

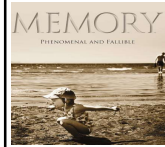
2021 Fall "Physiology"

Brain and Behaviour

Dong-Gen LUO

College of Life Sciences
Peking University

Without **memory**, we are nothing.



Sleep cures anything.



The power of **Speech**.



Emotion expression



Mnemonist

Solomon Shereshevsky
(1886-1958), Russian



OF SPECIAL INTEREST
An Extraordinary Memory

In the 1950s, a true marvel Shereshevsky came to me the Russian psychologist Alexander Luria. This began a life-long study of the extraordinary memory of the man. Luria, who was a friend of mine, had a unique way of describing the memory of this man. He said that Shereshevsky could remember anything that he heard, saw, or felt. He could remember the exact words of a speech, the exact date of an event, the exact color of an object. He could remember the exact words of a speech, the exact date of an event, the exact color of an object. He could remember the exact words of a speech, the exact date of an event, the exact color of an object.

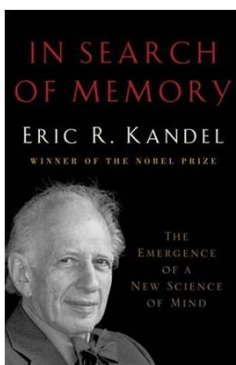
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Eric R. Kandel (1929-)
Columbia University

Nobel Prize in Physiology or Medicine (2000)
For his work on learning and memory

Aplysia (Sea Slug)



Learning: acquisition of new information or knowledge.

Memory: retention of learned information.

Forgetting: decay/fading of memory.

Memory Composition

Acquisition

Information is assembled from different sensory systems and translated into what to be remembered.

Consolidation

Converting acquired information into permanently-stored memory trace. The hippocampus accomplishes it.

Storage

The actual memories.

Retrieval

Recall memories. Using past experiences as cues to reconstruct a past event.

Types of Memory (I)

Long-Term Memory

Those you can recall days, months, or years after being stored.

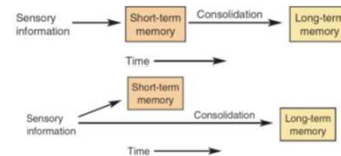
Short-Term Memory

Memories last on seconds to hours, vulnerable to disruption.

Working Memory

A short-term form that is limited in capacity and requires rehearsal.

Digit span: 7.



Types of Memory (II)

Declarative Memory

Memory for facts and events.

"I heard a most stimulating lecture." "I had milk for breakfast."

Non-declarative Memory

Procedural memory: memory for skills, habits, and behaviors.

"Play the piano, tie the shoes..." "learned fear..."

Explicit memory: resulting from conscious effort.

Easy to form and easy to forgotten.

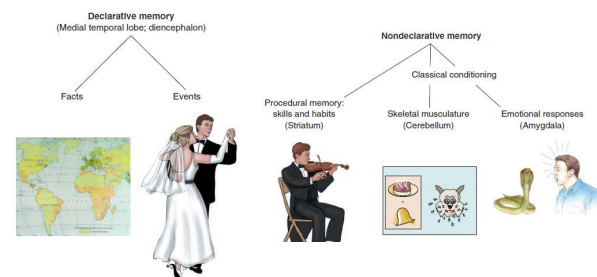
Storage capacity is high.

Episodic (events) vs. semantic (facts) memory.

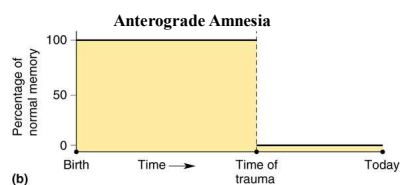
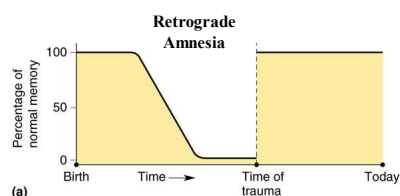
Implicit memory: resulting from direct experience.

Require repetition over a long time, but difficult to be forgotten.

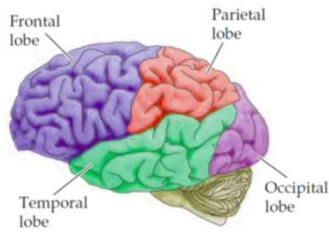
Memory Types



Amnesia



Locations of Memory

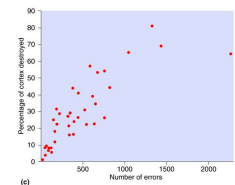
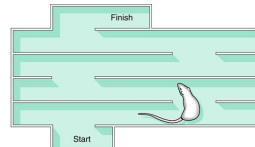
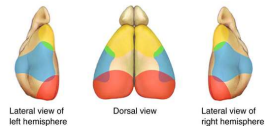


Frontal lobe: 额叶 Emotion, more function, social behavior
 Parietal lobe: 顶叶 Language, touch, pain, temperature
 Occipital lobe: 枕叶 Visual perception
 Temporal lobe: 颞叶 Hearing, speech, vision, memory

Lashley's Studies of Maze Learning in Rats

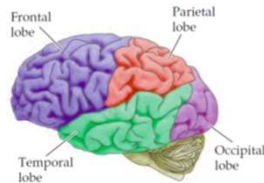
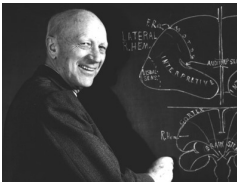


Karl Lashley
 (1890-1958)
 American psychologist
 "Memory is distributed."



Electrical Stimulation of Human Temporal Lobe

Wilder Penfield (1891-1976)



Stimulation anywhere on the cerebral cortex could bring responses of one kind or another, but he found that only by stimulating the temporal lobes could he elicit memory.

These memories were much more distinct, and were often about things unremembered.

Yet if stimulated the same area again, the exact same memory popped up.

It seemed he had found a physical basis for memory, an "engram."

Henry Molaison (1926-2008)



Partial seizures after 16
 Intractable Epilepsy (a bicycle accident at 7)

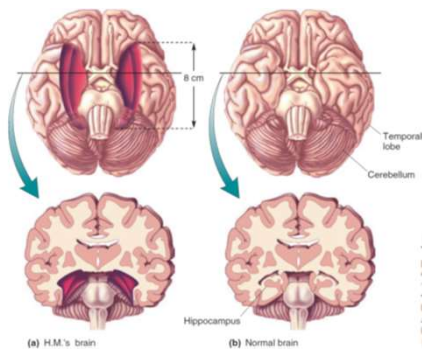


Dr. Scoville: locate medial temporal lobes for surgical resection.
 08/23/1953 Surgery
 MTLs: hippocampus, amygdala, entorhinal cortex.



Anterograde amnesia;
 Working memory and procedural memory intact;
 Retrograde amnesia: 1-2 year period before surgery;
 Cracking jokes, solving crossword puzzles.

Human Studies of Temporal Lobectomy



Clive Wearing (1938-)

03/27/1985, contracted Herpes simplex virus that attacked his Hippocampus.

Since this point, he has been unable to store new memories.
 His memory only lasts between 7 and 30 seconds
 He remembers little of his life before.

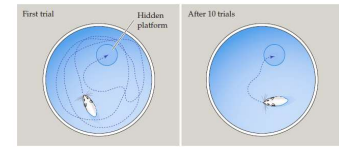
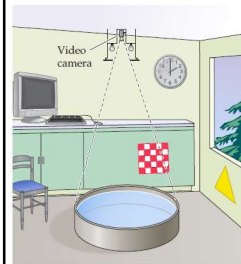
His love for his wife Deborah is undiminished.
 He still recalls how to play the piano.

Clive recorded his thoughts in a diary. Page after page, similar to the following:

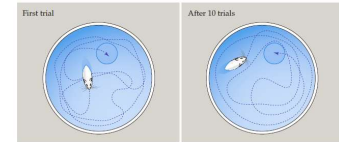
8:31 AM: Now I am really, completely awake.
 9:06 AM: Now I am perfectly, overwhelmingly awake.
 9:34 AM: Now I am superlatively, actually awake.

Molecular Mechanisms of Learning and Memory

Hippocampus



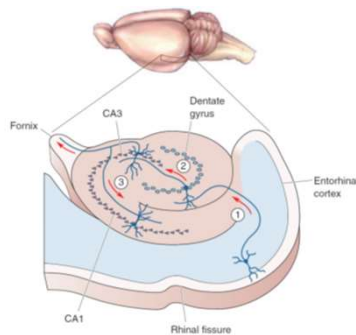
Hippocampus Lesion



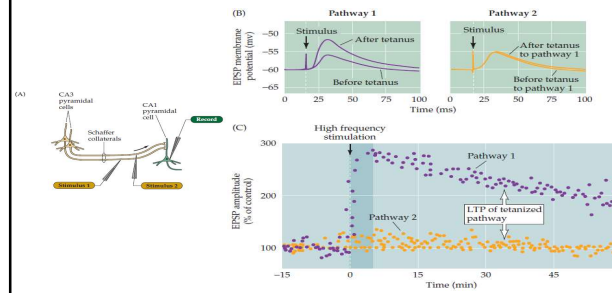
Hippocampus



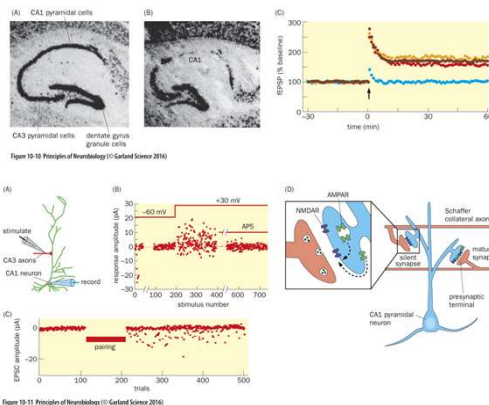
1. Perforant path to dentate gyrus;
2. Granule cells synapse on pyramidal neurons in CA3 with mossy fibers.
3. CA3 synapse on pyramidal neurons in CA1 via Schaffer collaterals.



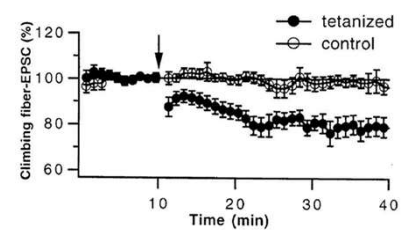
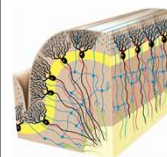
Synaptic Plasticity



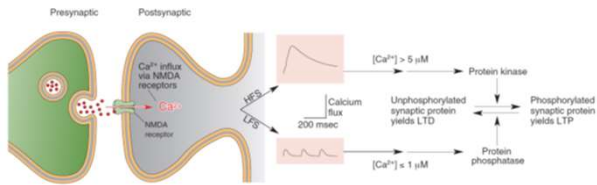
NMDA Receptor and Silent Synapses



Long-term Depression (LTD)



LTP vs. LTD



Structural Change of the Brain

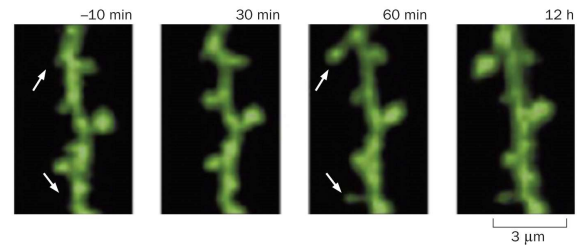
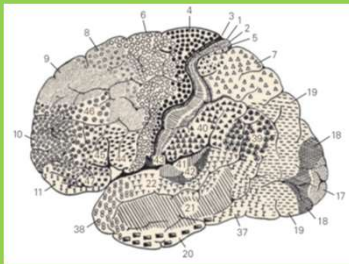


Figure 10-18 Principles of Neurobiology (© Garland Science 2016)

Language



Paul Broca (1824-1880)



Leborgne's aphasia: A defect in language production.

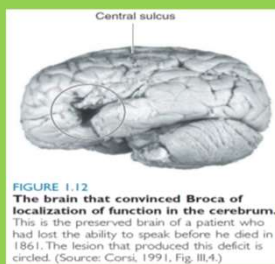


FIGURE 1.12
The brain that convinced Broca of localization of function in the cerebrum. This is the preserved brain of a patient who had lost the ability to speak before he died in 1861. The lesion that produced this deficit is circled. (Source: Corsi, 1991, Fig. III.4.)

Broca's area is in the left brain



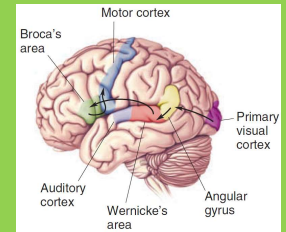
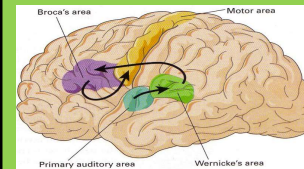
We speak with the left hemisphere!!!

Carl Wernicke, (1848-1905)
German neurologist/psychiatrist

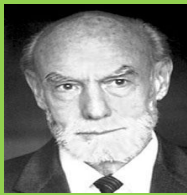


Wernicke's aphasia:
(1874)

Speaks fluently, but not
understand its meaning.



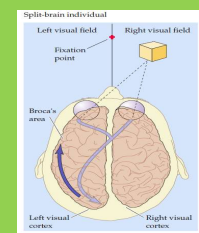
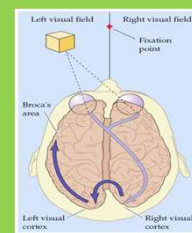
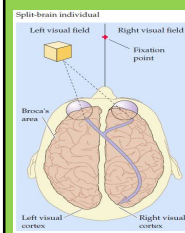
Roger Sperry (1913-1994)



1981 Nobel Prize (Split-Brain)



Split-Brain



Lateralization of the Brain



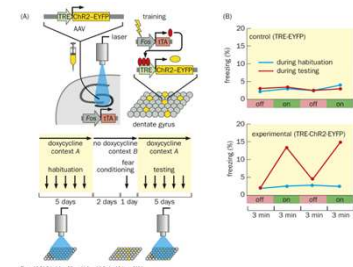
Left hemisphere functions	Right hemisphere functions
Analysis of right visual field	Analysis of left visual field
Stereognosis (right hand)	Stereognosis (left hand)
Lexical and syntactic language	Emotional coloring of language
Writing	Spatial abilities
Speech	Rudimentary speech

Cells Activates Fear Memory



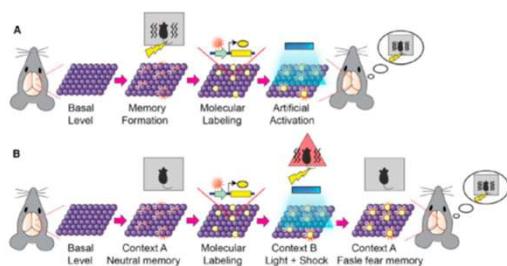
Susumu Tonegawa, MIT

1987 Nobel Prize for Physiology or Medicine
Genetic mechanism for antibody diversity



Liu X. et al., 2012 *Nature*

Creating False Memory



Ramirez et al., 2013 *Science*