Memory I

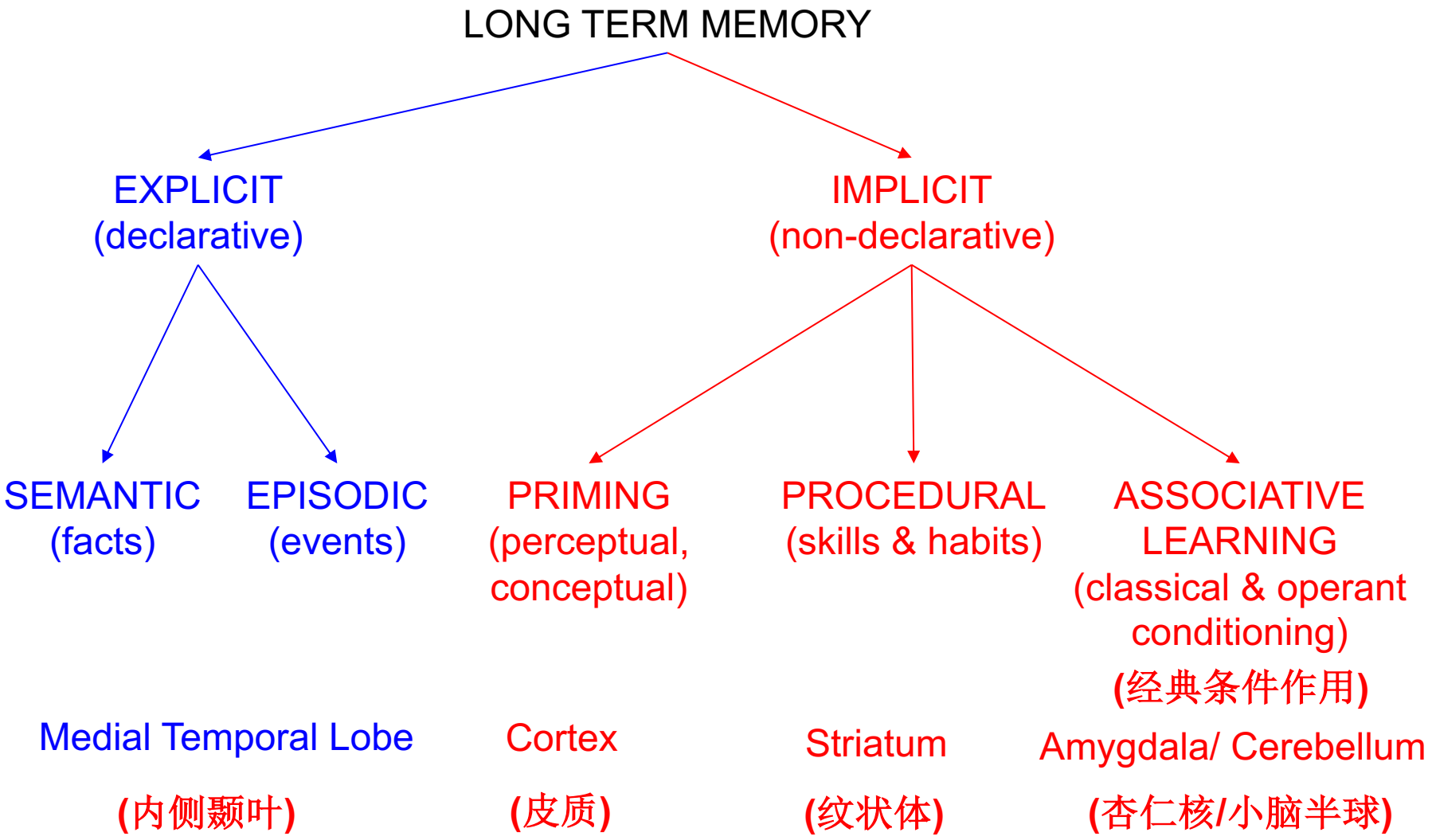
Long-term memory & Encoding

Are there multiple LTM memory systems?

- How do you learn a new skill?
- How do you learn a new fact?
- How about learning about an event?

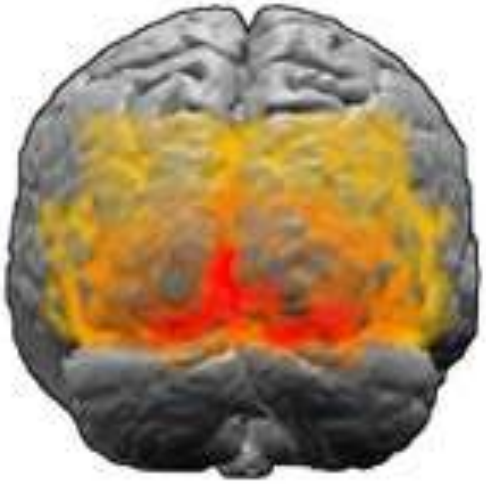
- Is there one long-term memory (LTM) system for these types of knowledge or are there multiple LTM systems?

A Taxonomy of Memory Systems



Priming Effect (启动效应)

启动效应 **(priming effect):** 是指前面接受的刺激（信息）影响到后续对某个刺激（信息）的加工。有研究者认为，这是内隐记忆的体现。 启动效应一般又可分为重复启动效应和间接启动效应二种。比如你先看到一张“医生”的图片，那么你对下一张是“护士”的图片会比“馒头”之类的其他图片反应更快。这就是启动效应。



The extrastriate cortex (shown in orange and red) is believed to be involved in perceptual priming

Procedural Memory (程序记忆)

Procedural memories are skill-based memories. They involve knowledge of “how to” do things. Procedural memories begin as explicit, but with practice and experience, become implicit. For instance, when you first learned to ride a bike, you had to watch the sidewalk, watch your hands, watch your feet. You had to balance your body and the bike, and think about which foot was cycling; left then right. You had to steer the handlebars. You had a lot on your mind and your body was involved in many simultaneous tasks. Each part of this task was explicit (you had to pay attention to and consciously monitor). Then, with practice, the task of riding your bike became easier. Over time, you no longer had to think about your feet, or focus on balancing. You didn’t have to think about it at all. The memory, with practice, became implicit. You don’t recollect the details, now, in how to ride a bike, you just “do it”.

Sidney Crosby

A reporter with TSN did an on-ice interview with Crosby: “ Sid, if you can, just take us through how that goal went in” Crosby replied: “I don’t really remember, I just shot it – I think from around here. That’s all I really remember. I think it went 5-hole, but, um, I didn’t really see it to be honest".

Classical Conditioning (经典条件作用)

Classical conditioning (also **Pavlovian conditioning** or **respondent conditioning**) is a form of learning in which one stimulus, the *conditioned stimulus* or CS, comes to signal the occurrence of a second stimulus, the *unconditioned stimulus* or US. The US is usually a biologically significant stimulus such as food or pain that elicits a response from the start; this is called the *unconditioned response* or UR. The CS usually produces no particular response at first, but after conditioning it elicits the *conditioned response* or CR.

Semantic & Episodic

- ***Semantic*** memories are memories for facts; meaning-based memory. They are explicit, and thus declarative. For instance, you may be able to state, “I know the first president of the United States was George Washington.”

- ***Episodic*** memories are memories for specific events of “episodes” in time. They, too, are explicit, and often involve personally-experienced events. For instance, you may remember the first roller coaster experience you had, or your first kiss. With episodic memories, you should be able to recollect the details revolving around that particular event.

Implicit and explicit memory

- **Implicit memory:** past experiences influence perceptions, thoughts & actions without awareness that any information from past is accessed

- **Explicit memory:** conscious access to info from the past

("I remember that..") ➔ involves **conscious recollection**

Explicit & Implicit Memory Tests

Look at the following words.

I will test your memory for these words in various ways.

SPONGE	**CANDY**	**DOLPHIN**
PACKAGE	**POSTER**	**LICORICE**
ZEBRA	**SECTION**	**CAMOFLAGE**
MISTAKE	**PORTAL**	**KNAPSACK**
COFFEE	**QUAIL**	**ALPINE**
HANDLE	**PANTRY**	**CARPET**
EAGER	**CELLO**	**PRESSURE**
LLAMA	**ORIOLE**	**ACRID**

Memory Test

- Explicit test of memory: recall
  - Write down the words you remember from the list in the earlier slide

- Implicit tests of memory
  - On the next slide, you will see some words missing letters, some "word fragments" and some anagrams. Guess what each word might be

EGNOPS	*AN*Y	*OL*H**
PACKAGE	P*S*E*	LICORICE
*E*RA	SE*T*O*	C**O*LA*E
*I*TA*E	PORTAL	KNAPSACK
COFFEE	*U*IL	AEILNP
*AN*LE	*A*T*Y	ACEPRT
*A*E*	C*L**	*RE*S**E
AALLM	EILOOR	*C*ID

Implicit Memory Tasks

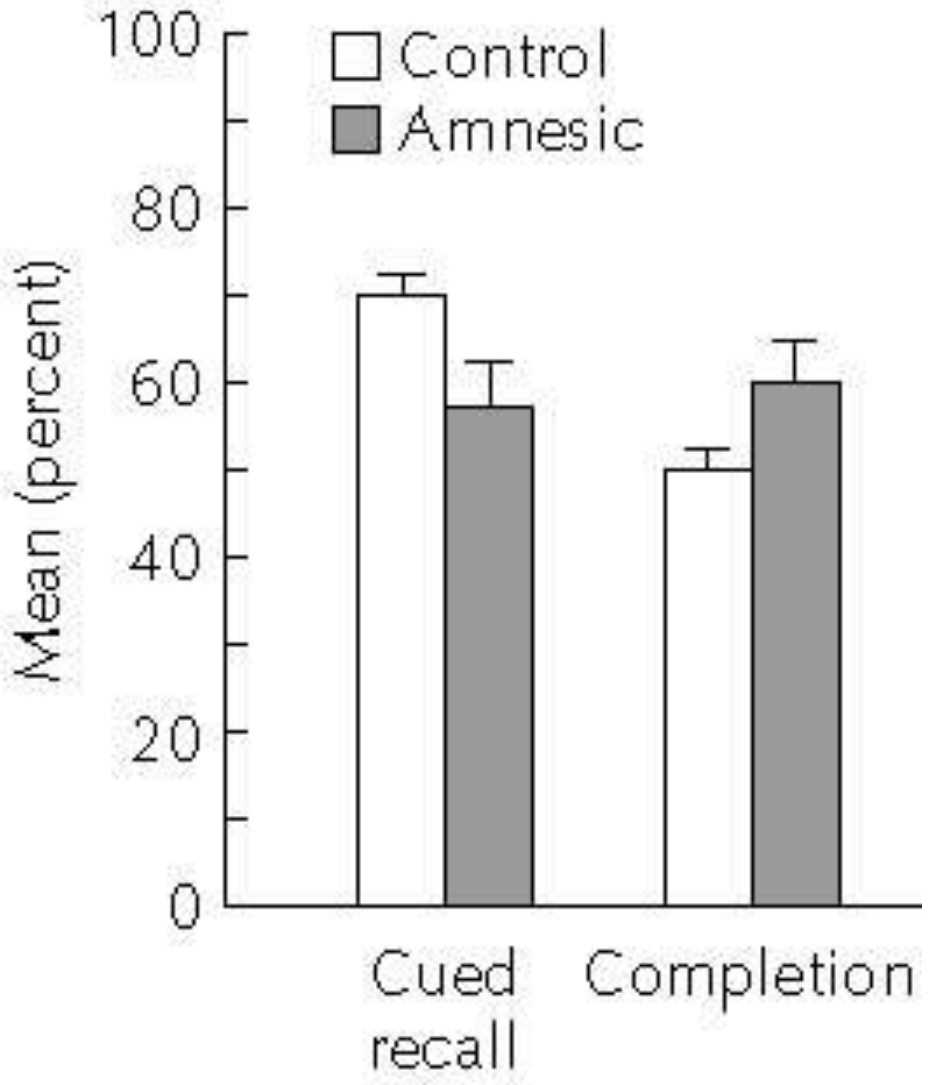
- **Word-fragment completion (残词补全)** is an implicit memory task. Fragments are (often) completed with words previously studied in the absence of an explicit instruction to remember the word

- **Amnesiacs (健忘症患者)** often showed **spared implicit memory (内隐记忆幸免)**, dissociation suggest different systems for implicit and explicit memory systems

Implicit vs. Explicit Memory

- Graf, Squire, & Mandler (1984):
  - Study words: *cheese, house, …*
  - Explicit memory test: cued recall
  - Complete fragment to a word from study list:
  - ch _ _ _ _
  - Implicit memory test: word stem completion **(词干补笔)**
  - Complete fragment to form *any* word:
  - ch _ _ _ _

Word-stem completion spared in amnesiacs



Graf et al. (1984).

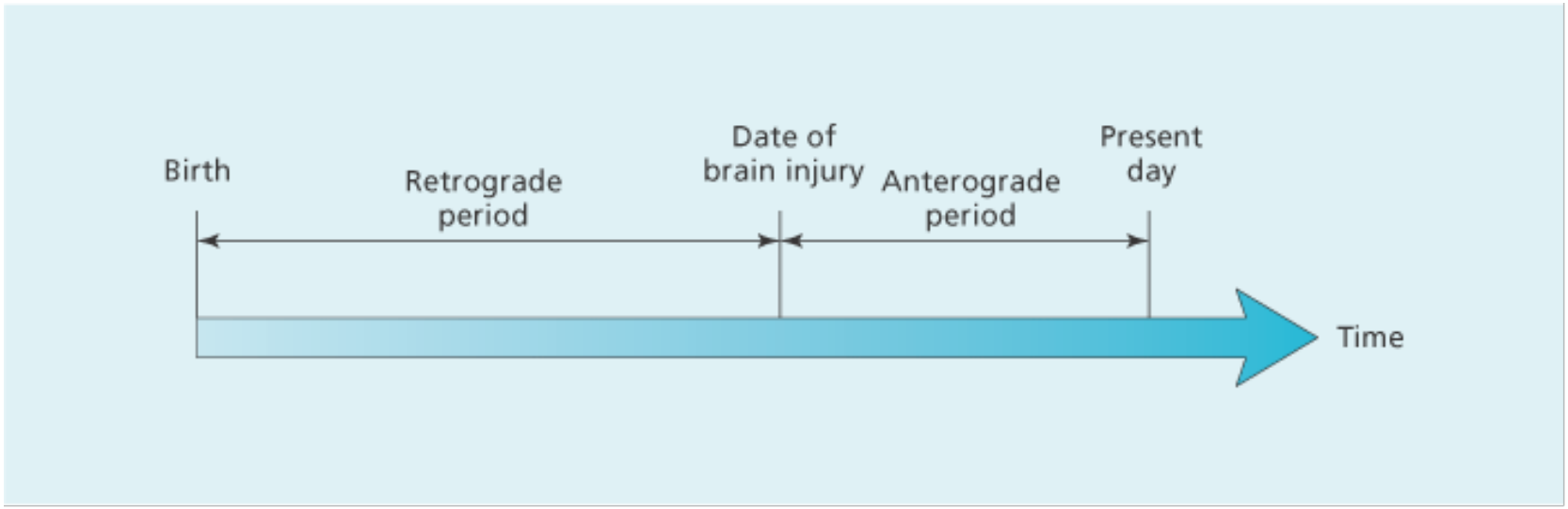
Amnesia

Sources

- Blow to head, Concussion **(脑震荡)**
- Korsakoff syndrome (severe vit. B1 deficiency) **(健忘综合征)**
- Alzheimer's **(老年痴呆症)**
- Damage to hippocampus, thalamic **(丘脑的)** structures
- ECT (electroconvulsive shock therapy) **(电休克疗法)**
- Midazolam: artifically induced amnesia **(咪达唑仑)**

Amnesia

- Types:
  - **Retrograde**: cannot remember old memories
  - **Anterograde**: cannot form new episodic memories



Retrograde amnesia

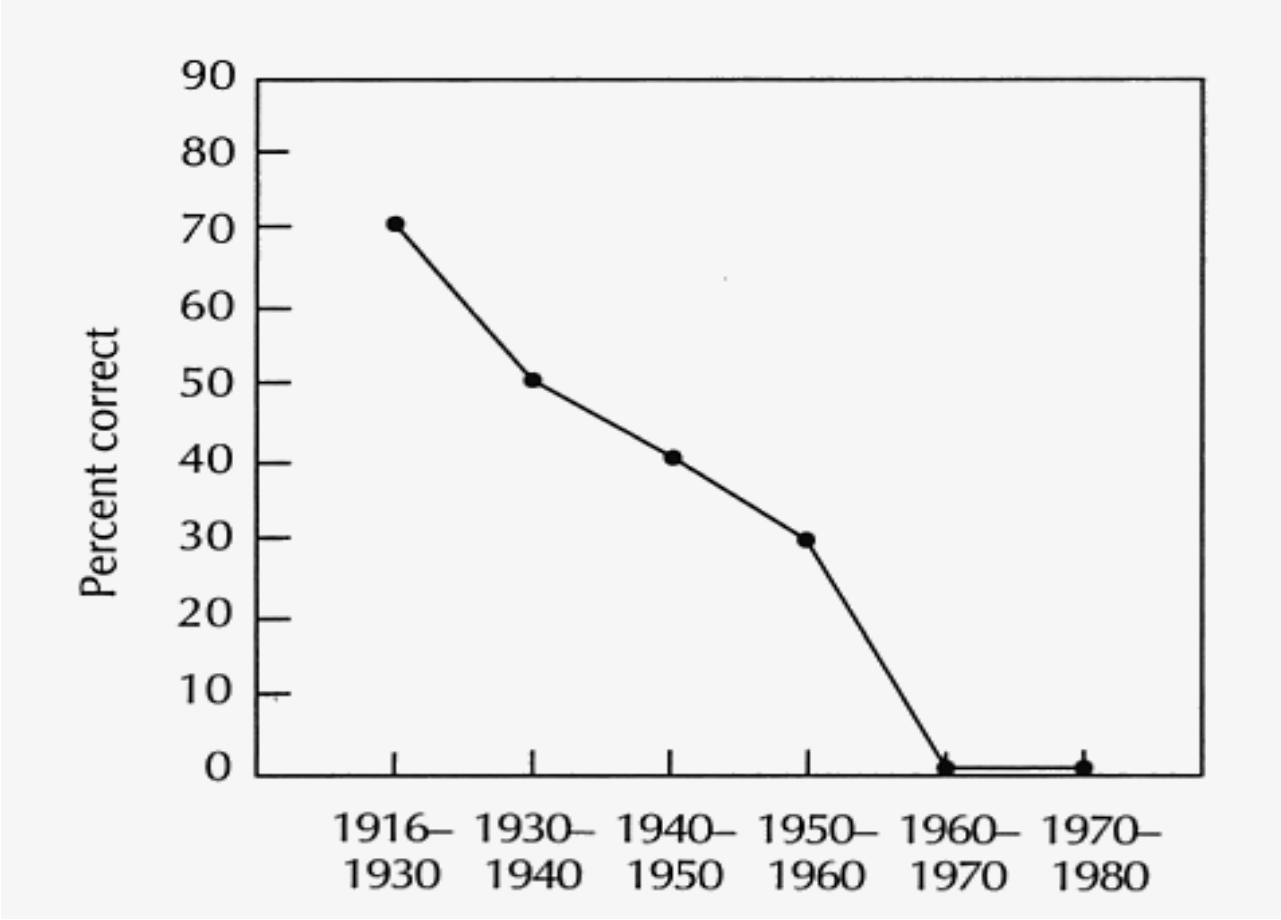
- Temporal gradient:
  - Early memories are better remembered than memories before trauma (*Ribot's law*)
  - Recently formed memories continue to undergo neurological change: memory consolidation

- Retrograde amnesia often becomes less severe over time
  - Most remote memories are likely to return first

- Does not affect overlearned information (e.g. skills) **(指学习或熟记到能立即回忆起的程度)**

Temporal Gradient

- Memory for diary entries from retrograde amnesic



(Butters & Cermak, 1986)

Anterograde Amnesia

- Inability to acquire **new information**
  - Think of movie “memento” 记忆碎片**Memento** ***(2000)***
  - Does not affect short-term memory
  - Does not affect general knowledge from the past
  - But, it is difficult to learn new facts
  - Affects memory regardless of modality (visual, auditory, tactile, etc).

Famous Anterograde Amnesiac: HM

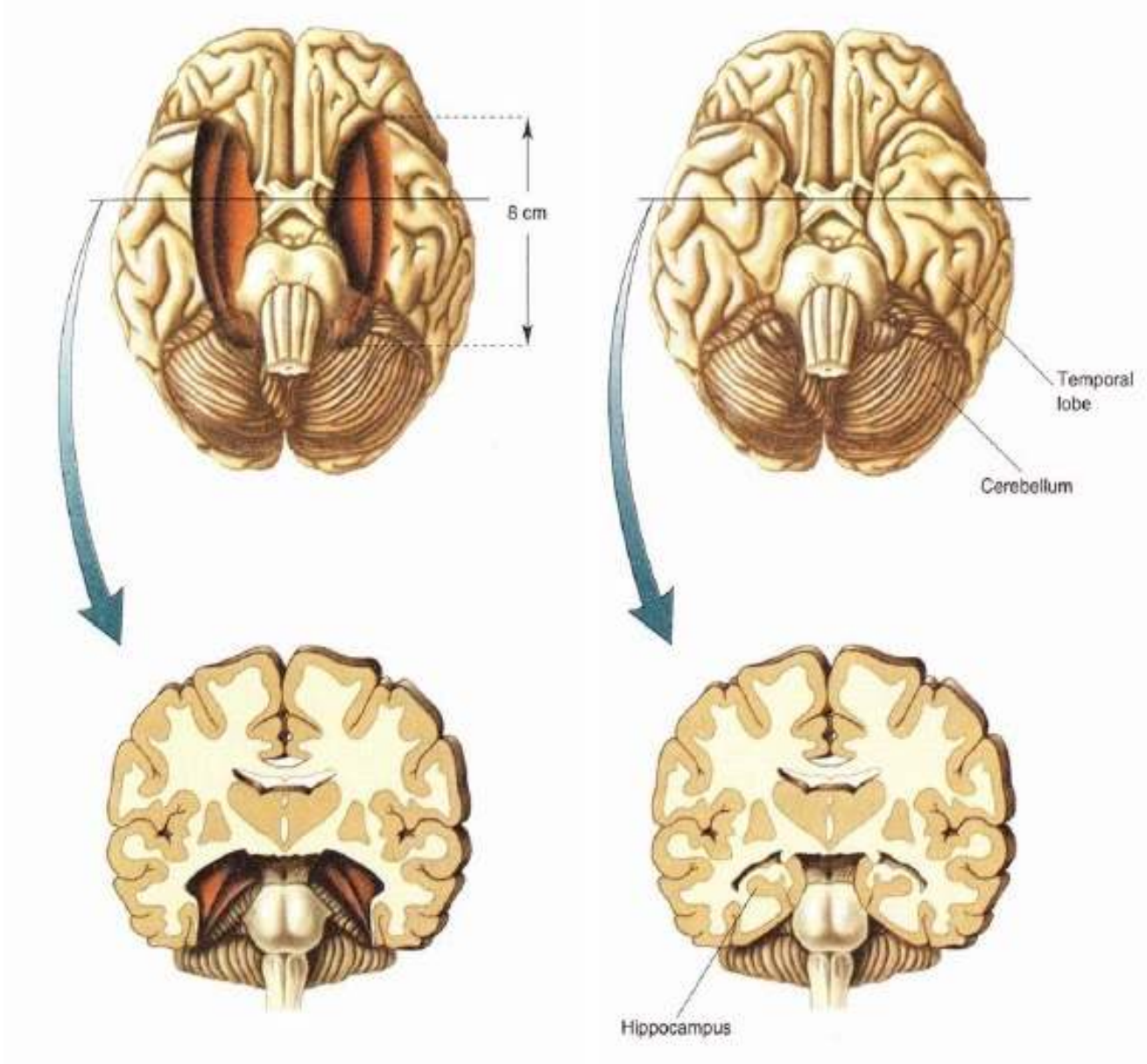
- Severe epilepsy
- Treated with surgery to bilaterally remove medial temporal lobes, including hippocampus
- Operation 9/1953, 27 years old

Henry Gustav Molaison (February 26, 1926 – December 2, 2008), previously known as H.M., was an American memory disorder patient whose hippocampus, parahippocampal gyrus, and amygdala were surgically removed in an attempt to cure his epilepsy. He was widely studied from late 1957 until his death

Henry Gustav Molaison

HM

Normal Brain

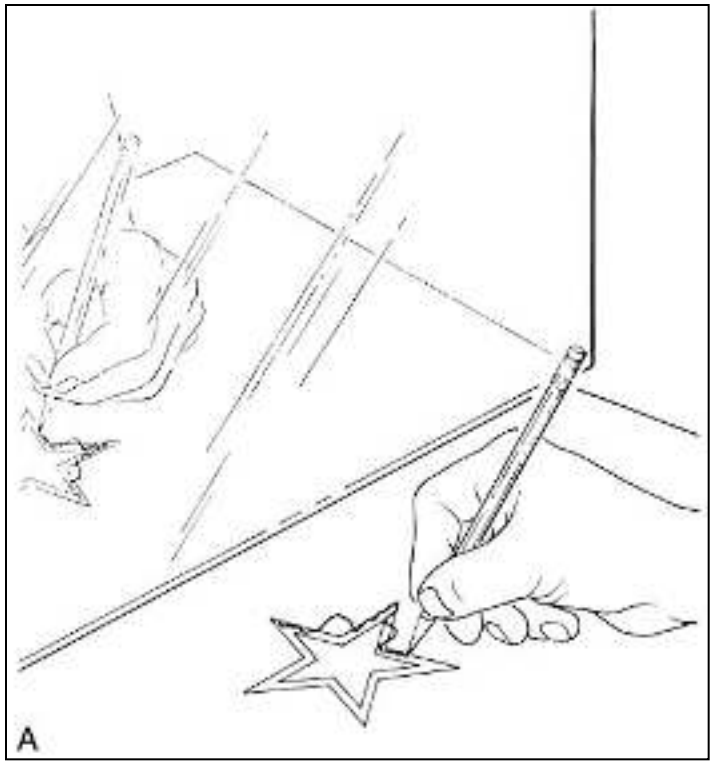


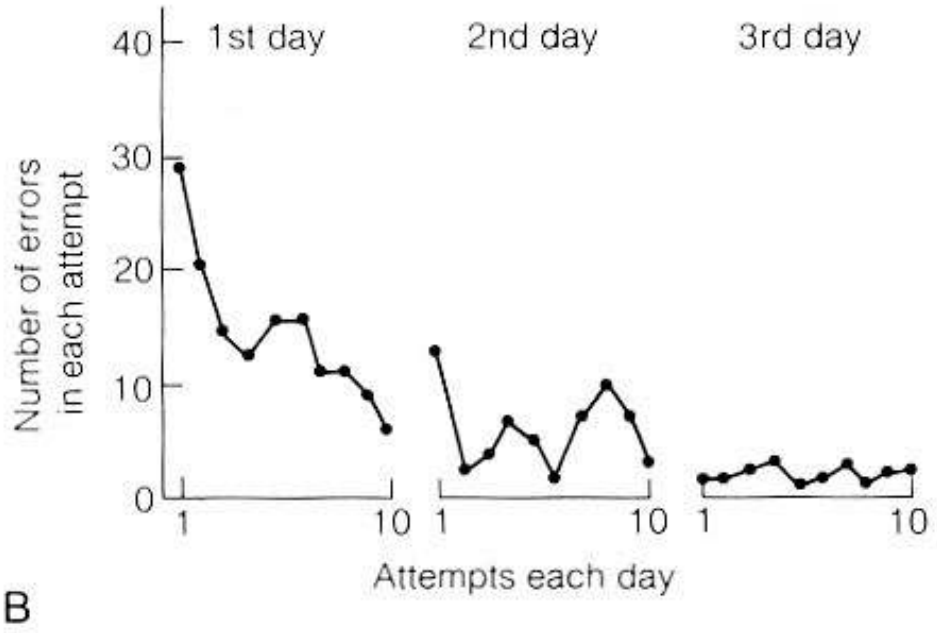
H.M

- General knowledge intact but “stuck in time”.
  - Did not learn words introduced after 1953: “Jacuzzi”, “granola”, “flower-child”

- Was able to form some memories
  - Initially couldn’t learn how to get to his new home. But after several years, he was able to draw make detailed map of his residence.
  - Showed sensitivity to long-term repetition priming **(重复启动效应：当对一个刺激的反应成绩在第二次呈现比第一次呈现更好时，就表现了重复启动效应。)**
  - Could learn to mirror reverse read and mirror trace

HM able to mirror trace





improvement in H.M. for mirror tracing task (without conscious recollection of previous training episodes) ➔ the ***medial temporal lobes*** are ***not*** necessary for all types of long-term memory

Milner, 1965

Can anterograde amnesics acquire any new knowledge?

- Declarative memory (memory for information/knowledge, e.g. episodic & semantic memory)

  ➔ impaired

- Procedural memory (e.g., how to ride a bike)

  ➔ yes

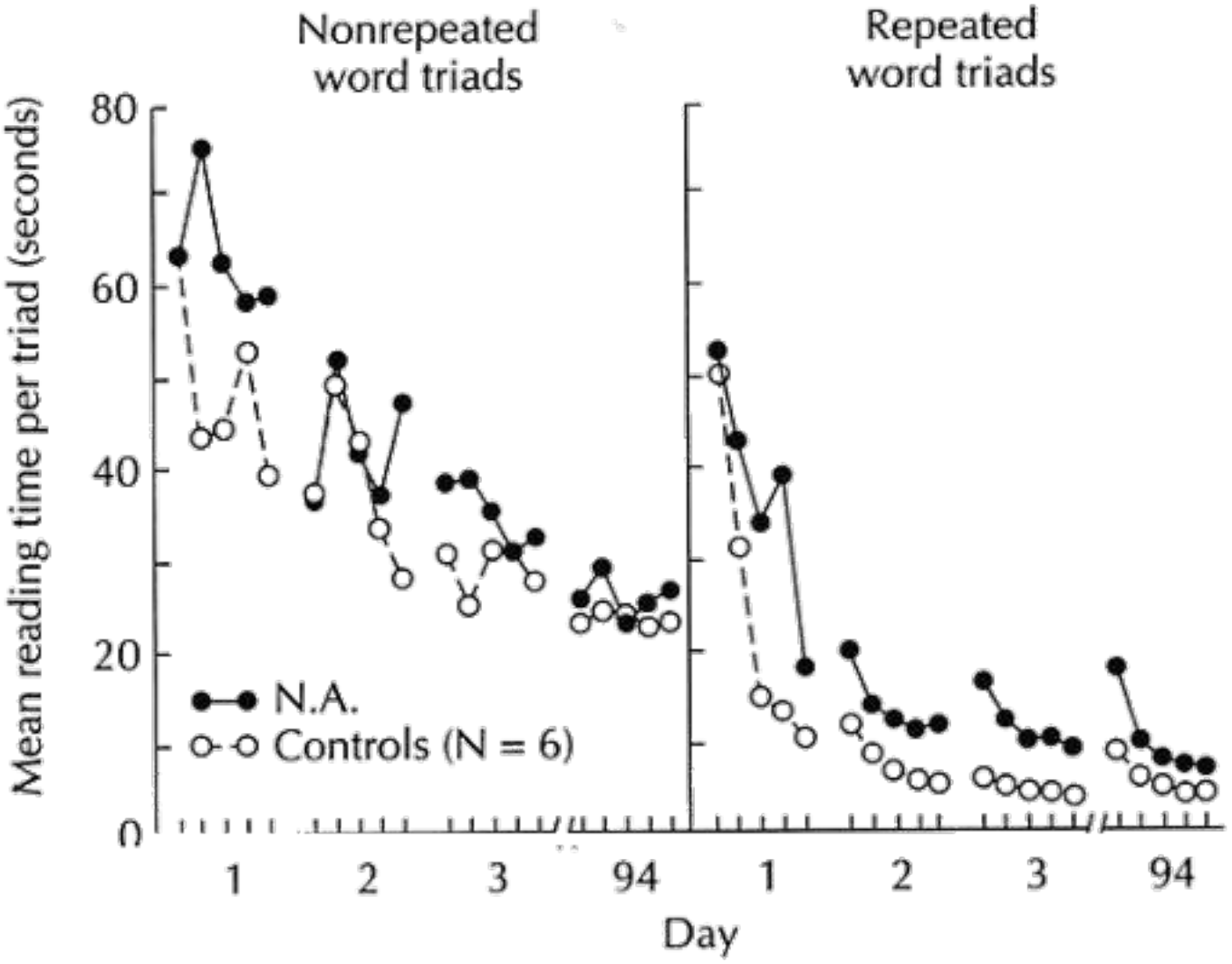
- Implicit memories (using past information possibly without being aware of it)

  ➔ yes

Learning a new skill: mirror-reverse reading

capricious	grandiose	bedraggled
adjunct	geometric	impotence
brakeman	abrogate	lethargy
capricious	grandiose	bedraggled
dinosaur	hydrant	paranoia

Anterograde amnesics can learn to mirror-reverse read and are sensitive to repetitions



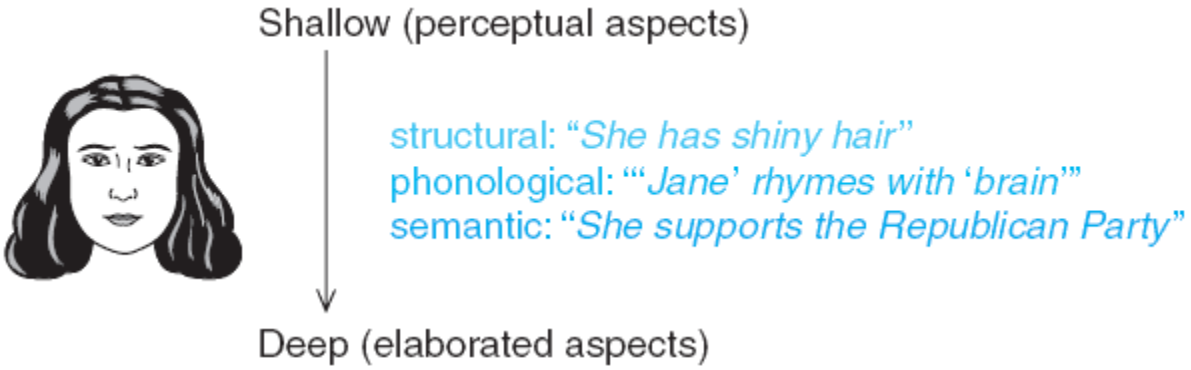
Spared (implicit) learning in anterograde amnesia

- Claparede study (1911)
  - Patient never remembered having met Claparede (doctor) before
  - Claparade offers handshakes with pinprick
  - Next time, no explicit memory of event (or doctor)
  - Still, patient refuses to shake hands and offers explanation: "sometimes pins are hidden in people's hands"

- Korsakoff patients & Trivia questions
  - Given feedback, then retested. No conscious memory for items but better performance. "I read about it somewhere". (Schacter, Tulving & Wang, 1981)

Encoding & Retrieval Effects

Levels of Processing



Levels of processing effect (加工层次): Deeper levels of processing (e.g., emphasizing meaning) tend to lead to better recall.

根据认知加工层次理论，对单个的词可进行形式和语义即浅层次和深层次加工；加工层次越深，记忆效果越好：

（1）记忆的久暂不取于时间，加工层次才是决定的因素；

（2）记忆依赖于提取与加工（学习）的一致性，提取线索是否有效由已记忆的信息来决定。也就是说，后来的提取过程与早先的加工过程越一致，回忆的成绩越好。

(Craik & Lockhart, 1972)

Encoding Specificity Principle

- Recollection performance depends not only on how the information was encoded but also how the way the information is retrieved at test

- **Encoding specificity principle**: recollection depends on the interaction between the properties of the encoded event and the properties of the retrieval information

(Related to “transfer appropriate processing”)

Role of Context

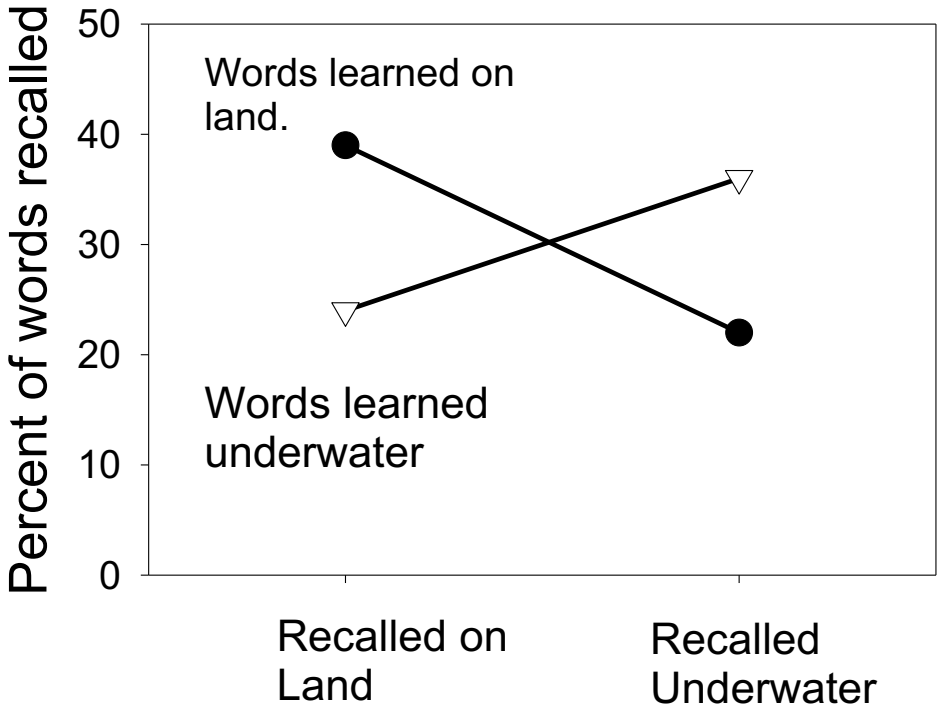
- Information learned in a particular context is better recalled if recall takes place in the same context

- Similarly, information learned in a particular context may be difficult to recall in a dramatically different context

- Context can relate to:
  - Mental context (e.g., how was item thought of)
  - Physical context (e.g. physical location, state)

Role of Context

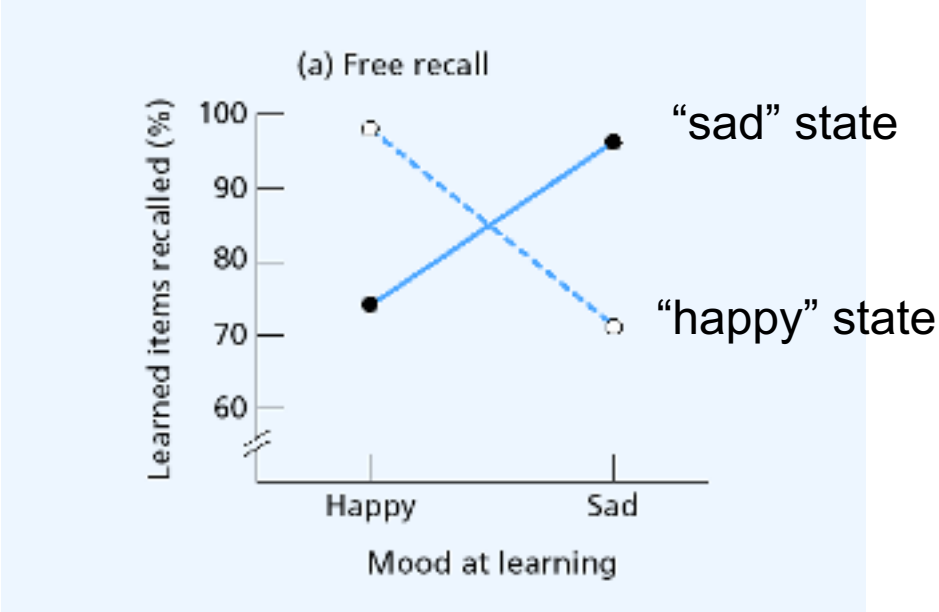
- Memory experiment with deep-sea divers
  - Deep-sea divers learned words either on land or underwater
  - They then performed a recall test on land or underwater



Godden & Baddeley (1975, 1980)

Mood-Dependent Memory

- Easier to remember happy memories in a happy state and sad memories in a sad state ➔ mood primes certain memory contents



Kenealy (1997)

State-Dependent Recall

- Does physical state matter?
- Eich et al. (1975): study while smoking normal or marijuana cigarette. Test words under same or different physical condition

Table 7.7 Interaction between Effects of Drugged State at Study and Test

	Test		
Study	Ordinary Cigarette	Marijuana Cigarette	Average
Ordinary cigarette	25%	20%	23%
Marijuana cigarette	12%	23%	18%

The Spacing Effect

- **Massed practice**: many trials with the same stimulus are undertaken without interruption.
- **Distributed practice**: the trials with the same stimulus are separated by other stimuli.
- **Spacing effect**: Memory is better for repeated information if repetitions occur spaced over time than if they occur massed, one after another

In psychology, the **spacing effect** is the phenomenon whereby humans and animals more easily remember or learn items in a list when they are studied a few times over a long period of time ("spaced presentation"), rather than repeatedly in a short period ("massed presentation").

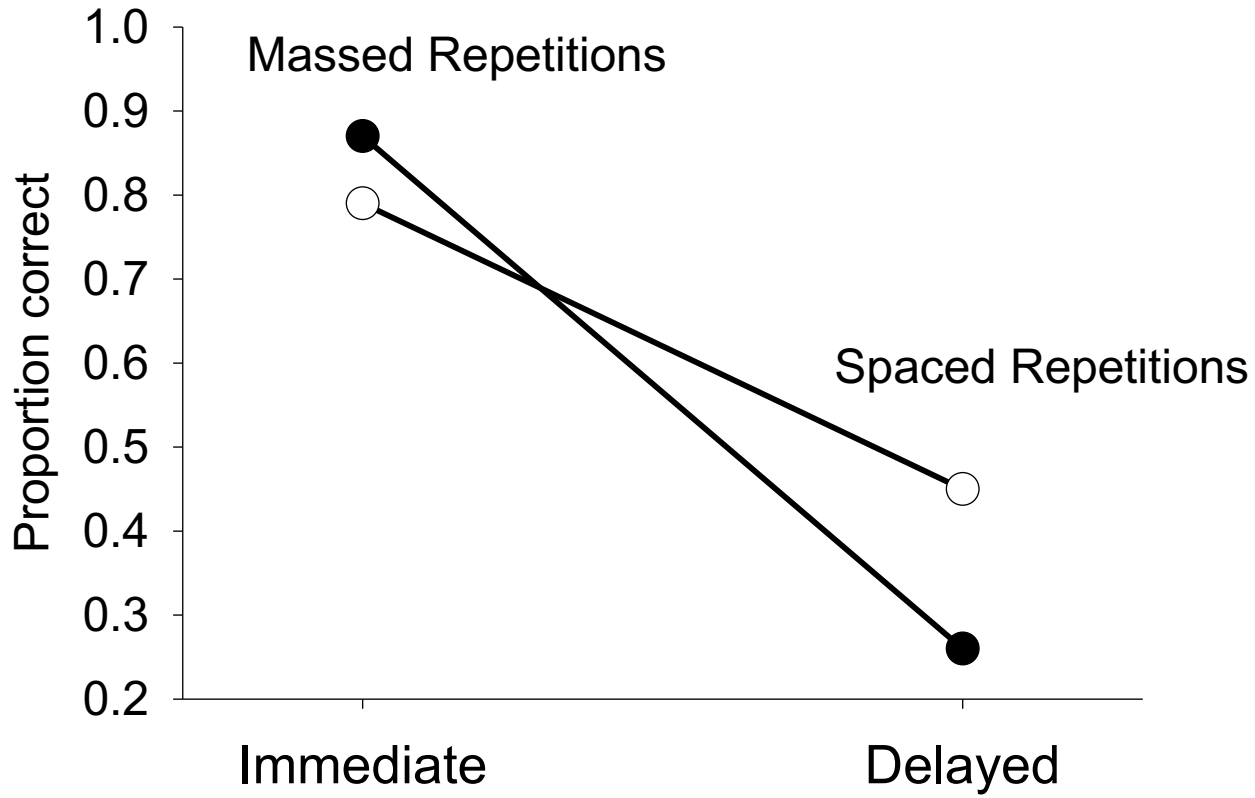
One explanation for spacing effect

- **Encoding variability (编码变异性)**: in subsequent encounters of a stimulus, different aspects of a stimulus are selected for encoding

- Because spacing increases encoding variability, there are more ways in which information can be accessed and retrieved

Spacing Effects

- Spaced repetitions better for long term retention
- Massed better for short term retention **(保留,记忆力)**



Long-Term Effects of Spacing

- Bahrick et al. (1993). Authors studied foreign language vocabulary for four years and tested themselves over the next five years.
- During study, items were repeated in 14, 28, 56 day intervals.
- Results: even 5 years after study, words studied in 56 day intervals were recalled 50% more than words studied in 14 day intervals.