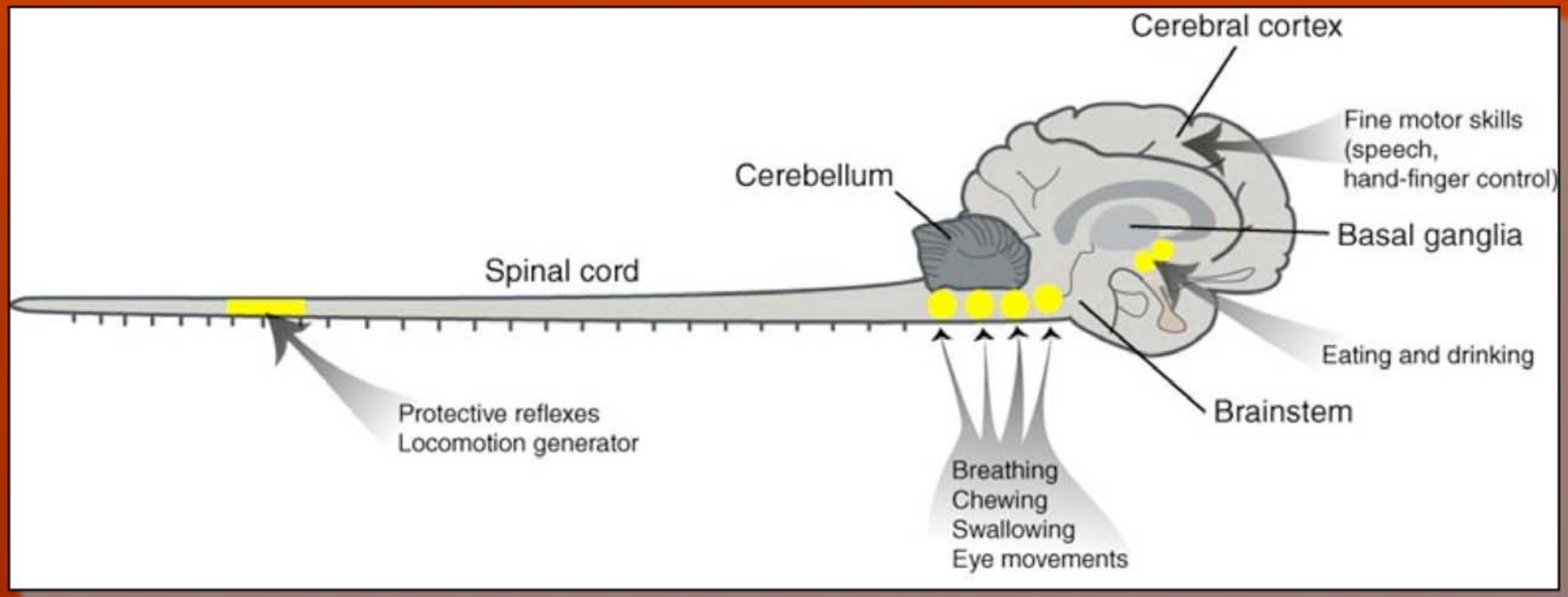
The Basal Ganglia

System for control, selection and initiation of motor sequences.

Martin Wikström

Neuronala networks that coordinate different movement patterns.



The basal ganglia affects the motor system through the modulation of ”higher” motor areas.

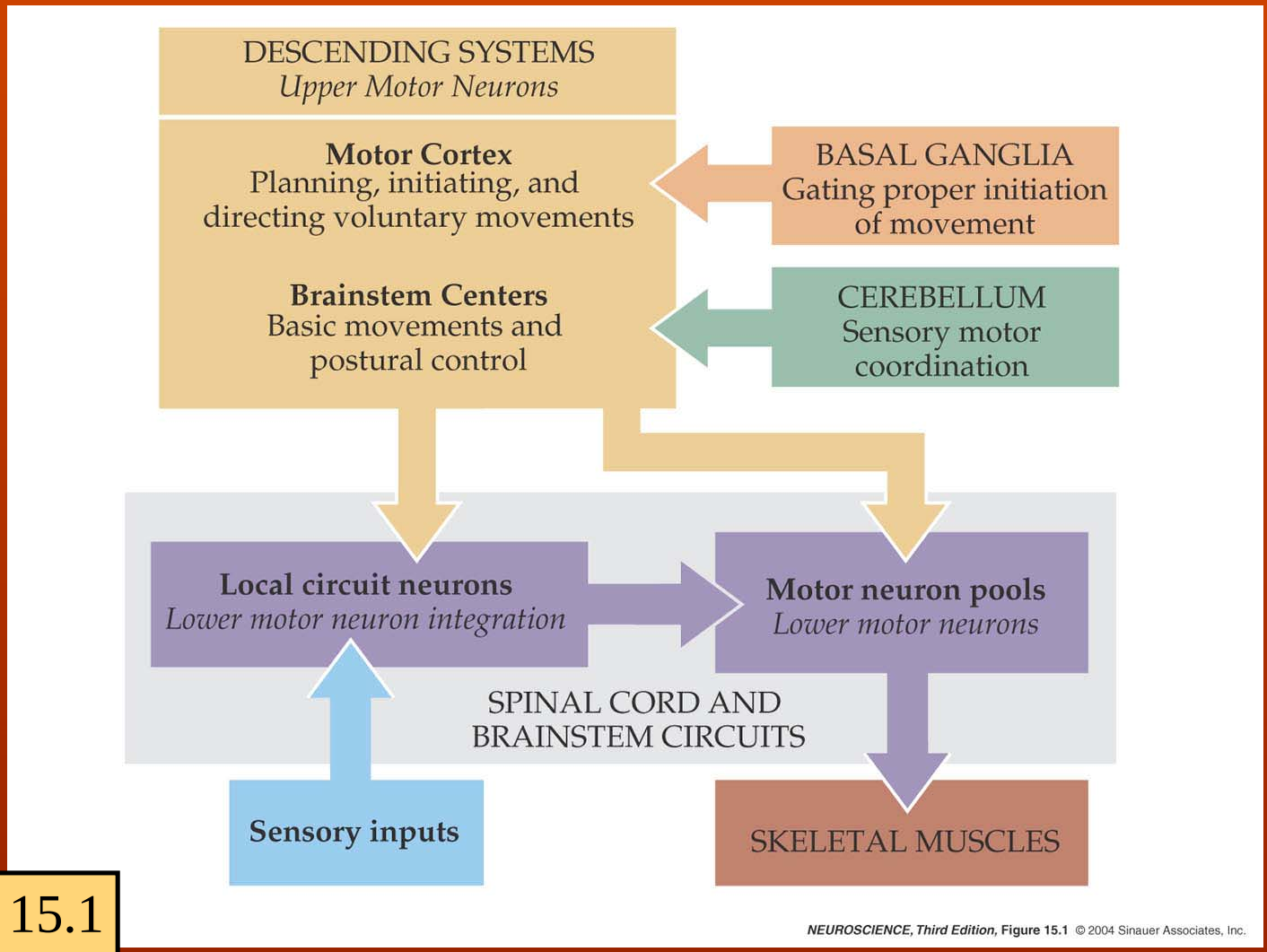
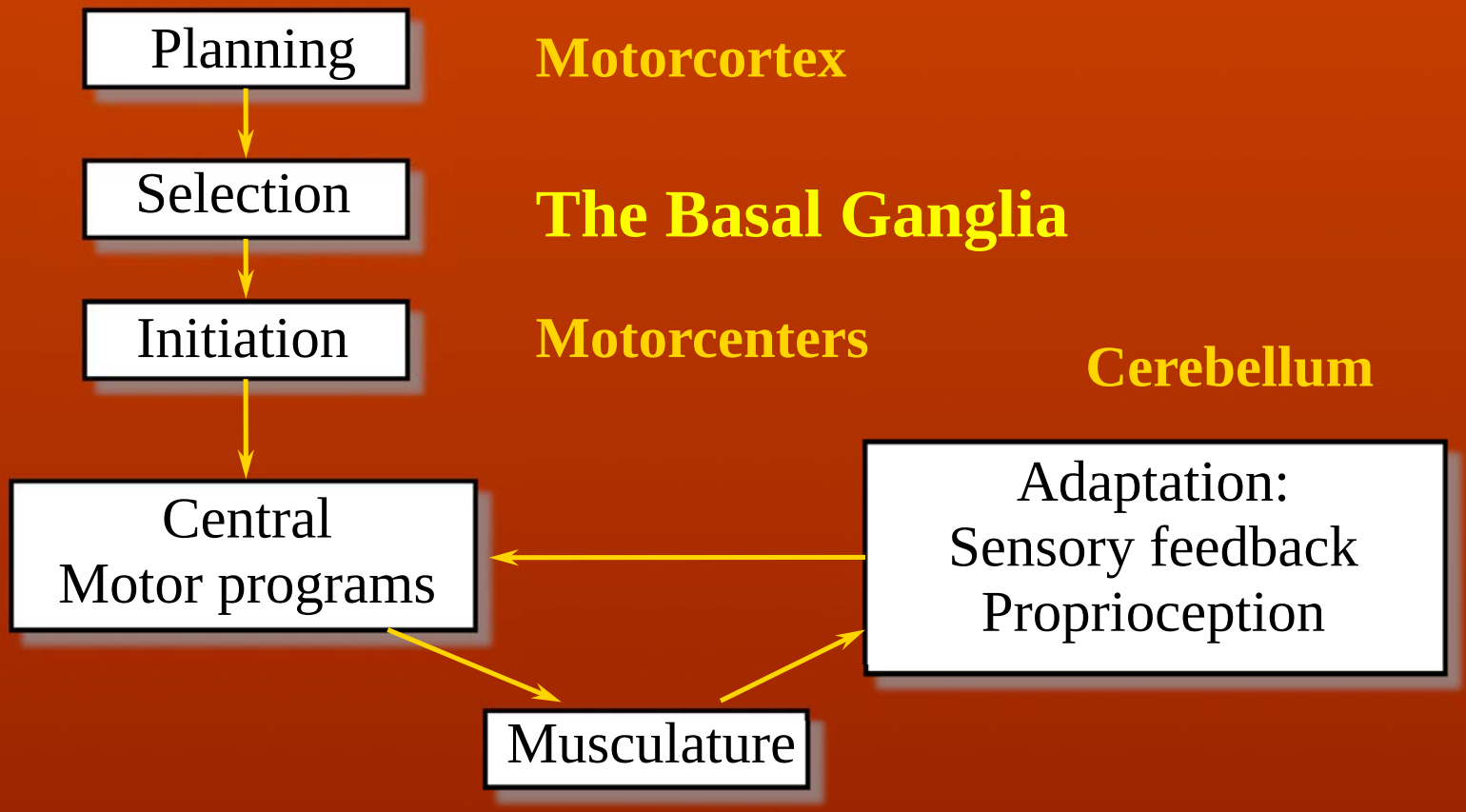
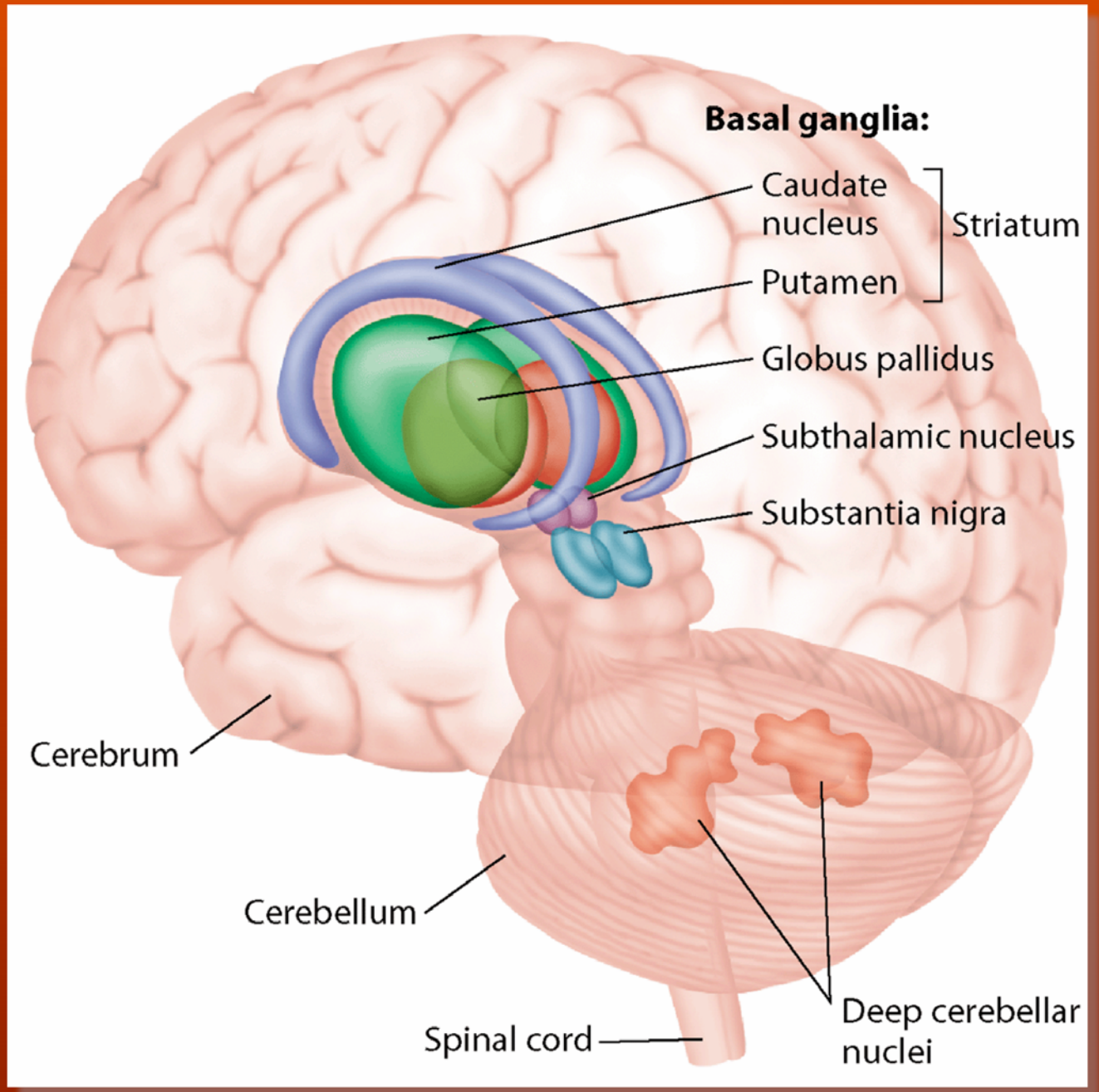


Fig 15.1

Regulation of motor functions: The Basal Ganglia

Planning, Regulation and Initiation of Motor Programs.




Basal ganglia:
Caudate nucleus
Striatum
Putamen
Globus pallidus
Subthalamic nucleus
Substantia nigra
Cerebrum
Cerebellum
Spinal cord
Deep cerebellar nuclei

Striatum

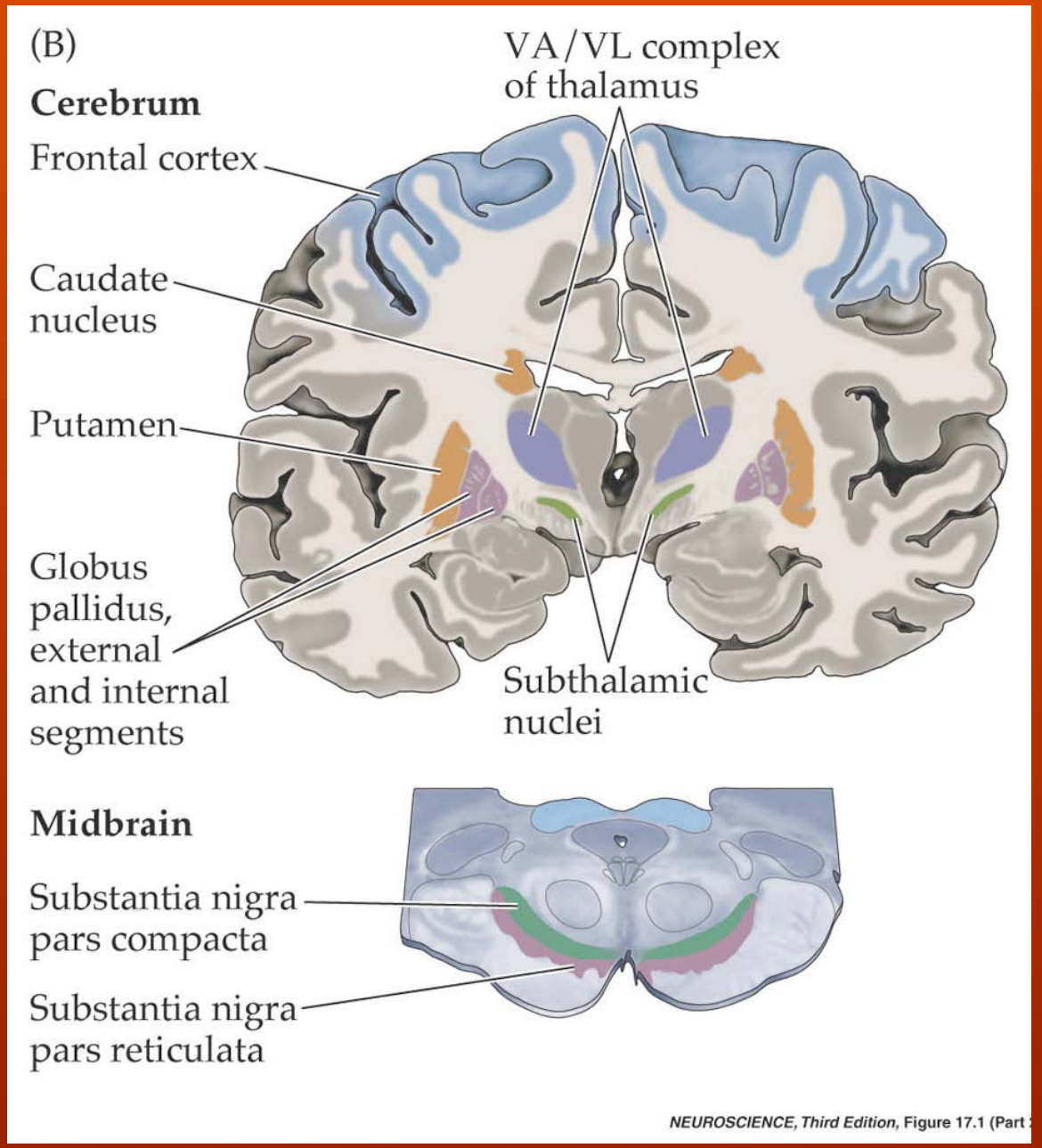
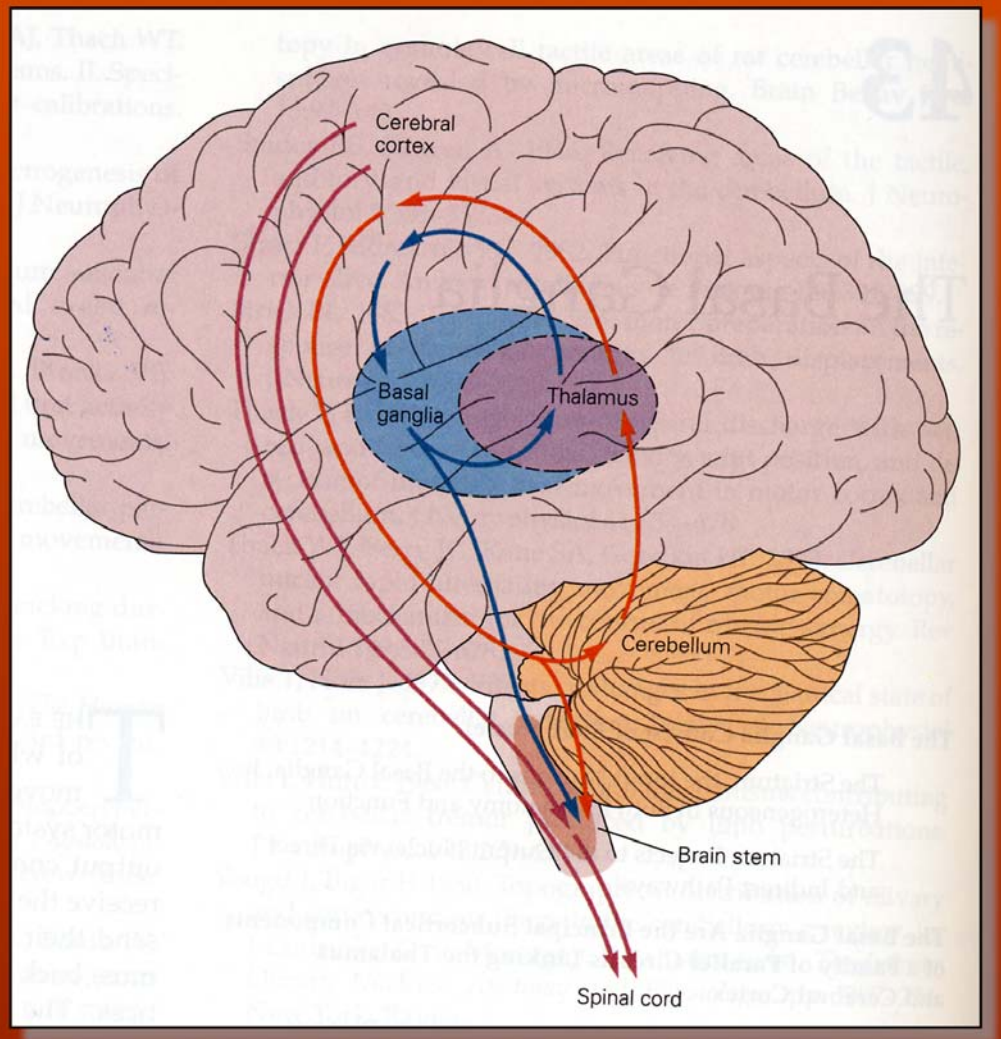
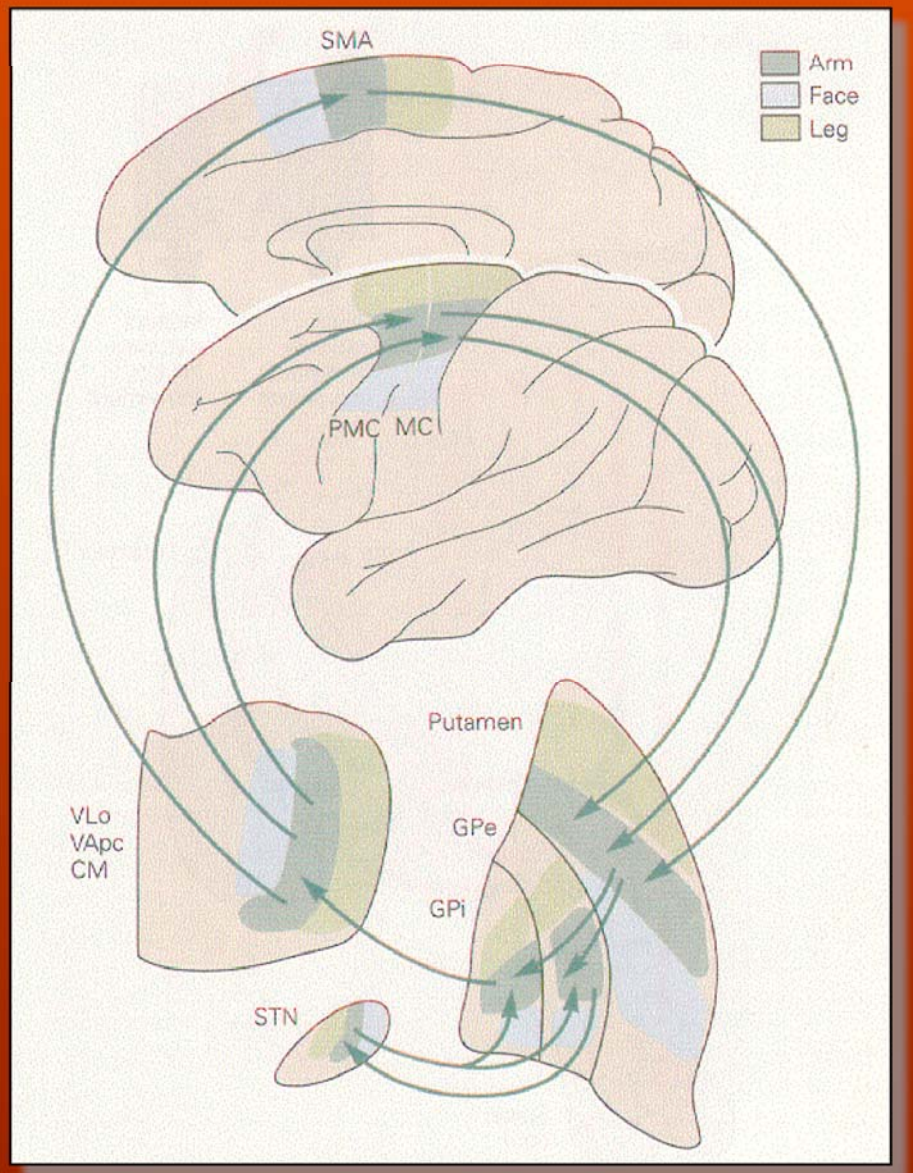


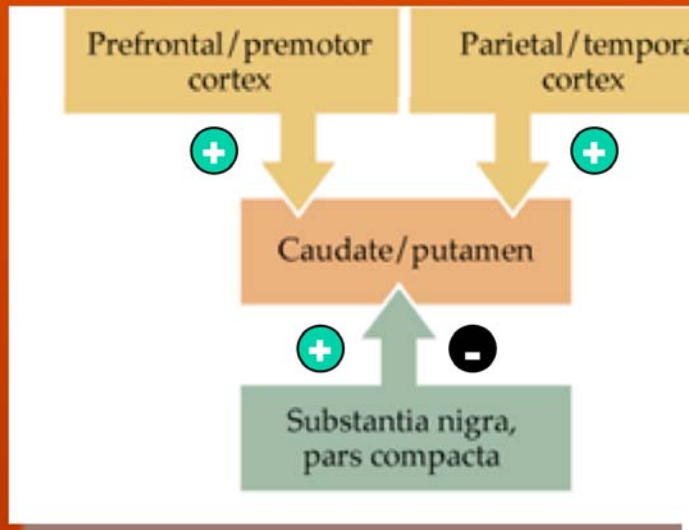
Fig 17.1B

Sub-cortical loop



The somatotopic organization is maintained throughout the basal ganglia and the thalamus





Inputs to the Basal Ganglia

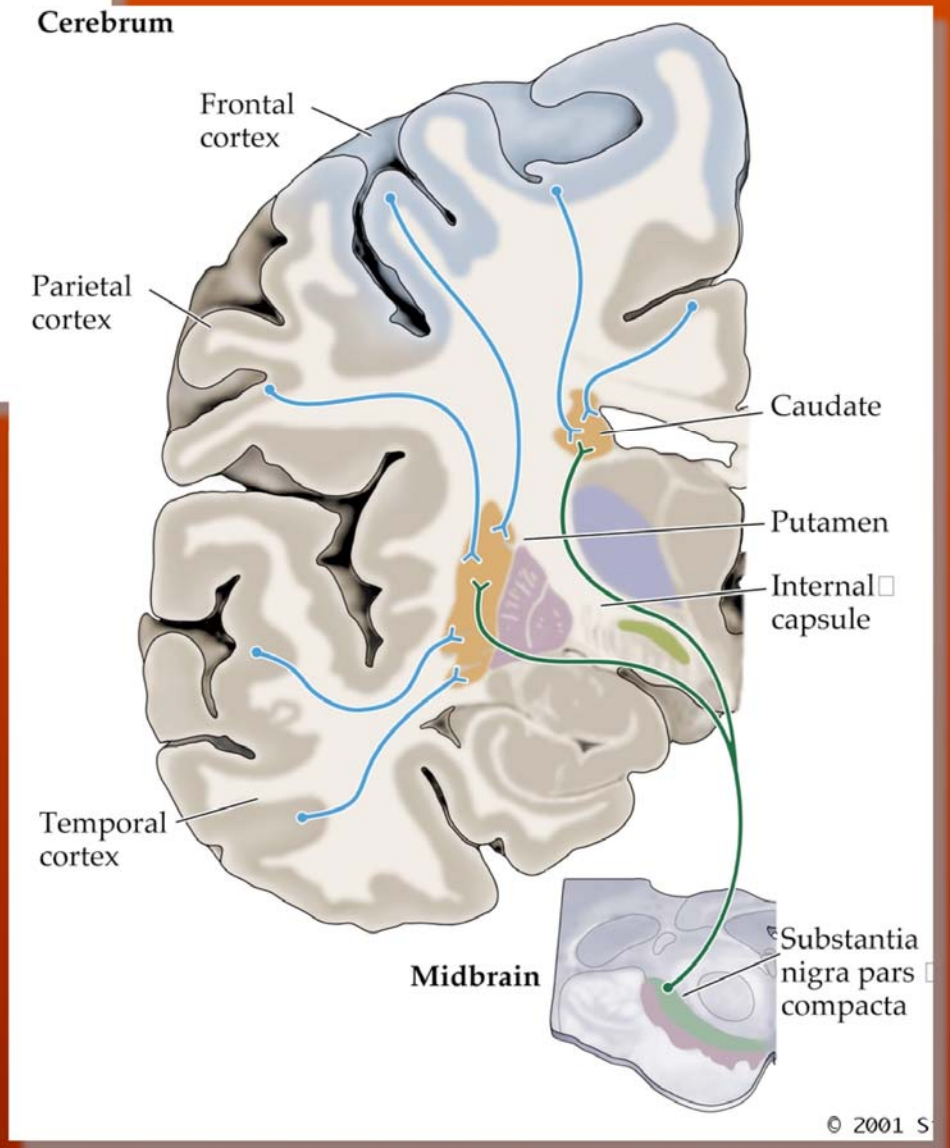


Fig 17.2

Input from nearly all of cortex. Not from primary visual cortex and auditory cortex.

Largest projections from association-areas in the frontal- and parietal-lobes.

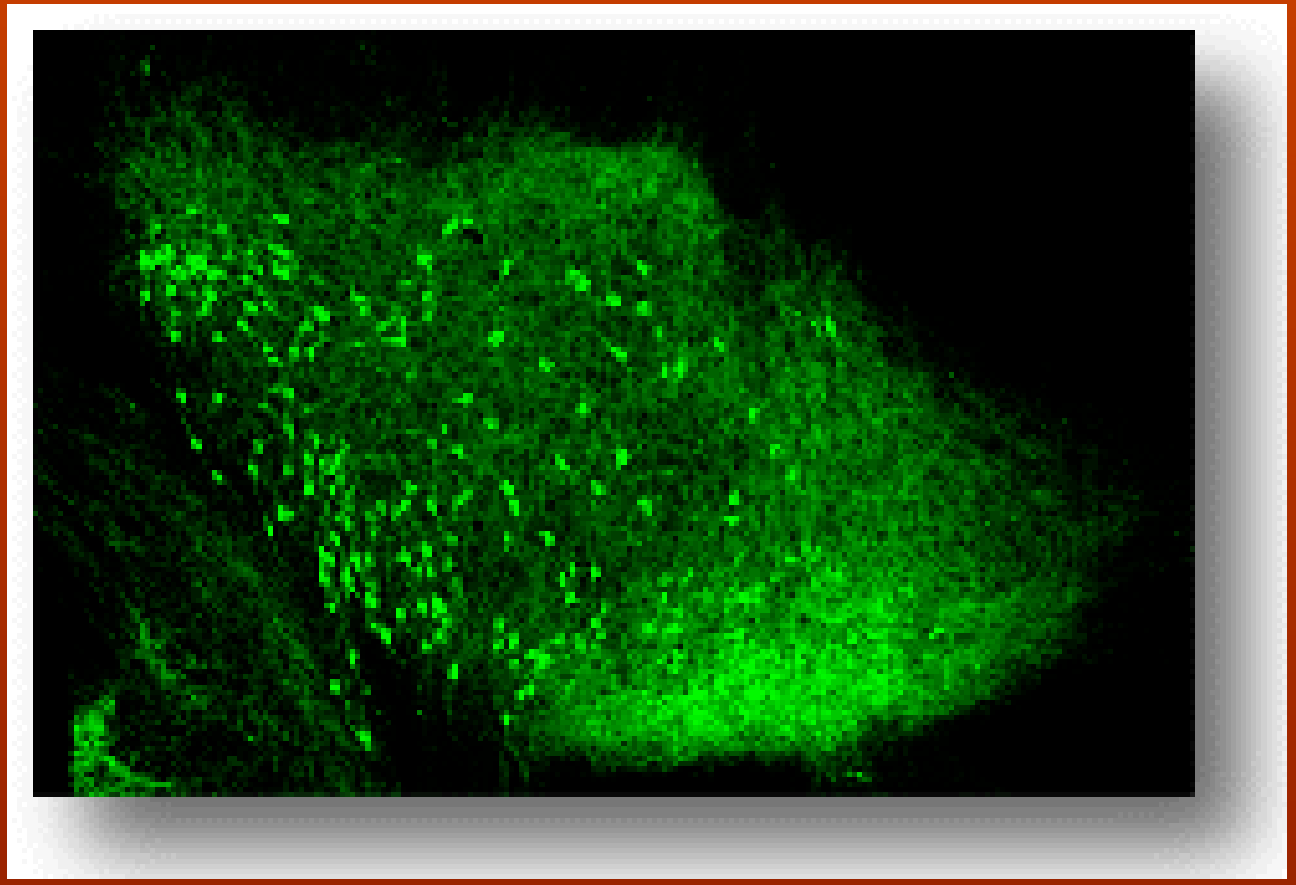
n. Caudatus:

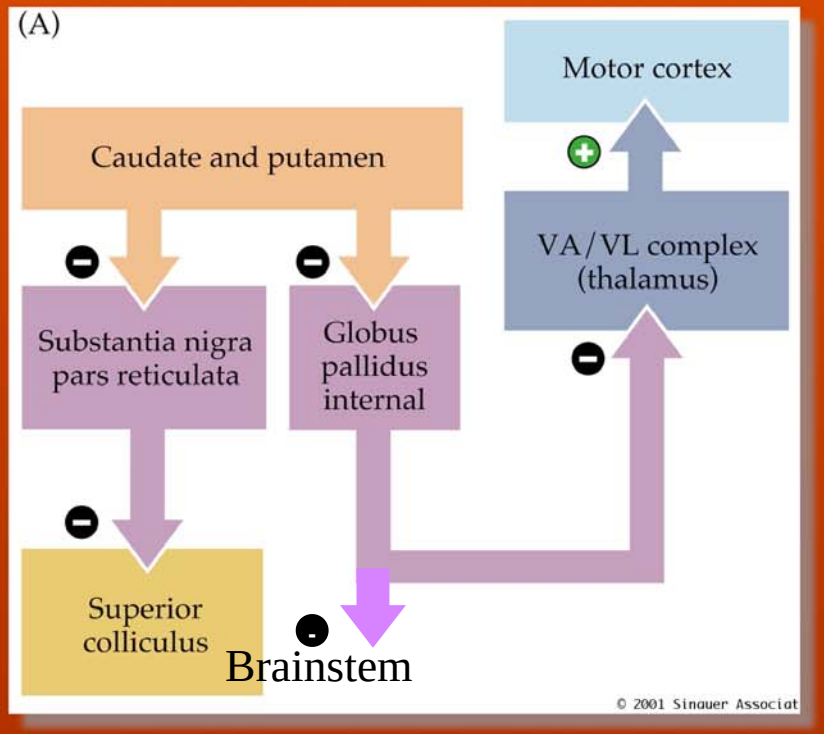
- Multimodal association areas
- areas relevant for the eye motor systems (frontal-lob)

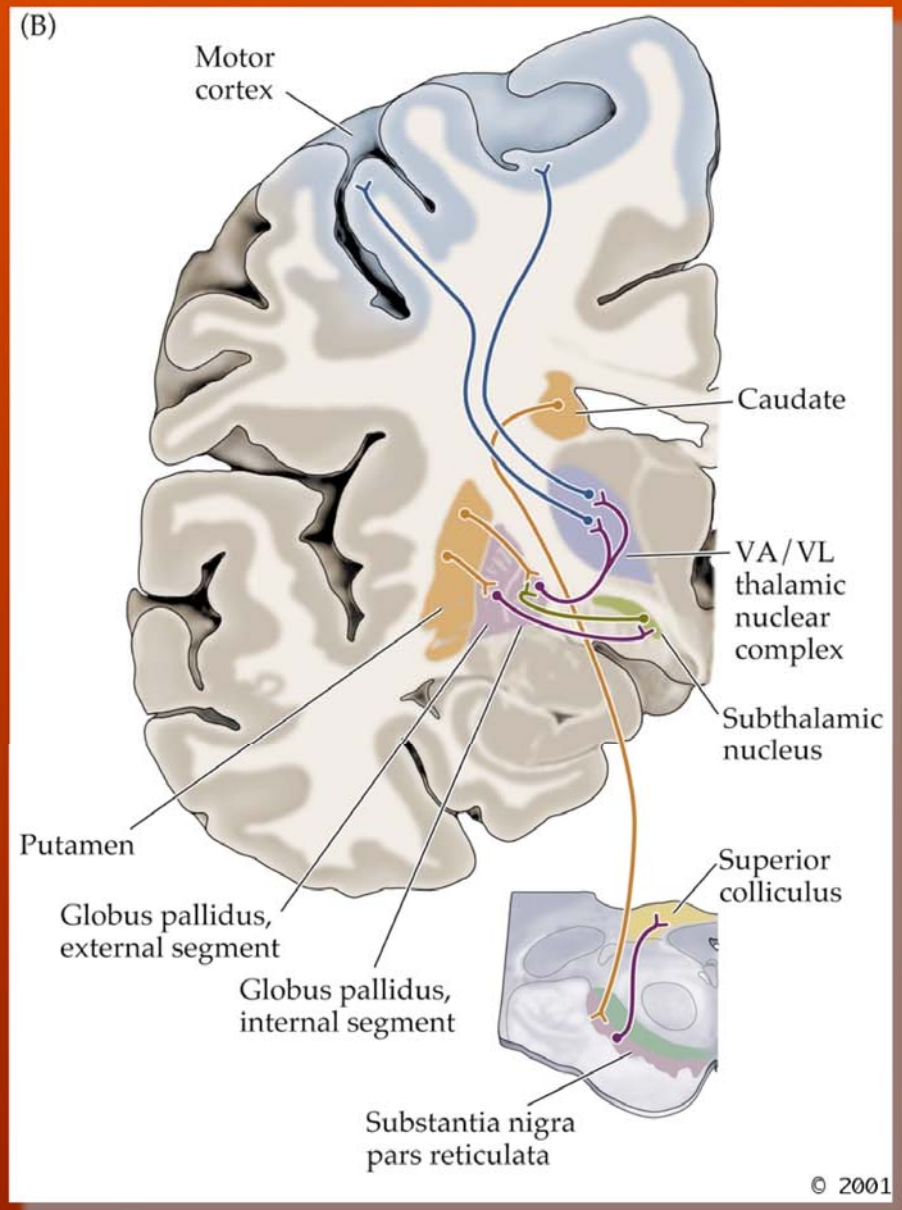
Putamen:

- Primary and secondary somatosensory cortex (parietal)
- Secondary visual cortex
- Premotor and motorcortex (frontal)
- Auditory association areas (temporal)

Substantia nigra in mesencephalon (rat). Dopaminergic neurons labelled with a green fluorescense marker (tyrosinhydroxylase)







Outputs from the Basal Ganglia.

Fig 17.5

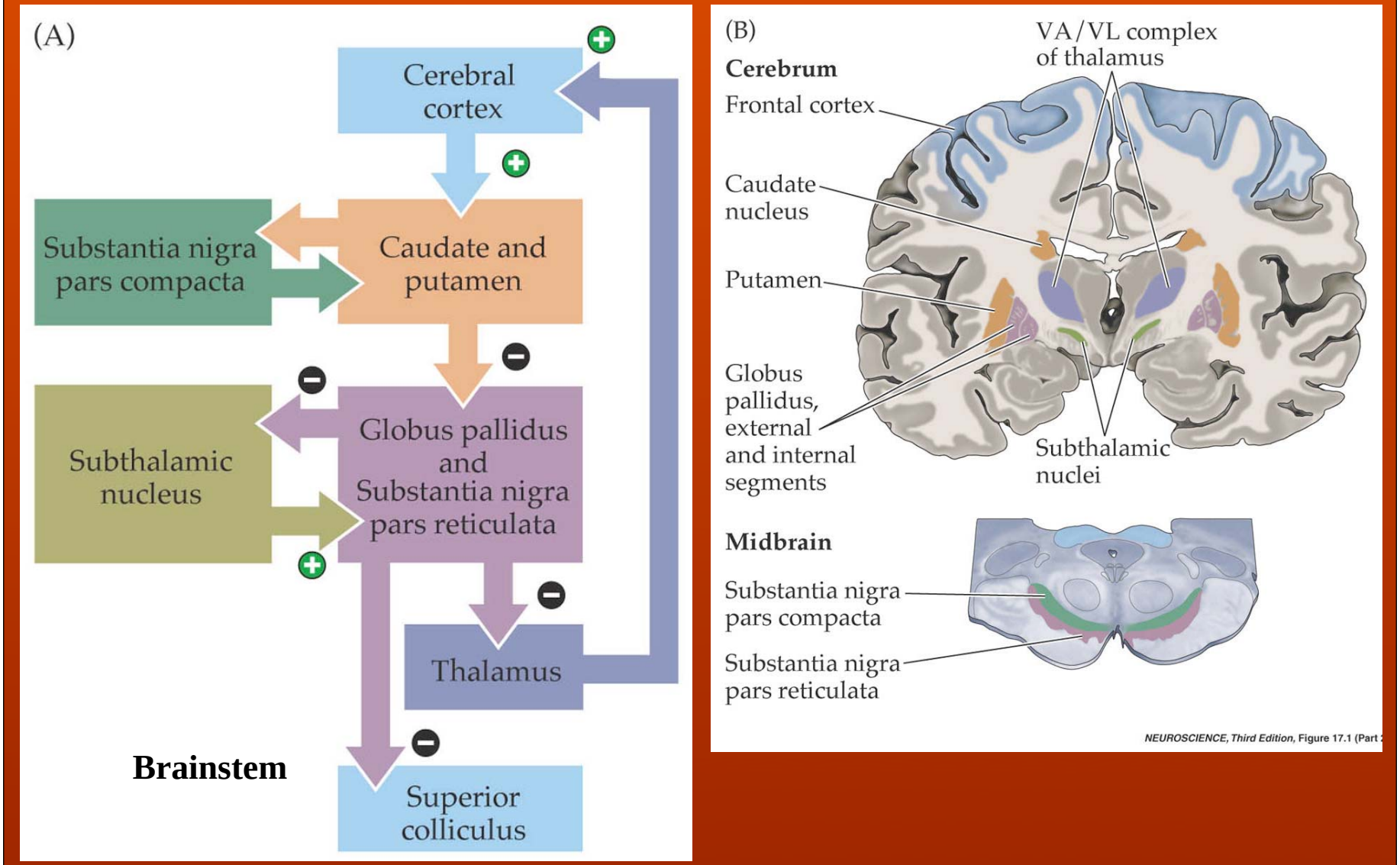

(A)
Cerebral cortex
Caudate and putamen
Substantia nigra pars compacta
Globus pallidus and Substantia nigra pars reticulata
Subthalamic nucleus
Thalamus
Superior colliculus
Brainstem
(B)
VA/VL complex of thalamus
Cerebrum
Frontal cortex
Caudate nucleus
Putamen
Globus pallidus, external and internal segments
Subthalamic nuclei
Midbrain
Substantia nigra pars compacta
Substantia nigra pars reticulata
NEUROSCIENCE, Third Edition, Figure 17.1 (Part

Fig 17.1

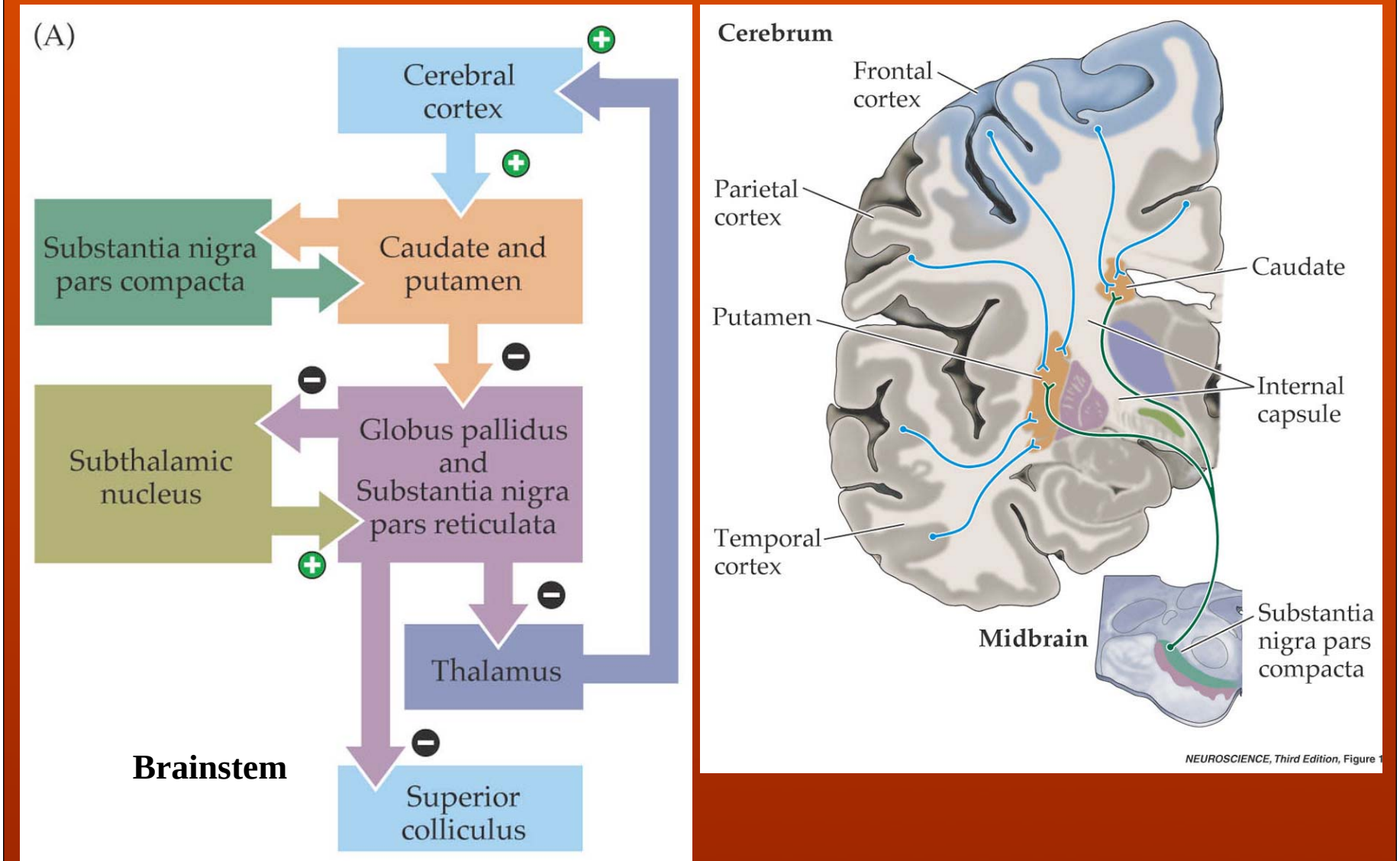
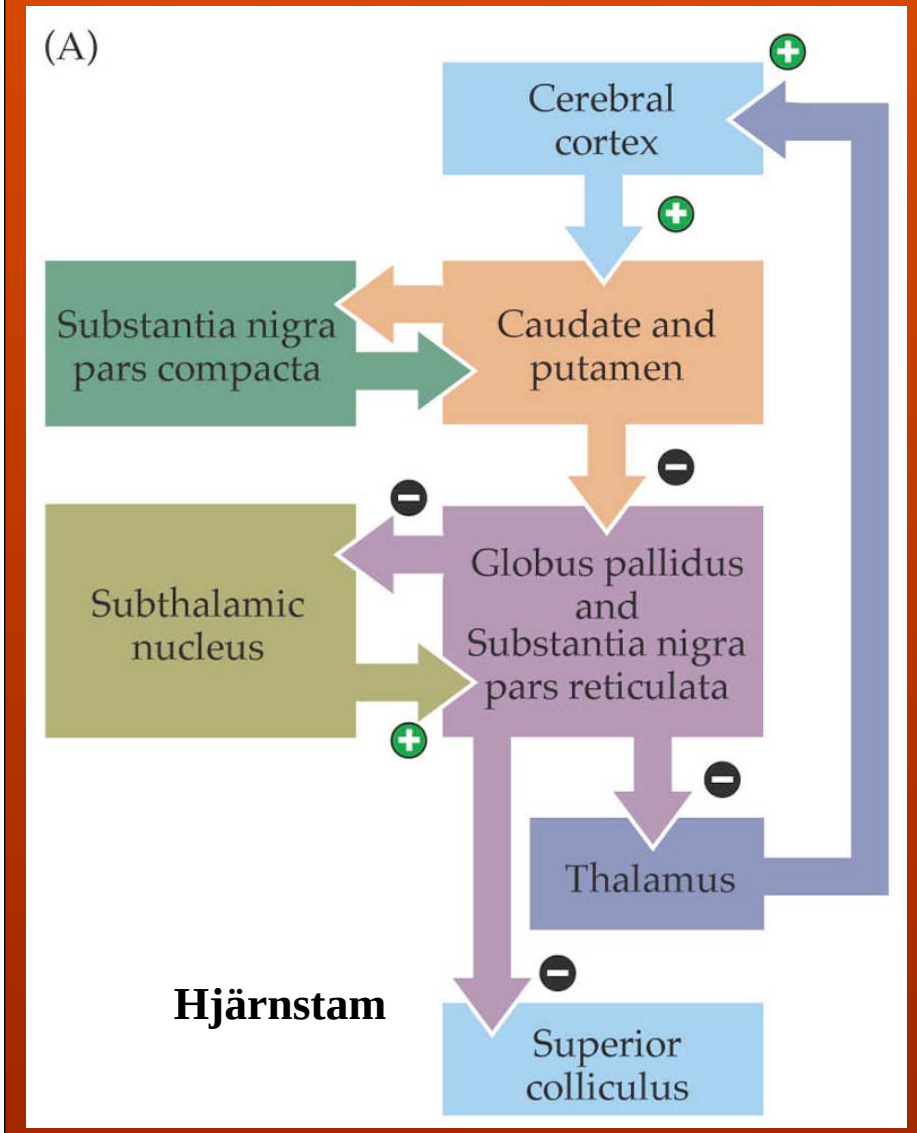

(A)
Cerebral cortex
Caudate and putamen
Substantia nigra pars compacta
Globus pallidus and Substantia nigra pars reticulata
Subthalamic nucleus
Thalamus
Superior colliculus
Brainstem
Cerebrum
Frontal cortex
Parietal cortex
Caudate
Putamen
Internal capsule
Temporal cortex
Midbrain
Substantia nigra pars compacta
NEUROSCIENCE, Third Edition, Figure 1

Fig 17.1


(A)
Cerebral cortex
Caudate and putamen
Substantia nigra pars compacta
Globus pallidus and Substantia nigra pars reticulata
Subthalamic nucleus
Thalamus
Superior colliculus
Hjärnstam

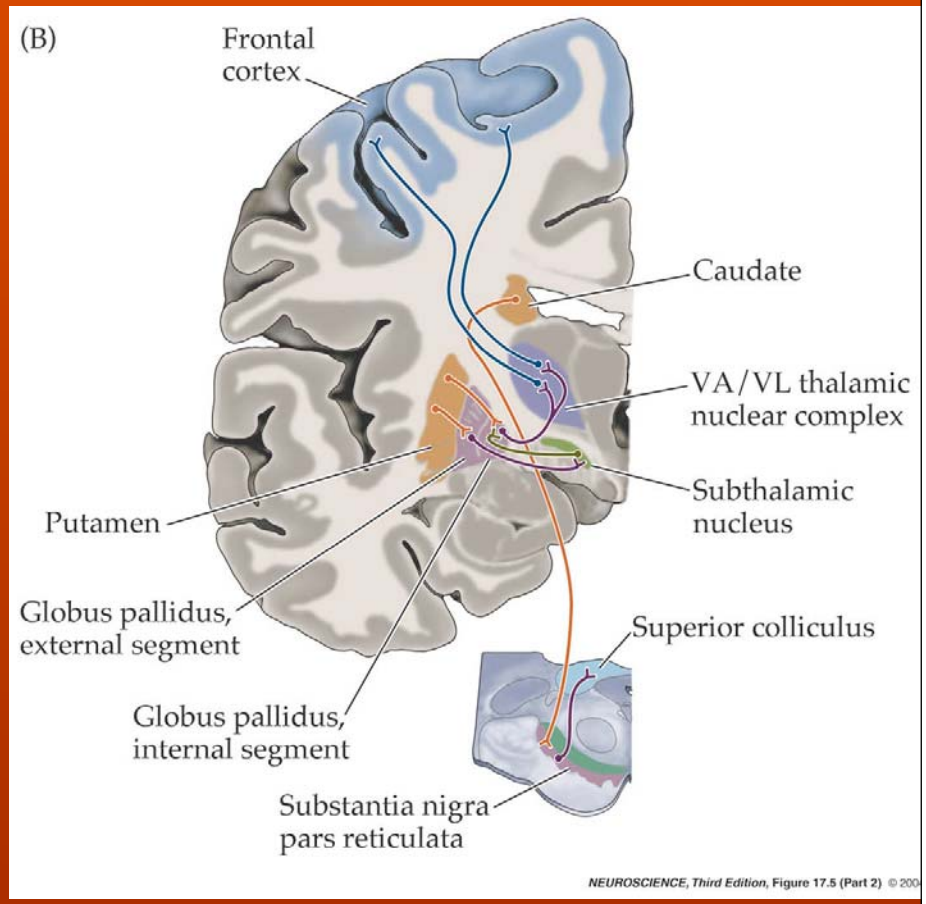
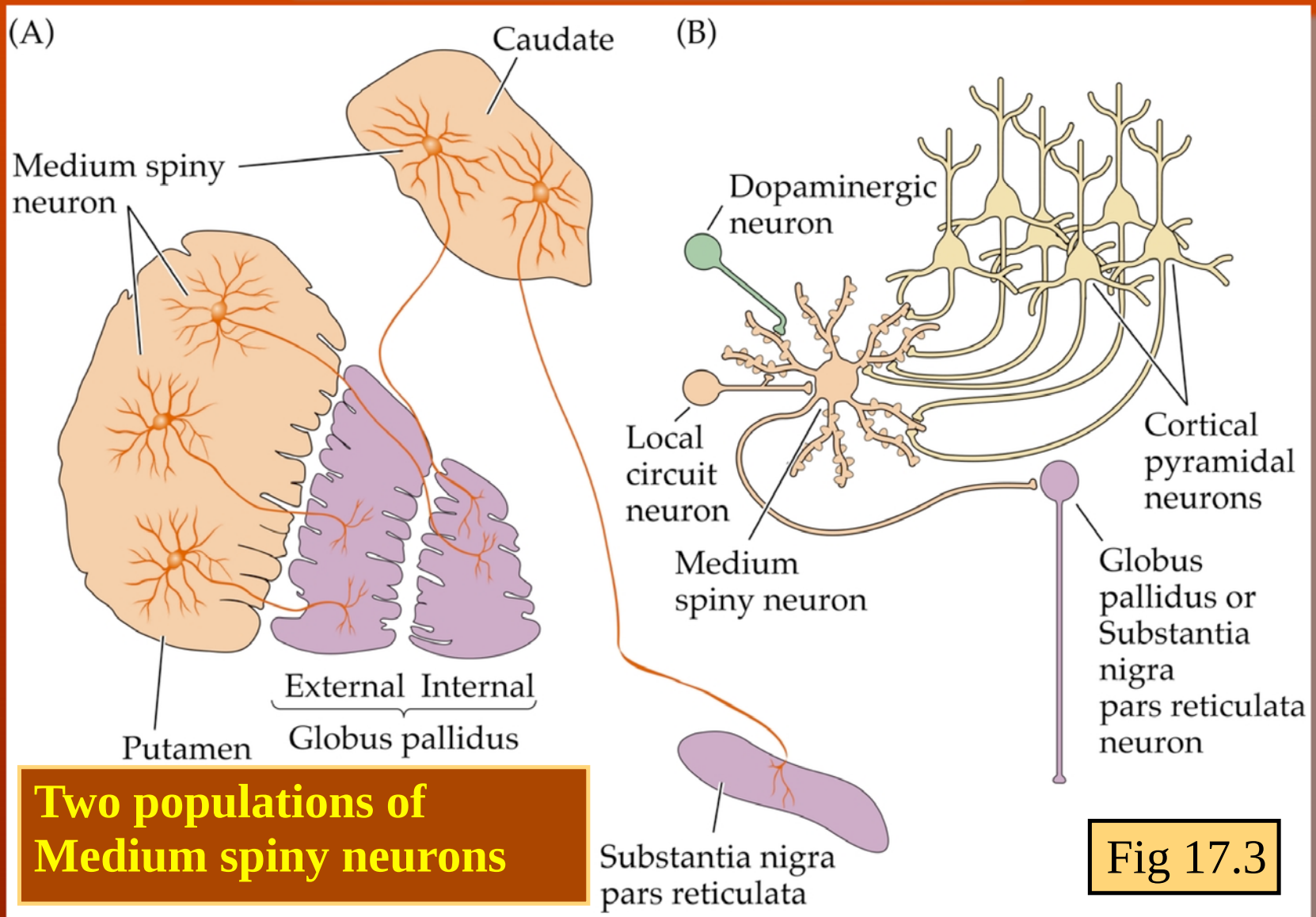

(B)
Frontal cortex
Caudate
VA/VL thalamic nuclear complex
Subthalamic nucleus
Putamen
Globus pallidus, external segment
Superior colliculus
Globus pallidus, internal segment
Substantia nigra pars reticulata
NEUROSCIENCE, Third Edition, Figure 17.5 (Part 2)

Fig 17.1

Basal Ganglia Networks



Two populations of Medium spiny neurons

Fig 17.3

Neurons in the Striatum.

Around 77-98% Medium Spiny Neurons - GABAergic Projektion Neurons.

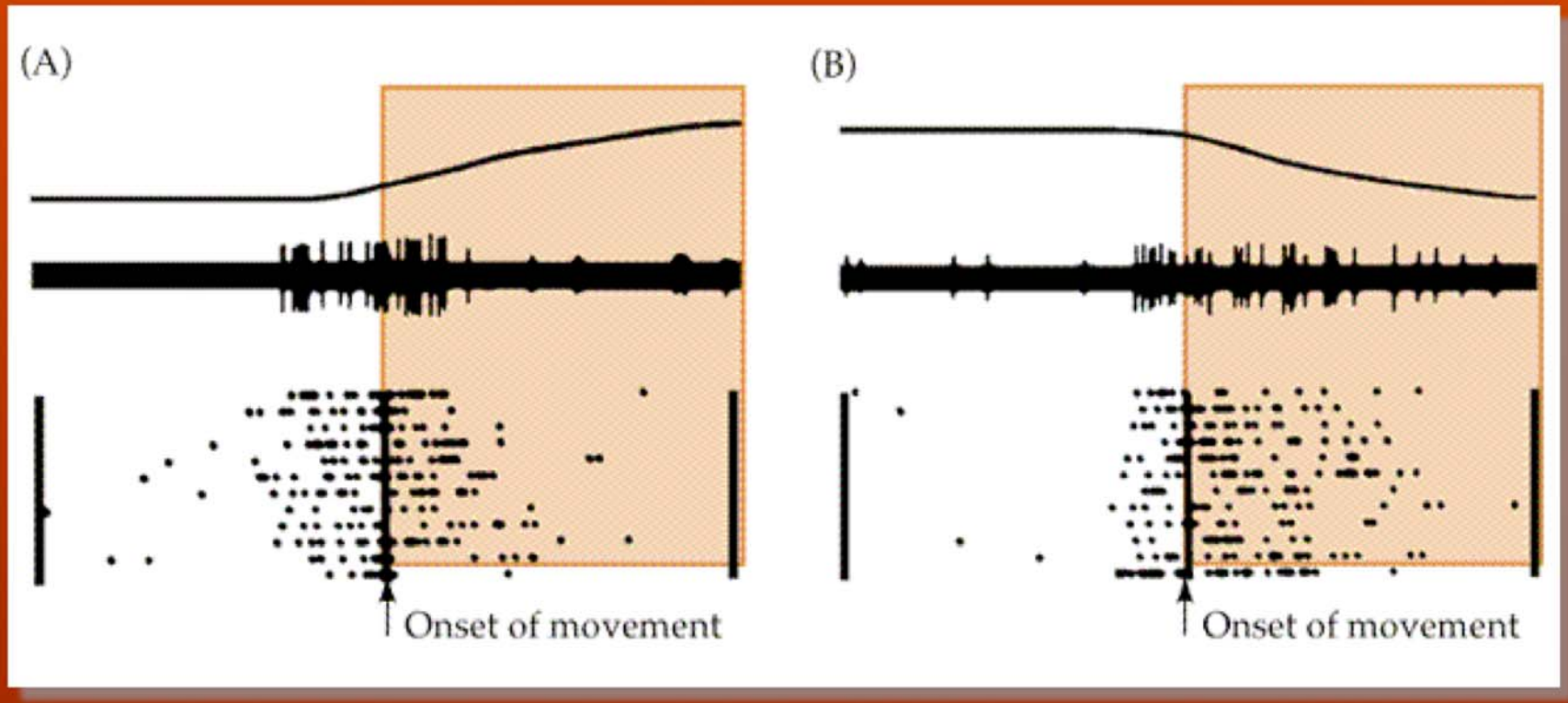
Silent at rest.

Interneuron of a couple of different kinds:

Three types of GABAergic neurons.

Giant aspiny cholinergic neurons.

Striatal neurons are active before the initiation of movements.



”Medium Spiny Neuron” in Putamen

The direct route through the basal ganglia: Starts/facilitates movements.

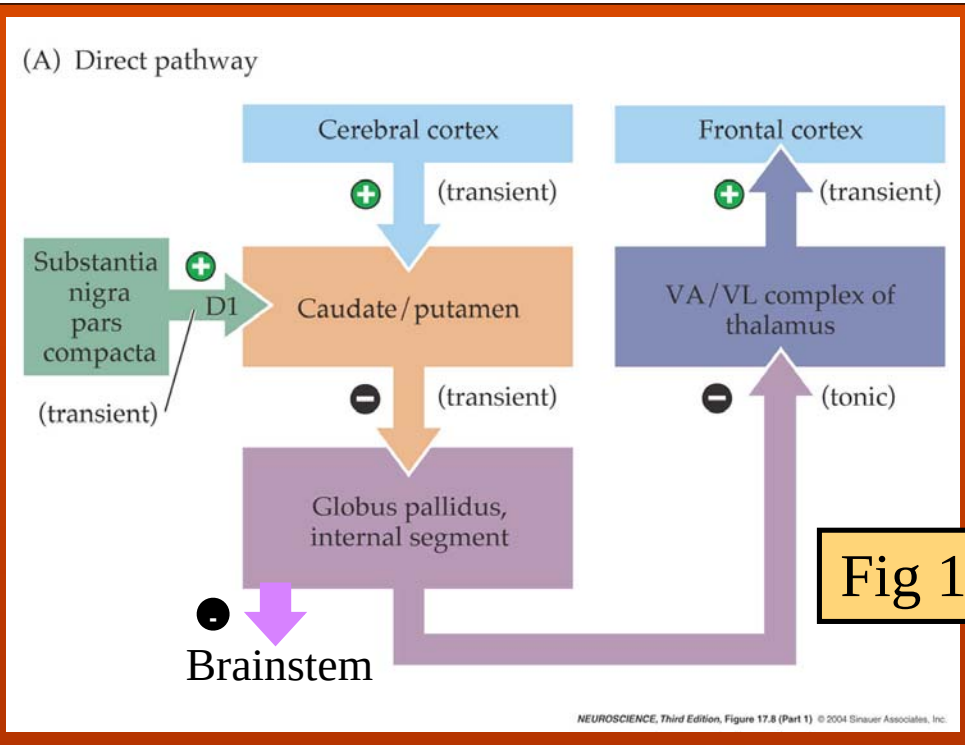


Fig 17.8A

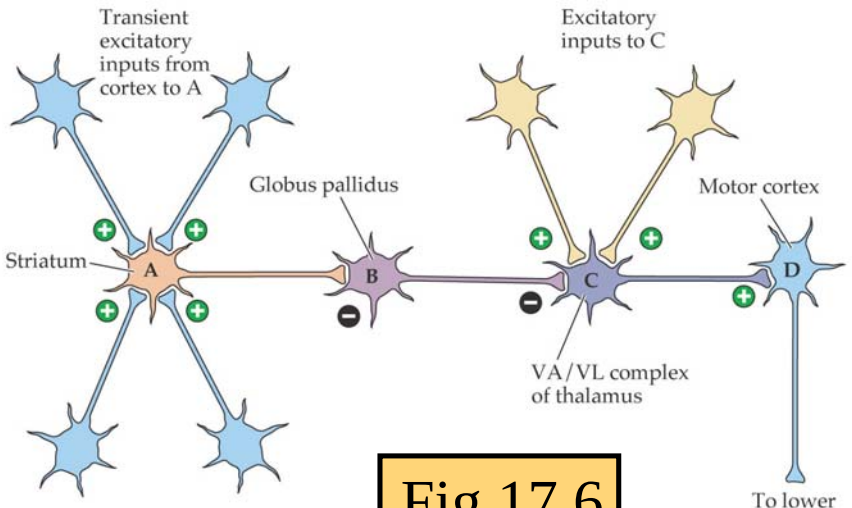
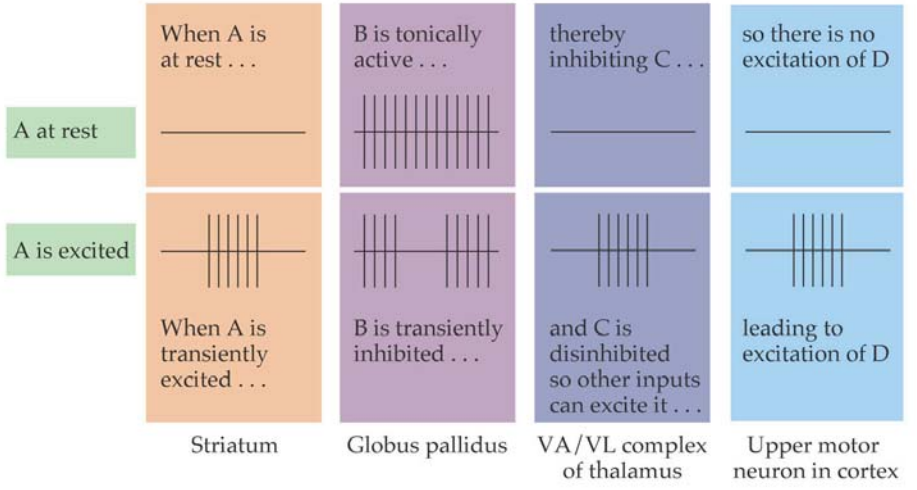


Fig 17.6



Disinhibition requires baseline activity!

The indirect route through the Basal Ganglia: Breaks and depresses movements.

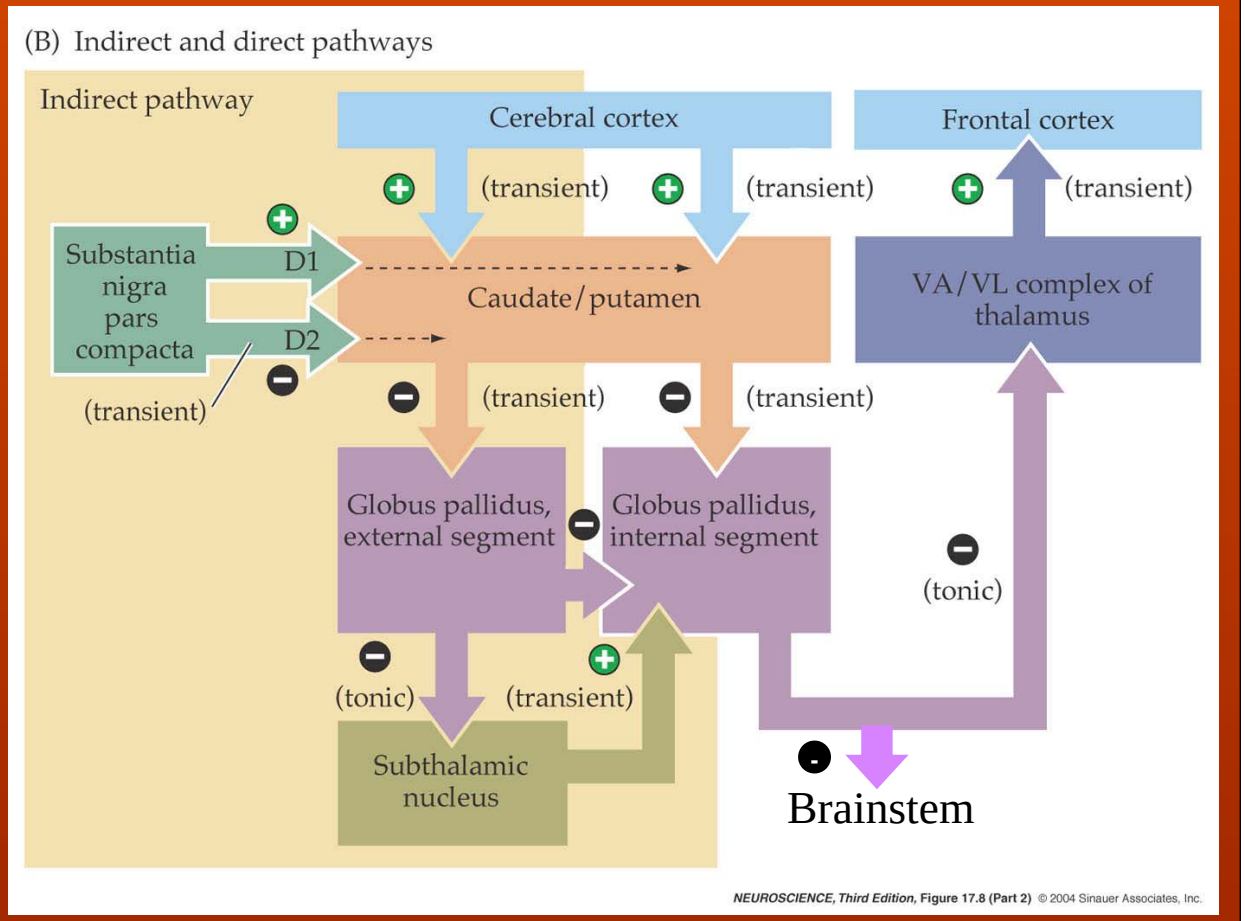
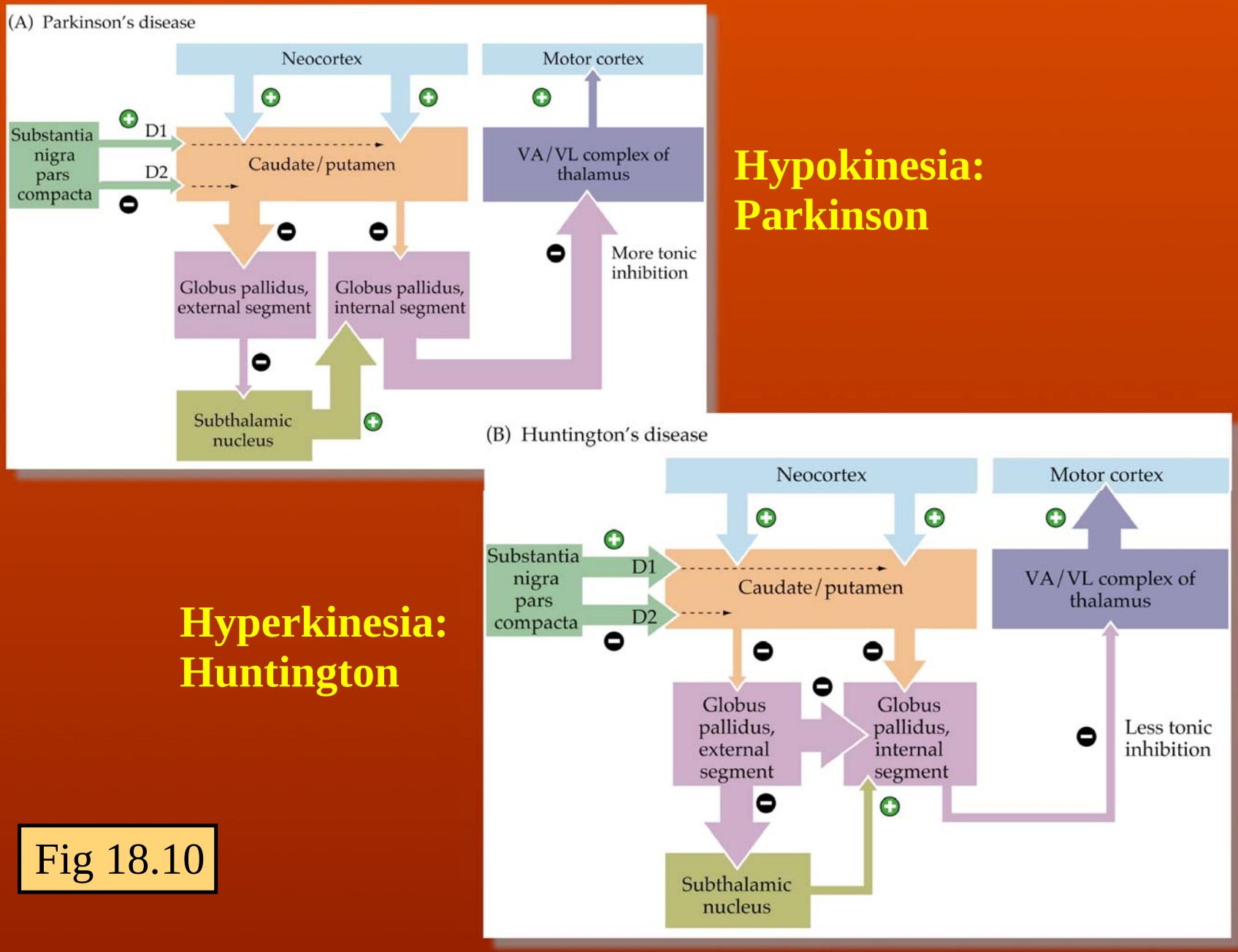


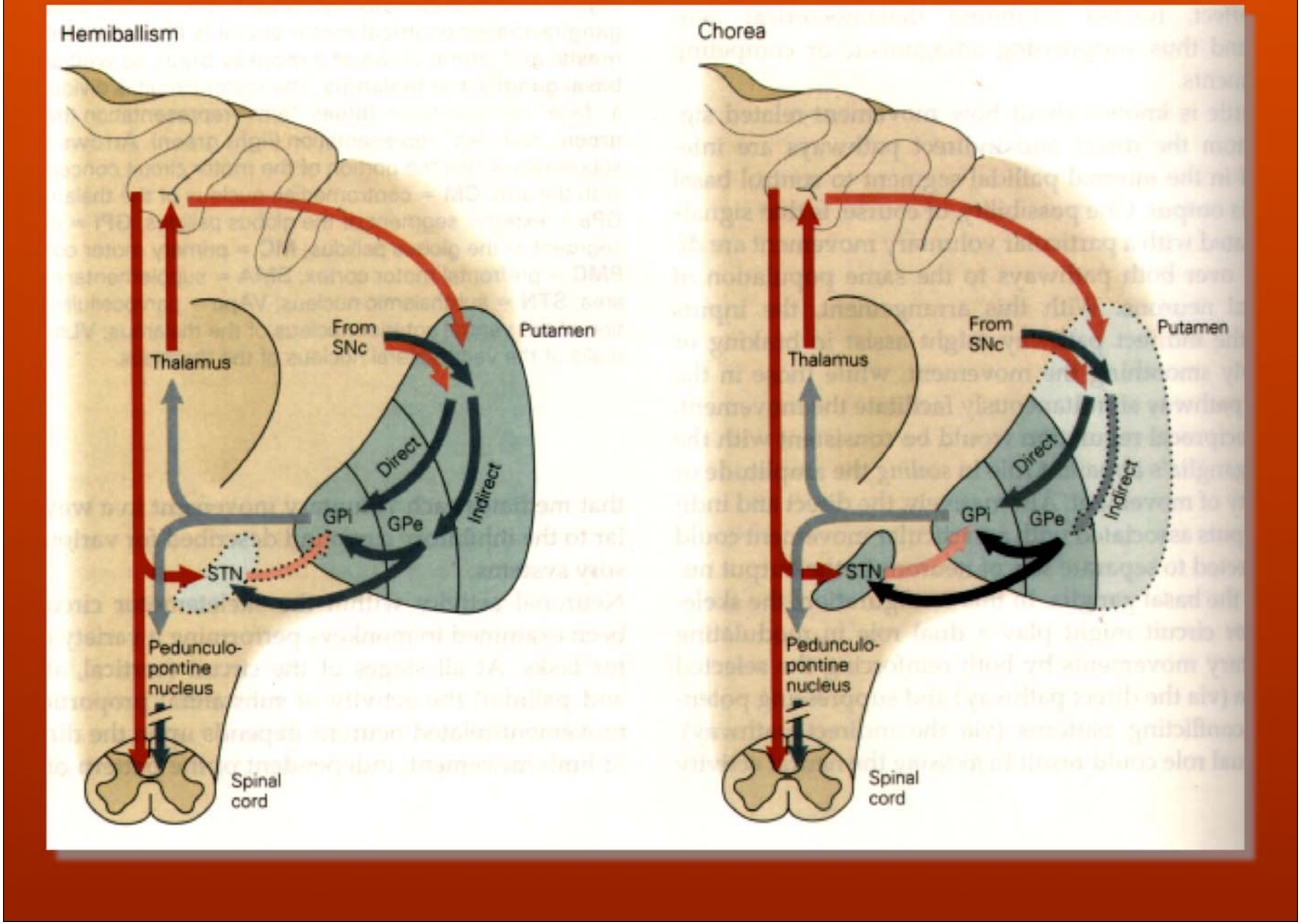
Fig 17.8B



Hypokinesia: Parkinson

Hyperkinesia: Huntington

Fig 18.10


Hemiballism
Thalamus
From SNc
Putamen
Direct
Indirect
GPi
GPe
STN
Pedunculo-pontine nucleus
Spinal cord
Chorea
Thalamus
From SNc
Putamen
Direct
Indirect
GPi
GPe
STN
Pedunculo-pontine nucleus
Spinal cord