A Bit of Anatomy

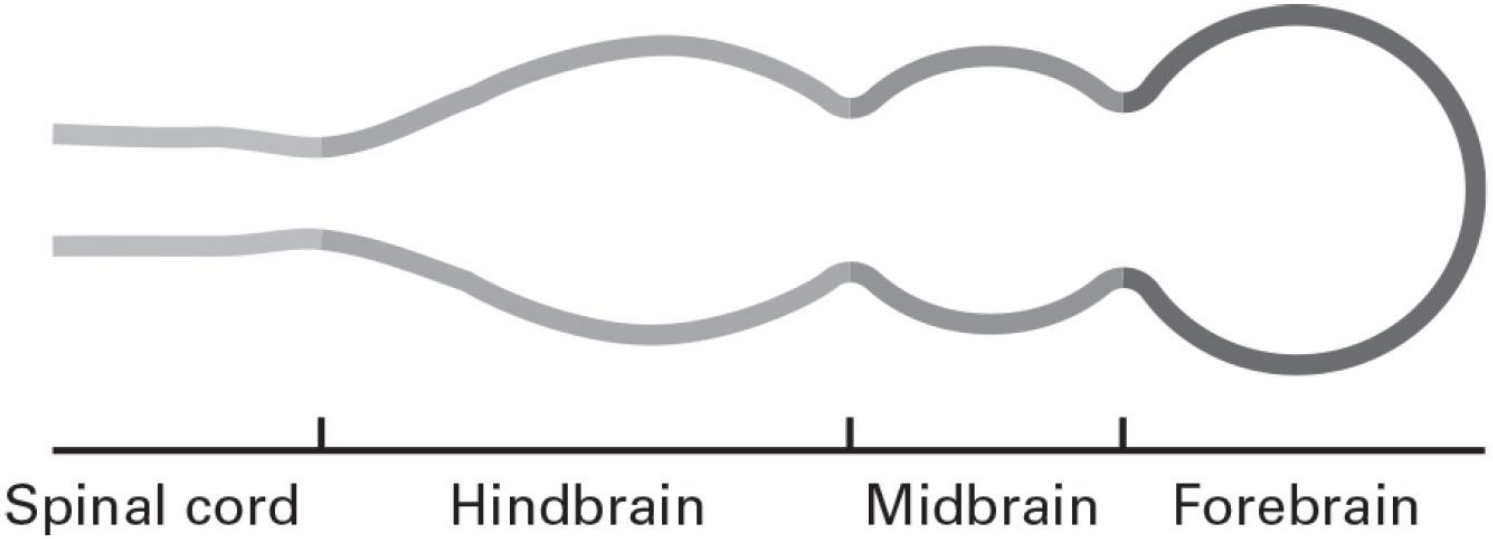
Zi-Seok Lee

2023-03-12

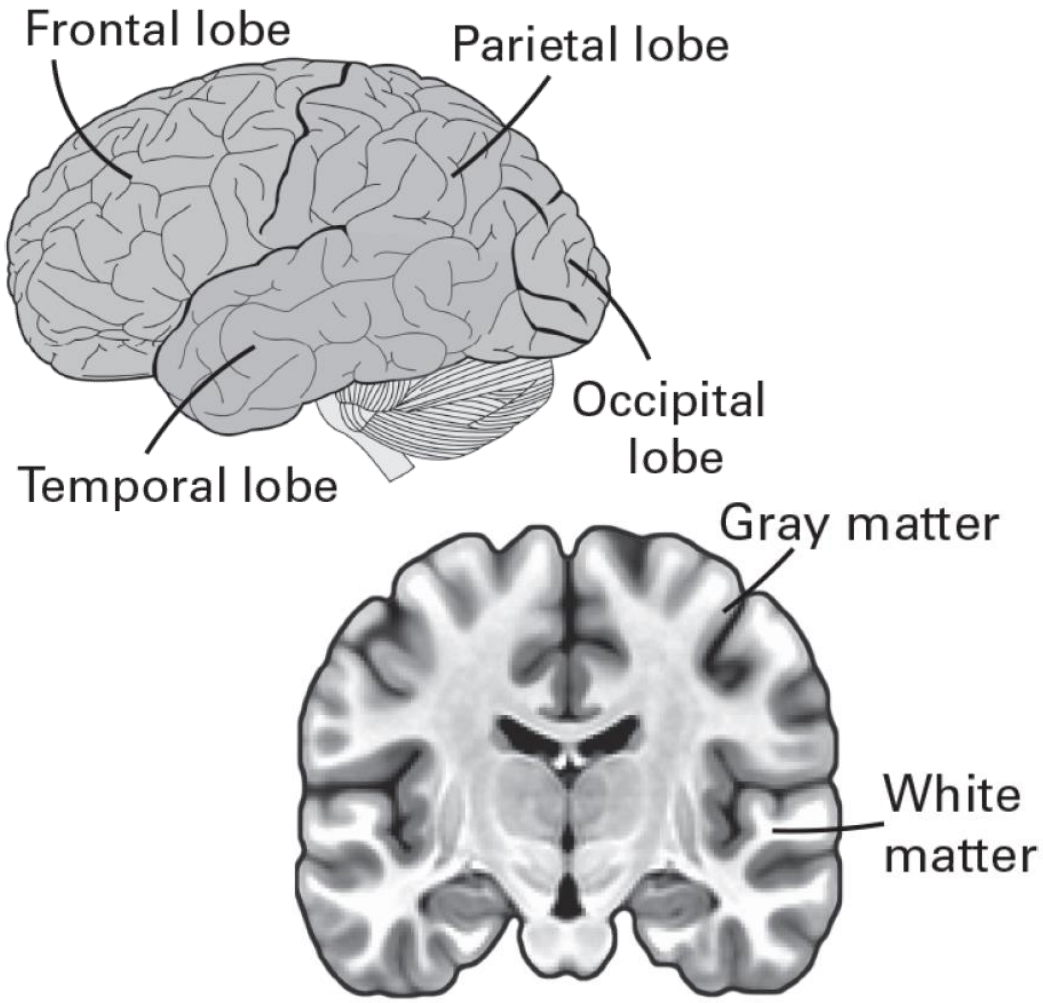
Contents

0. Embryonic Compartments

- The **forebrain** (전뇌); cerebrum (대뇌) + diencephalon (간뇌)
  - Contains all of the cortex and several subcortical structures
- The **midbrain** (중뇌); mesencephalon (중뇌)
- The **hindbrain** (후뇌); pons (뇌교) + medulla (연수) + cerebellium (소뇌)
- The **spinal cord** (척수)

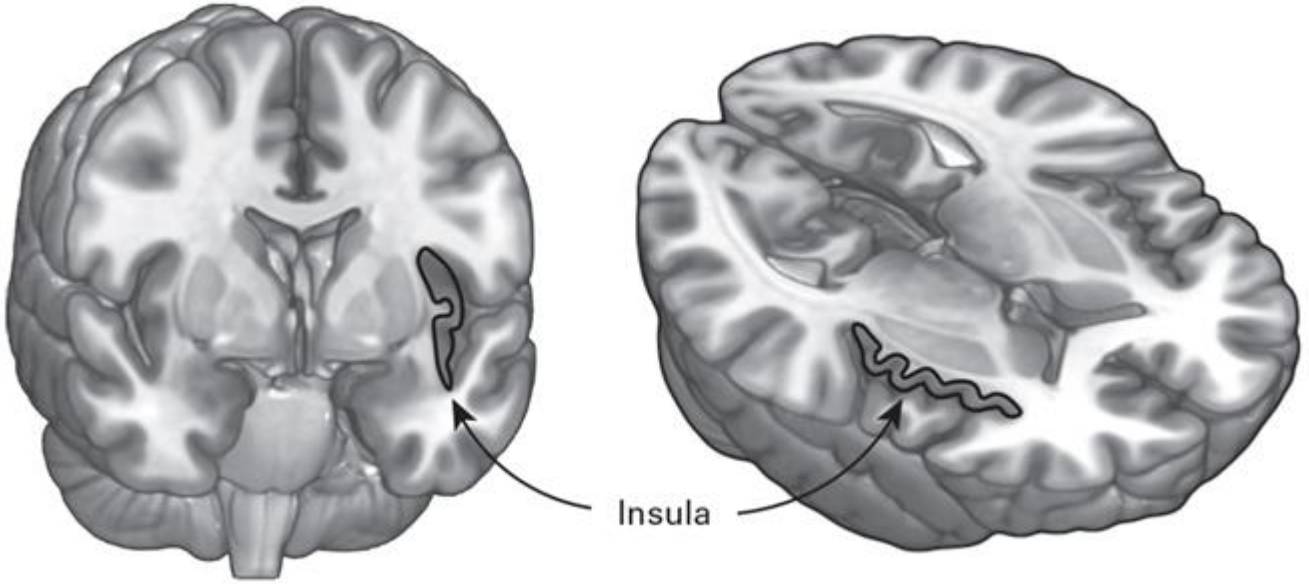


1. The Cortex (피질)



- The outer zone of the cerebrum with bumps and grooves
- Highly convoluted that it would spread to the size of a large pizza
- Fine layered structure of varying cellular complexity
- Present in all mammals
- Shares a laminated pattern

Cingulate cortex (띠이랑)



Insula (섬엽)

Hippocampus (해마)

2. The Subcortex (피질하)

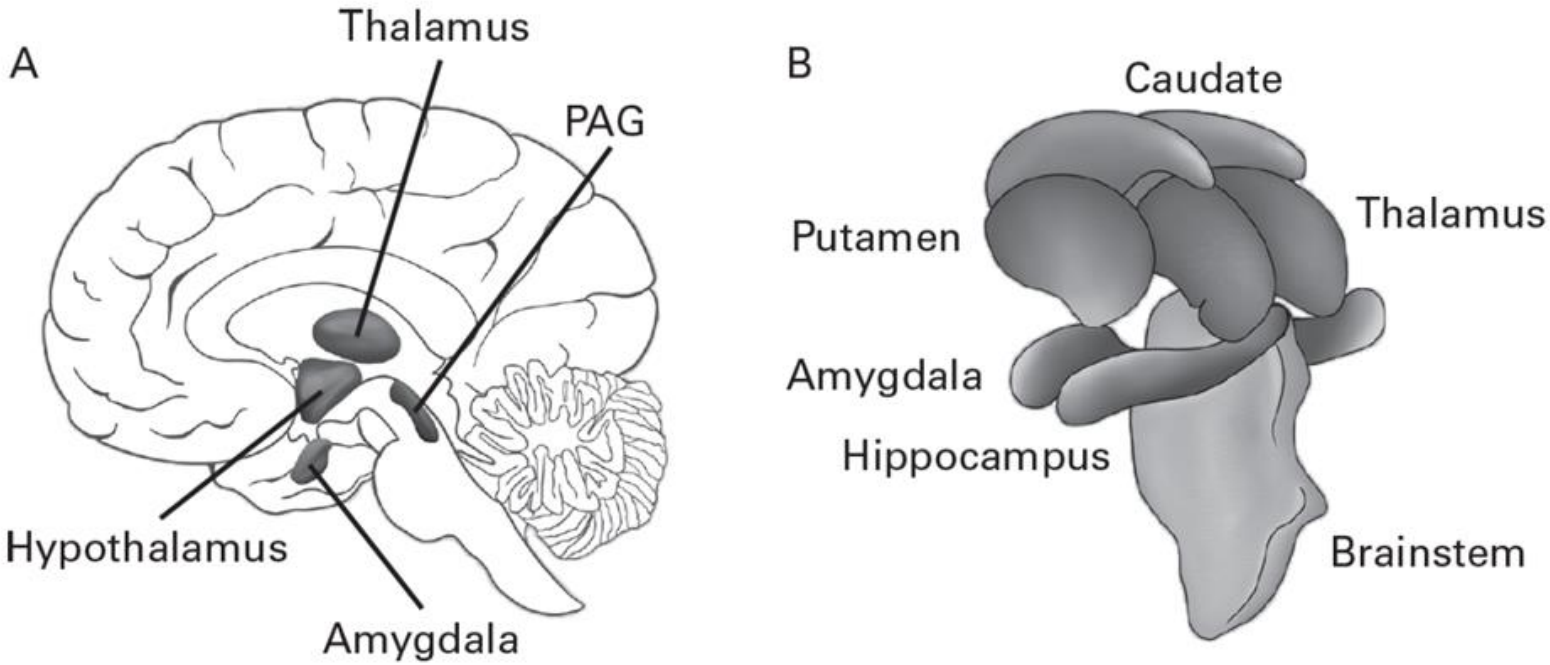


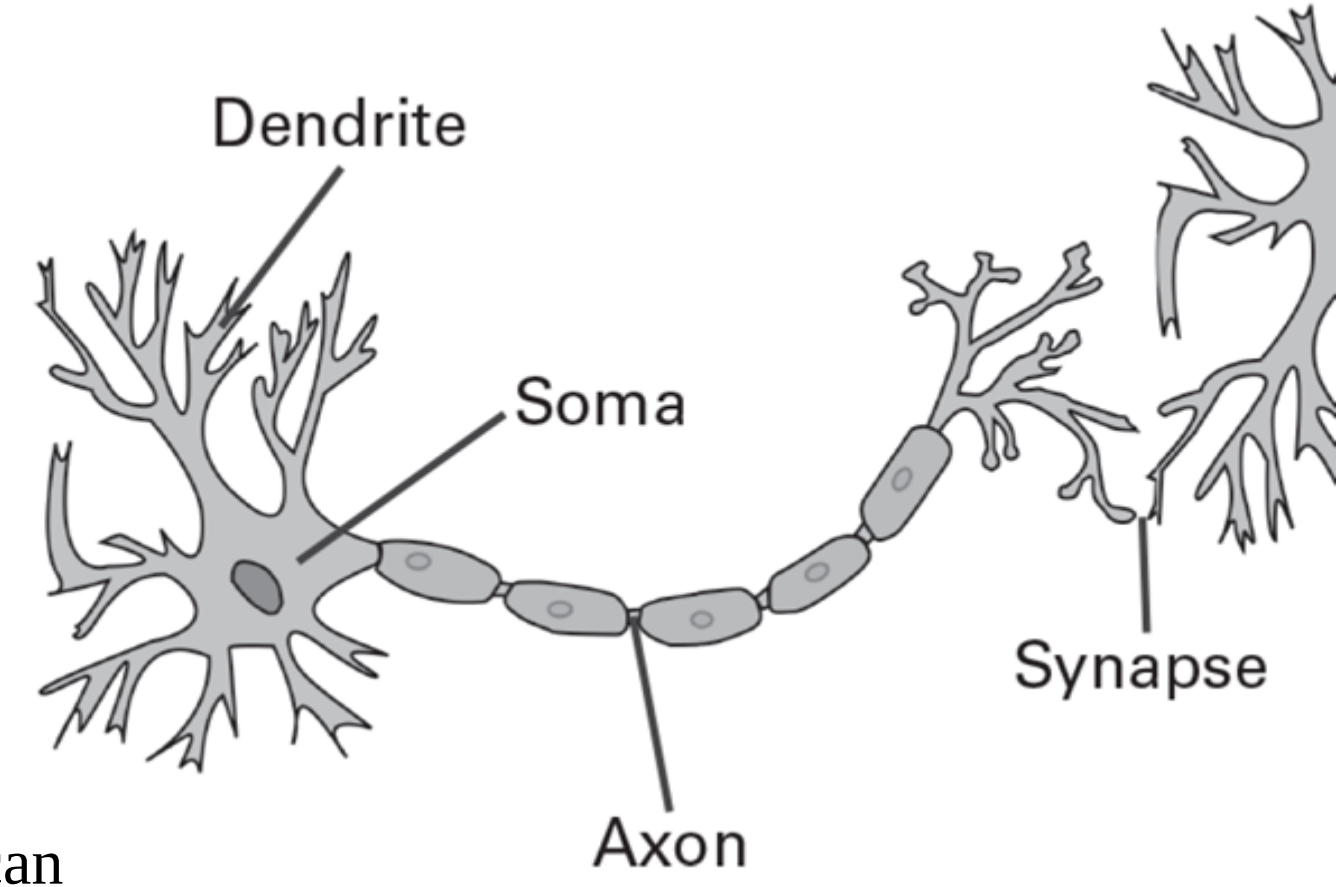
Figure 2.2
Subcortical brain regions. (a) Cut through the middle of the brain illustrates the position of some subcortical regions (PAG is the periaqueductal gray). (b) Rendering of some important structures. The striatum, which is discussed at length throughout the book, has two parts: the caudate and the putamen.

Some prominent subcortical structures

- Thalamus (시상)
- Hypothalamus (시상하부)
- Amygdala (편도체)
- ***Striatum*** (선조체); Caudate (미상핵) and putamen (조가비핵)
  - ALL of the cortex projects to it from sensory regions to frontal areas that participate in abstract processes
  - The ***basal ganglia*** (striatum and its adjacent structures) have been understood as the “motor system”

3. Neurons

- 200 cell types and 86 billion neurons
- Some axons extend over a meter
- Communicates through action potentials
  - Triggered only in an all-or-none fashion
  - Binary on/off signal
- Chemical synapses: neurotransmitters
  - Dopamine, serotonin, acetylcholine, histamine
- It is ***electrochemical*** – multiple signals can converge and be integrated.



4. Two Types of Tissue: Gray and White

Gray Matter

- Contains neurons and other cells
- Serves as the key processing elements
- Where much of the communication occurs locally

White Matter

- Contains nerve fibers (axons)
- Serves as a communication highway
- Many nerve fibers are enveloped by myelin – which creates the *whiteness*
- ***White matter tracts*** form an essential road for signal transmission

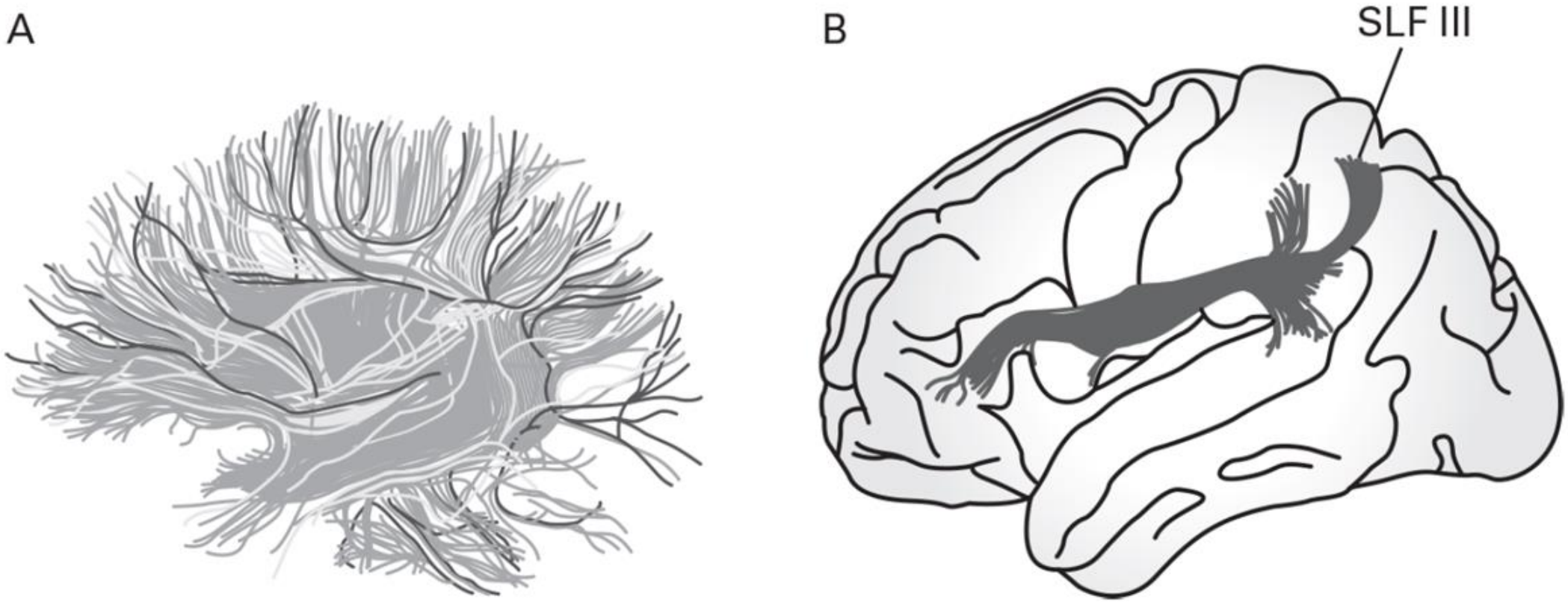


Figure 2.5

White matter. (a) The extensive white matter fibers of the brain interlink brain regions. (b) The fibers are organized in terms of fasciculi (a fasciculus is a bundle of axons), such as the superior longitudinal fasciculus (SLF) III.

5. The Axiom in Biology

- Axiom: Function is tied to structure (~> cytoarchitecture)

  ⇔ different structure implies different function

- i.e., parts of the cortex that are structurally different carry out different functions
- The Vogts and Brodmann were searching for ***functional units*** of the cortex
- Corollary: Individual brain regions implement specialized mechanisms
- Individual parts were understood as the ***mechanistic unit*** of the brain

The Notion of "Computation"

- ***Functionalism***: mental states are identified by their functional role, not by how they are physically implemented.
  - Then, a mind can be instantiated by even computers as long as they compute properly
- The question: to what extent is functionalism true in the brain?
- Some terminology

Up	Superior	Dorsal	**Front**	Anterior
Down	Inferior	Ventral	**Back**	Posterior

Early Network Theory: Associationism

- ***Associationism***: A deficit following a brain lesion could be due to impairment in regions distant from the damaged site. Two situations arise:
- ***Diaschisis***: a region was affected because it was connected with a damaged area
- ***Disconnection***: two intact areas are disconnected because of an insult to the major tract linking them.
- "Brain functions are not carried out by single, isolated regions but by coalitions of regions that may be involved in neural circuits that are not local"