A few questions on the content of the previous lecture

slido

Peripheral psychophysiological measures enable researchers to record physiological processes which are under the control of the...

ⓘ Start presenting to display the poll results on this slide.

slido

Skin conductance response record changes in the skin's...

ⓘ Start presenting to display the poll results on this slide.

slido

Cardiac activity centers around the systole, which reflects..., and the diastole, which refers to...

ⓘ Start presenting to display the poll results on this slide.

Memory

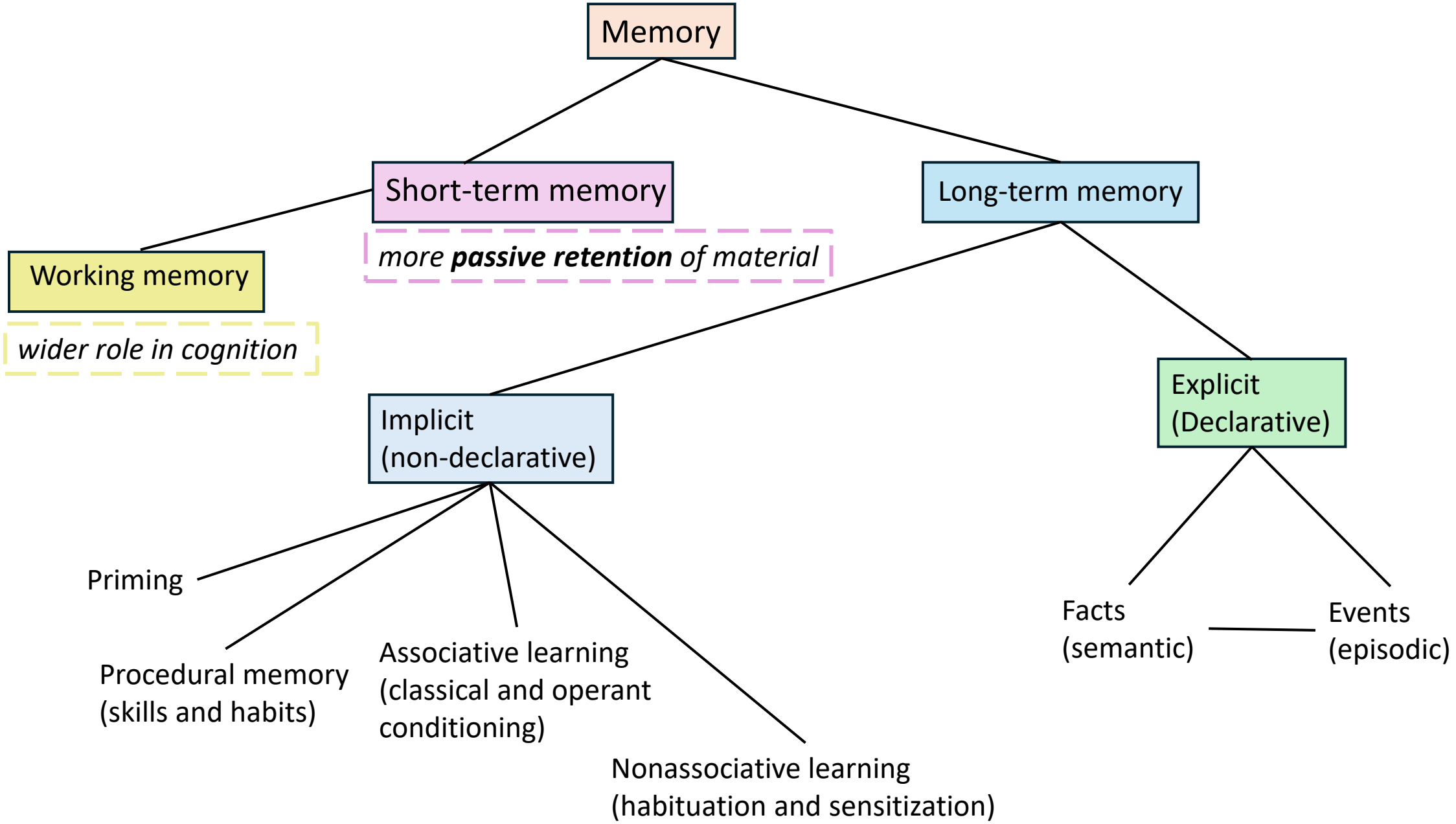
Dr. Lavinia Carmen Uscătescu

April 1st , 2024

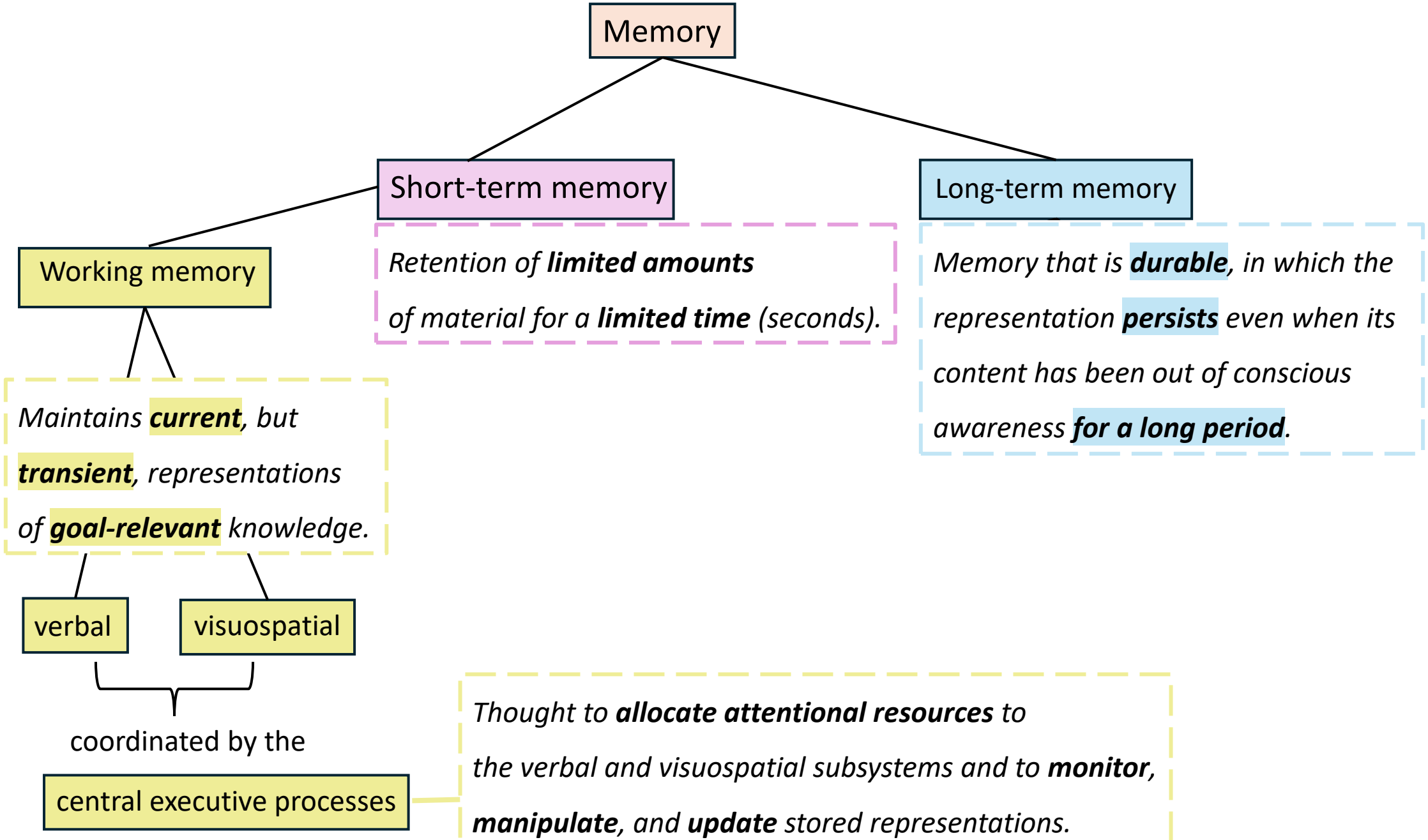
Outline

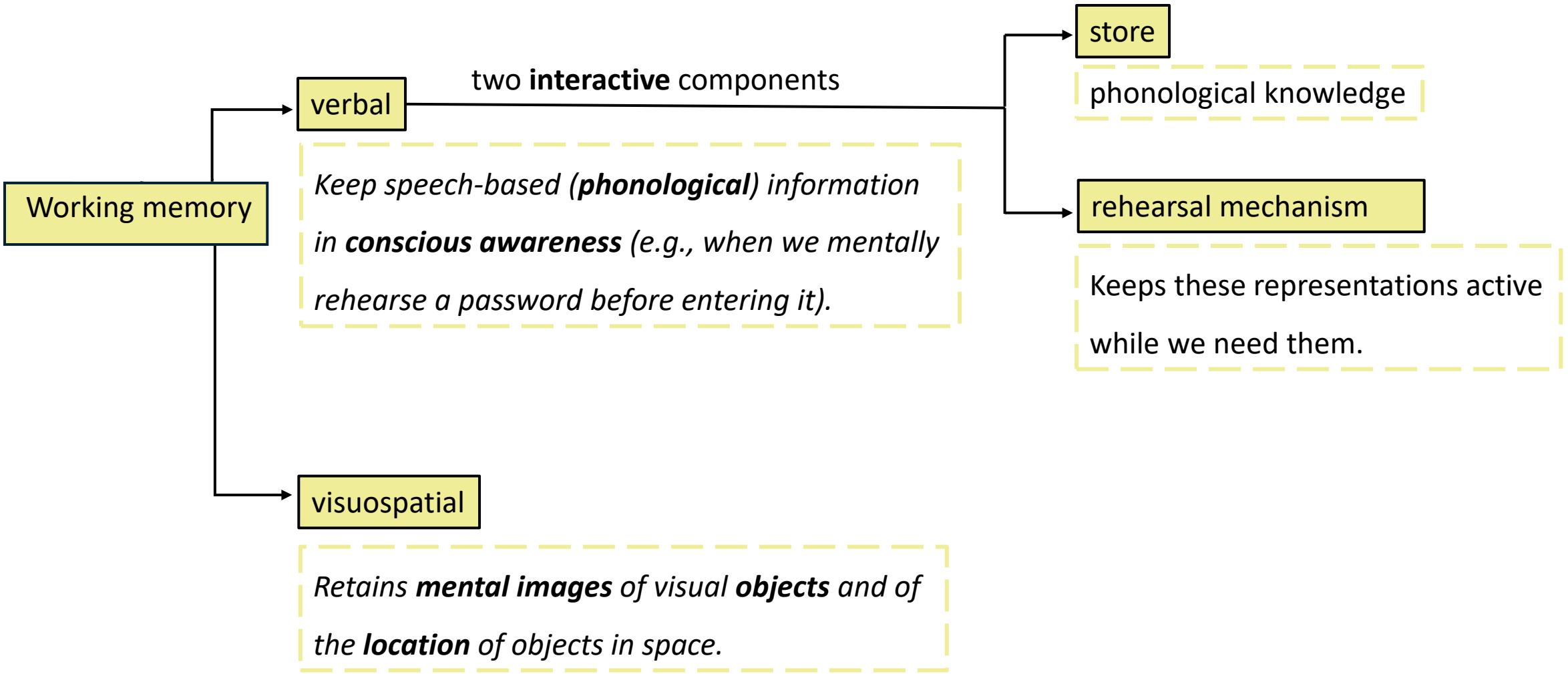
1. Short-term and working memory
2. Long-term memory
3. Neural mechanisms of learning and memory

Short-term and working memory

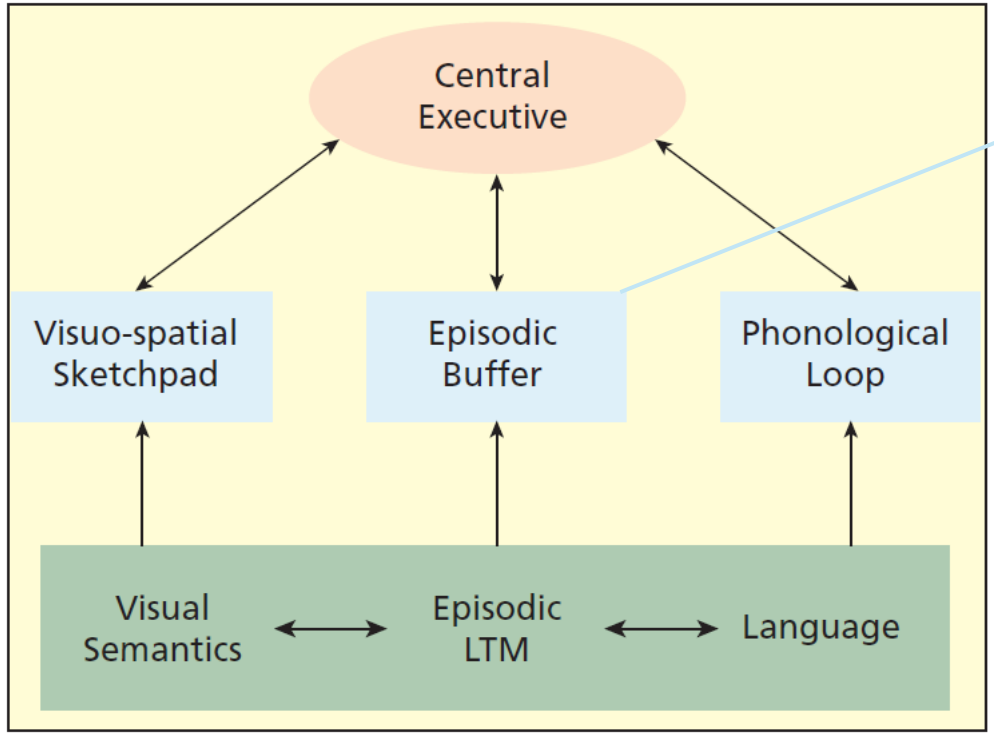


Adapted from Kandel et al., (2020), p. 1297


Memory
Short-term memory
Long-term memory
Working memory
Retention of limited amounts of material for a limited time (seconds).
Memory that is durable, in which the representation persists even when its content has been out of conscious awareness for a long period.
Maintains current, but transient, representations of goal-relevant knowledge.
verbal
visuospatial
coordinated by the
central executive processes
Thought to allocate attentional resources to the verbal and visuospatial subsystems and to monitor, manipulate, and update stored representations.

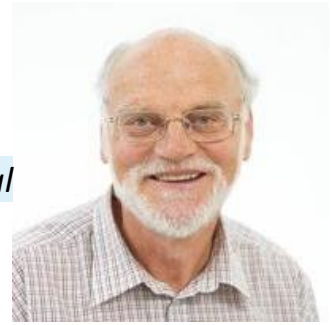

Working memory
verbal
two **interactive** components
store
phonological knowledge
*Keep speech-based (**phonological**) information in **conscious awareness** (e.g., when we mentally rehearse a password before entering it).*
rehearsal mechanism
Keeps these representations active while we need them.
visuospatial
*Retains **mental images** of visual **objects** and of the **location** of objects in space.*

Baddeley's model of working memory (extension of Baddeley and Hitch (1974))



maintaining *and* ***manipulating*** *information from* ***episodic long-term memory***

Alan Baddeley



Graham Hitch

"The ***episodic buffer*** *is assumed to be capable of* ***storing information*** *in a* ***multi-dimensional*** *code. It thus provides a* ***temporary interface*** *between the* ***slave systems*** *(the phonological loop and the visuospatial sketchpad) and* ***LTM****. It is assumed to be* ***controlled by the central executive****, which is responsible for* ***binding information from a number of sources into coherent episodes****. Such episodes are assumed to be* ***retrievable consciously****. The buffer serves as a modelling space that* ***is separate from LTM****, but which forms an* ***important stage in long term episodic learning****."*

FIGURE 11.1*:* ***Baddeley****'s (2000) model of* ***working memory*** *was revised to incorporate three kinds of* ***short-term systems*** *(blue) that interface with* ***long-term memory*** *(green).*

Ward, (2020), p. 267

Baddeley, A. D., & Hitch, G. (1974). Working Memory. Psychology of Learning and Motivation, 47–89. https://doi.org/10.1016/s0079-7421(08)60452-1

Baddeley, A. (2000). The episodic buffer: a new component of working memory? Trends in Cognitive Sciences, 4(11), 417–423. https://doi.org/10.1016/s1364-6613(00)01538-2

Long-term memory

Endel Tulving
(1927–2023)

- Memory
  - Long-term memory
    - Implicit (non-declarative)
      - Priming
      - Procedural memory (skills and habits)
      - Associative learning (classical and operant conditioning)
      - Nonassociative learning (habituation and sensitization)
    - Explicit (Declarative)
      - Facts (semantic)
      - Events (episodic)

Distinction proposed by Endel Tulving in 1972.

(https://psycnet.apa.org/record/1973-08477-007)

episodic memory

memory of specific **events** in one's **own life**

semantic memory

knowledge about the **world** (i.e., **people**, **places**, the meaning of **objects** and **words**)

The **episodic storage** of any item of knowledge is **widely distributed** among **many brain regions** that process different aspects of the content of the memory and can be accessed **independently** (by visual, verbal, or other sensory clues).

Episodic memory is mediated by at least **four related** but **distinct** types of processing:

encoding

*New information is **acquired** and processed to form a new memory. **Attention**, **motivation** and **relevance** influence how well information is encoded.*

storage

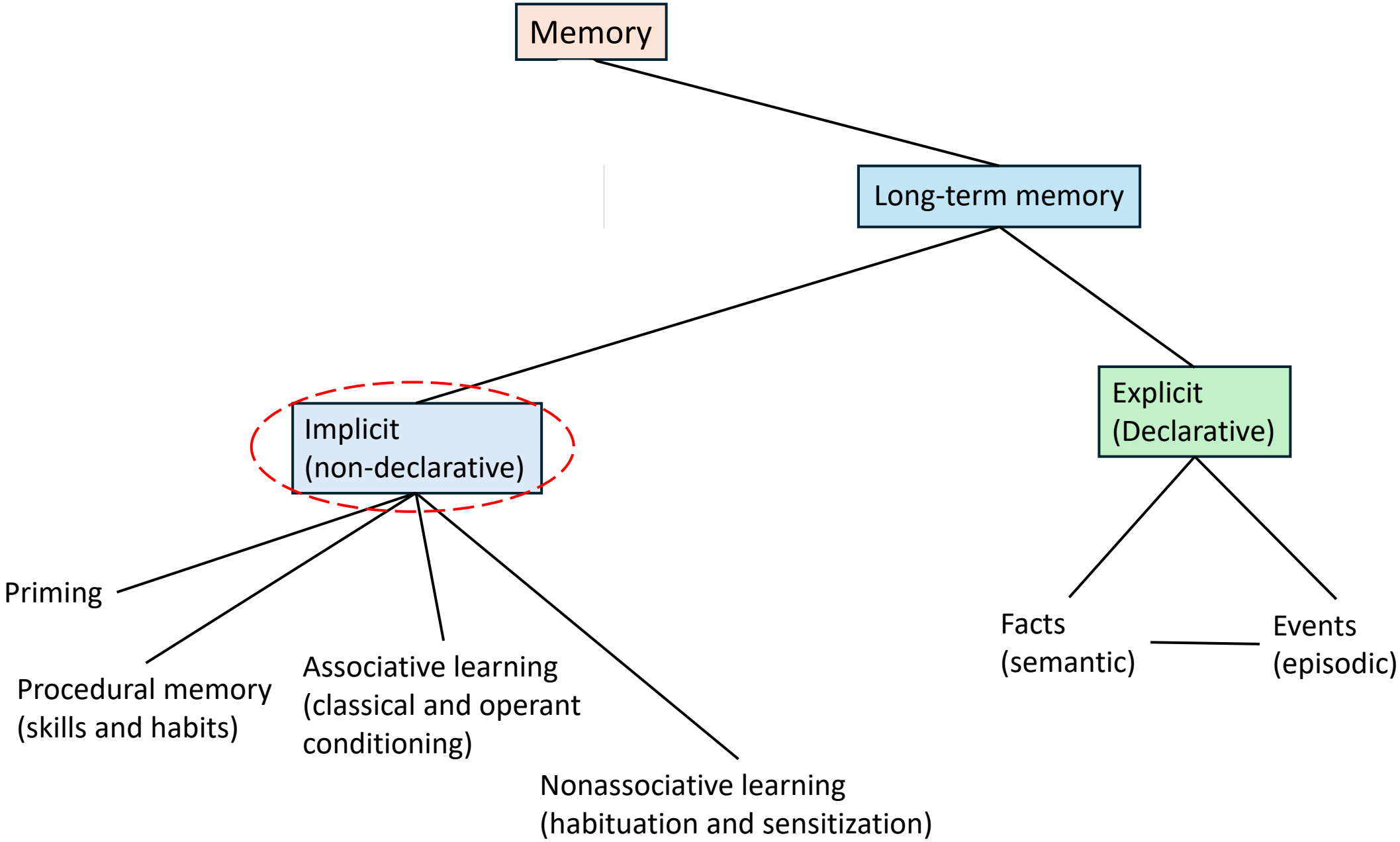
***Neural mechanisms** and **sites** by which the newly acquired information is **retained** as a lasting memory over time.*

consolidation

***Transforming** temporarily stored and still labile information into a more **stable** form.*

retrieval

*The **reconstructive** process by which stored information is recalled.*


Memory
Long-term memory
Implicit
(non-declarative)
Explicit
(Declarative)
Priming
Procedural memory
(skills and habits)
Associative learning
(classical and operant
conditioning)
Nonassociative learning
(habituation and sensitization)
Facts
(semantic)
Events
(episodic)

priming

the **automatic influence** of **exposure** to one cue on **processing** of a later cue

conceptual priming

enhanced access to **task-relevant semantic knowledge** because that knowledge has been used before

perceptual priming

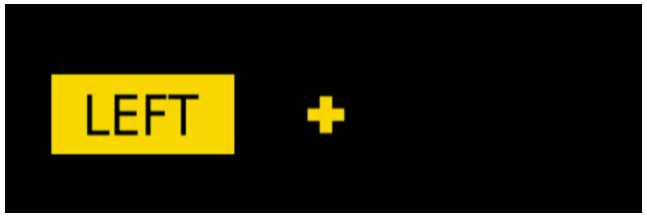
occurs within a **specific sensory** modality (e.g., when stimuli have similar physical properties)

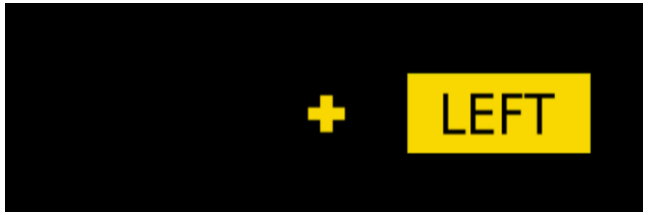
"The Simon Effect"

*participants respond **fastest** when the stimulus is in the **same spatial location** as the **required response***

Richard Simon
(1929 – 2017)

In this example, you need to respond to the words left and right with the "a" key (which is on the left side of the keyboard) and with the "l" key (which is on the right side of the keyboard).
*The Simon effect here simply means that you will respond more slowly to the word **LEFT** when it appears on the right side of the screen (i.e., **incompatible** condition) than when it appears on the left side (**compatible** condition) of the screen.*





https://www.psytoolkit.org/experiment-library/simon.html

not to be confused with *social priming*

nature

Explore content ▾ About the journal ▾ Publish with us ▾ Subscribe

nature › news feature › article

NEWS FEATURE | 11 December 2019

What's next for psychology's embattled field of social priming

A promising field of research on social behaviour struggled after investigators couldn't repeat key findings. Now researchers are trying to establish what's worth saving.

By Tom Chivers

https://www.nature.com/articles/d41586-019-03755-2

Three years ago, a team of psychologists challenged 180 students with a spatial puzzle. The students could ask for a hint if they got stuck. But before the test, the researchers introduced some subtle interventions to see whether these would have any effect.

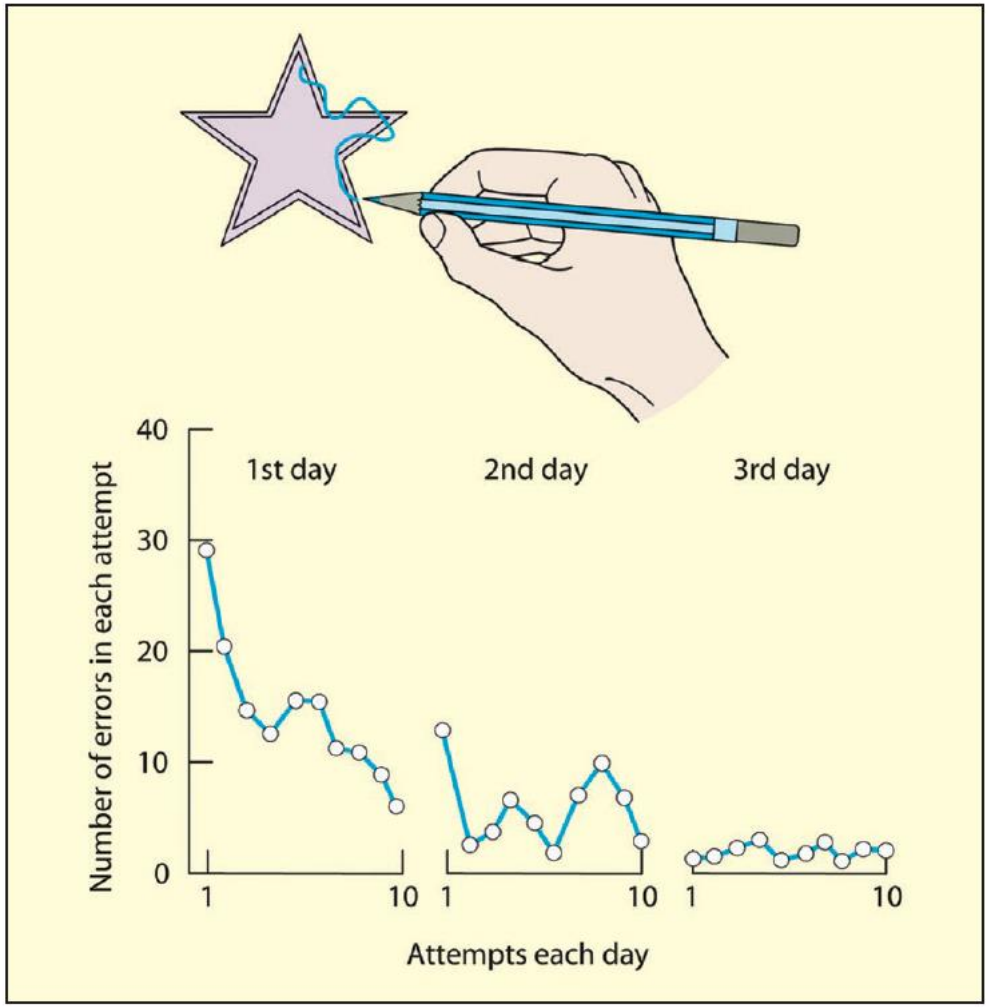
The psychologists split the volunteers into three groups, each of which had to unscramble some words before doing the puzzle. One group was the control, another sat next to a pile of play money and the third was shown scrambled sentences that contained words relating to money.

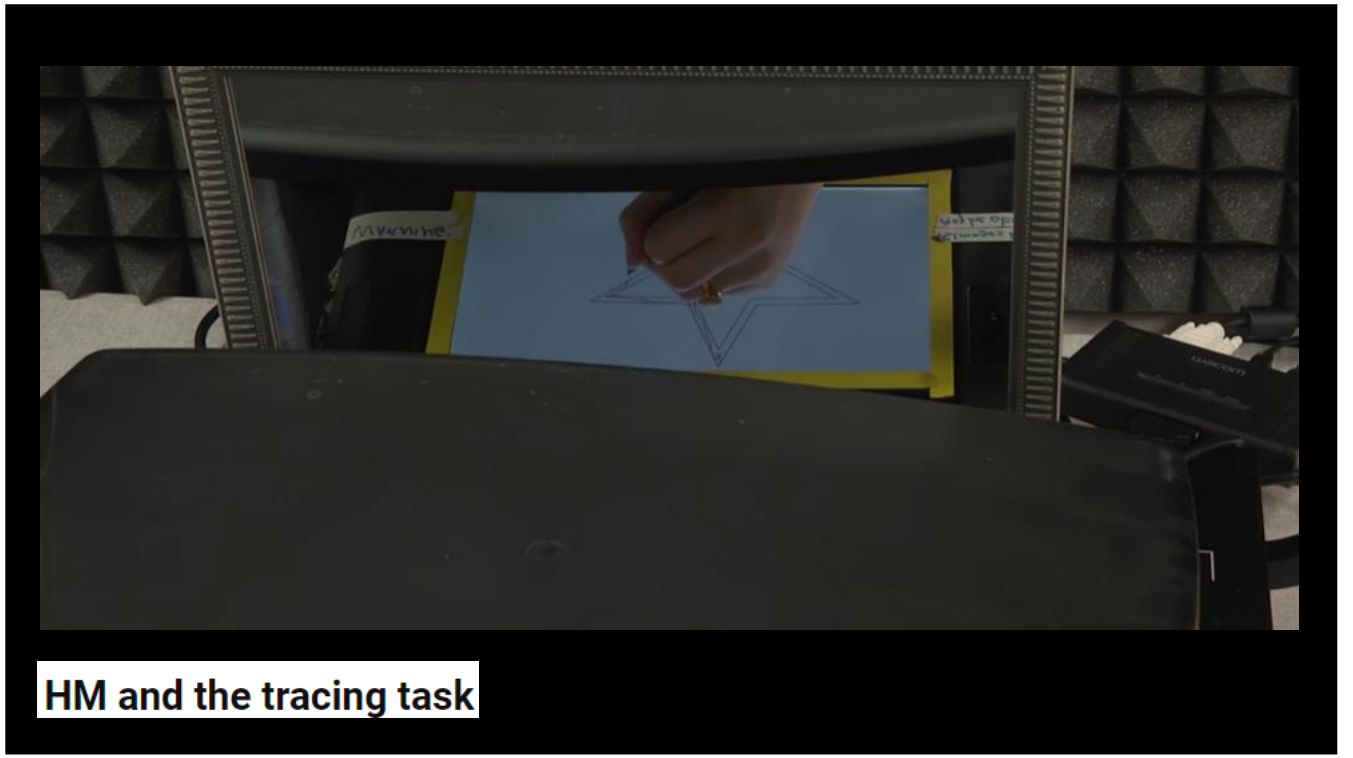
The study, published this June[1], was a careful repeat of a widely cited 2006 experiment[2]. The original had found that merely giving students subtle reminders of money made them work harder: in this case, they spent longer on the puzzle before asking for help. That work was one among scores of laboratory studies which argued that tiny subconscious cues can have drastic effects on our behaviour.

Known by the loosely defined terms 'social priming' or 'behavioural priming', these studies include reports that people primed with 'money' are more selfish[2]; that those primed with words related to professors do better on quizzes[3]; and even that people exposed to something that literally smells fishy are more likely to be suspicious of others[4].

The most recent replication effort[1], however, led by psychologist Doug Rohrer at the University of South Florida in Tampa, found that students primed with 'money' behave no differently on the puzzle task from the controls. It is one of dozens of failures to verify earlier social-priming findings. Many researchers say they now see social priming not so much as a way to sway people's unconscious behaviour, but as an object lesson in how shaky statistical methods fooled scientists into publishing irreproducible results.

Procedural memory: skills and habits



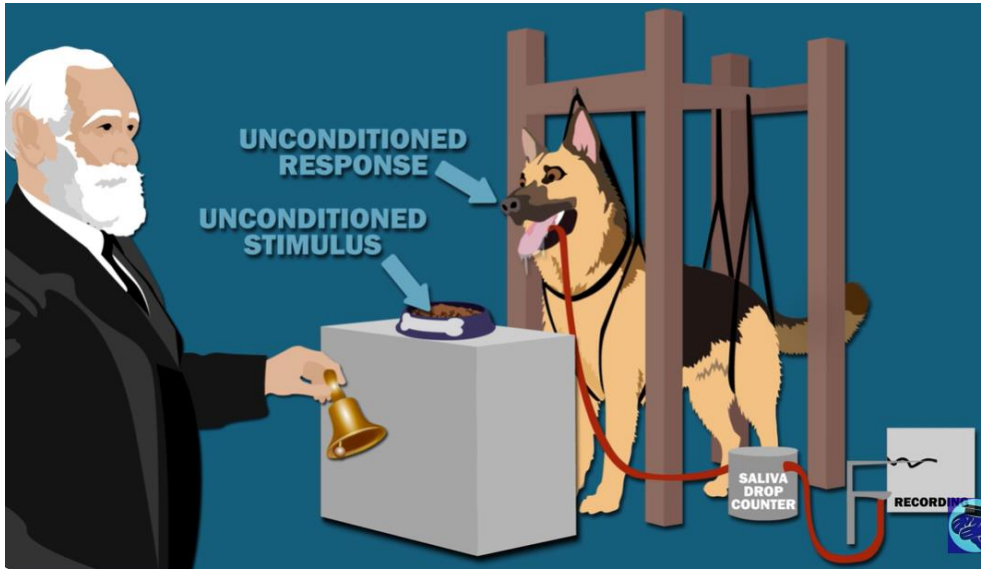


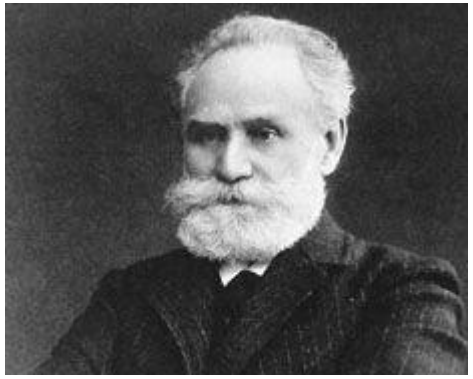
https://www.youtube.com/watch?v=wFoIvB-04YY

FIGURE 11.10: *Patient **HM** was able to **learn mirror drawing** over a 3-day period, despite no apparent memory for having performed the task before.*

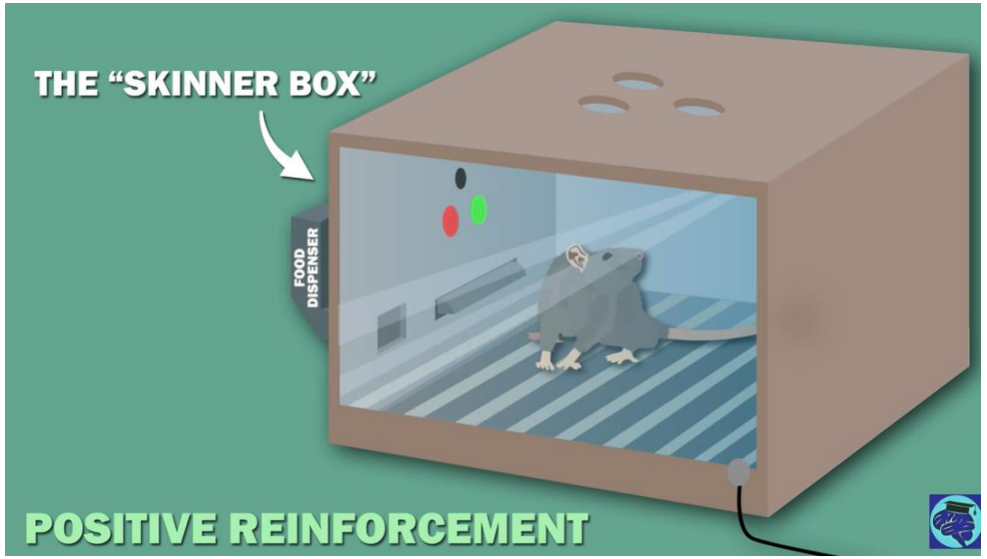
Ward, (2020), p. 276

Associative learning: classical and operant conditioning





Ivan Pavlov
(1849 – 1936)



Burrhus Skinner
(1904 – 1990)

https://www.youtube.com/watch?v=PRdCowYEtAg

Nonassociative learning: habituation and sensitization

habituation

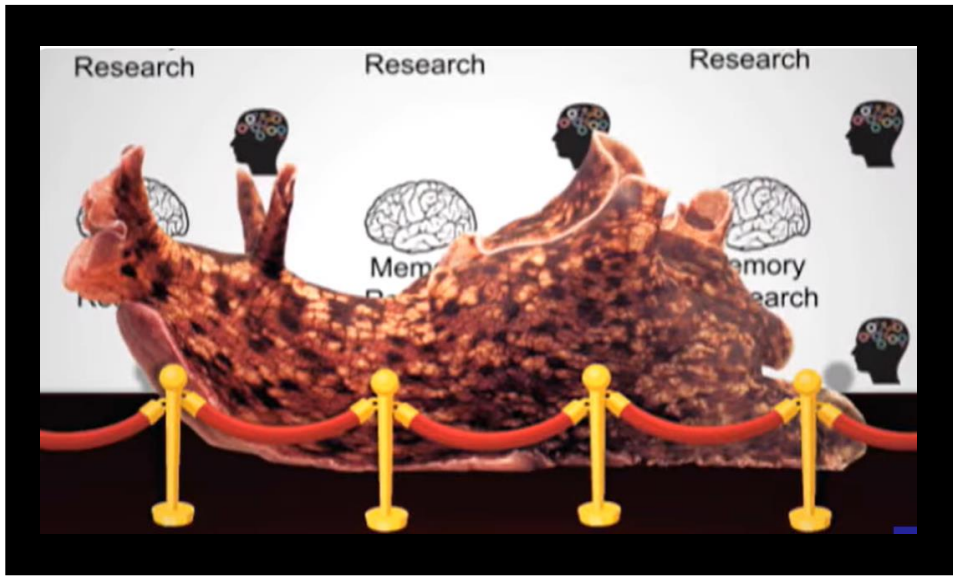
decrease in response to a stimulus after **repeated** presentations

sensitization

the progressive **amplification of a response** following repeated administration of a stimulus

Eric Kandel, with colleague James Schwartz, observing trays containing Aplysia sea slugs

https://tinyurl.com/4tc2hj4n



https://www.youtube.com/watch?v=cvCXFp-jCDs

The Nobel Prize in Physiology or Medicine 2000

Photo from the Nobel Foundation archive.
Arvid Carlsson
Prize share: 1/3

Photo from the Nobel Foundation archive.
Paul Greengard
Prize share: 1/3

Photo from the Nobel Foundation archive.
Eric R. Kandel
Prize share: 1/3

https://www.nobelprize.org/prizes/medicine/2000/summary/

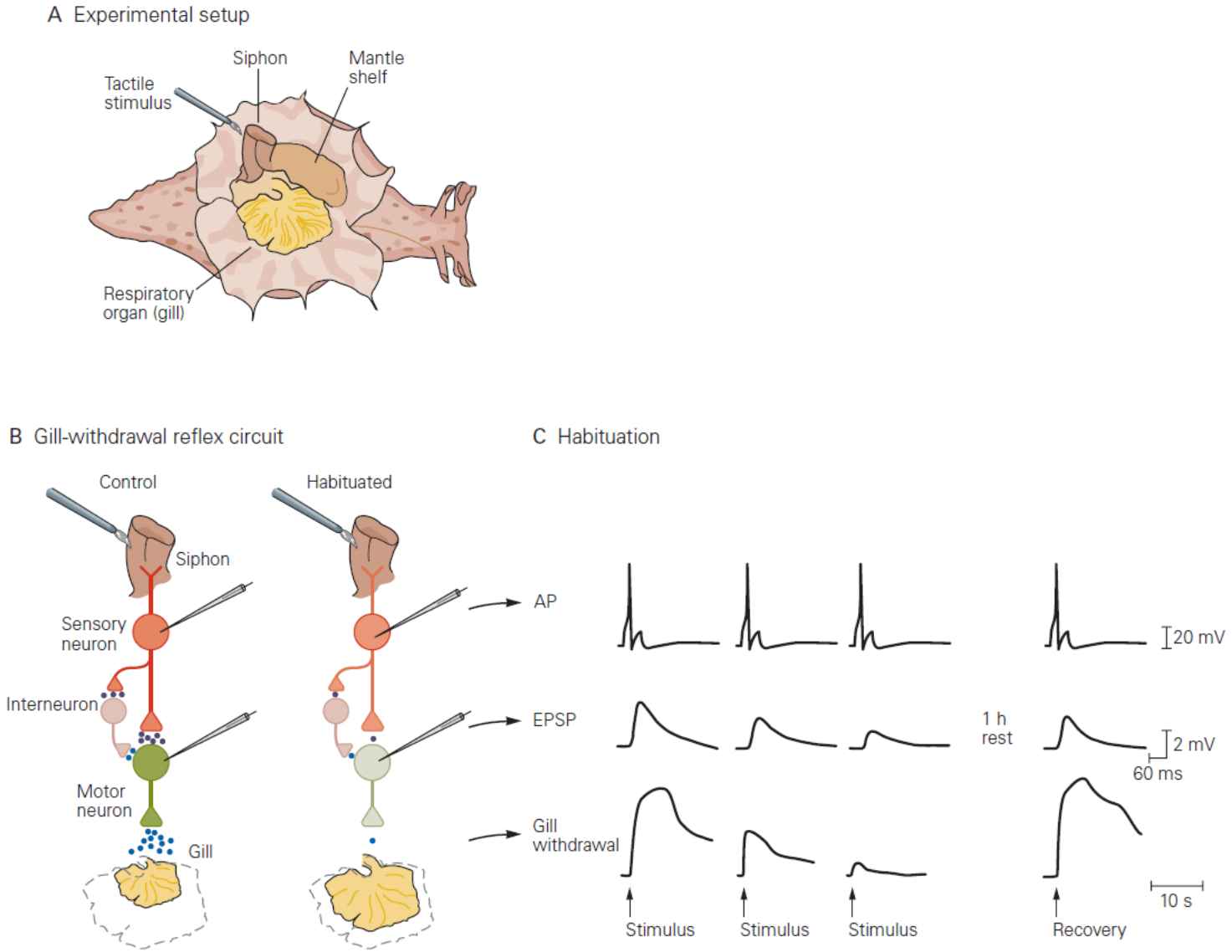


Figure 53–2 Short-term habituation of the gill-withdrawal reflex of the marine snail *Aplysia*.

A. A dorsal view of *Aplysia* illustrates the respiratory organ (gill) and the mantle shelf, which ends in the siphon, a fleshy spout used to expel seawater and waste. Touching the siphon elicits the gill-withdrawal reflex. Repeated stimulation leads to habituation.

B. Simplified diagrams of the gill-withdrawal reflex circuit and sites involved in habituation. Approximately 24 mechanoreceptor neurons in the abdominal ganglion innervate the siphon skin. These sensory cells make excitatory synapses onto a cluster of six motor neurons that innervate the gill, as well as on interneurons that modulate the firing of the motor neurons. (For simplicity, only one of each type of neuron is illustrated here.) Touching the siphon leads to withdrawal of the gill (**dashed outline** shows original gill size; **solid outline** shows maximal withdrawal).

C. Repeated stimulation of the siphon sensory neuron (**top traces**) leads to a progressive depression of synaptic transmission between the sensory and motor neurons. The size of the motor neuron excitatory postsynaptic potential (**EPSP**) gradually decreases despite no change in the presynaptic action potential (**AP**). In a separate experiment, repeated stimulation of the siphon results in a decrease in gill withdrawal (habituation). One hour after repetitive stimulation, both the EPSP and gill withdrawal have recovered. Habituation involves a decrease in transmitter release at many synaptic sites throughout the reflex circuit. (Adapted, with permission, from Pinsker et al. 1970; Castellucci and Kandel 1974.)

Kandel, (2021), p. 1315

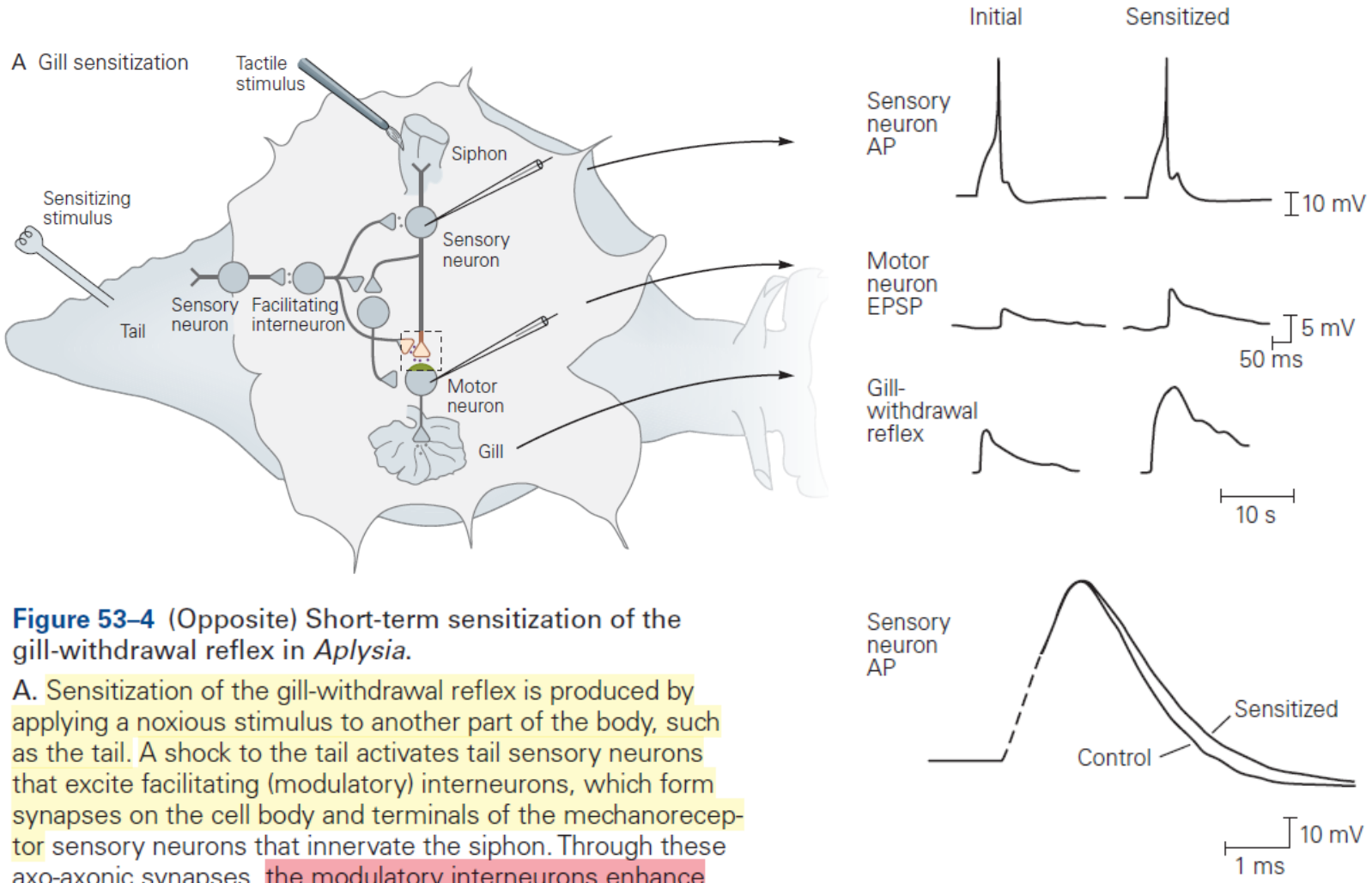
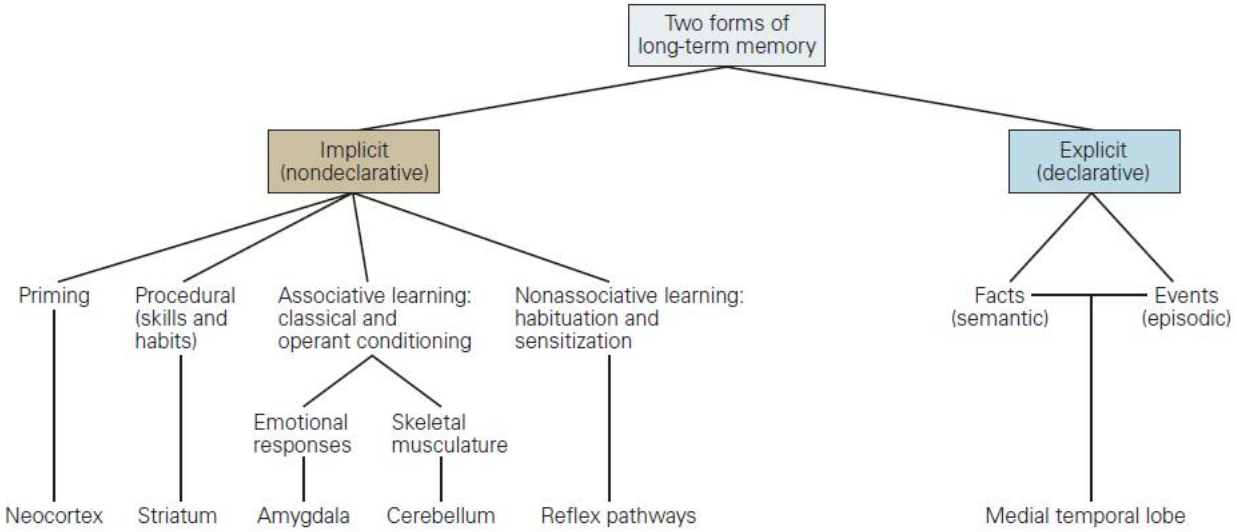


Figure 53–4 (Opposite) Short-term sensitization of the gill-withdrawal reflex in *Aplysia*.

A. Sensitization of the gill-withdrawal reflex is produced by applying a noxious stimulus to another part of the body, such as the tail. A shock to the tail activates tail sensory neurons that excite facilitating (modulatory) interneurons, which form synapses on the cell body and terminals of the mechanoreceptor sensory neurons that innervate the siphon. Through these axo-axonic synapses, the modulatory interneurons enhance transmitter release from the siphon sensory neurons onto their postsynaptic gill motor neurons (presynaptic facilitation), thus enhancing gill withdrawal. Presynaptic facilitation results, in part, from a prolongation of the sensory neuron action potential (AP; bottom traces). (Abbreviation: EPSP, excitatory postsynaptic potential.) (Adapted, with permission, from Pinsker et al. 1970; Klein and Kandel 1980.)

Kandel, (2021), p. 1318

Neural mechanisms of learning and memory



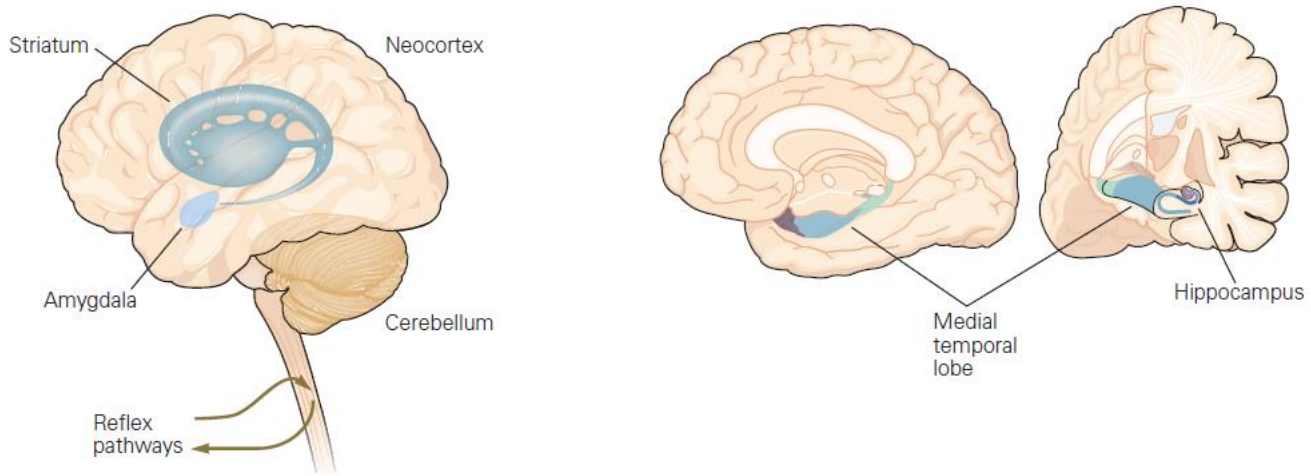
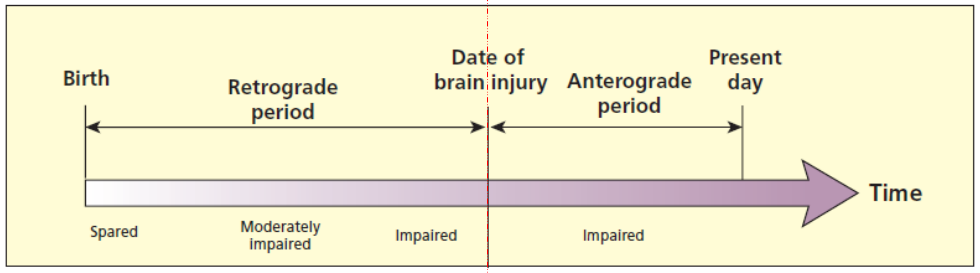


Figure 53–1 Two forms of long-term memory involve different brain systems. Implicit memory involves the neocortex, striatum, amygdala, cerebellum, and, in the simplest cases, the reflex pathways themselves. Explicit memory requires the medial temporal lobe and the hippocampus, as well as certain areas of neocortex (not shown).

Kandel, (2021), p. 1313

retrograde amnesia | anterograde amnesia



Ward, (2020), p. 276

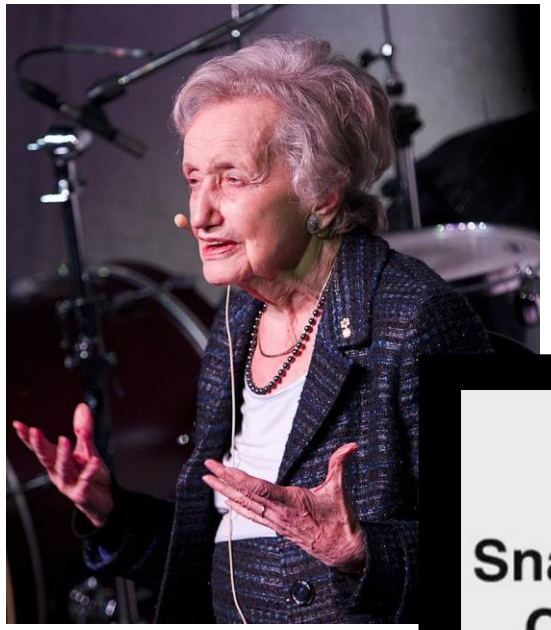
*Amnesic patients have **impaired episodic memory**, typically in both retrograde and anterograde periods. In contrast they have **generally spared short-term memory, procedural memory and perceptual priming**.*

Ribot's law

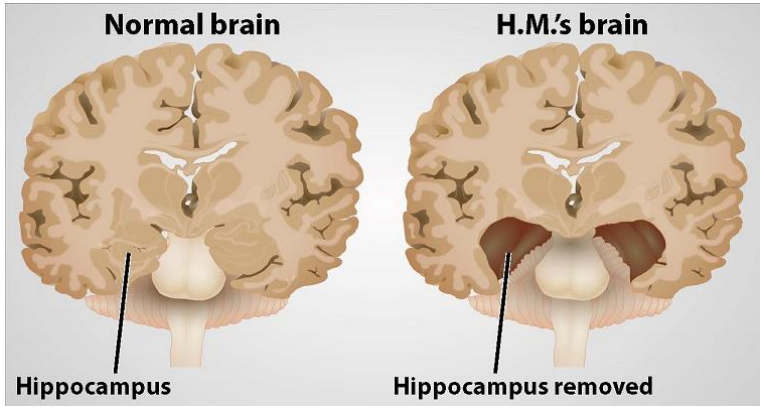
the observation that **memories** from **early in life** tend to be **preserved in amnesia**

Patient H.M (Henry Molaison)

(anterograde amnesia)



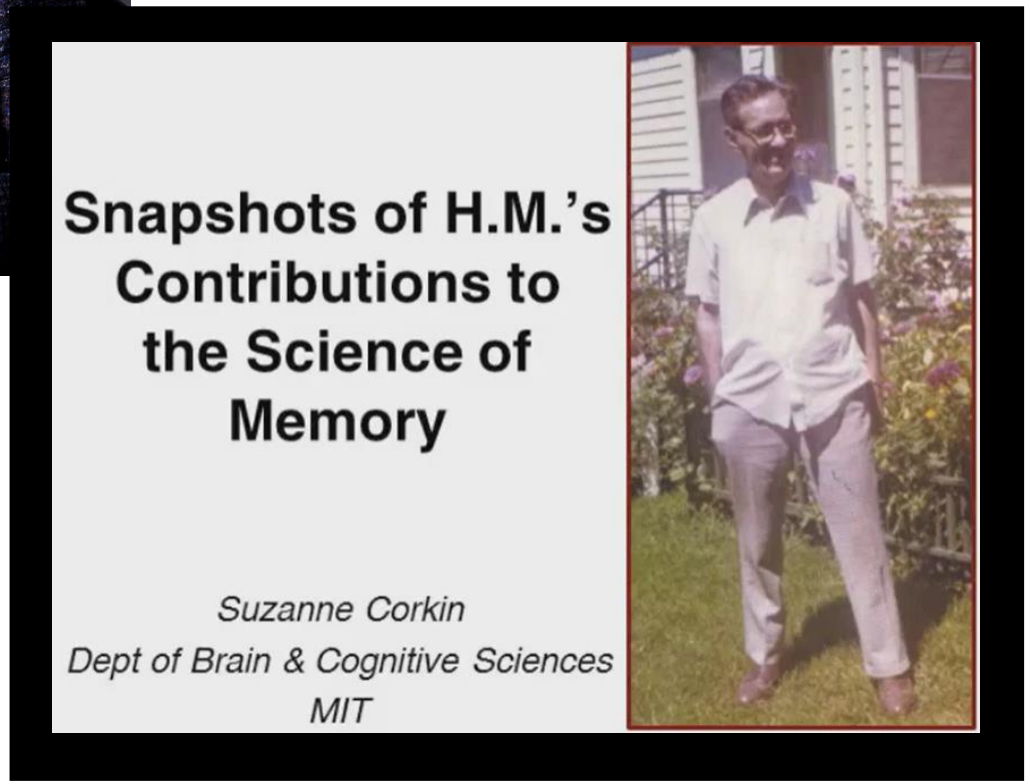
Brenda Milner



"When Milner first visited H.M., she saw that the epilepsy was now controlled but that his ***memory impairment*** *was […]* ***severe*** *[…]. What she observed was someone who* ***forgot daily events*** *nearly as fast as they occurred, apparently* ***in the absence of any general intellectual loss or perceptual disorder****.*

He ***underestimated his own age****, apologized for forgetting the names of persons to whom he had just been introduced, and described his state as* ***"like waking from a dream ... every day is alone in itself..."""***

(Milner et al., 1968, p. 217).



https://www.youtube.com/watch?v=s4tF4K78BD8

Long-term potentiation (LTP)

a form of **activity-dependent plasticity**

which results in a **persistent enhancement**

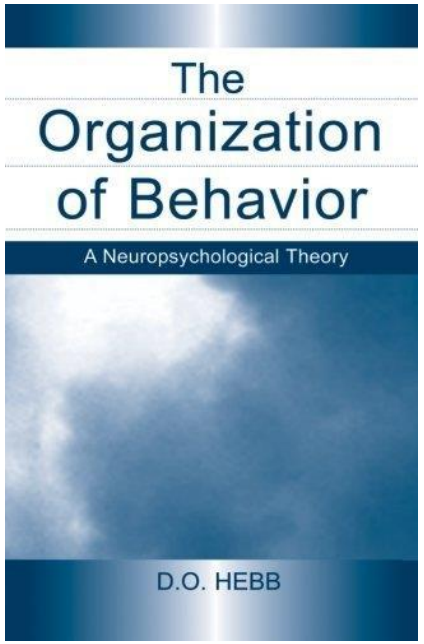
of **synaptic transmission**

Long-term depression (LTD)

the opposite of LTP, and is characterized

by a **decrease** in **postsynaptic strength**

Donald Hebb
(194 – 1985)



Philos Trans R Soc Lond B Biol Sci. 2003 Apr 29; 358(1432): 617–620.
doi: 10.1098/rstb.2002.1226

The discovery of long-term potentiation.

Terje Lømo

Terje Lømo

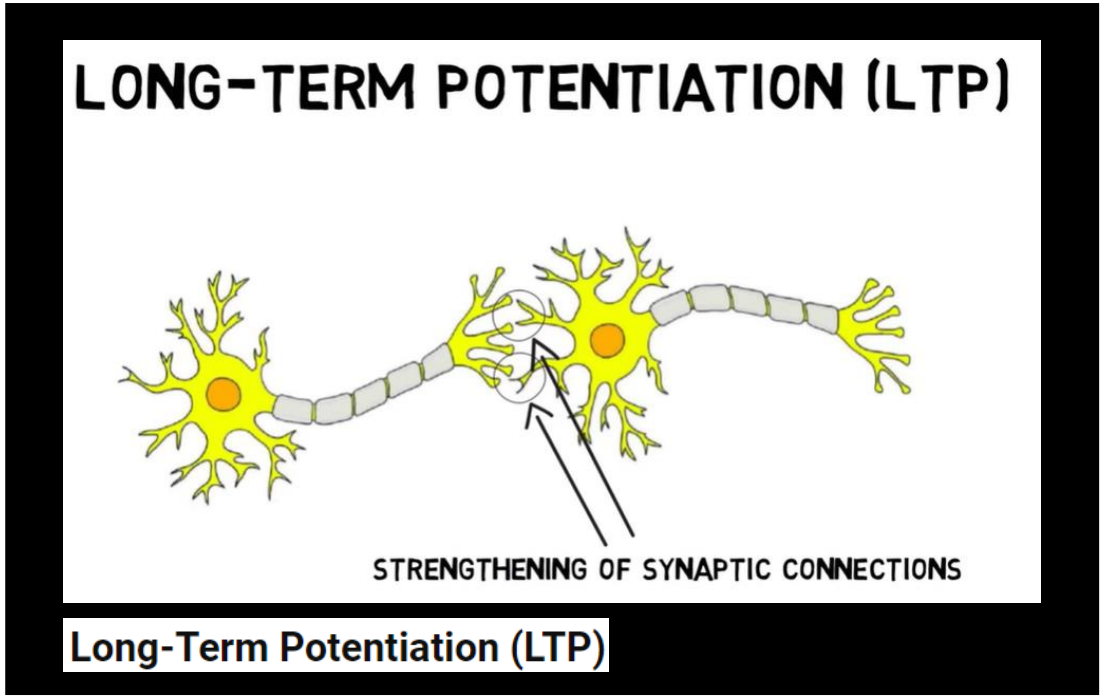
ABSTRACT

This paper describes circumstances around the discovery of long-term potentiation (LTP). In 1966, I had just begun independent work for the degree of Dr medicinae (PhD) in Per Andersen's laboratory in Oslo after an eighteen-month apprenticeship with him. Studying the effects of activating the perforant path to dentate granule cells in the hippocampus of anaesthetized rabbits, I observed that brief trains of stimuli resulted in increased efficiency of transmission at the perforant path-granule cell synapses that could last for hours. In 1968, Tim Bliss came to Per Andersen's laboratory to learn about the hippocampus and field potential recording for studies of possible memory mechanisms. The two of us then followed up my preliminary results from 1966 and did the experiments that resulted in a paper that is now properly considered to be the basic reference for the discovery of LTP.

"Cells that fire together, wire together" and, more formally,

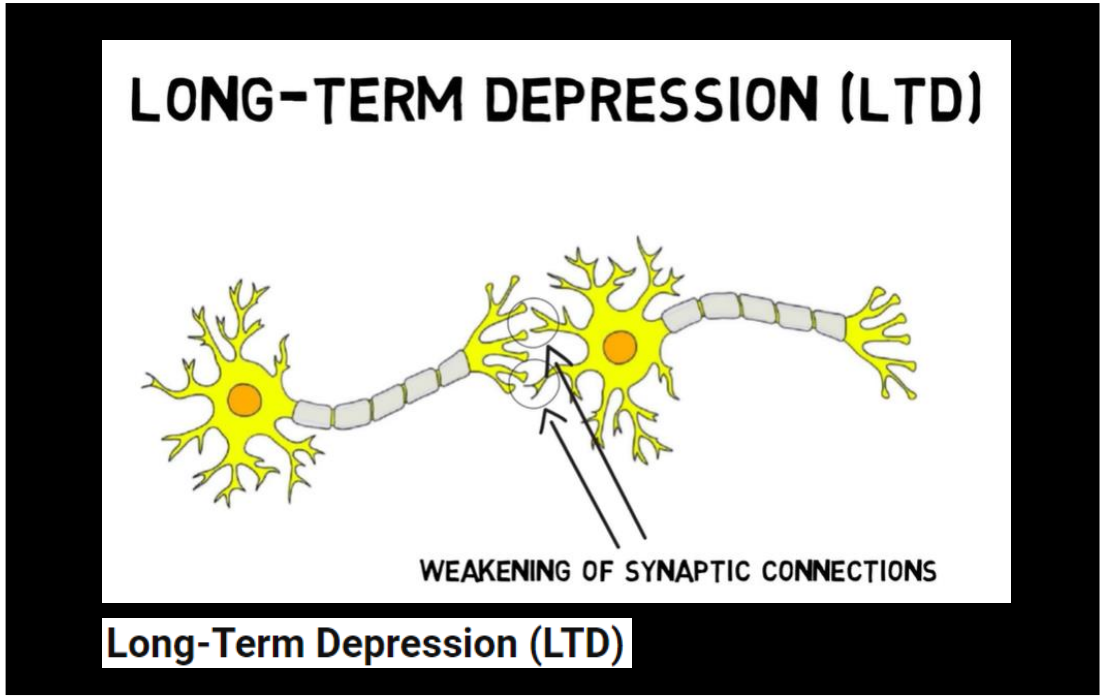
"any two cells or systems of cells that are repeatedly active at the same time will tend to become 'associated,' so that activity in one facilitates activity in the other".

Molecular mechanisms of LTP



https://www.youtube.com/watch?v=-mHqPfXHzJE

Molecular mechanisms of LTD

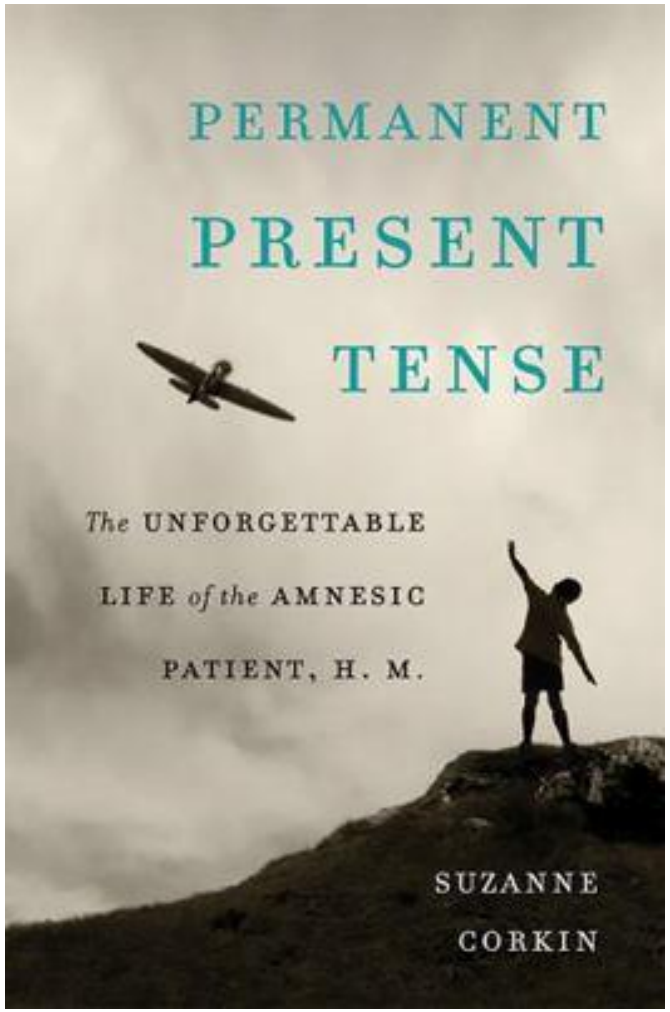


https://www.youtube.com/watch?v=B7ig6sIwIC8

Further resources

Inside the Psychologist's Studio with Brenda Milner

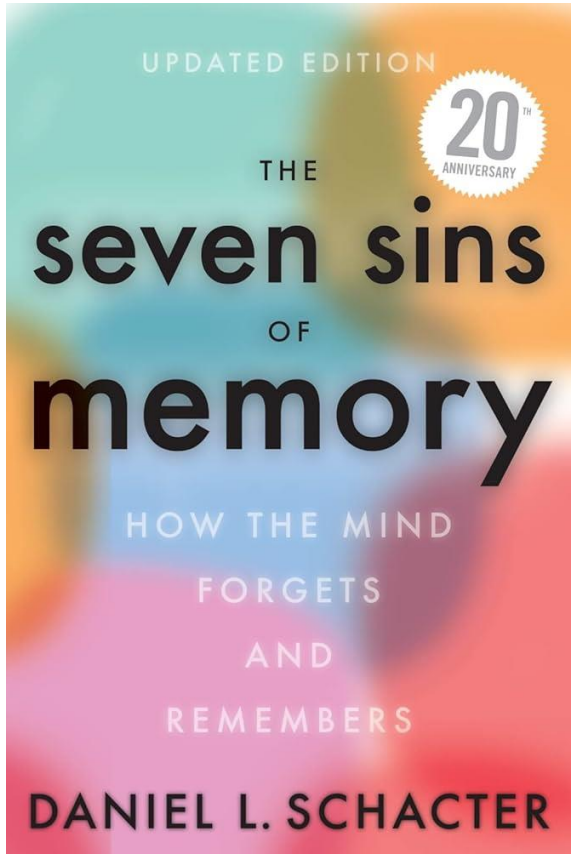
https://www.youtube.com/watch?v=fIR6JTt_Xsc

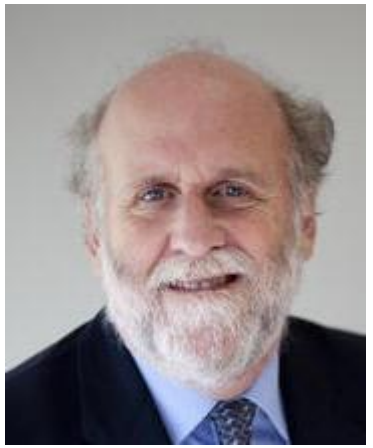


Memory. Author manuscript; available in PMC 2023 Jan 1.
Published in final edited form as:
Memory. 2022 Jan; 30(1): 37–42.
Published online 2021 Jan 17. doi: 10.1080/09658211.2021.1873391

The Seven Sins of Memory: An Update

Daniel L. Schacter[a]





Daniel Schacter

Abstract

Memory serves critical functions in everyday life, but it is also vulnerable to error and illusion. Two decades ago, I proposed that memory errors could be classified into seven basic categories or "sins": *transience, absent-mindedness, blocking, misattribution, suggestibility, bias*, and *persistence*. I argued that each of the seven sins provides important insights concerning the fundamentally constructive nature of human memory, while at the same time reflecting its adaptive features. In this article I briefly summarize some key developments during the past two decades that have increased our understanding of the nature, consequences, and adaptive functions of the memory sins.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8285452/