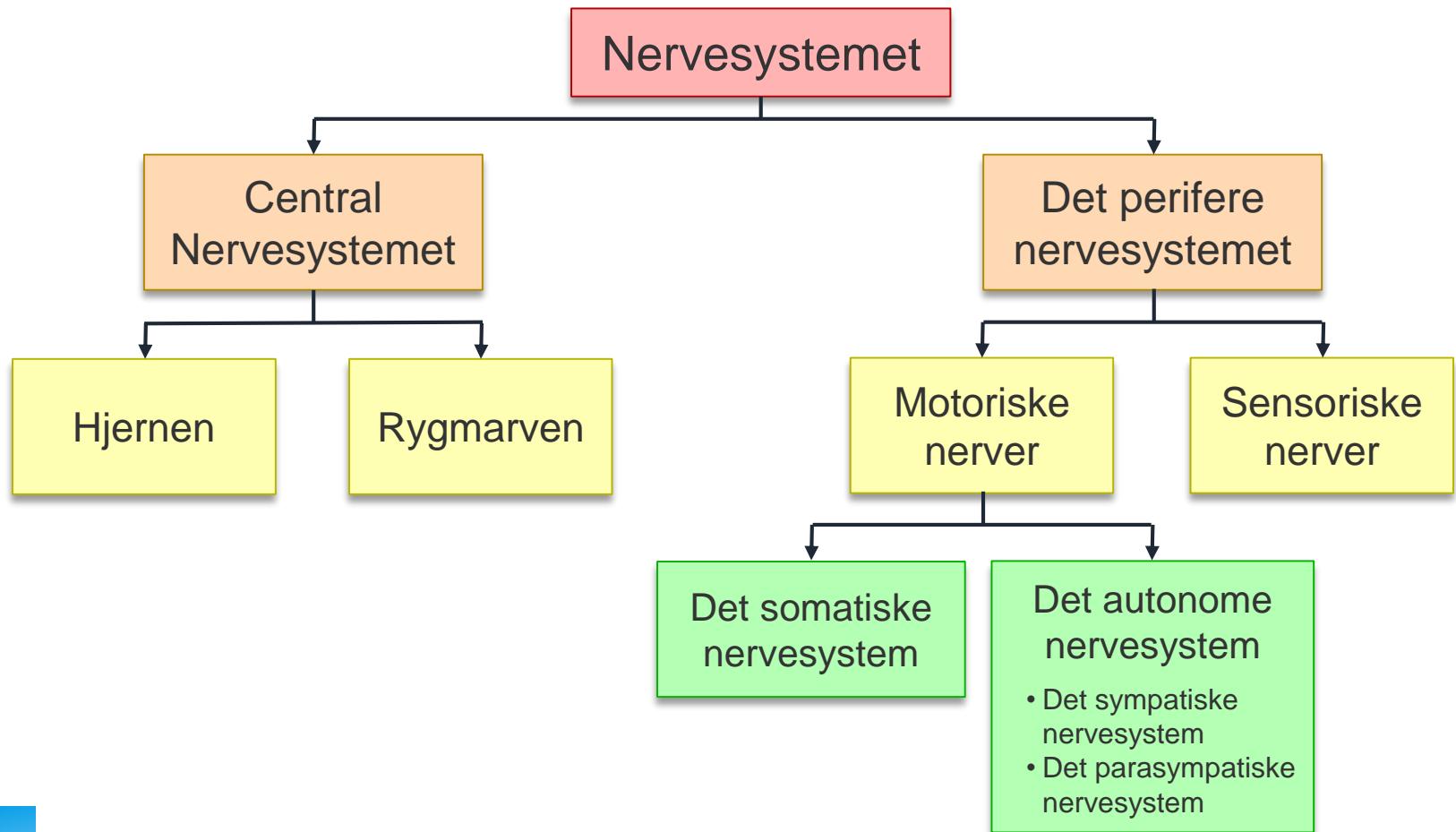
Trivia om nervesystemet

- 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

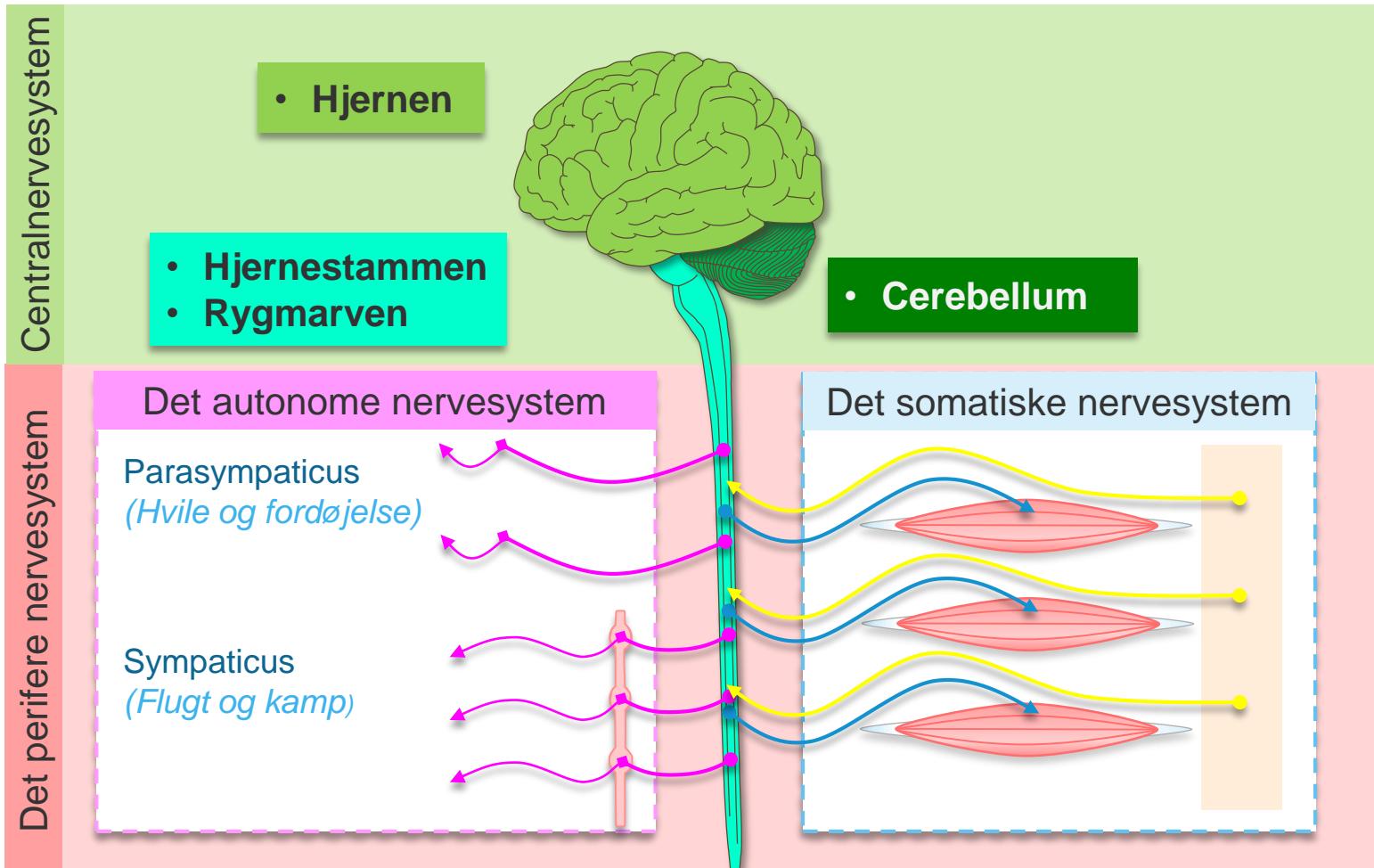


Overblik

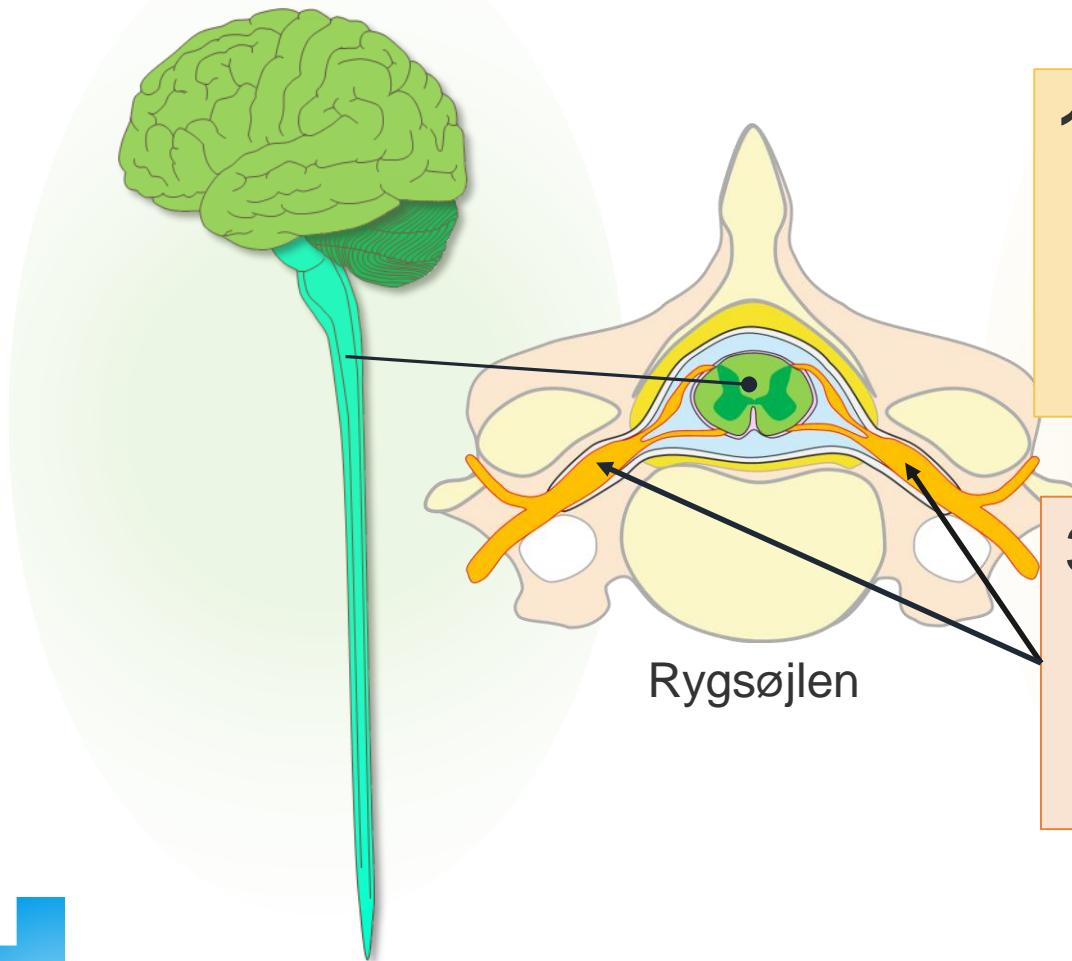
Kategorisk model



Model af nervesystemet



Centralt



Perifert

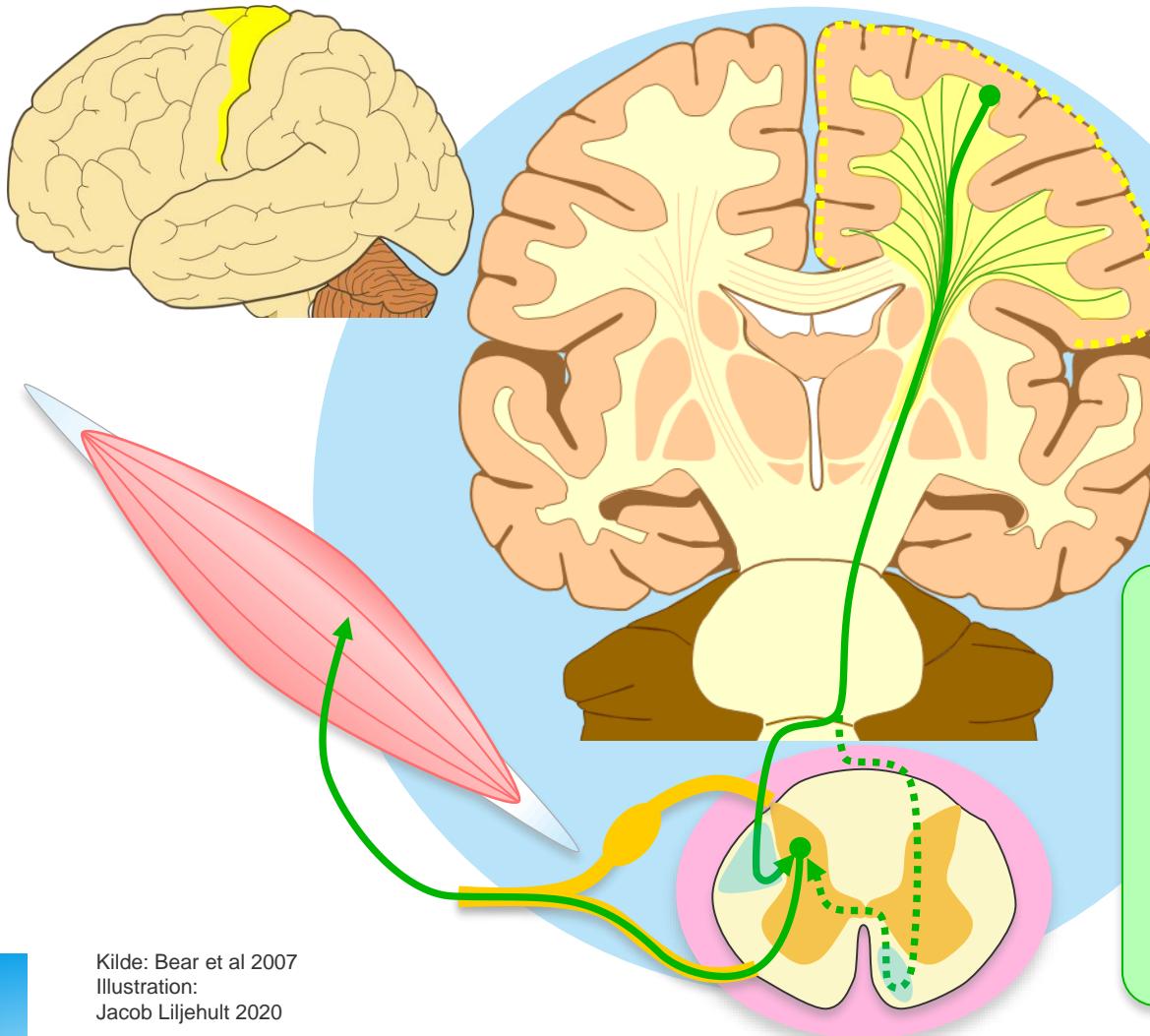
12 kranienerve par

- sensorisk
- motorisk
- parasympatisk

31 spinalnerves par

- sensorisk
- motorisk
- sympathisk

De motoriske baner



Motorisk cortex og
projektionsbaner

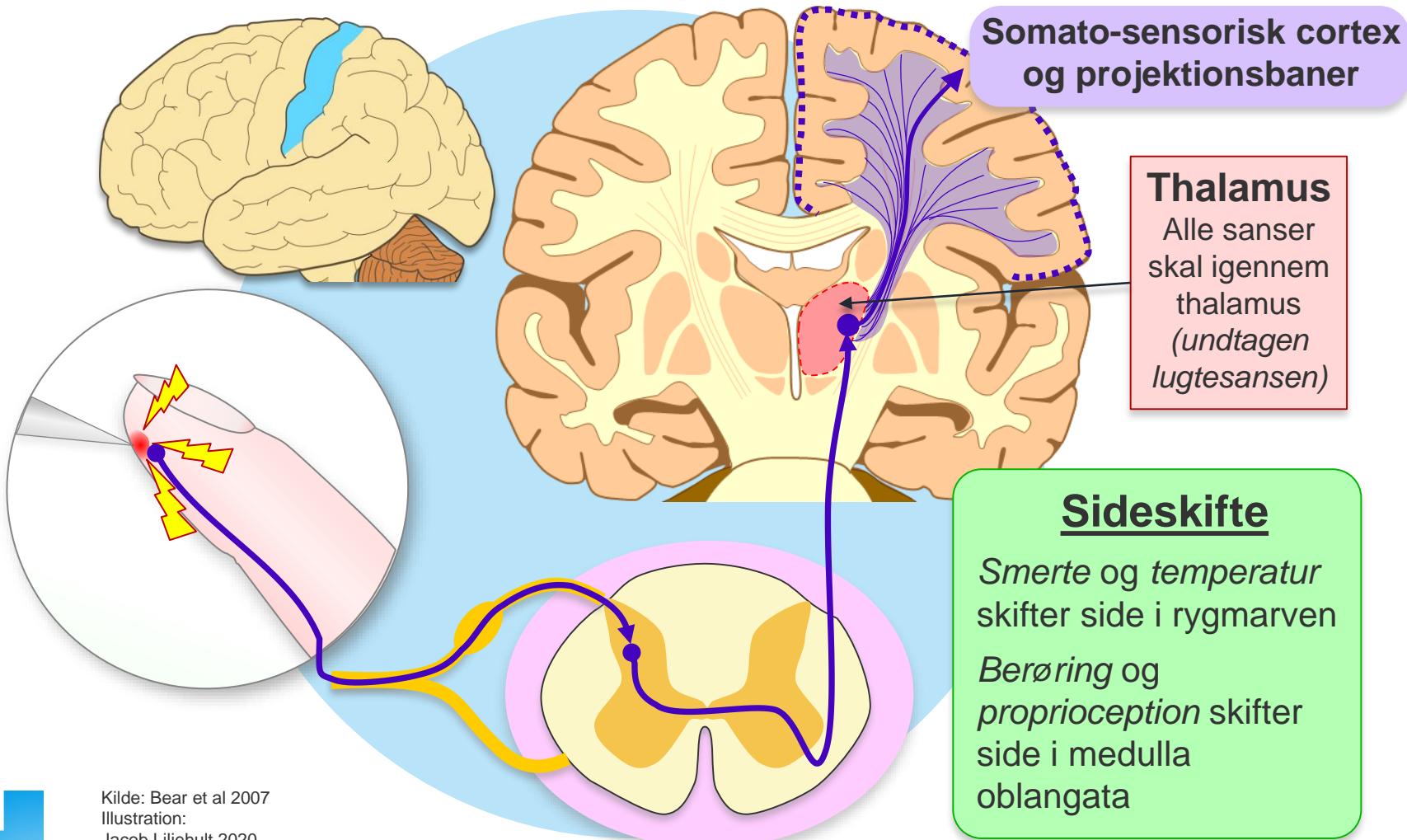
Sideskifte

Baner for *voluntære* bevægelser skifter side i medulla oblangata

Baner for *involuntære* bevægelser skifter side i rygmarven

Kilde: Bear et al 2007
Illustration:
Jacob Liljehult 2020

De somato-sensoriske baner



Hjernehinderne

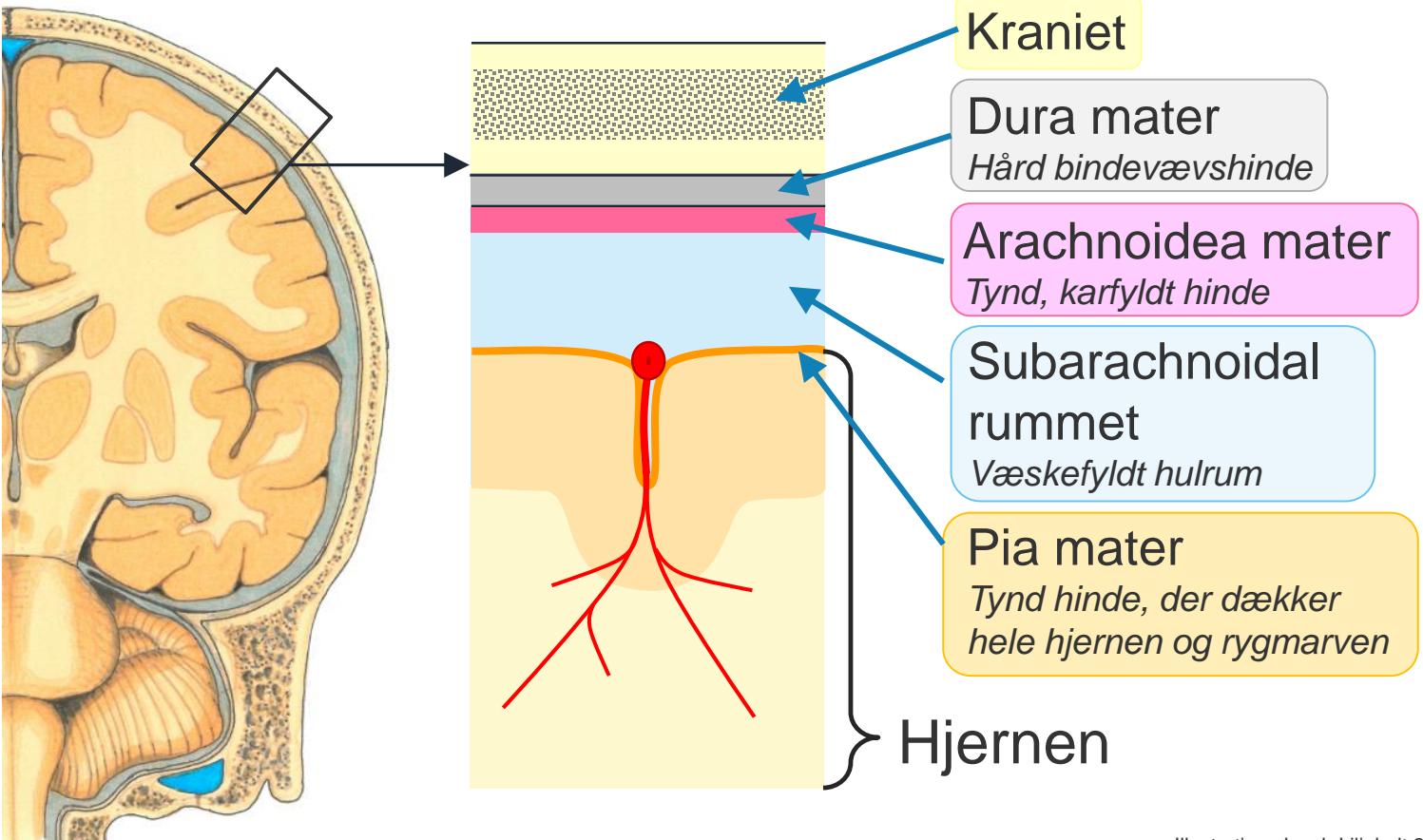
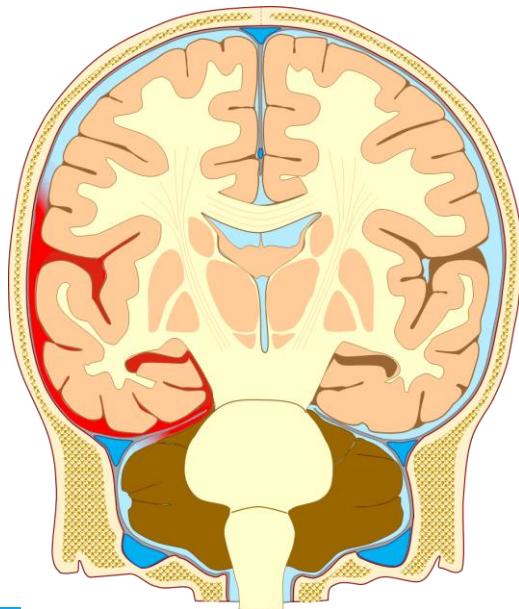


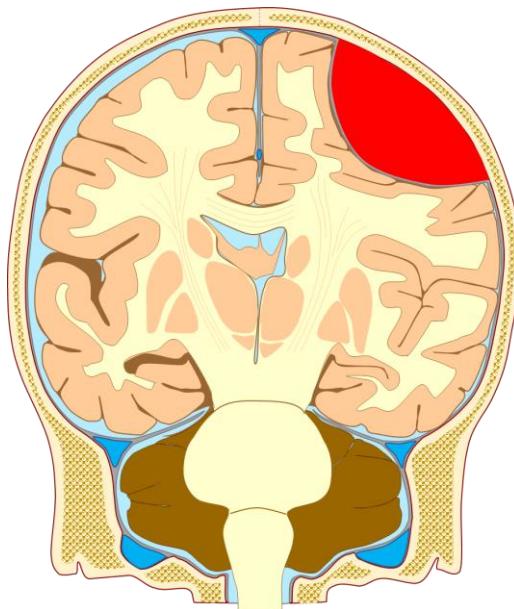
Illustration: Jacob Liljehult 2021

Blødning mellem hjernehinderne

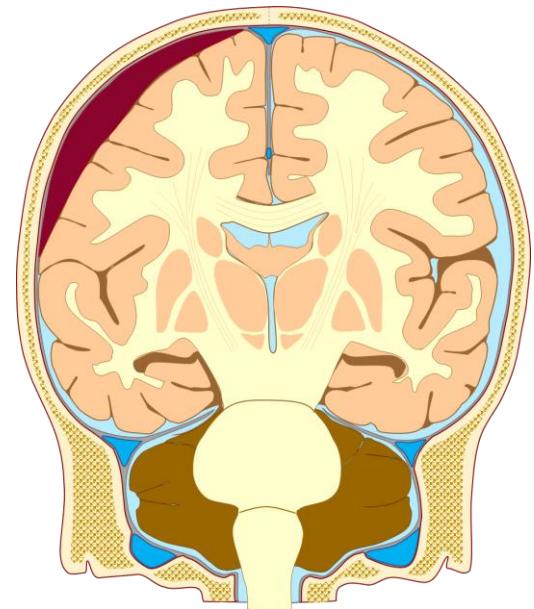
SAH



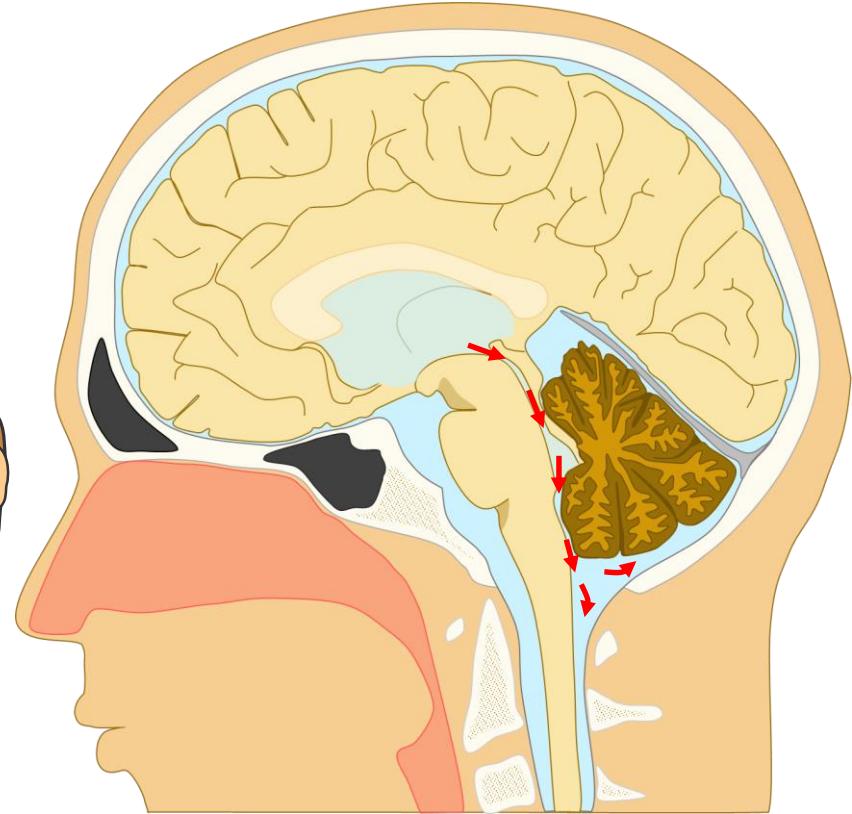
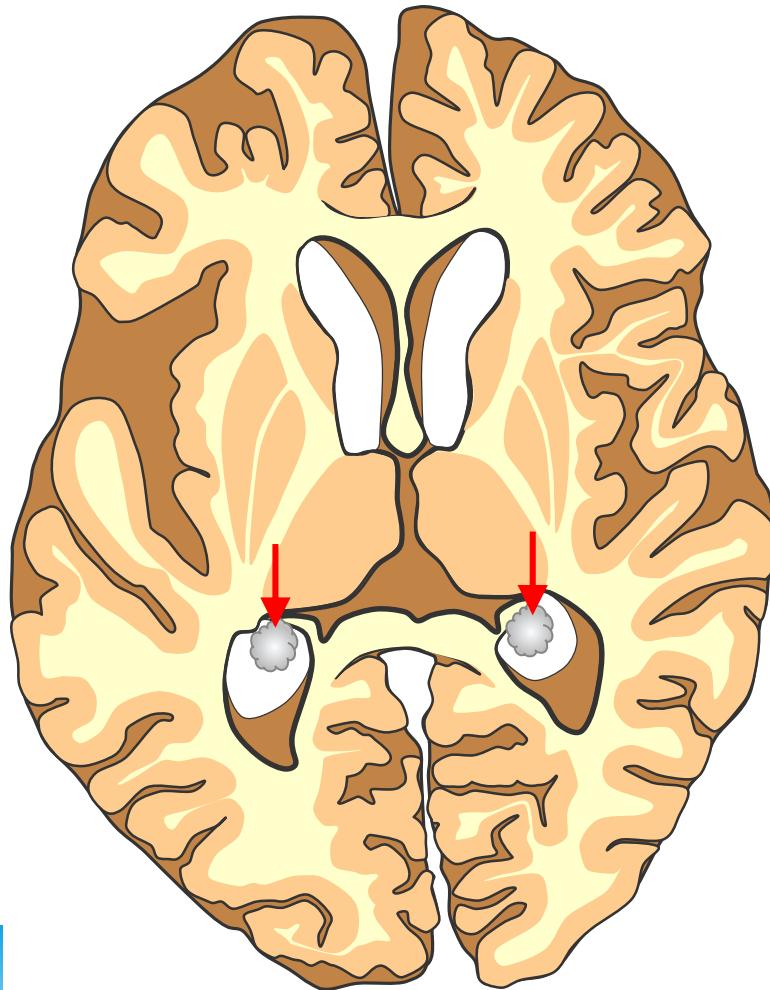
EDH



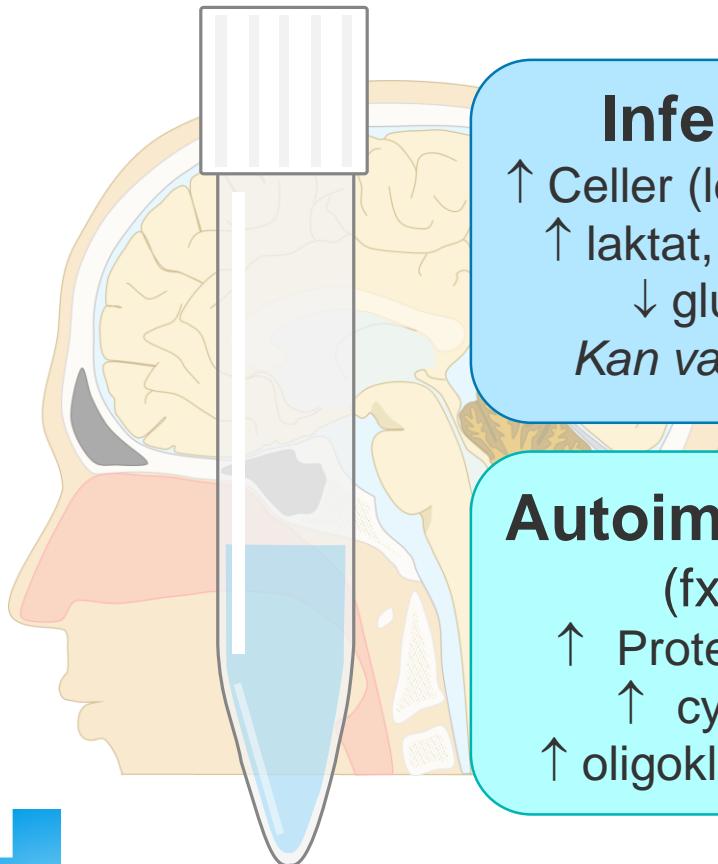
SDH



Cerebro-spinal væske



Spinalvæske



Infektion

↑ Celler (leukocytter),
↑ laktat, ↑ protein,
↓ glukose
Kan være uklar

SAH

↑ Celler (erytrocytter),
↑ protein, ↑ hæmoglobin/
+derivater
Kan være gullig/rød

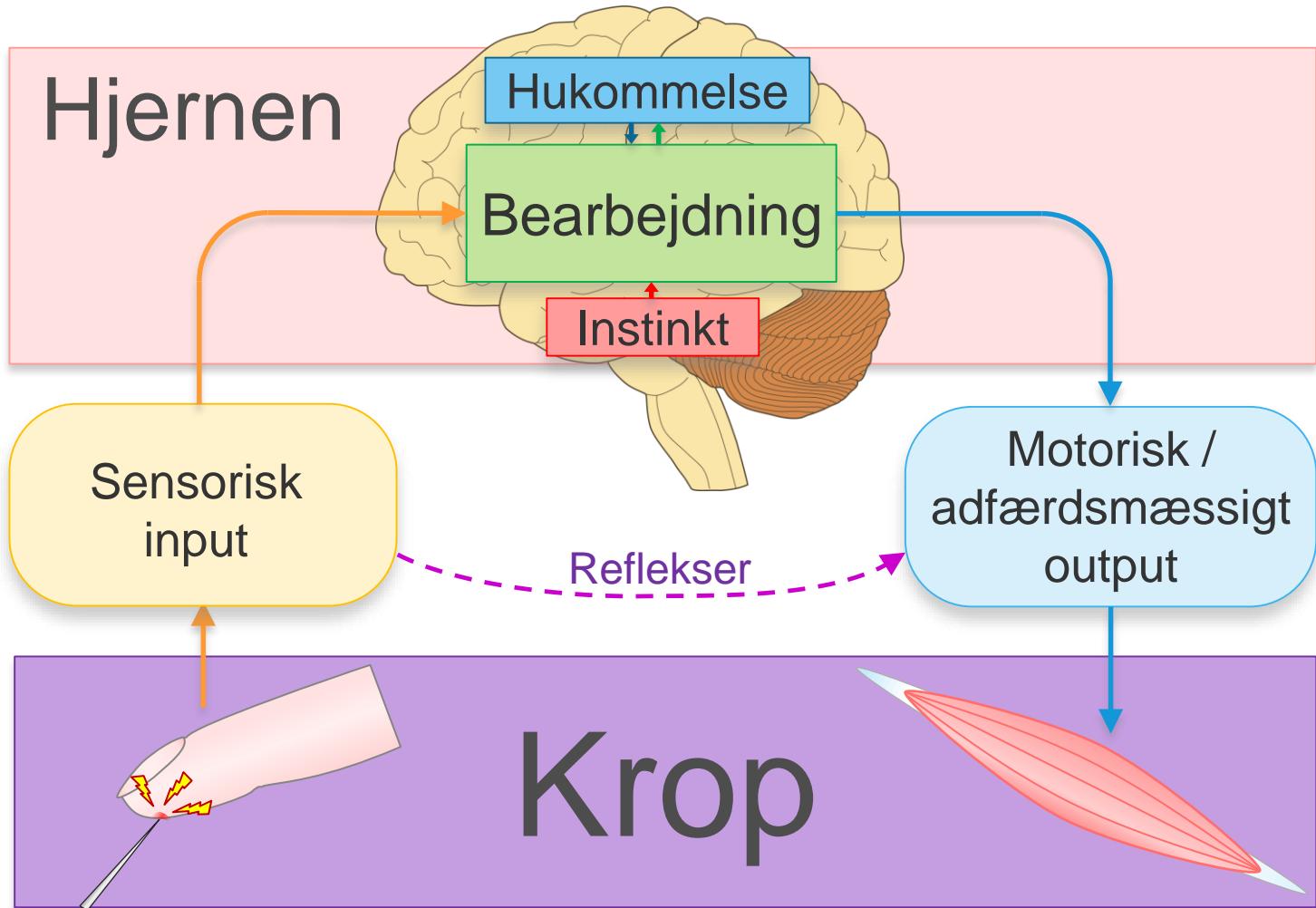
Autoimmun sgd

(fx MS)
↑ Protein, ↑ IGG,
↑ cytokiner,
↑ oligoklonale bånd

Alzheimer

↑ Beta-amyloid,
↑ tau-protein

Proces-model

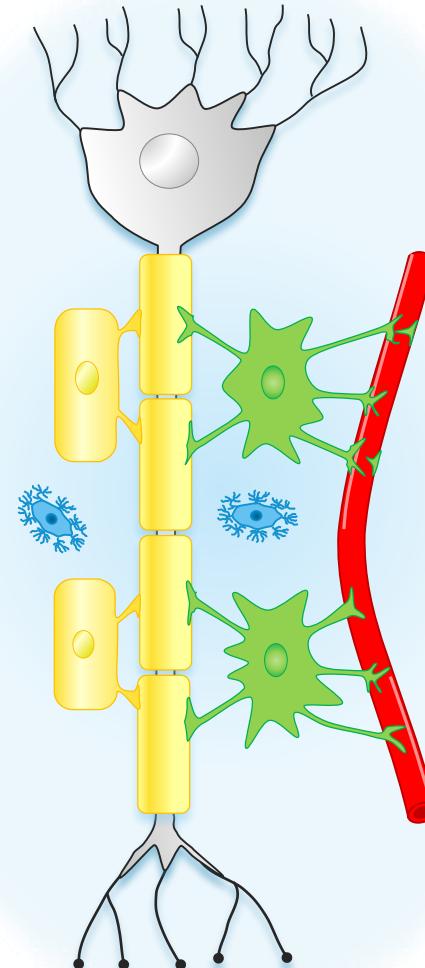




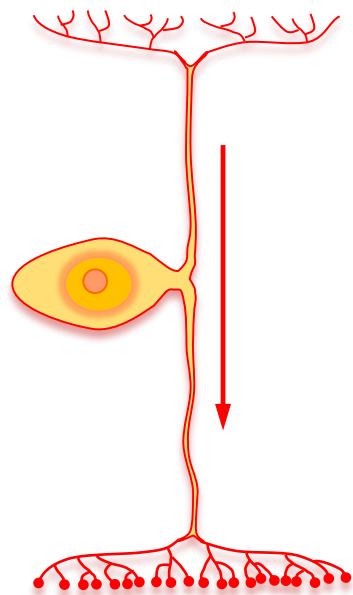
Bestanddele

Nervesystemets celler

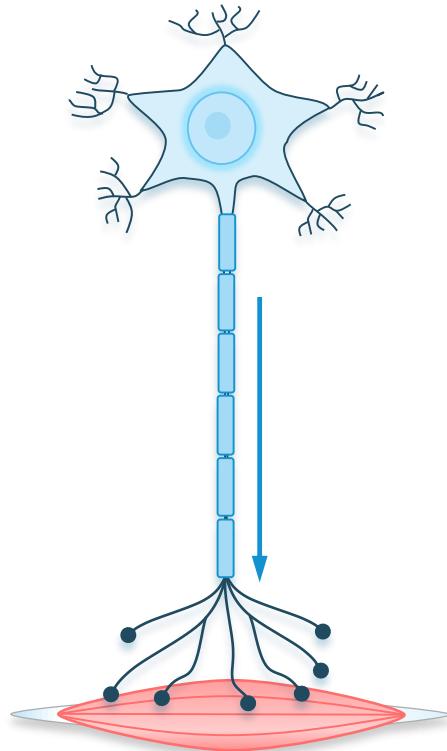
- Nerveceller (Neuroner)
- Støtteceller (Gliaceller)
 - Astrocytter ●
 - Myelinierende celler ●
 - Oligodendrocytter (CNS)
 - Swann'ske celler (PNS)
 - Mikrocytter ●



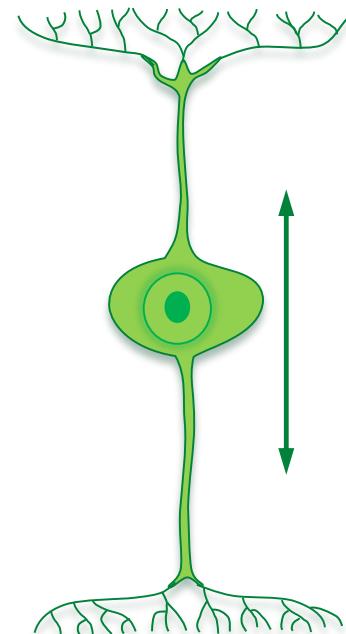
Neuroner



**Sensorisk neuron
(Unipolar)**

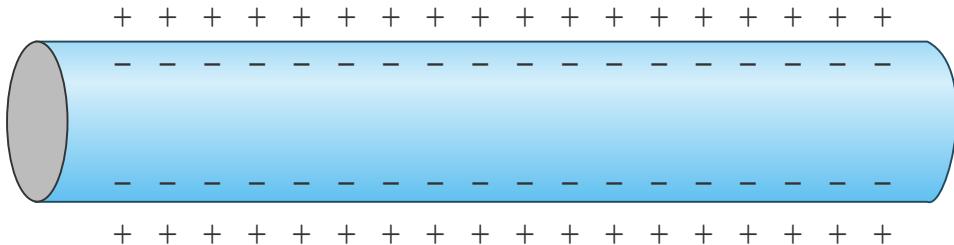


**Motorisk neuron
(Multipolar)**

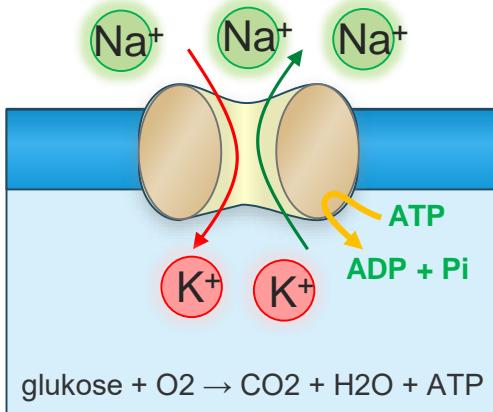


**Interneuron
(Bipolar)**

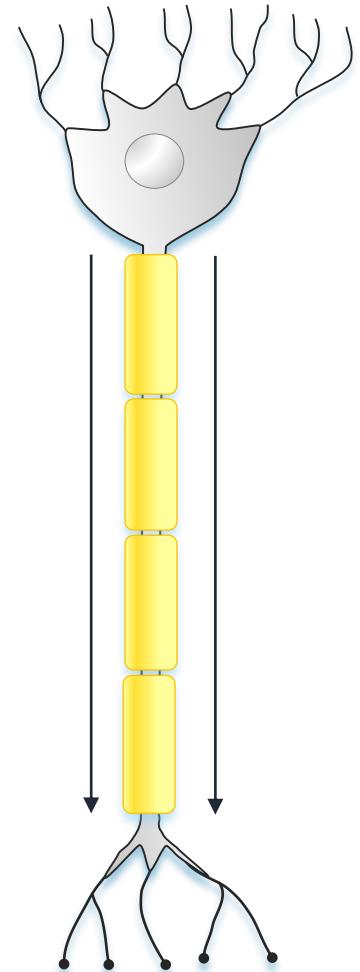
Nervesignalet



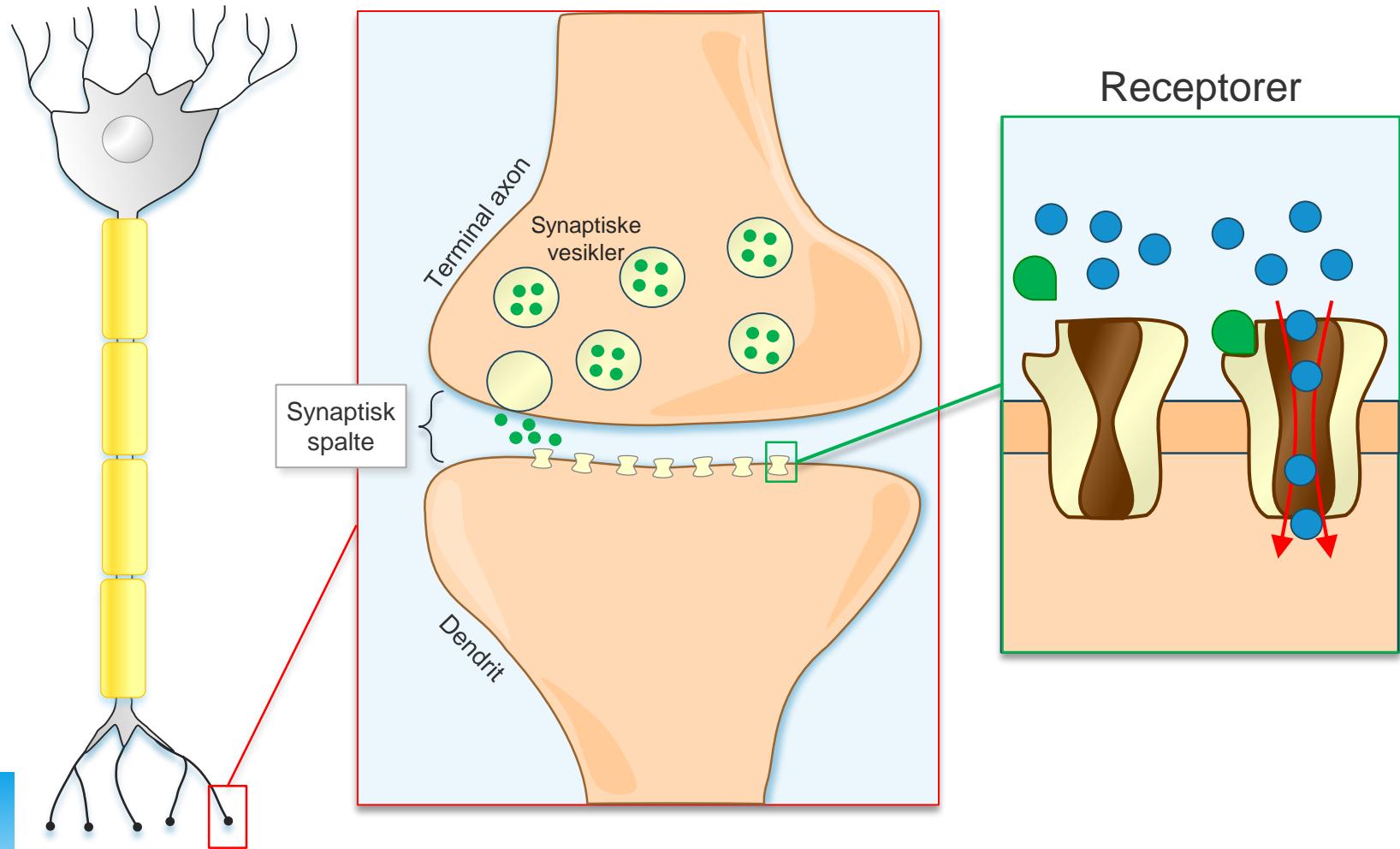
Natrium-Kalium
pumpen



- 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

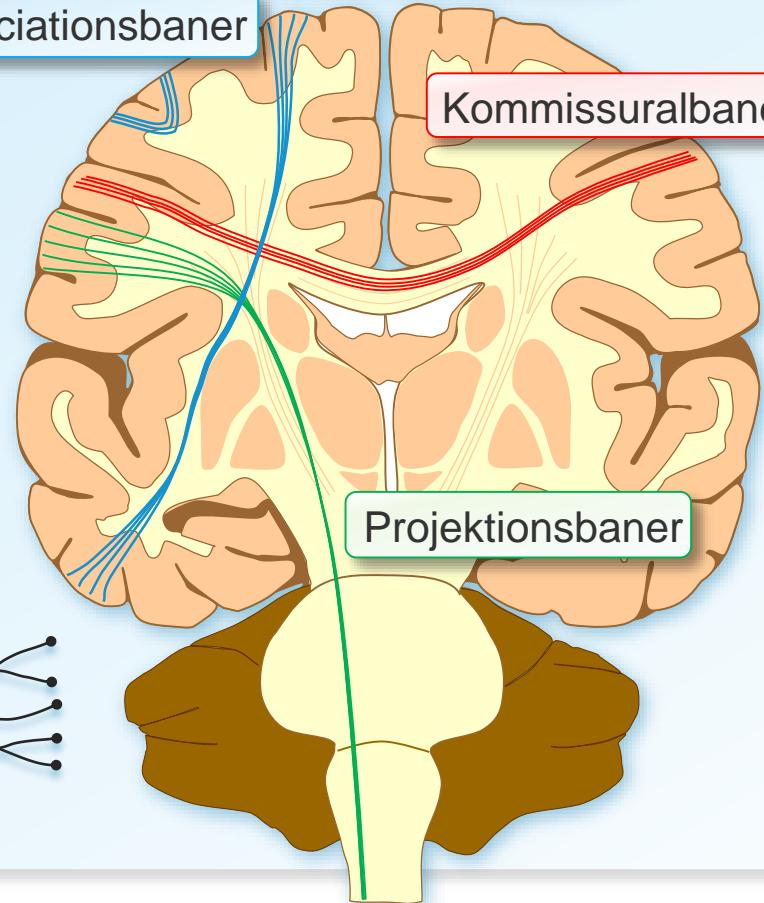
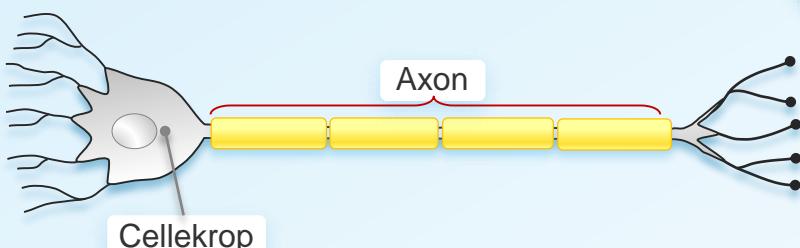


Kilde: neuroanatomy.ca

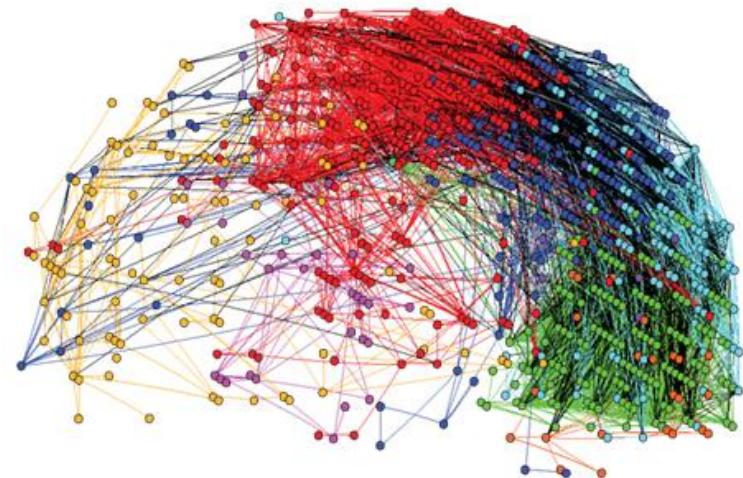
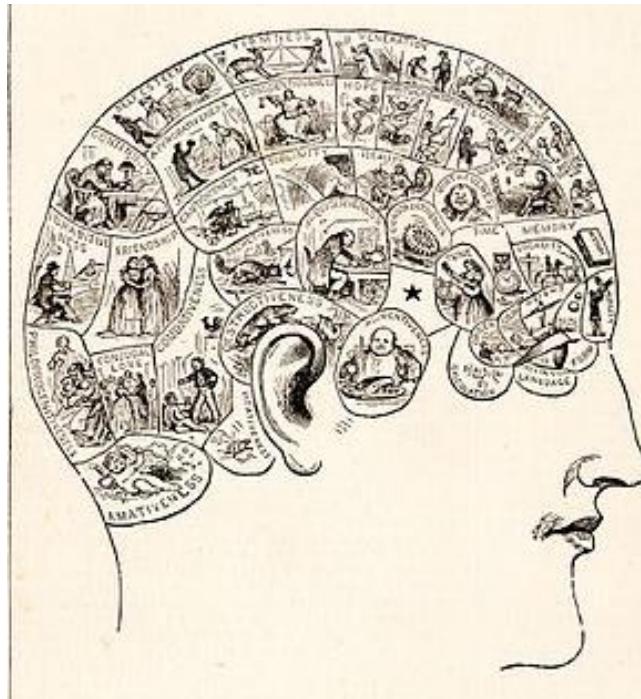
Associationsbaner

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

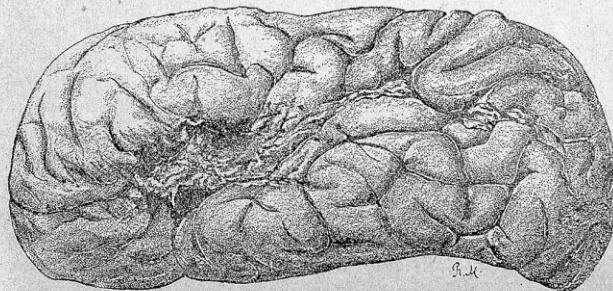
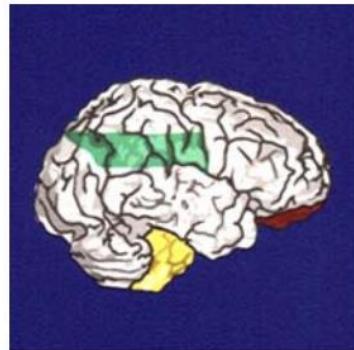


Fig. 1 — Hémisphère gauche du cerveau de Leborgne, première autopsie de Broca. Dessin fait sur la photographie de la pièce actuellement conservée au Musée Dupuytren. On voit que, en outre de la lésion de la troisième frontale, le ramollissement existait tout le long de la scissure de Sylvius et siégeait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



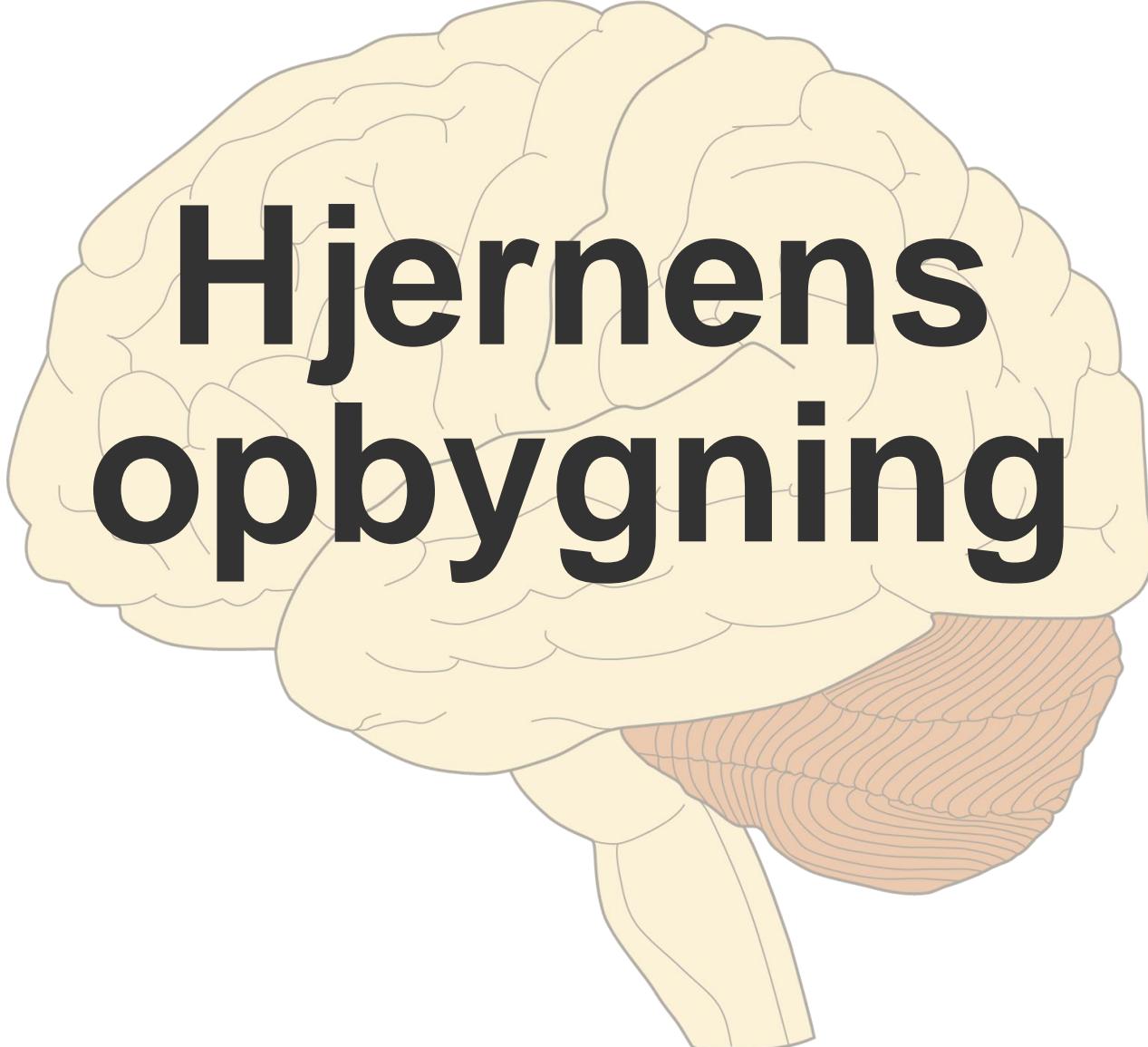
Lateral sagittal view



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

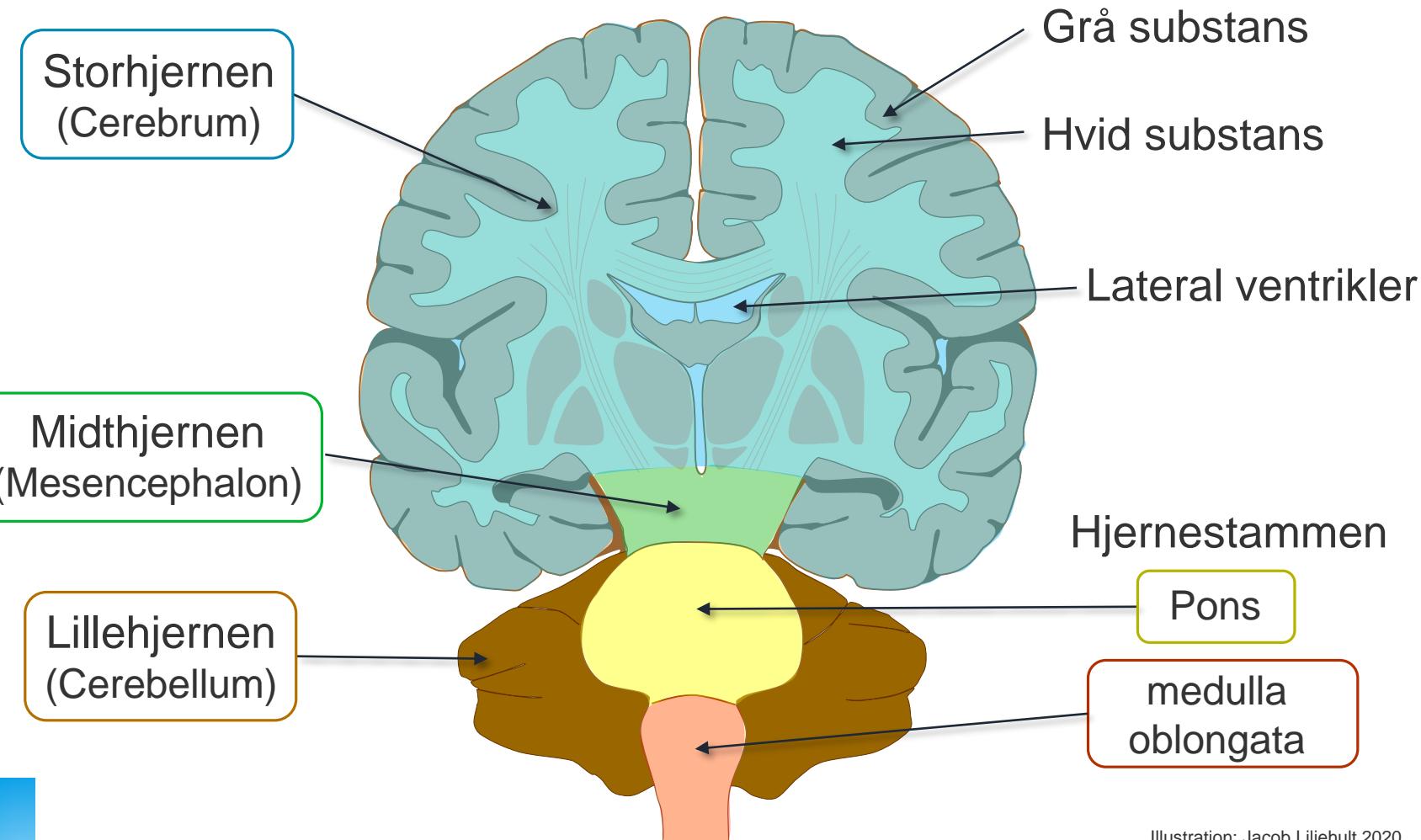


Illustration: Jacob Liljehult 2020

Hjernens overflade

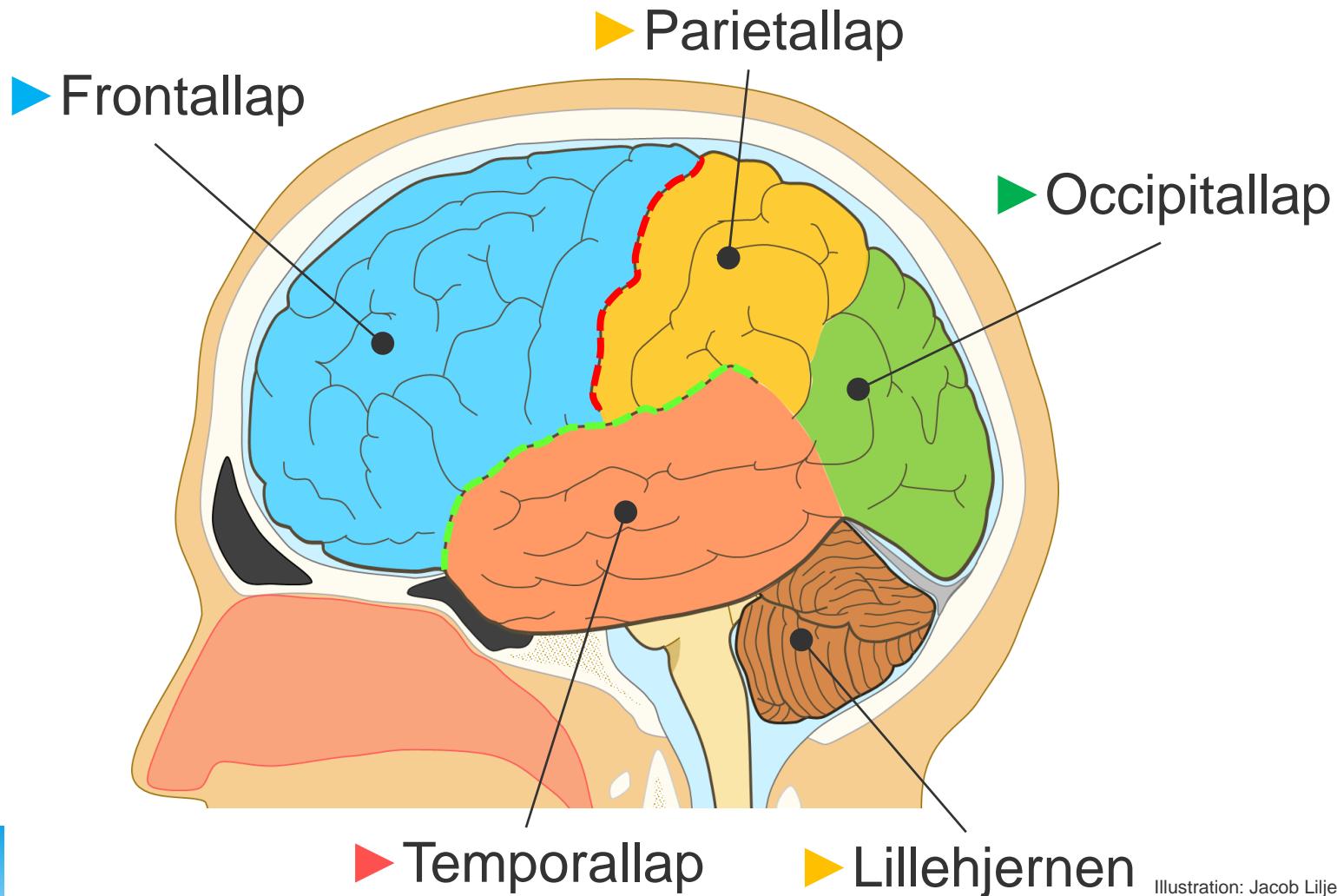
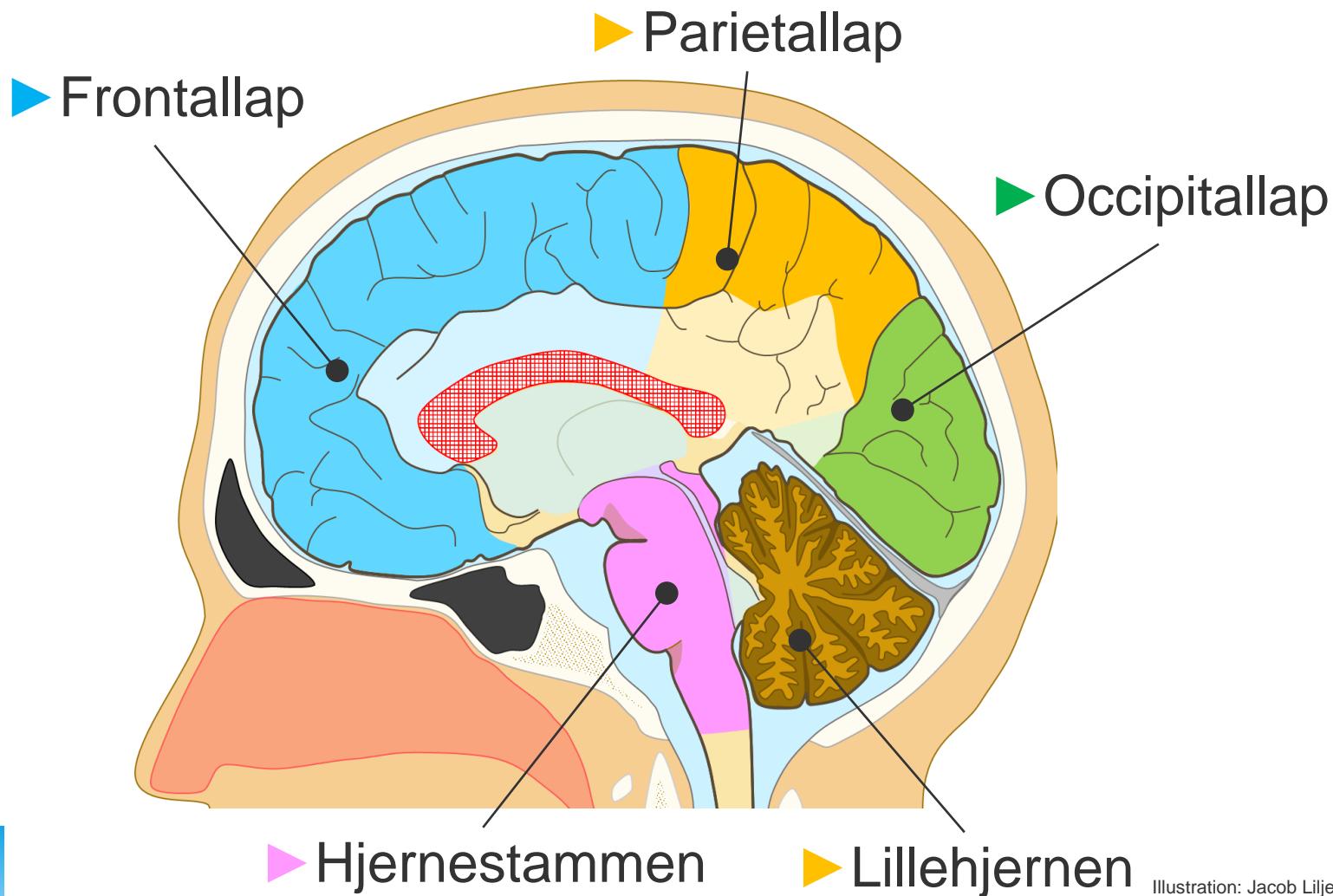


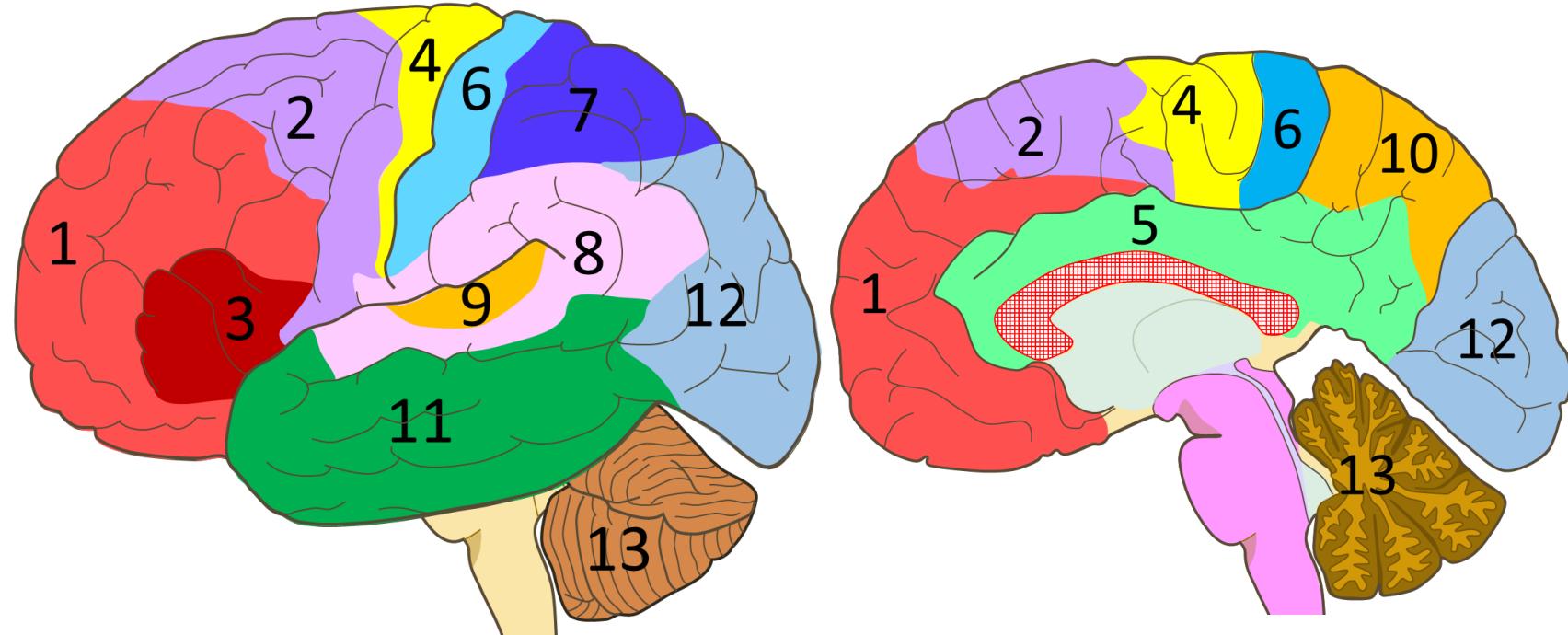
Illustration: Jacob Liljehult 2020

Hjernens overflade



Jacob Mesot Liljehult

Illustration: Jacob Liljehult 2020



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

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

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

Illustration: Jacob Liljhult 2022

Dybe strukturer

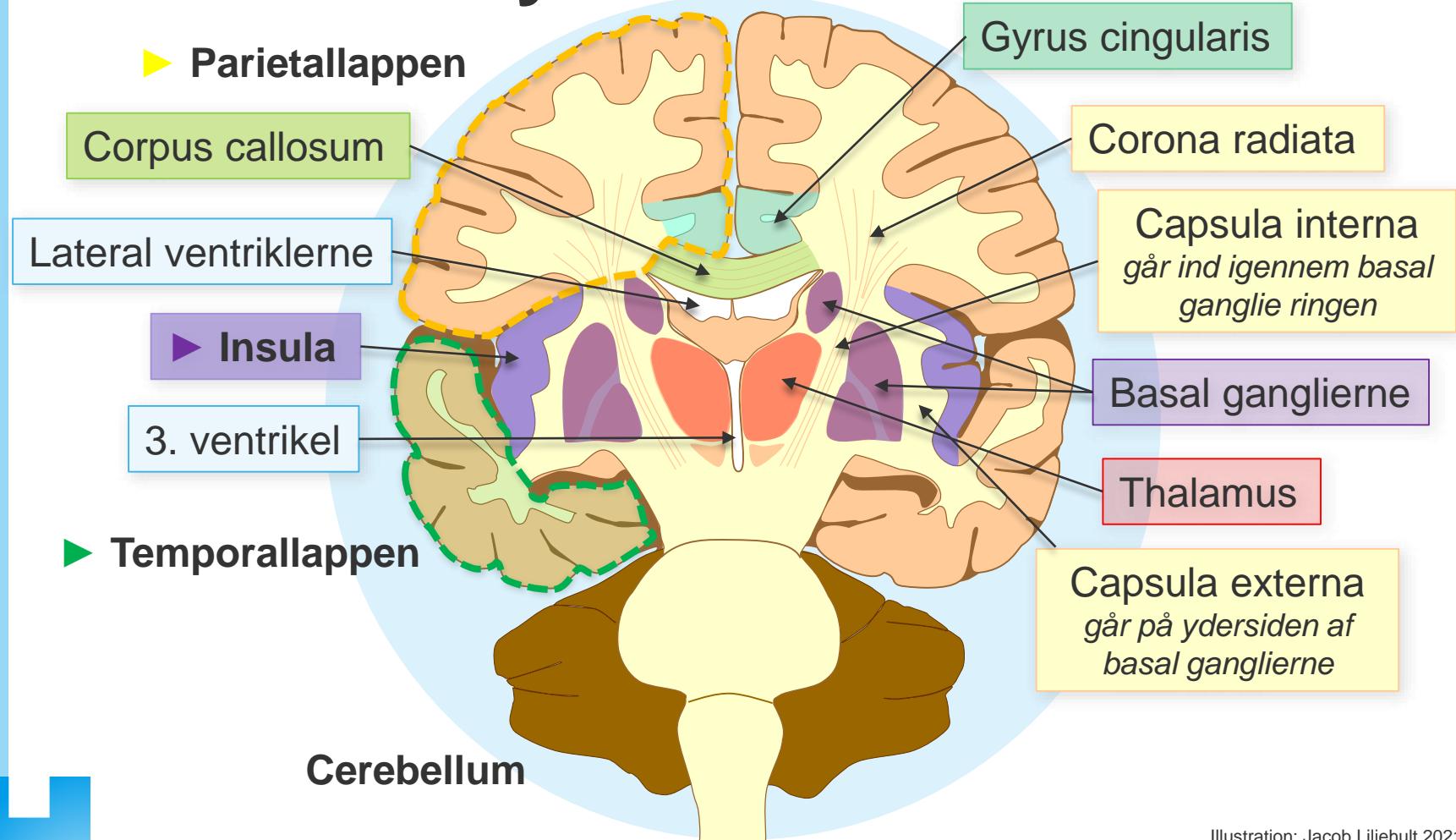


Illustration: Jacob Liljehult 2021

Hemisfære-lateralisering

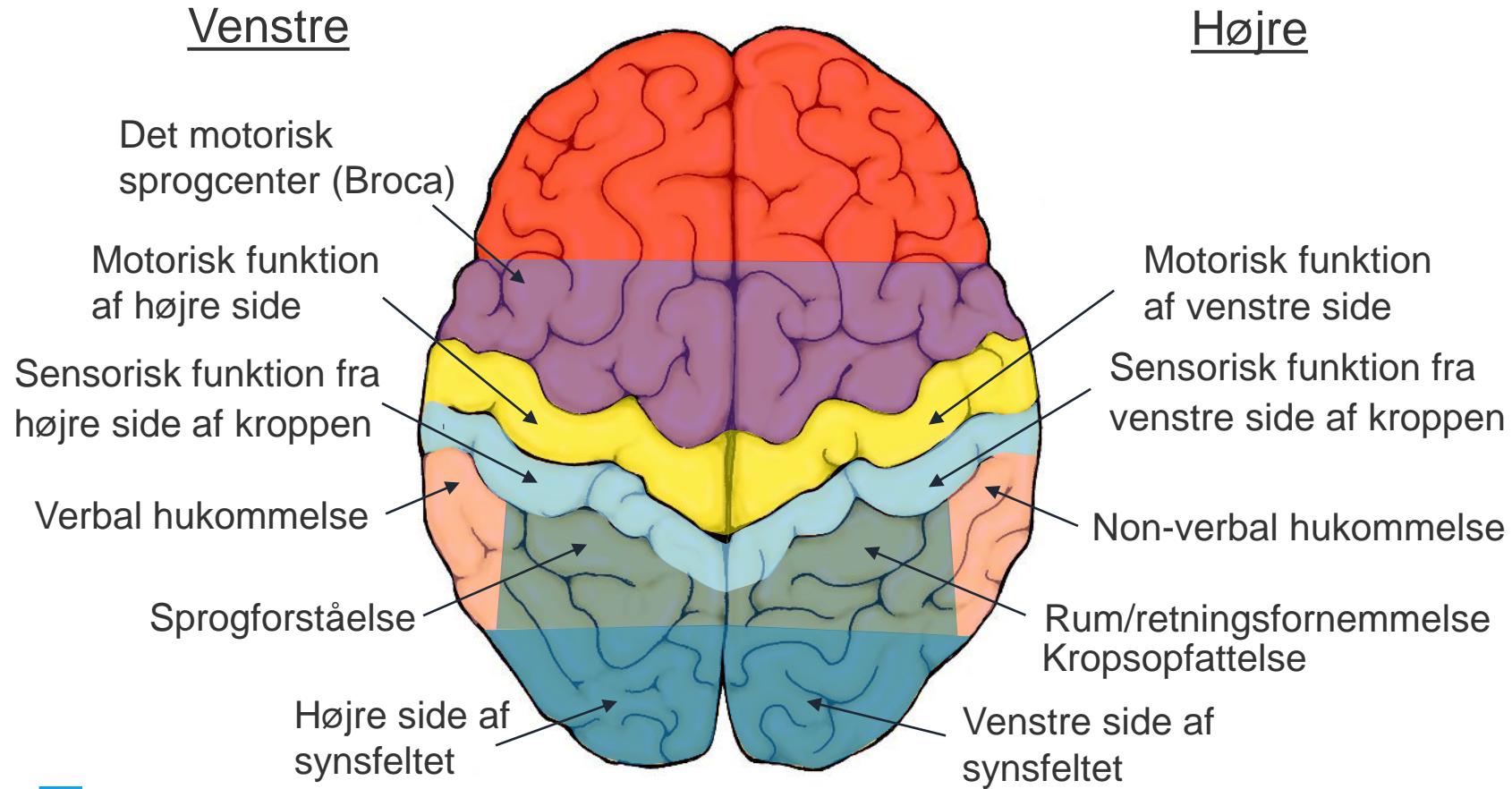
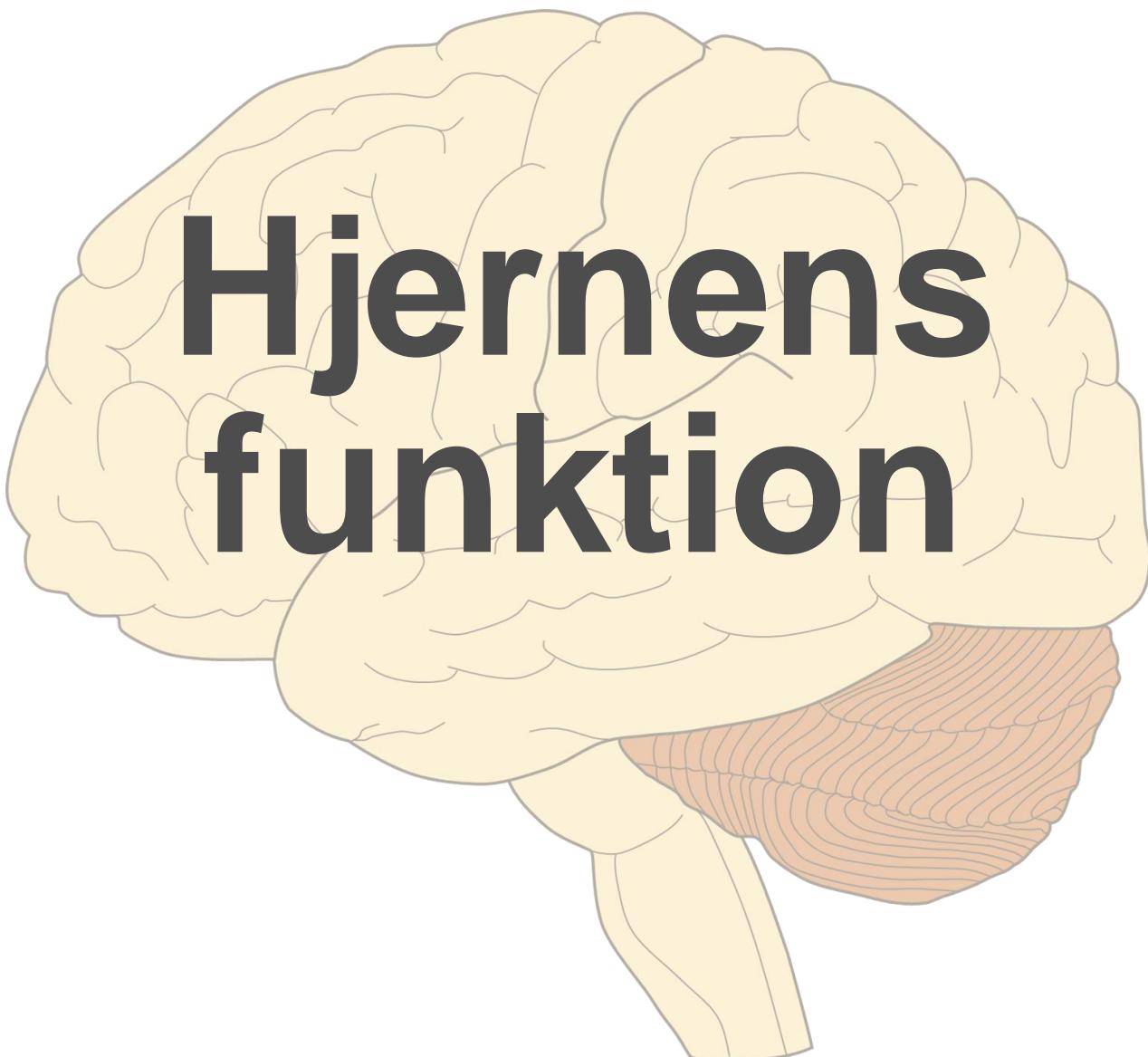
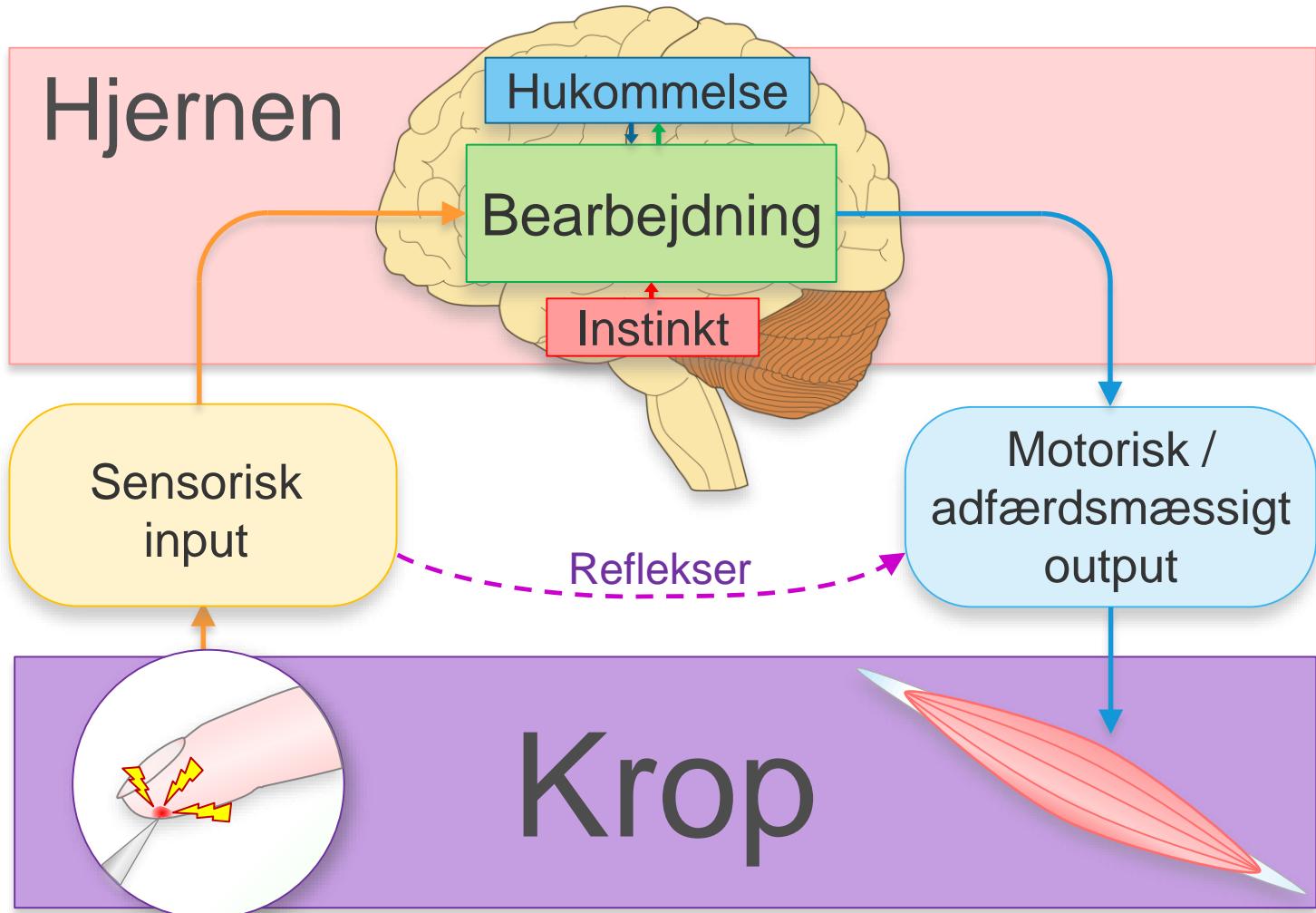


Illustration: Jacob Liljehult 2020



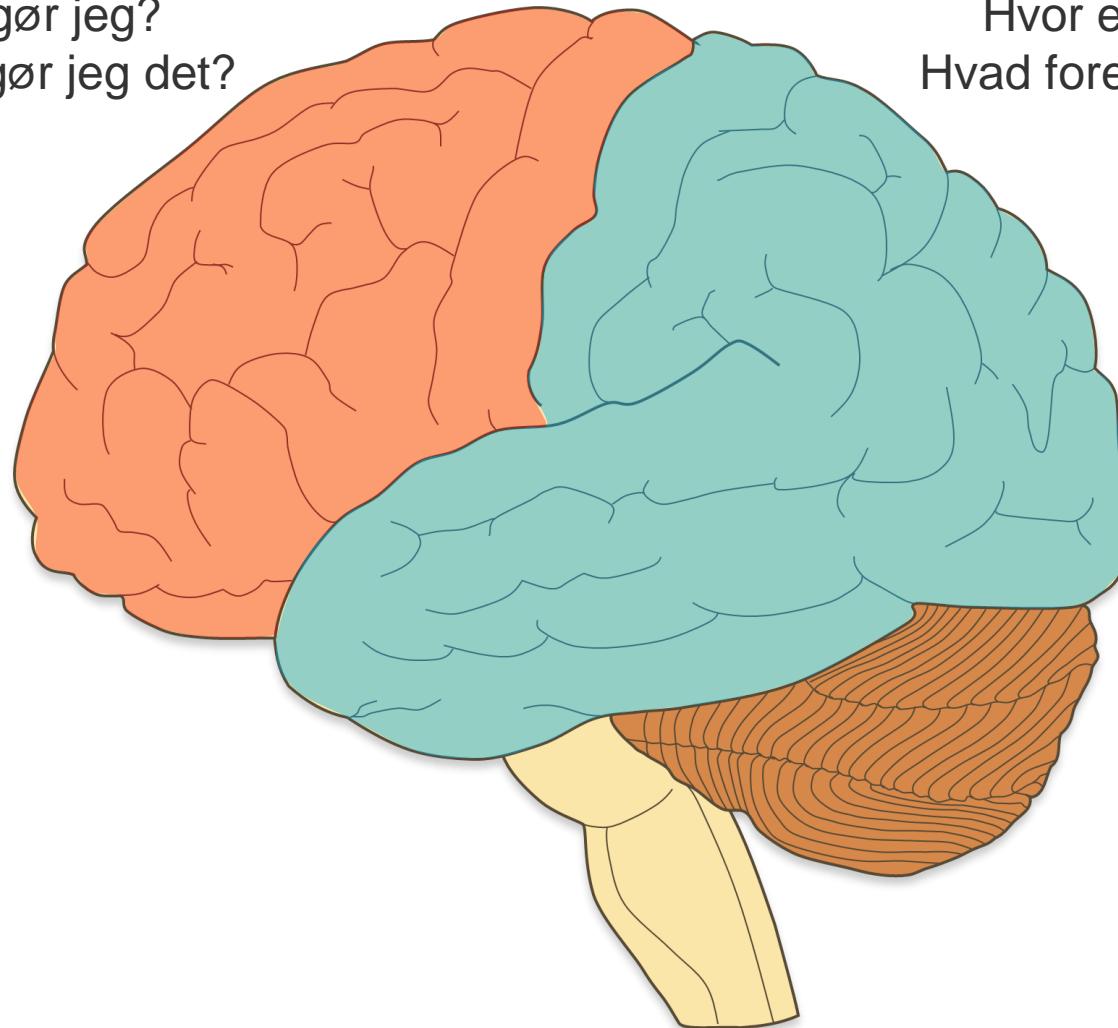
Hjernens funktion

Funktionel model



Eksekution

Hvad gør jeg?
Hvordan gør jeg det?



Perception

Hvor er jeg?
Hvad foregår der?

Perception

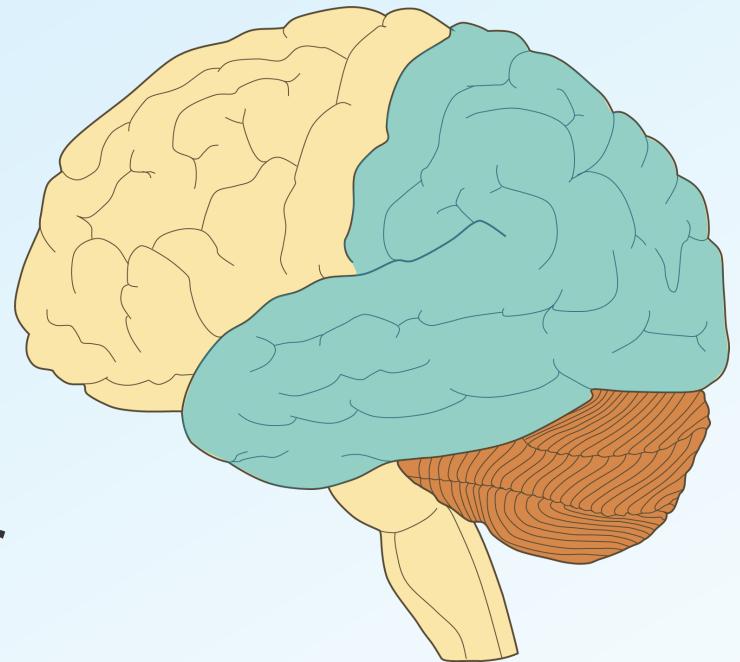
Sanser

- **Specialiserede sanser**

- Lugt
- Smag
- Syn
- Hørelse
- Balance

- **Somato-sensoriske sanser**

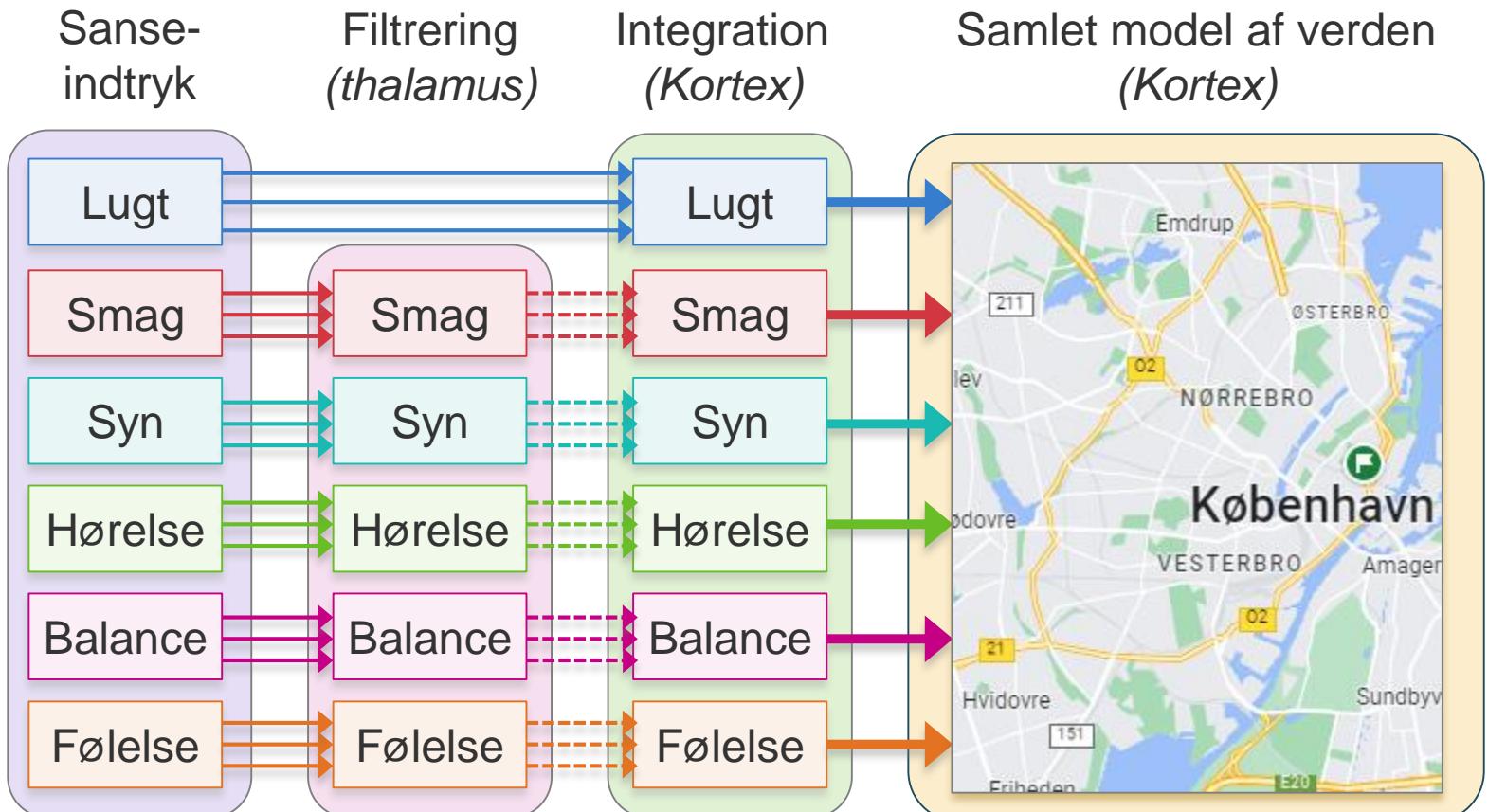
- Berøring
- Smerte/temperatur
- Proprioception



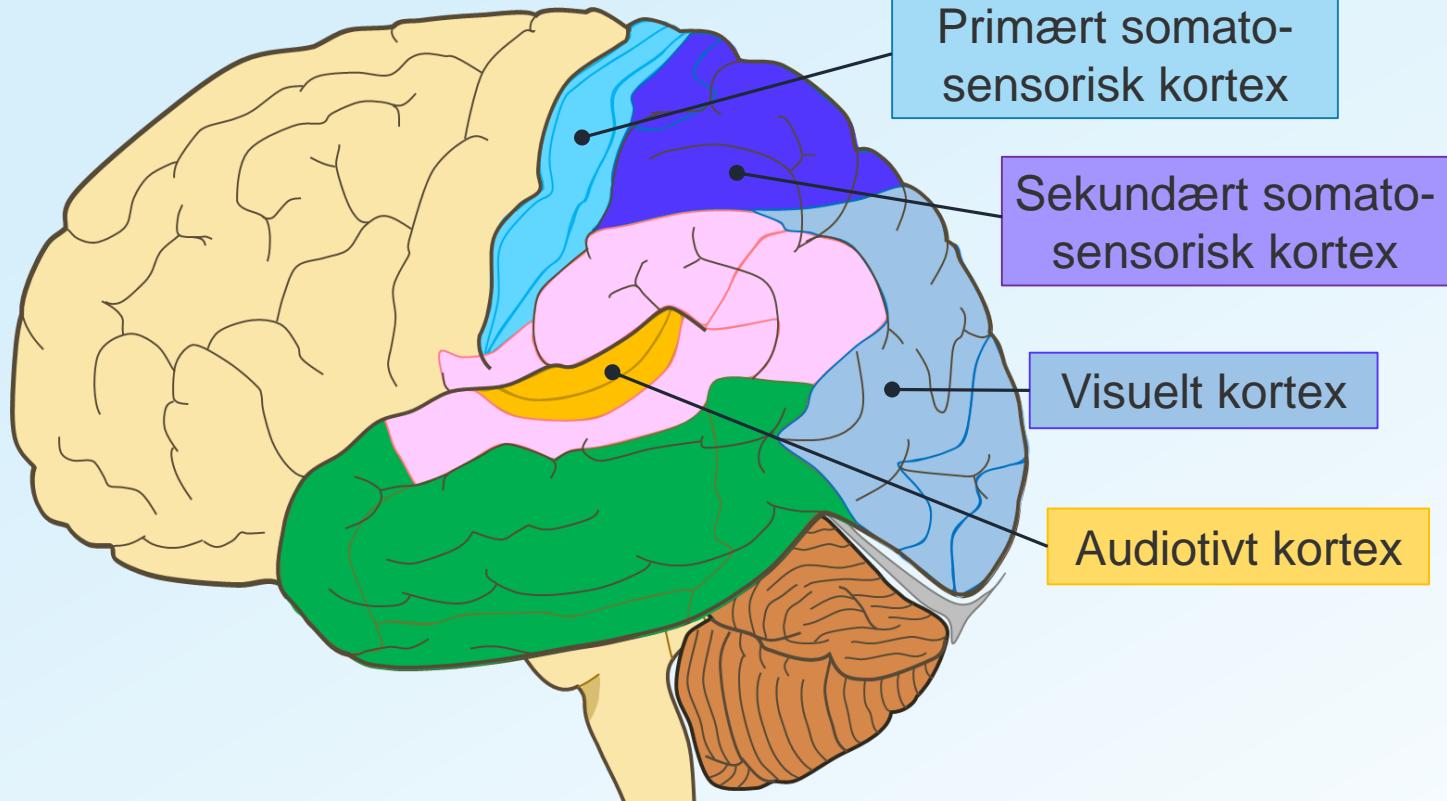
Kilde: Gade 2009

Illustration: Jacob Liljehult 2020

Perception



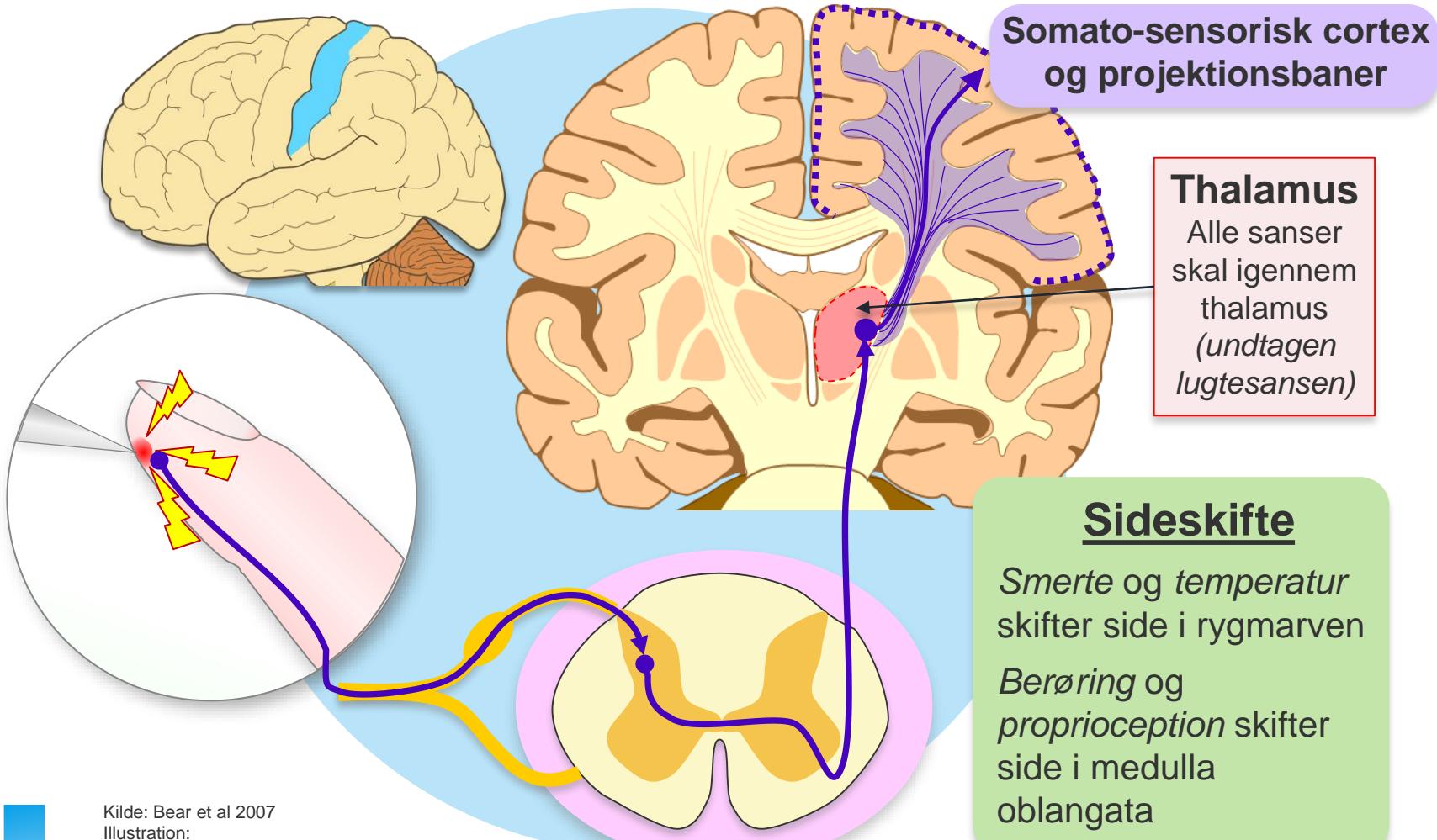
Perception



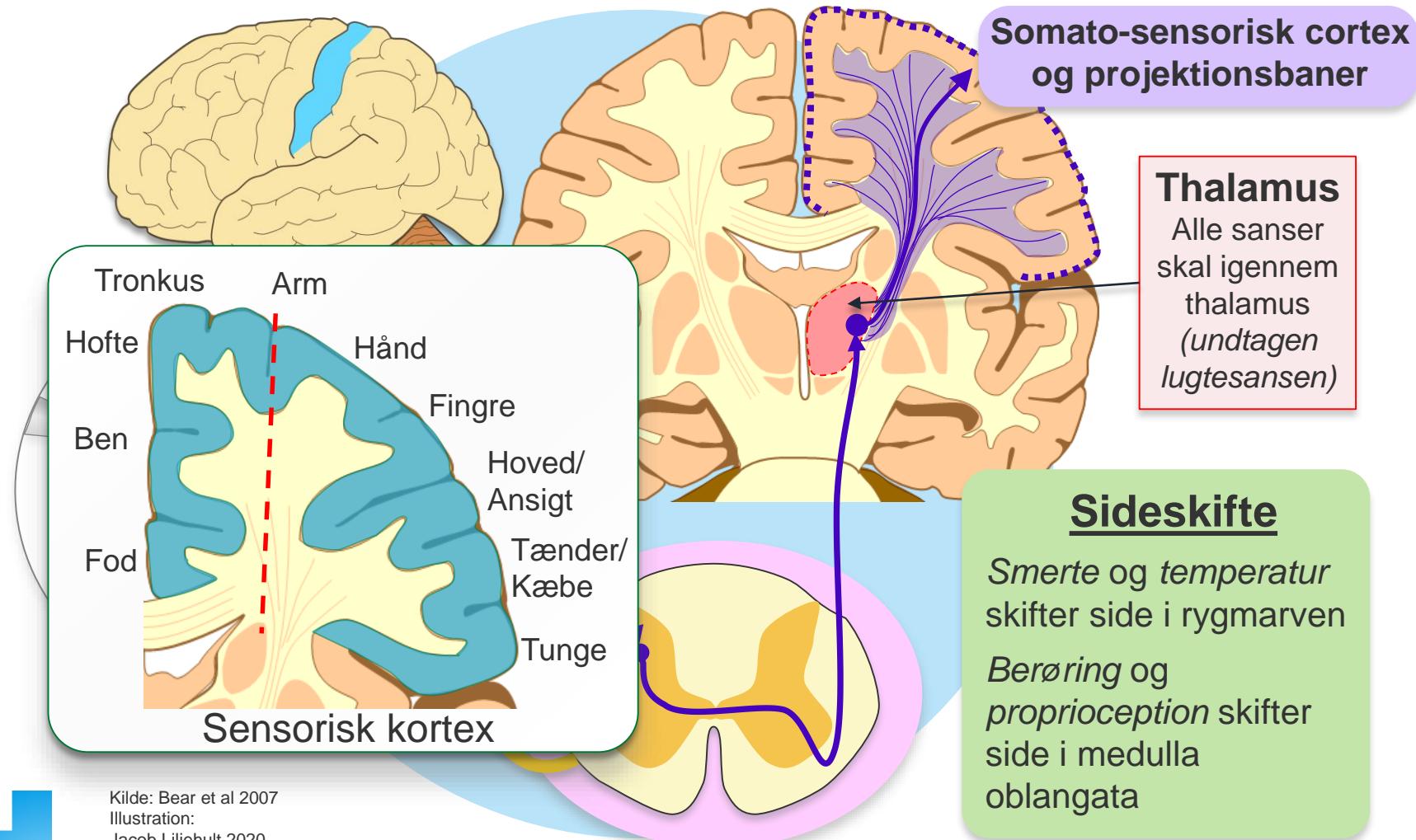
Kilde: Gade 2009

Illustration: Jacob Liljehult 2020

De somato-sensoriske baner



De somato-sensoriske baner



Synet

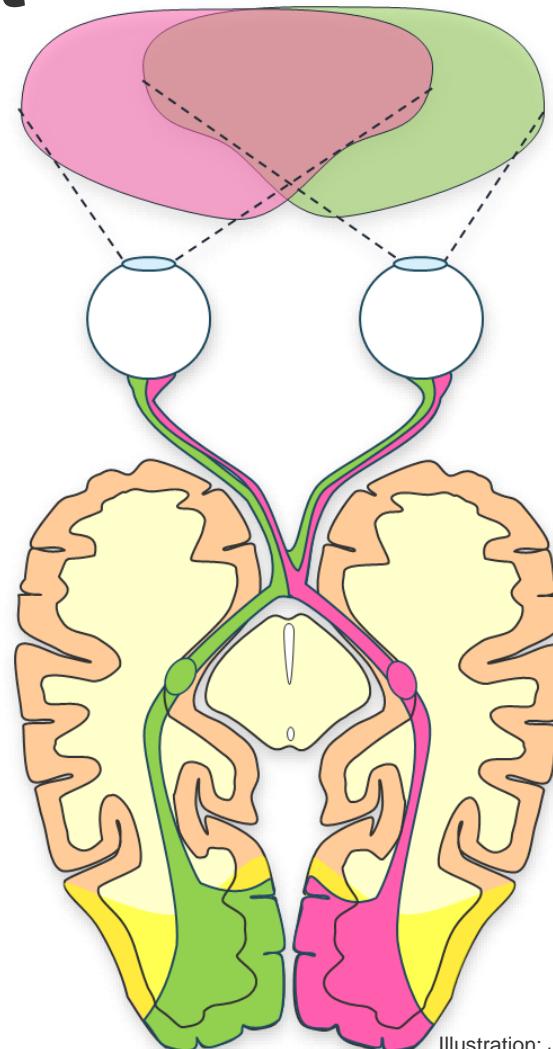
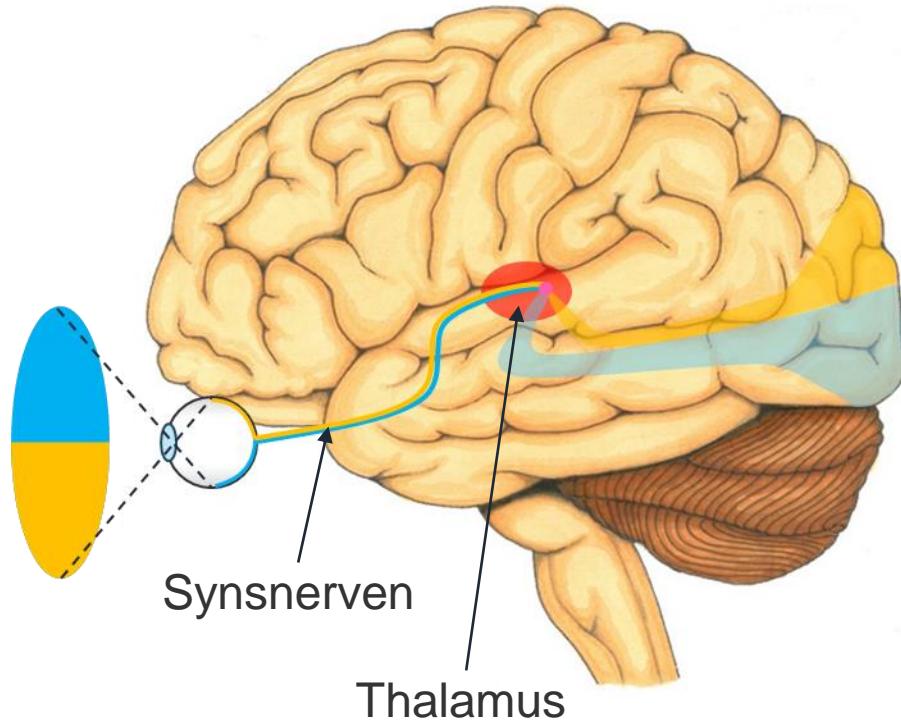
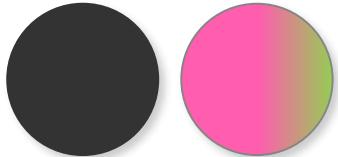


Illustration: Jacob Liljehult 2021

Visuelle forstyrrelser

Ved apopleksi er
anopsi altid i
 modsatte side

Amaurosis fugax



Hvis begge
occipitallapper
er ramt



Kortikal blindhed +
anosognosi
(Anton's syndrom)

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

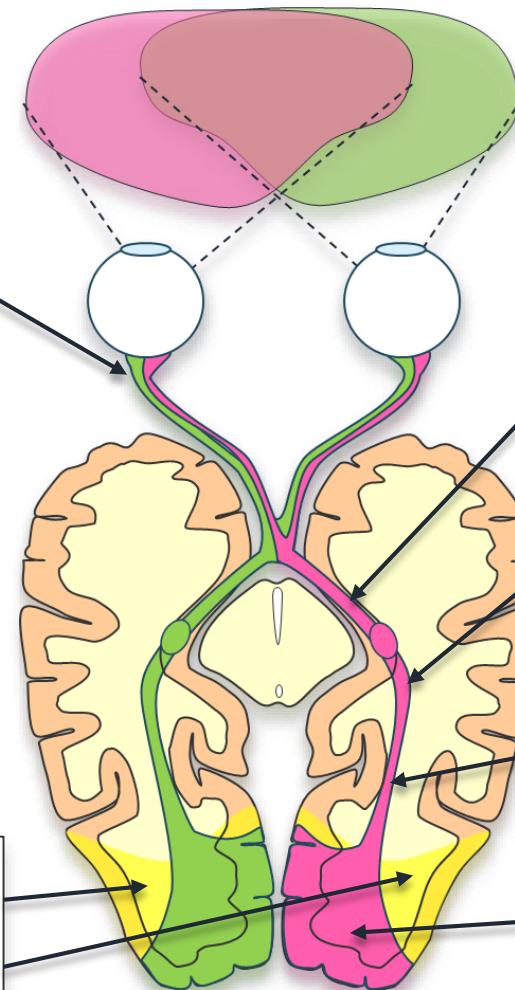
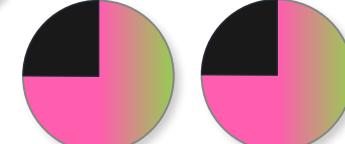


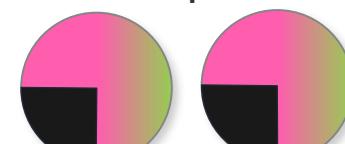
Illustration: Jacob Liljehult 2021



hemianopsi



Øvre kvadrant
anopsi



Nedre kvadrant
anopsi



hemianopsi

Visuo-spartielle forstyrrelser

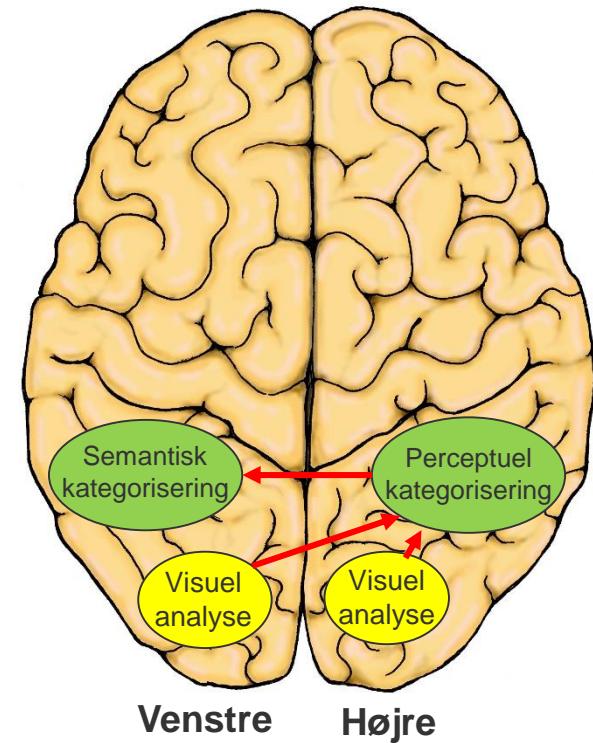
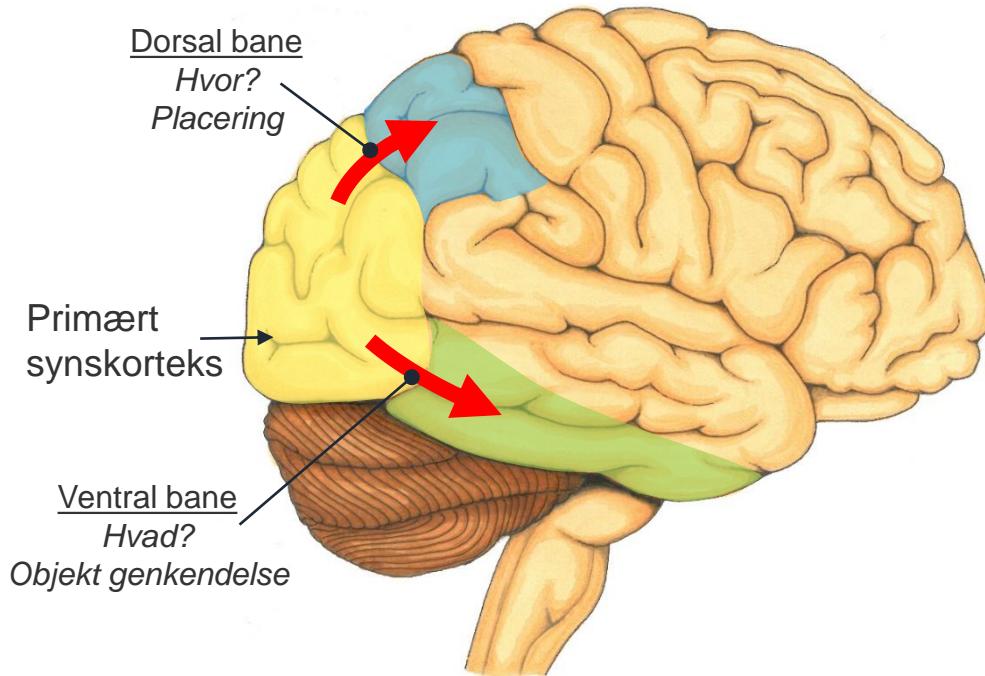


Illustration: Jacob Liljehult 2021

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

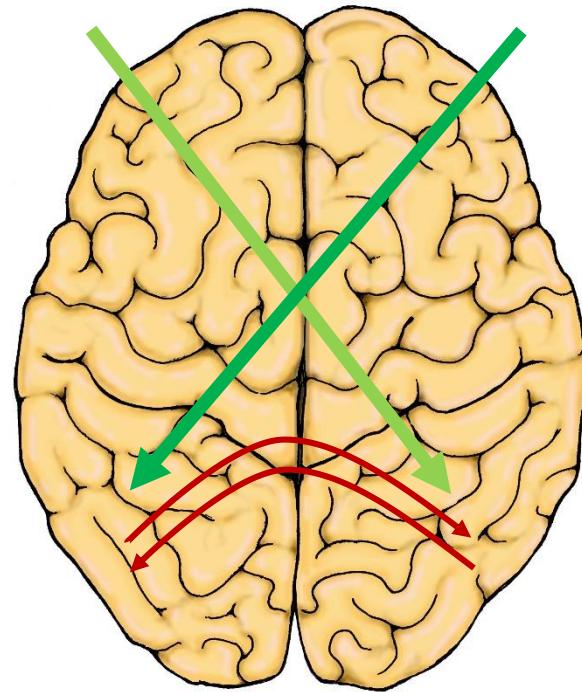
Visuo-spartiel disorientering

- Problemer med at vurdere genstandenes placering i rummet

Topografisk amnesi/agnosi

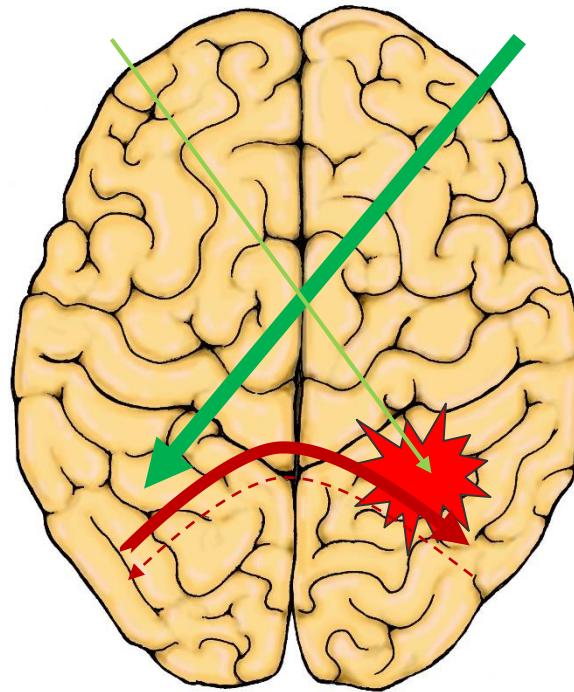
- Problemer med at huske/genkende kendte omgivelser

Neglekt og inattention



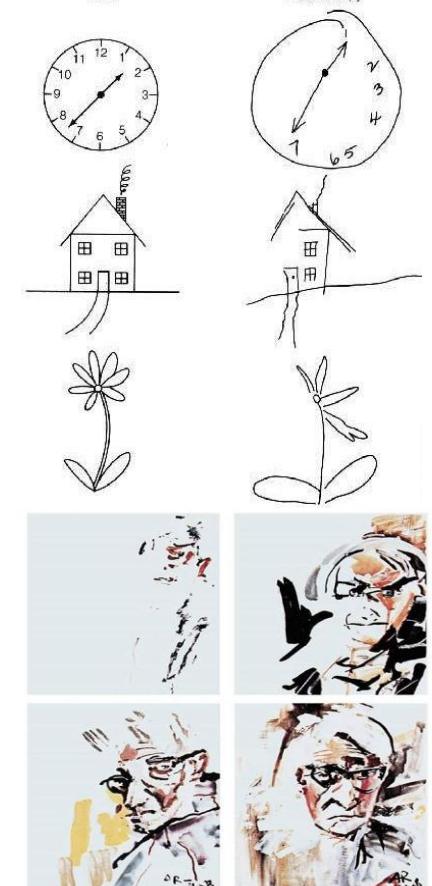
Normal hjerne

Illustration: Jacob Liljehult 2020
Kilde Gazzaniga et al 2009



Læsion i højre
parietallap

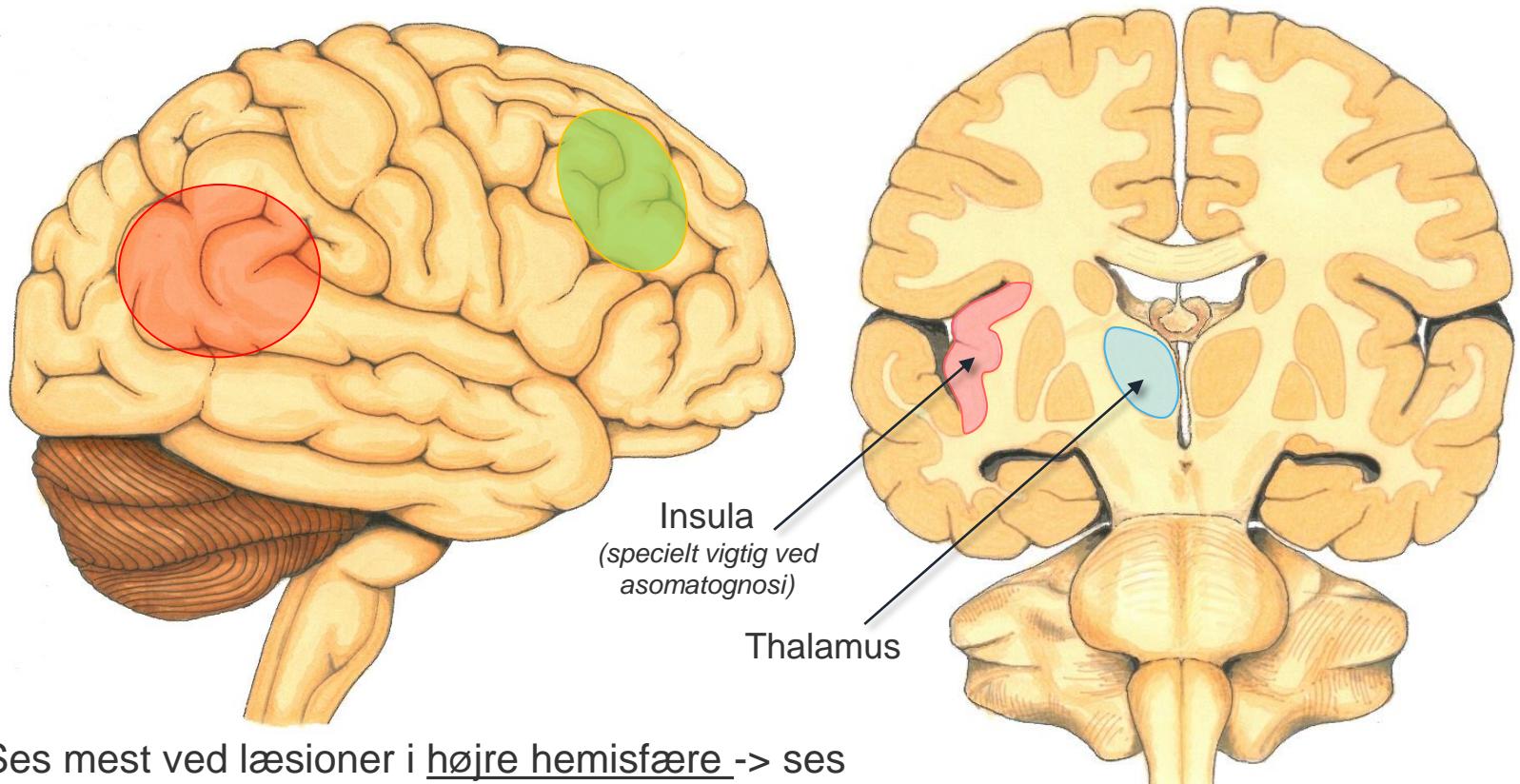
Figure 13. Drawings by a patient with left-side neglect.
Model
Patient's copy



Hvor er gaflen?



Anosognosi



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

Anosognosi

Manglende sygdoms- eller symptomerkendelse

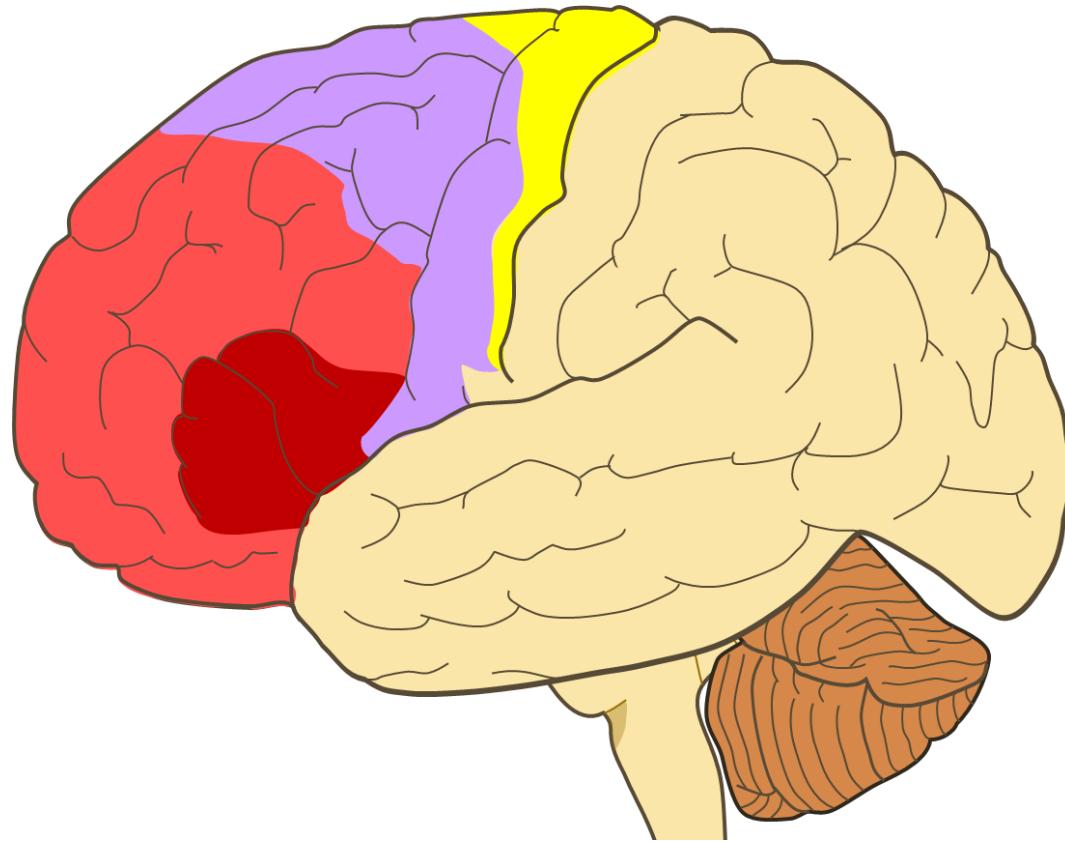
Kategorier

- 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)

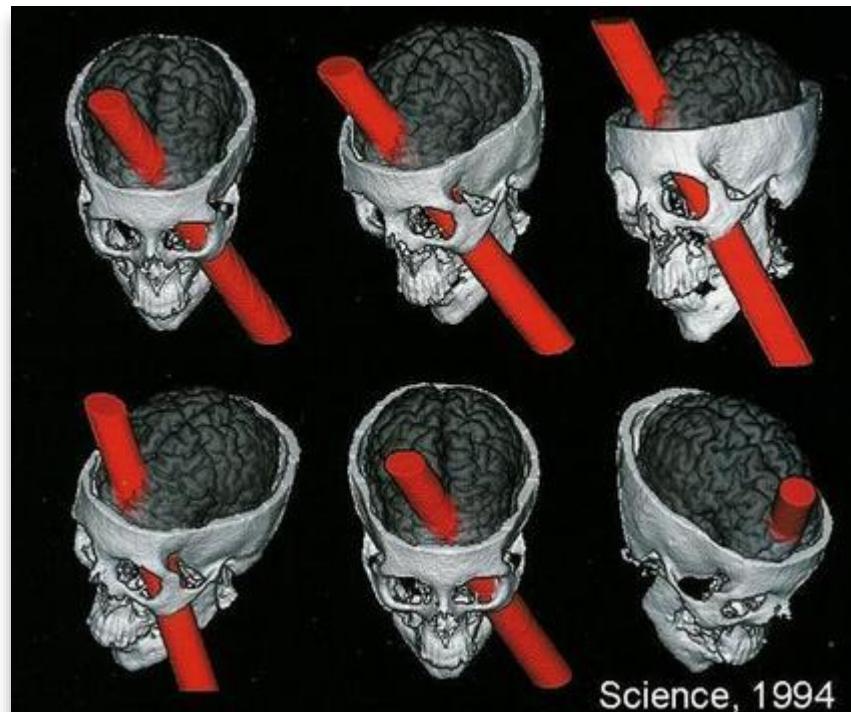
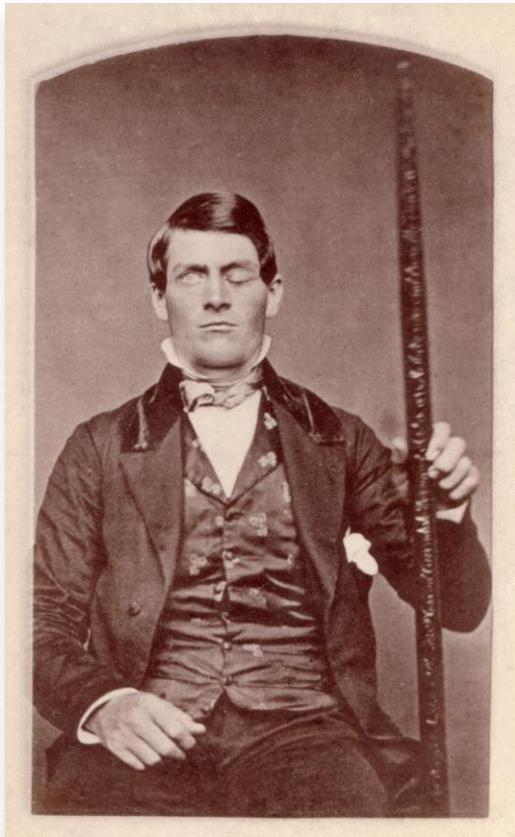
Karakteristika

- Fortæller ikke spontant om symptomer
- Benægter eksplícit 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)

Eksikution *fra plan til handling*



Frontallapperne



Science, 1994

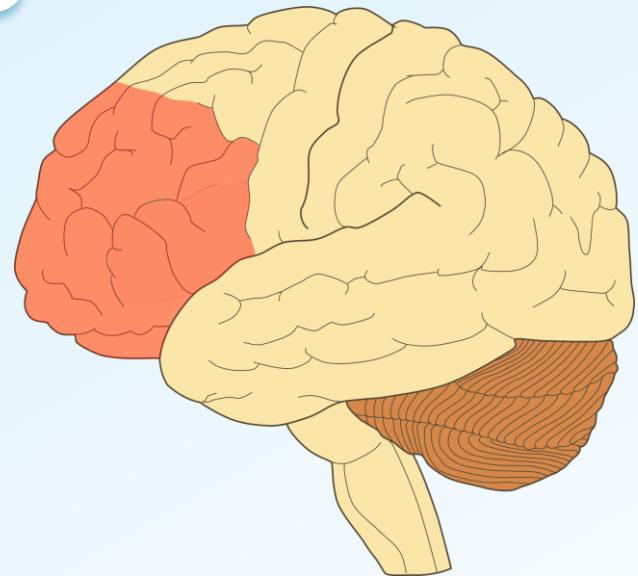
Phineas P Gage (1823-1860)

Billeder: Wikipedia; Damasio et al, 1994

Præfrontale funktioner

Beslutninger om hvad man
skal gøre og hvordan

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



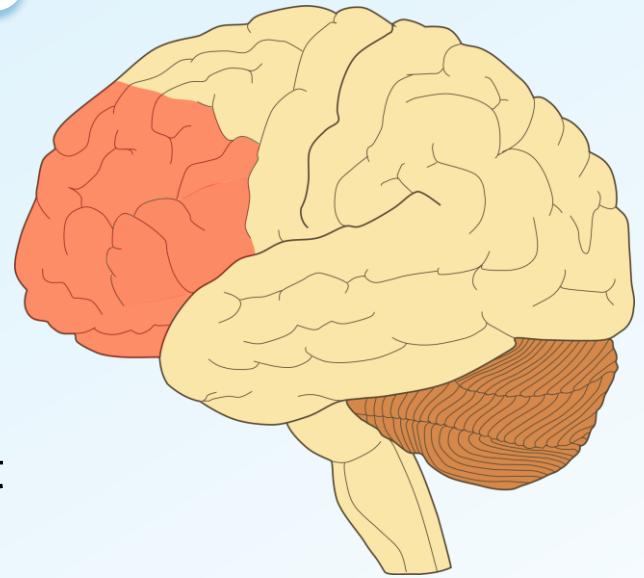
Kilde: Gade 2009

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 Liljehult 2020

Præfrontale funktioner

Dorso-lateralt

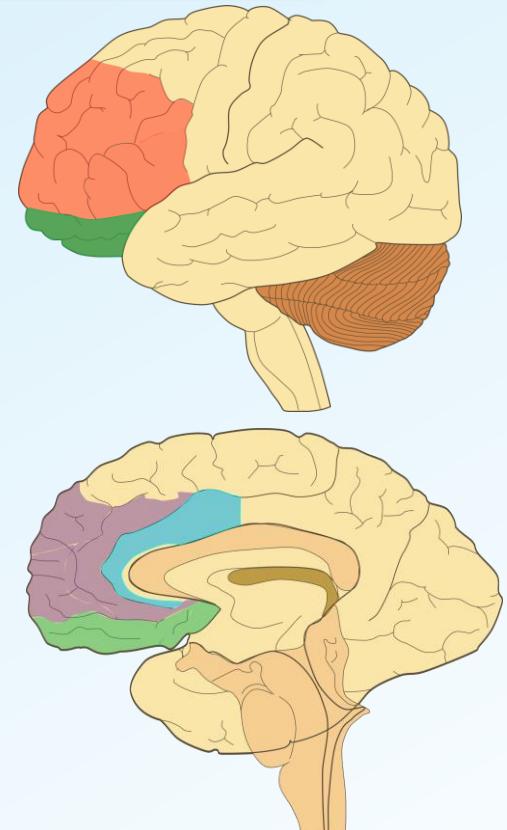
Nedsat energi, initiativløshed, nedsat evne til planlægning, ligegyldig

Orbitalt

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

Medialt

Nedsat opmærksomhed, nedsat bevidsthed, desorienteret, konfabulerende

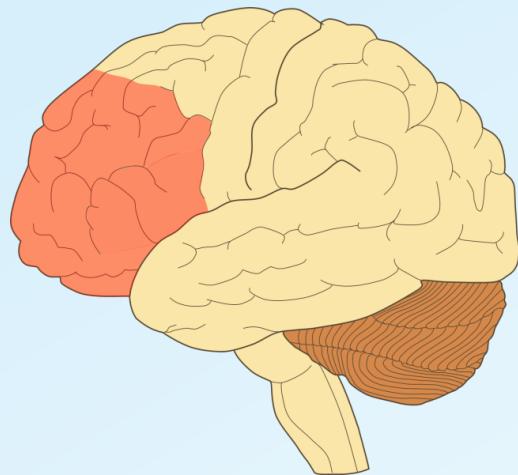


Kilde: Gade 2009

Illustration: Jacob Liljehult 2020

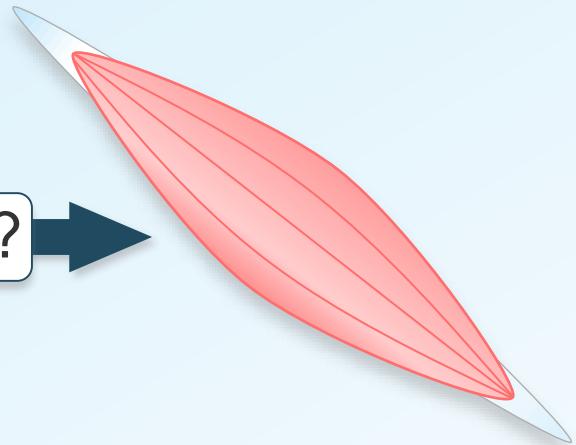
Det motorisk system

Beslutning



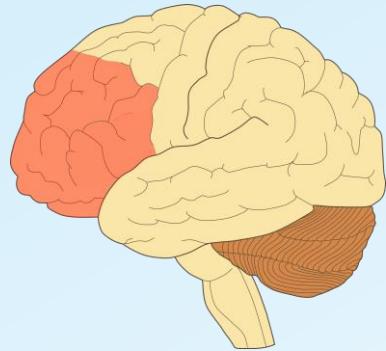
Bevægelse

Hvordan? 

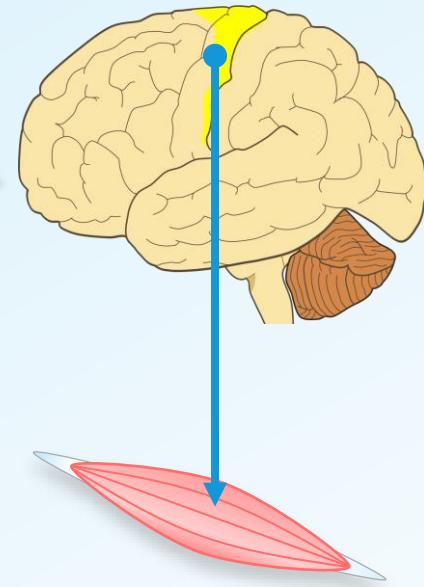


Det motorisk system

Beslutning



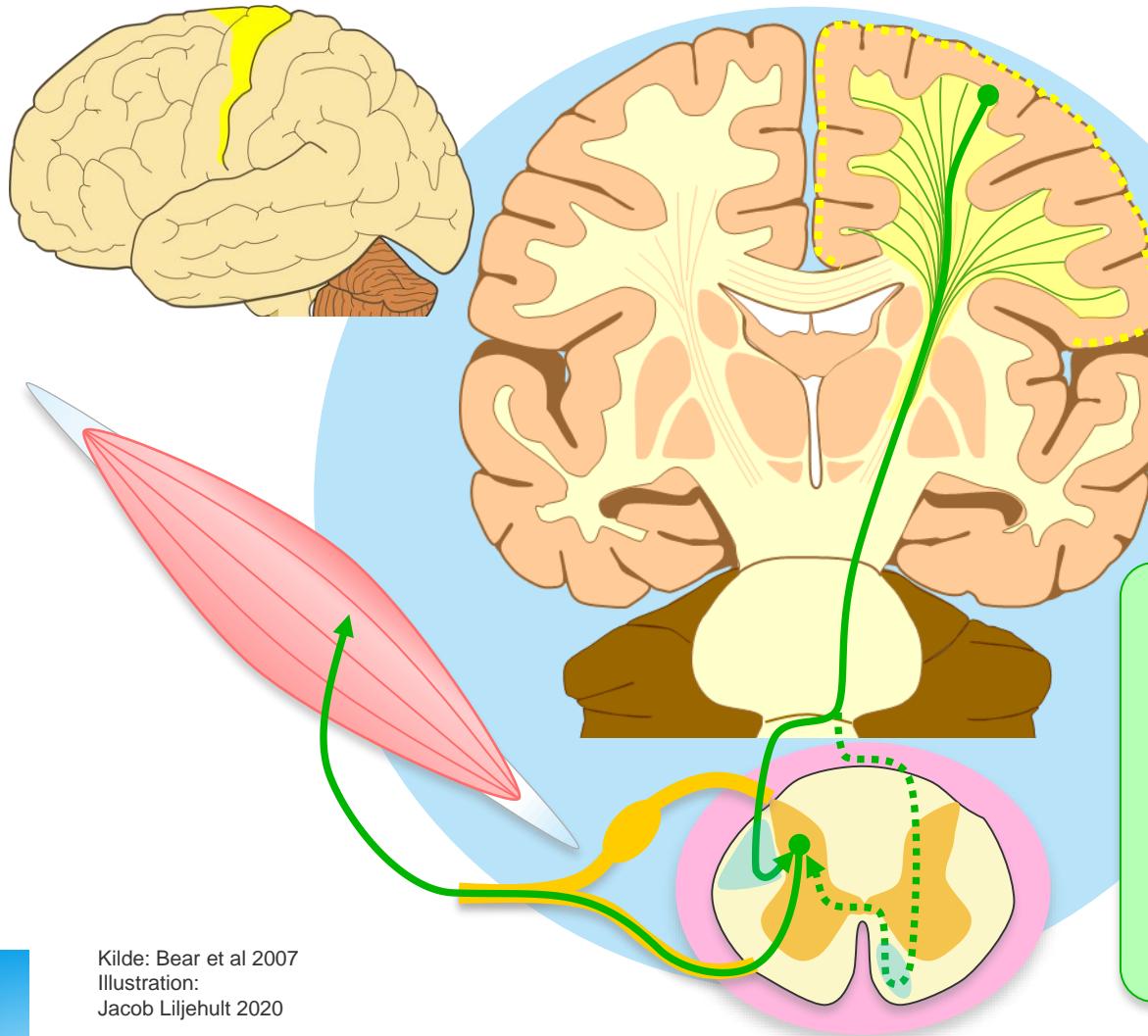
Primært
motorisk kortex



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

Bevægelse

De motoriske baner



Motorisk cortex og
projektionsbaner

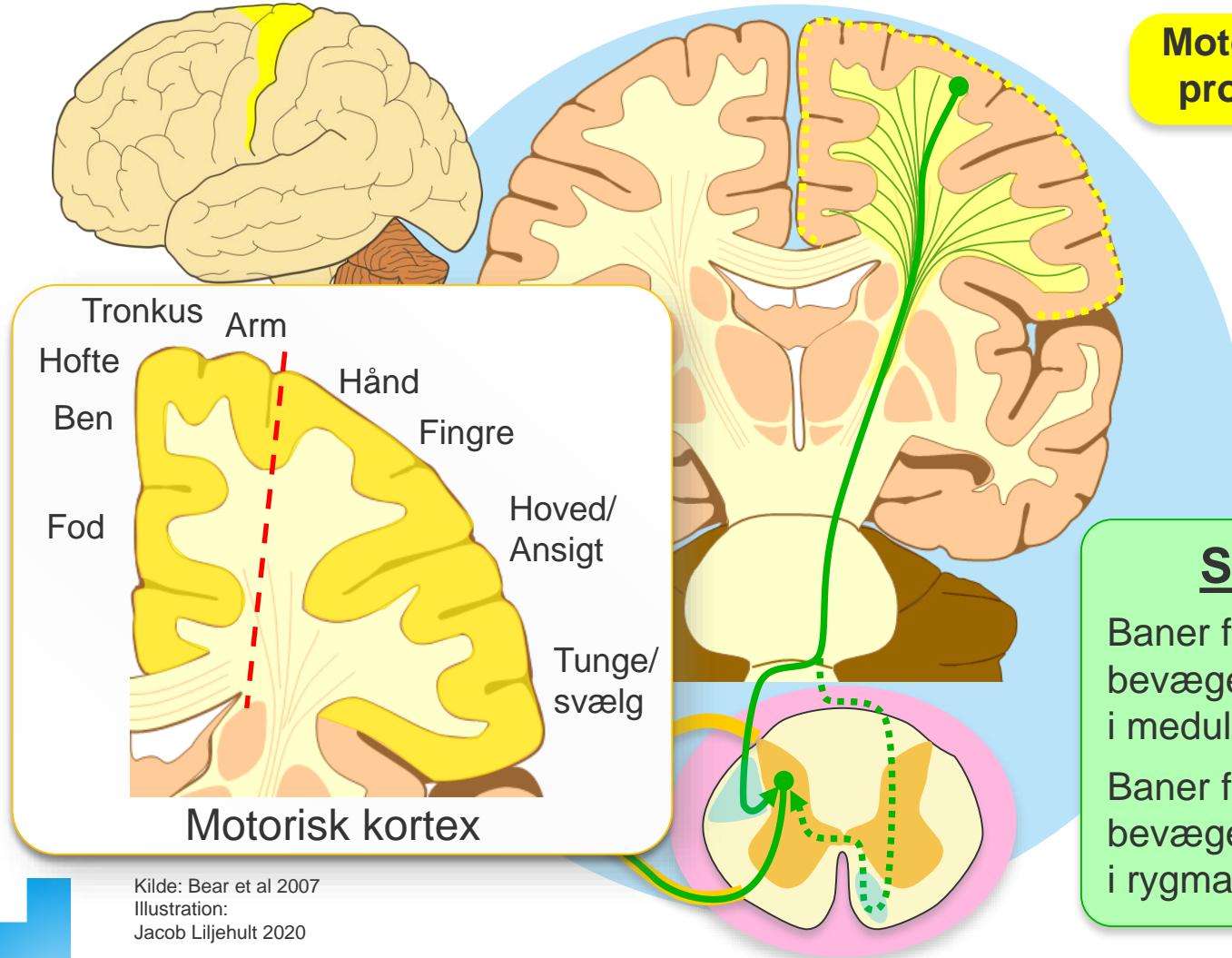
Sideskifte

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



Motorisk cortex og
projektionsbaner

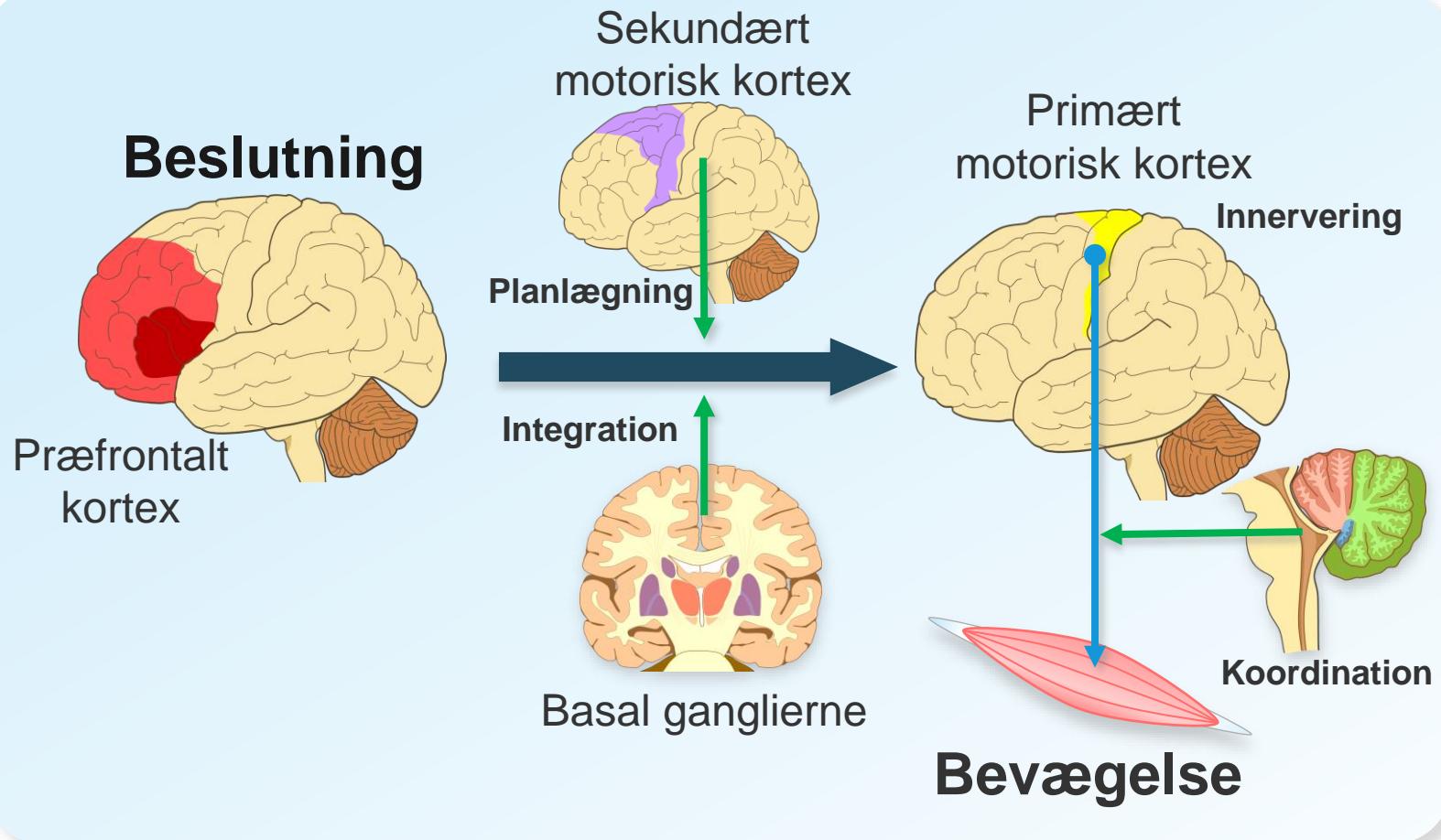
Sideskifte

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

Det motorisk system



Kilde: Bear et al 2007 Illustration: Jacob Liljhult 2020

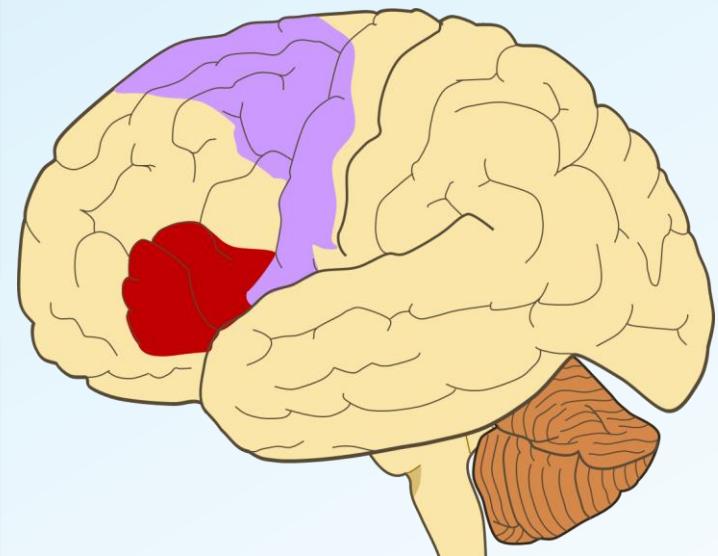
Jacob Mesot Liljhult

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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

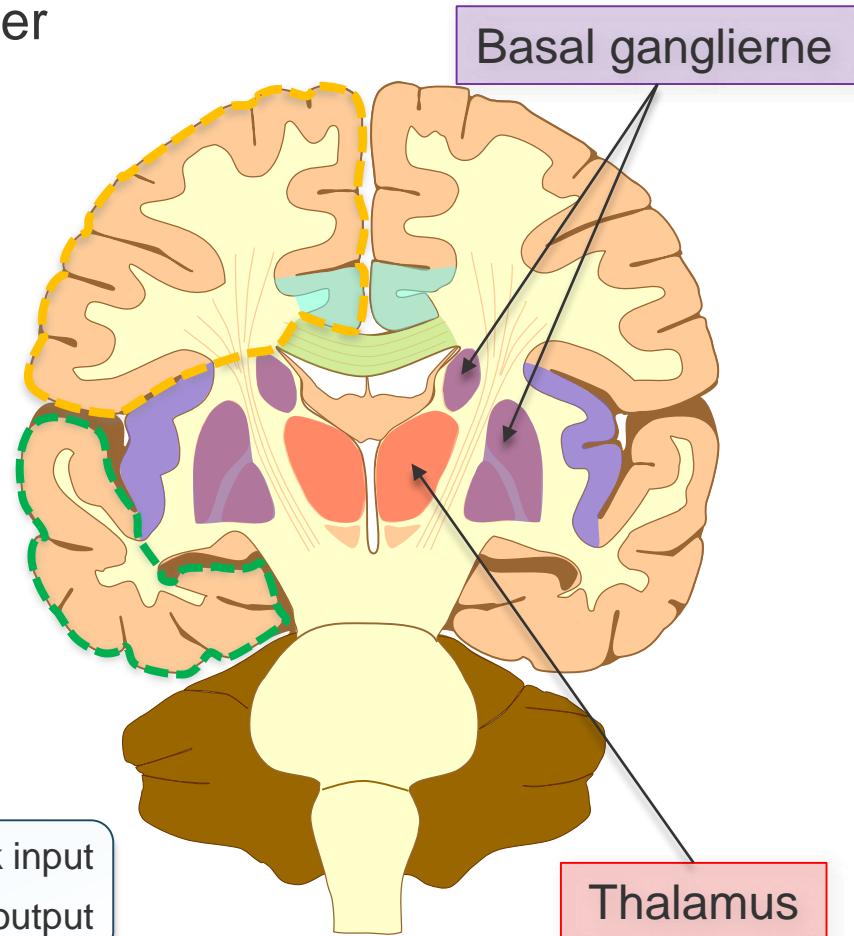
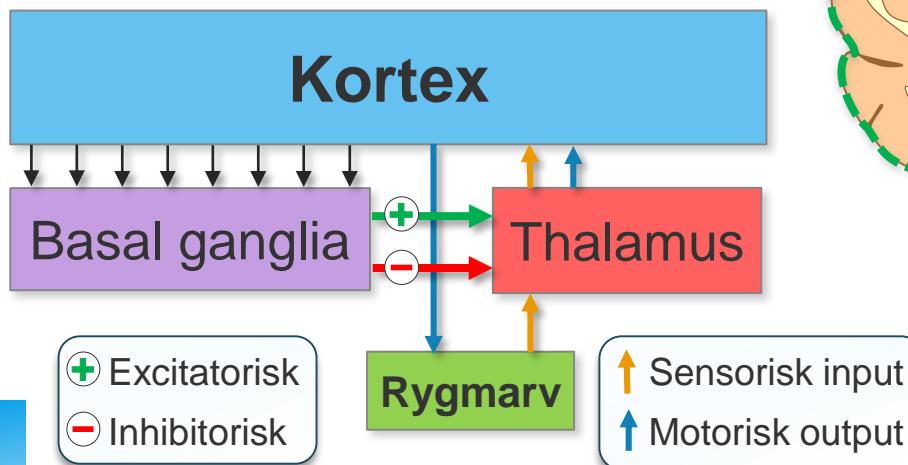
Illustration: Jacob Liljeblad 2020

Basal ganglierne

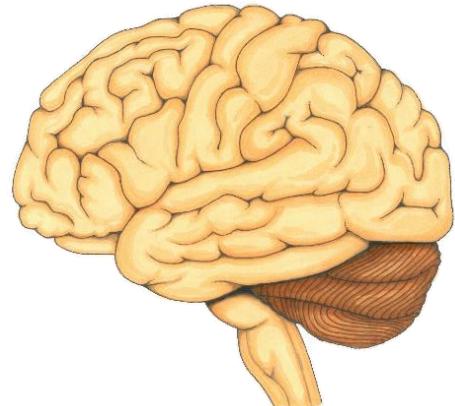
Tager input fra kortex og samordner det til et samlet adfærds-output

Tre kredsløb:

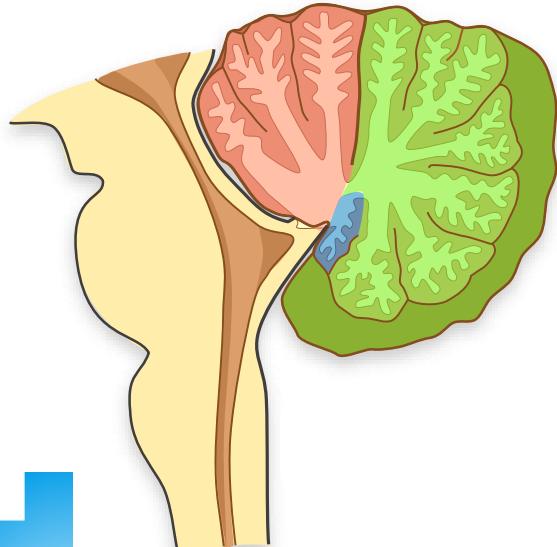
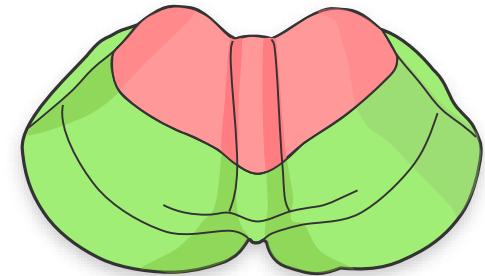
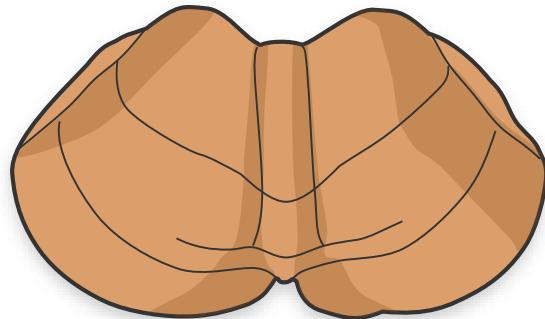
1. Integration af motorisk output
2. Læring og kognition
3. Regulering af emotionelle aspekter af adfærd



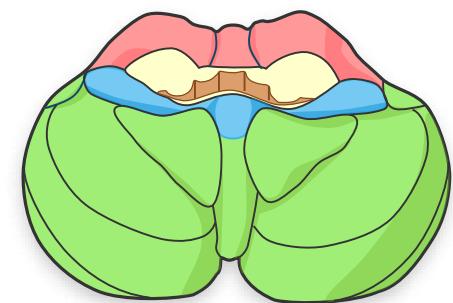
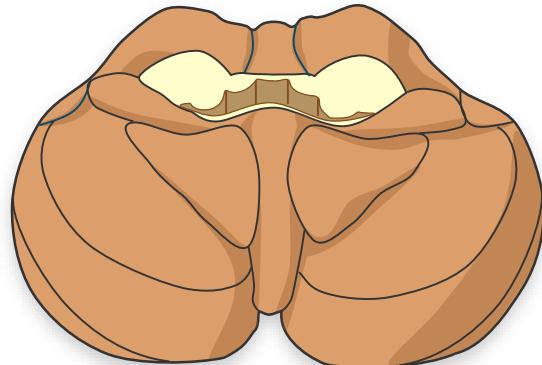
Cerebellum



Superiort

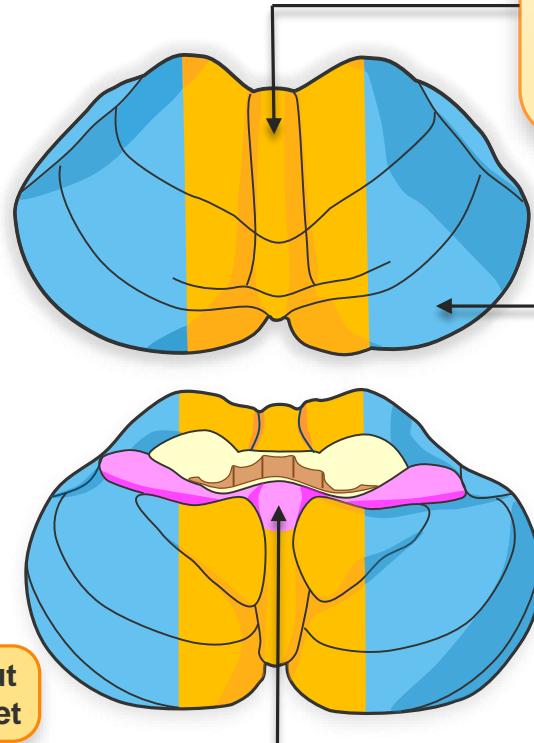
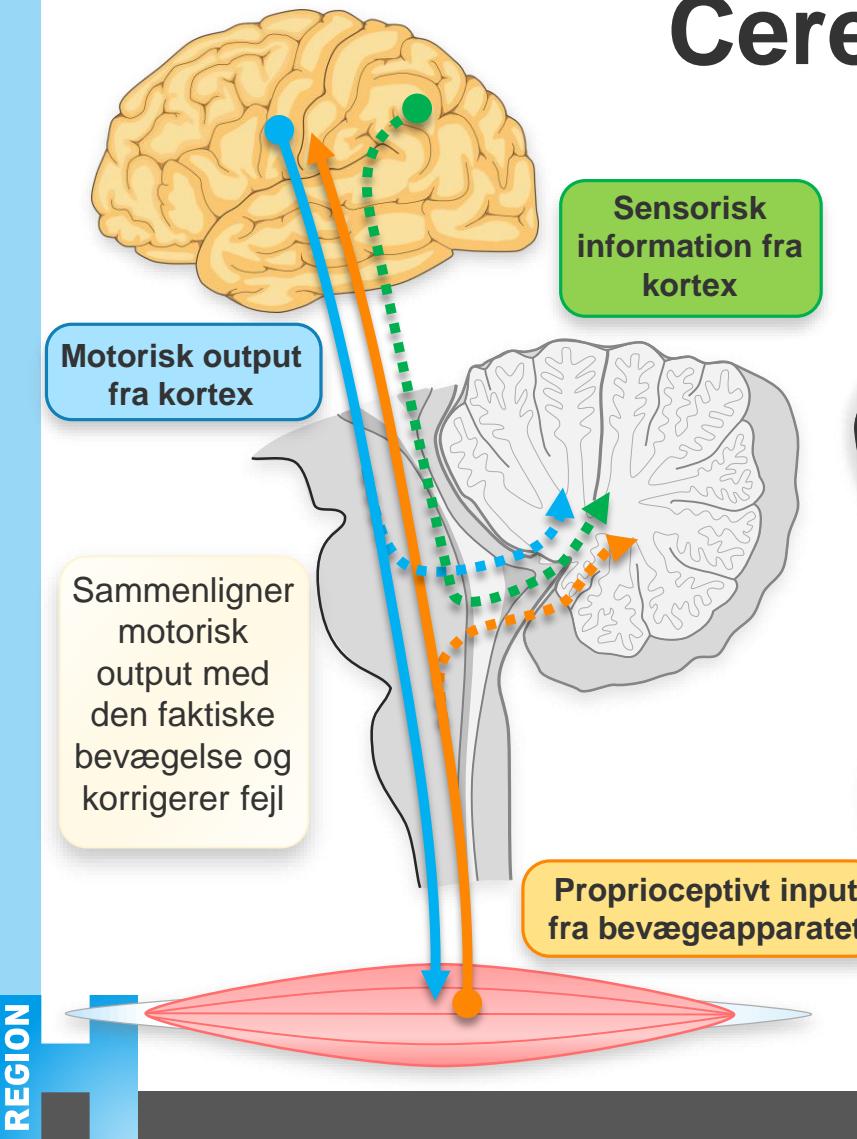


Inferiort



- Lobus Anterior
- Lobus Posterior
- Lobus Flocculonodularis

Cerebellum

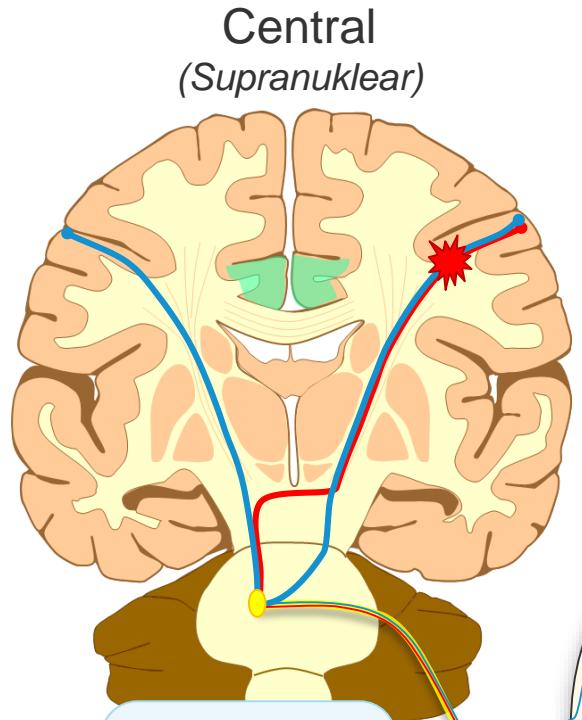


- Propriotion
- Tonus
 - Truncus instabilitet
 - Gang-ataksi

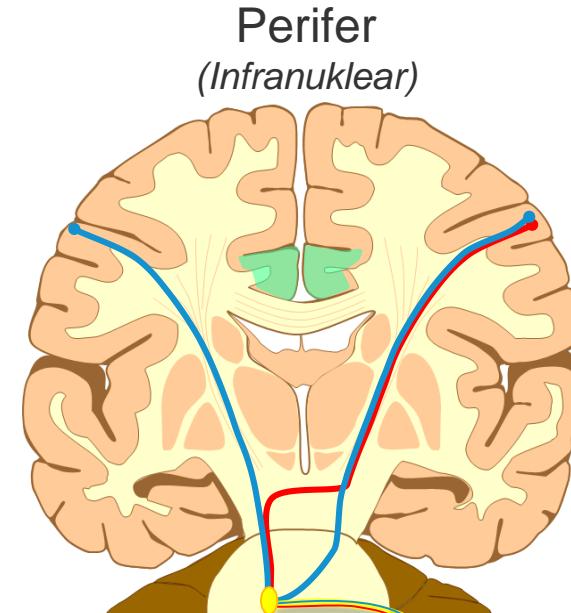
- Koordination
 - Koordinations problemer
 - Ataksi (ekstremitet)
 - Intentions-tremor
 - Dysmetri
 - Dysarthri

- Balance
 - Balance-problemer

Faciales parese



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



- 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*

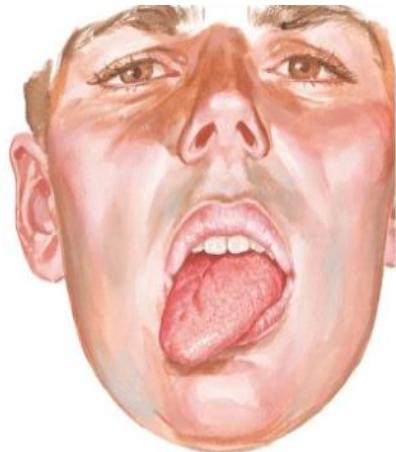
Ideomotorisk apraksi



<https://youtu.be/vTFdNk7Jloo>

Mund og svælg

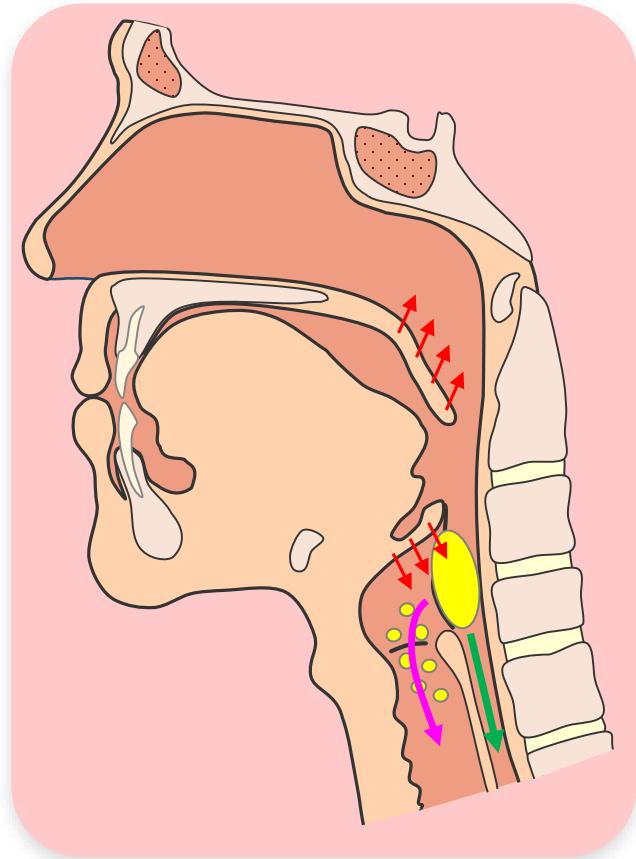
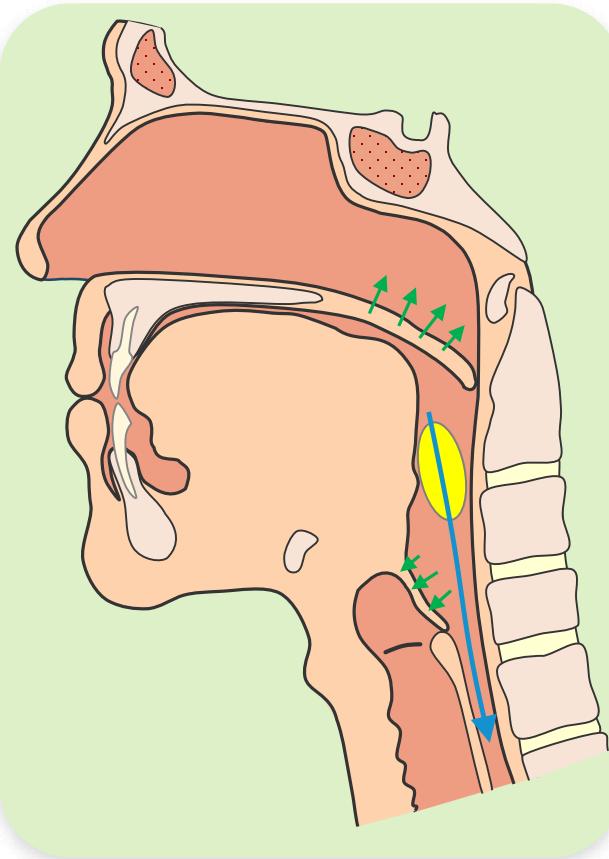
Tungedeviation



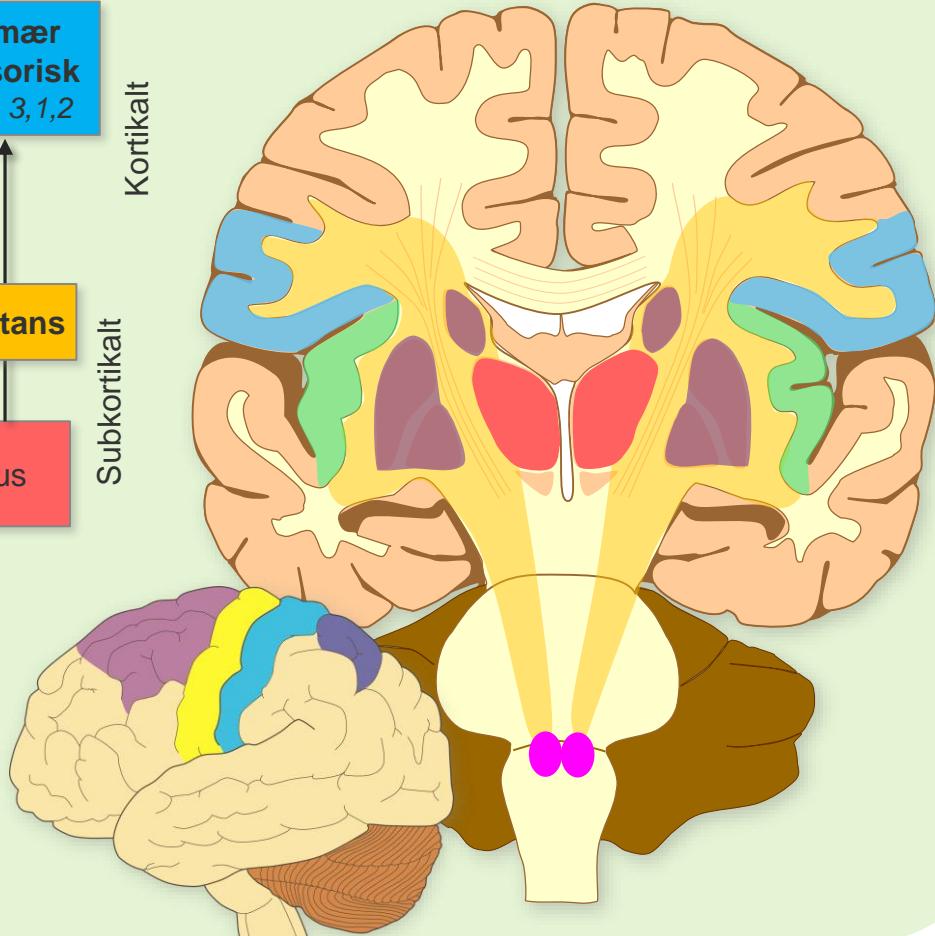
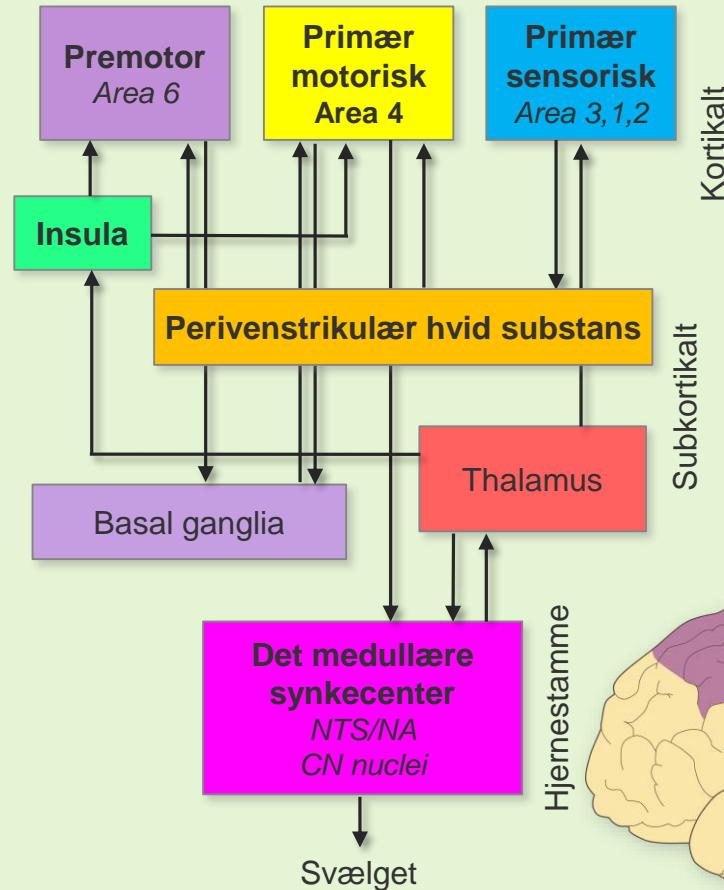
Ganesejlsparese



Dysfagi (*Synkeproblemer*)



Fysiologisk synkning



Sprog og kommunikation

Venstre side

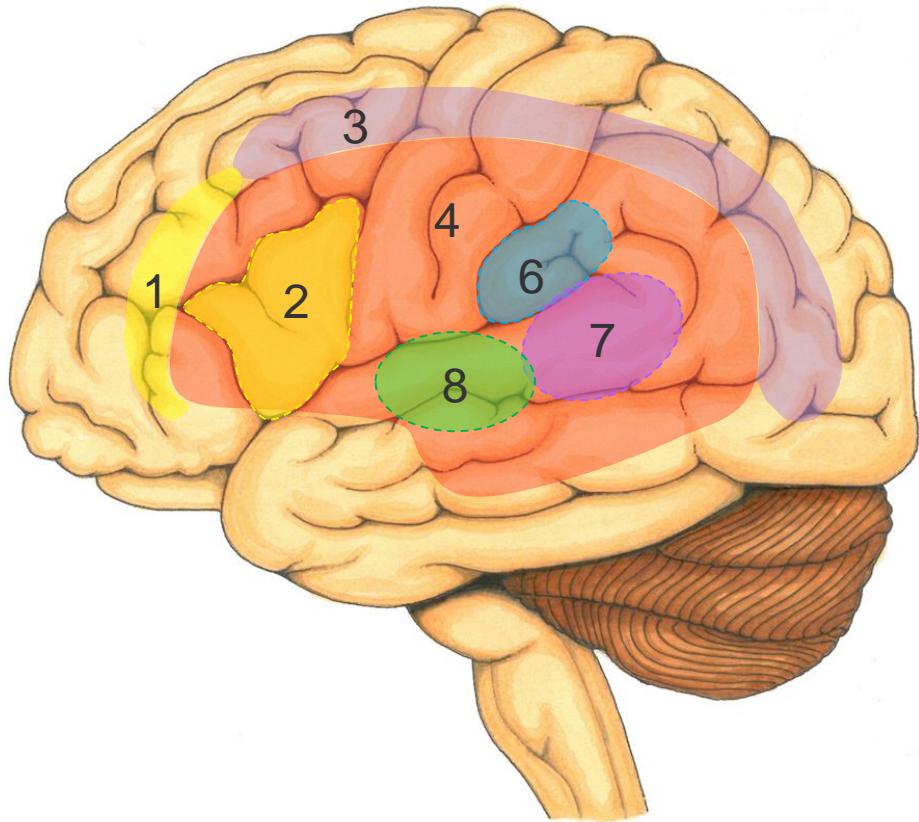
- Afasi (Produktion, forståelse)
 - Flydende
 - Ikke-flydende
 - Global
- Agraphi (Skrivning)
- Alexi (Læsning)

Højre side

- Intonation af sproget
- Giver sproget affekt
- Sproglig struktur

Begge sider

- Dysartri (Eksikution)



Ikke-flydende afasi

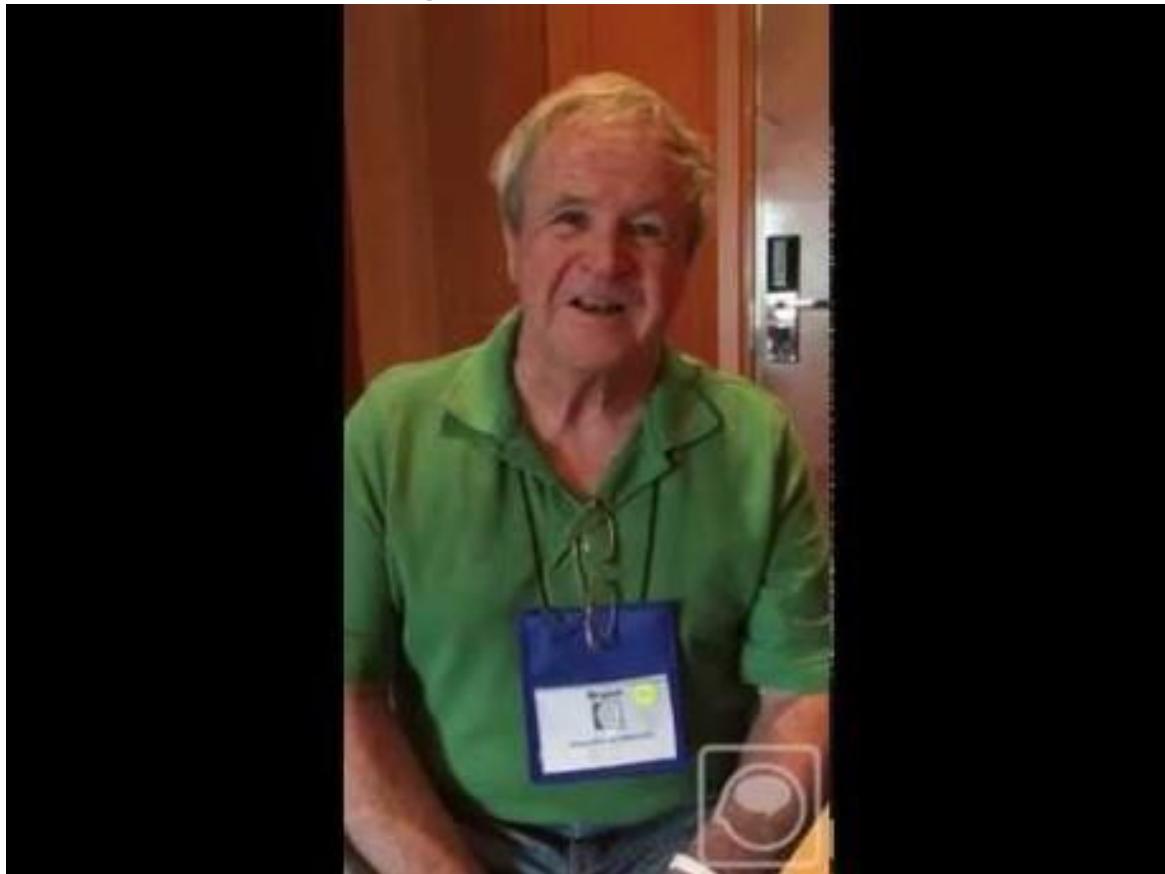
	Forståelse	Gentagelse	Afasitype
1	God	God	Transkortikal motorisk afasi
2	God	Dårlig	Broca-afasi
3	Dårlig	God	Blandet transkortikal afasi
4	Dårlig	Dårlig	Global afasi

Flydende afasi

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

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

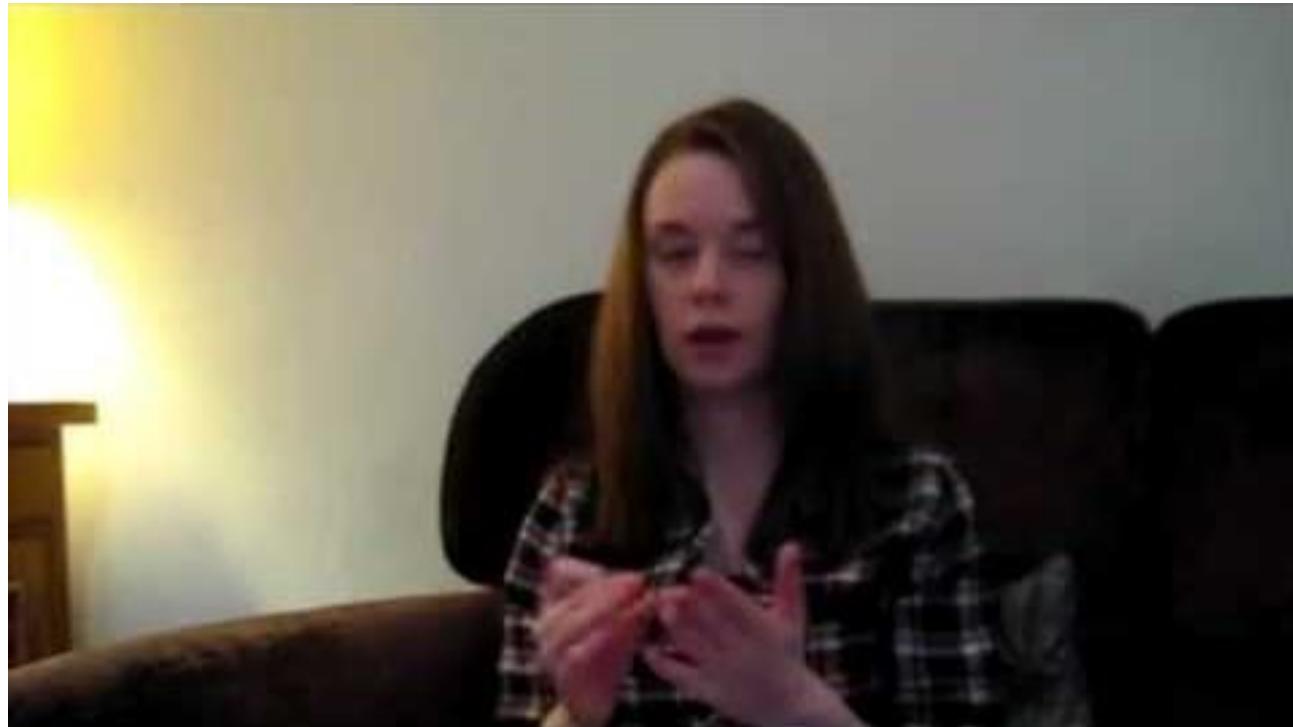
Flydende afasi



Manglende forståelse; flydende talestrøm uden relevant indhold

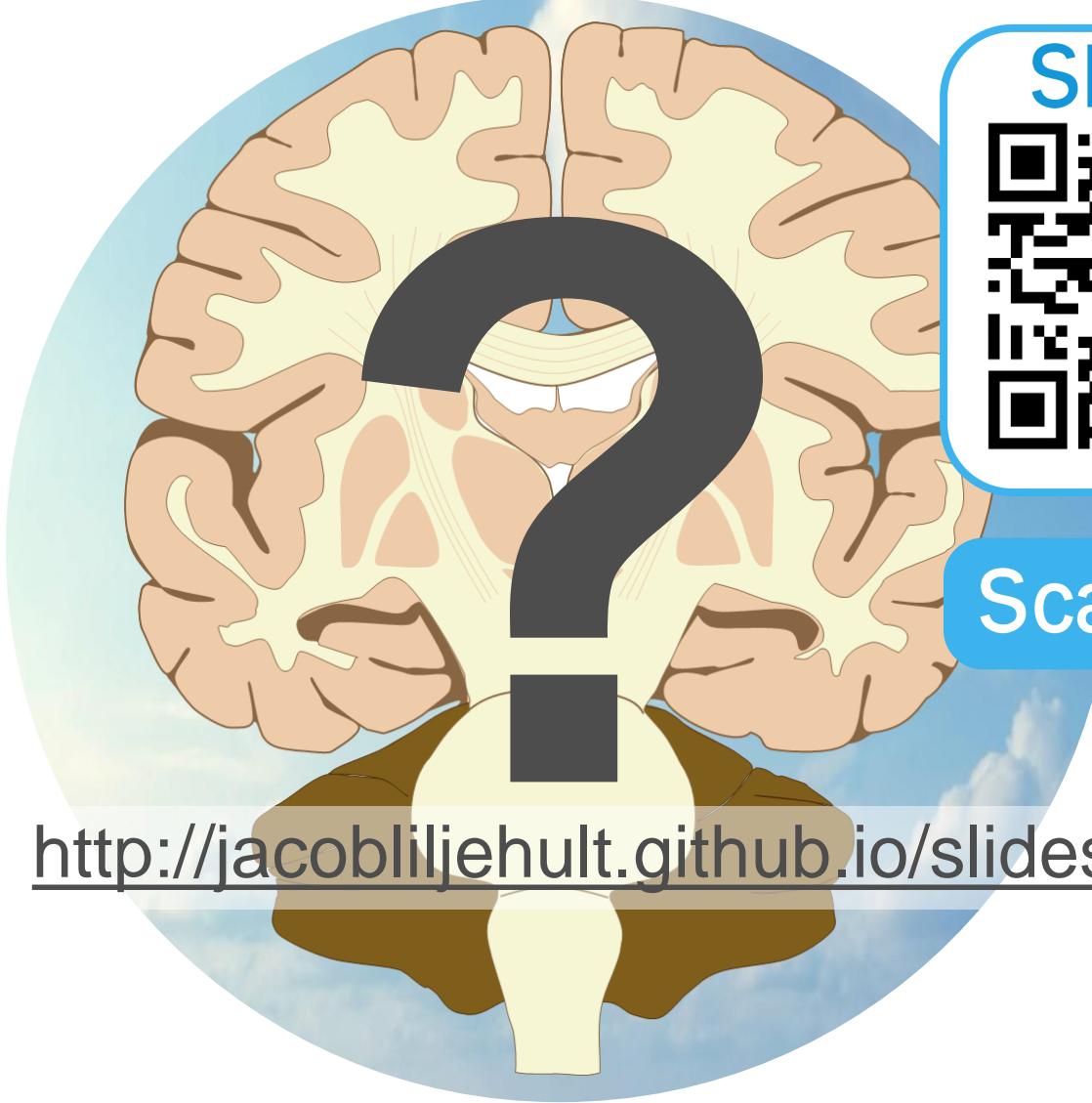
<https://youtu.be/3oef68YabD0>

Ikke-flydende afasi

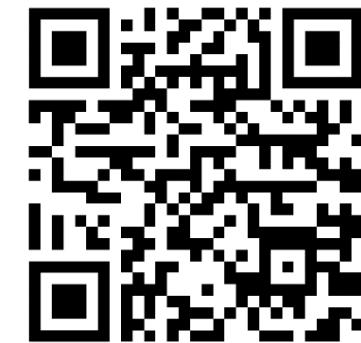


God forståelse
Svarene er opbrudte og indeholder kun
meningsbærende enheder

<https://youtu.be/lP8hkopObvs>



Slides



Scan mig

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

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.