

Human Cognitive Processes: psyc 345

Ch. 5: Short-term & Working memory

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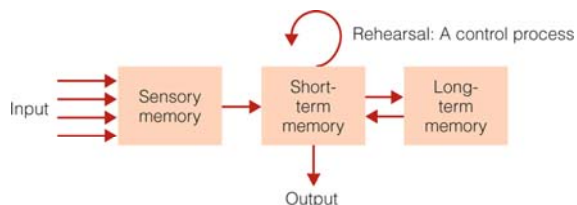
- (Q1) Are there different memory systems?
- (Q2) How do we remember things for a short term?
- (Q3) Is there a way to enhance the ability to remember things that have just happened?
- (Q4) Is there a relationship between memory capacity and intelligence?

What is memory?

- Memory: processes involved in retaining, retrieving, and using information about stimuli, images, events, ideas, and skills after the original information is no longer present.
- Encoding, Storage, Retrieval

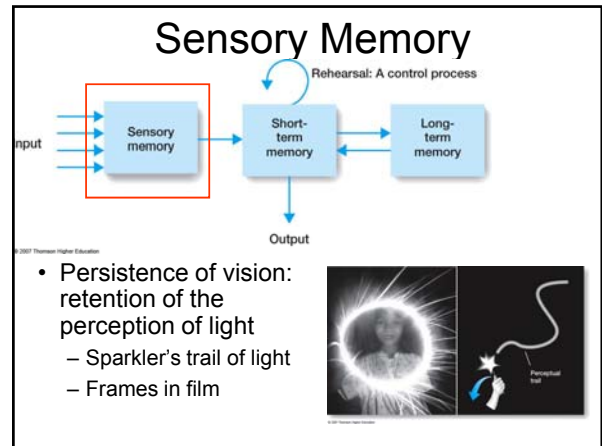
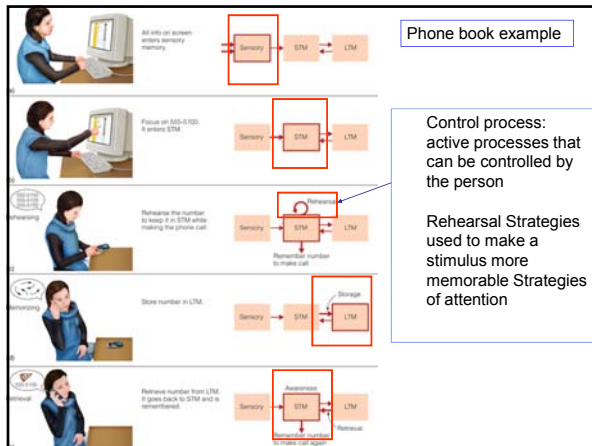
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- (Q2) How do we remember things for a short term?
-

• Atkinson & Shiffrin: Modal model of memory



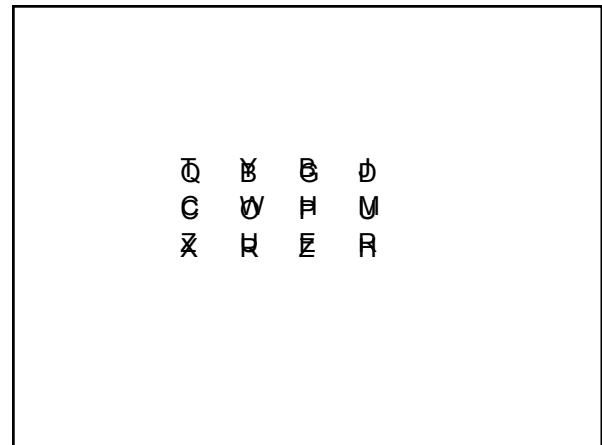
Modal Model of Memory

- Atkinson and Shiffrin (1968)
 - Control processes: active processes that can be controlled by the person
 - Rehearsal
 - Strategies used to make a stimulus more memorable
 - Strategies of attention



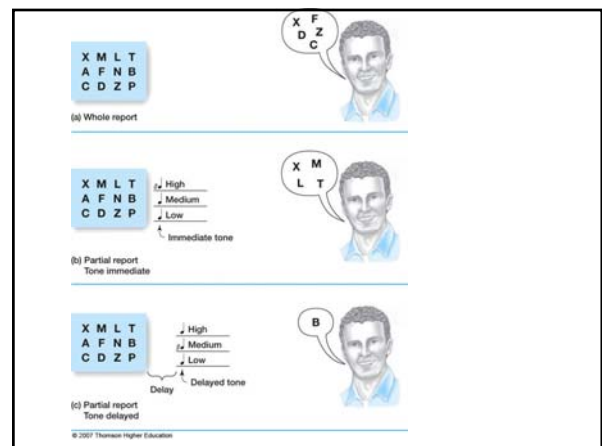
Sensory Memory

- How big is sensory memory?
- Sperling (1960)
 - array of letters flashed quickly on a screen
 - participants asked to report as many as possible
 - CogLab: Partial report demonstration



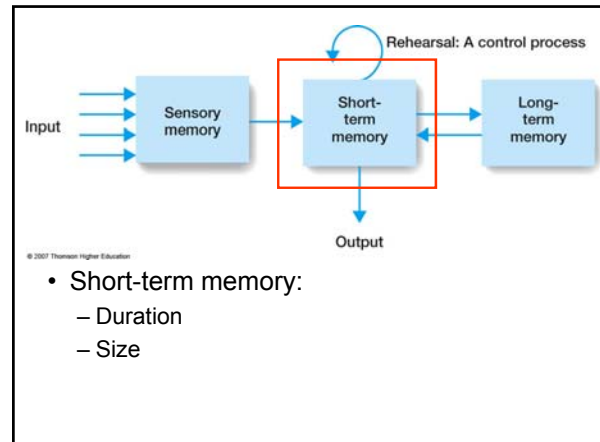
Sensory Memory

- Whole report: participants asked to report as many as could be seen
 - Report average of 4.5 out of 12 letters
- Partial report: participants heard tone which told them which row of letters to report
 - Report average of 3.3 out of 4 letters



Sensory Memory

- Short-lived sensory memory registers all or most information that hits our visual receptors
 - Information decays very quickly
- Brief sensory memory
 - Iconic memory
 - Visual icon
 - Corresponds to sensory memory



• Duration of short term memory

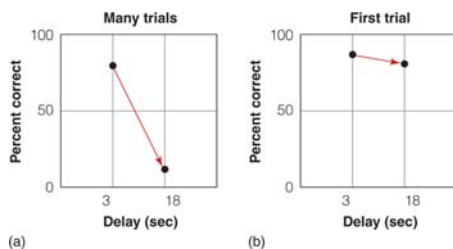
- CogLab: Brown-Peterson
 - Read three letters, then a number
 - Begin counting backwards by 3's
 - After a set time, recall three letters

Short Term Memory

- 3 sec delay → recall rate 80%
- 18 sec delay → recall rate 10%

Short Term Memory

- 3 sec delay → recall rate 80%
- 18 sec delay → recall rate 10%



Why?

- Proactive interference (PI):
 - information learned previously interferes with learning new information
- How come?
 - Some semantic information intervene short-term memory

Short Term Memory

- Short term memory, when rehearsal is prevented, is about 15-20 seconds.

How is information coded in STM?

- Auditory coding
 - sound
- Visual coding
 - appearance
- Semantic coding
 - meaning

- Coglab: demonstration
 - Irrelevant speech

- People encode auditory information for STM.
- But other studies showed that people also use visual and semantic information.

- (Q3) Is there a way to increase the ability to remember things that have just happened?

• Capacity of short term memory

– CogLab: Memory span

– Digit span: how many digits a person can remember

- Typical result: 5-8 items
- But what is an item?

- Chunking – small units can be combined into larger meaningful units
 - Chunk: collection of elements strongly associated with one another but weakly associated with elements in other chunks

- Memory list

1 4 5 6 2 0 8 3 9 7

→ you remember 7 or so digits

H L Q T U Z X P S M N

→ you remember 7 or so letters

Jane, Ken, Steve, Kate, Mary, Brad, Tom,
Ellen, Les, Pete, Jun, Susan,

→ you remember 7 or so names

Not absolute digits or letters that you remember but groups (**chunks**) of things that you remember.

Chunking

- Chunking in terms of meaning improve short-term memory **tremendously**.
- Chess master vs. beginner
 - memorize chess pieces positioned for a real chess game for 5 seconds
 - reproduce the arrangement shortly after.

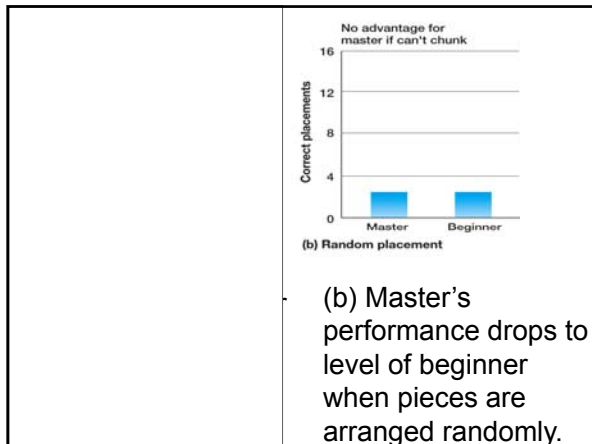
Actual Game



(a) The chess master is better at reproducing actual game positions.

Random Game





- Ericcson et al. (1989)
 - S.F. had an initial digit span of 7
1 4 6 8 3 5 9
 - After 320 one-hour training sessions for 2 years,
 - S.F. could remember up to 79 digits
7 9 3 0 5 1 5 7 9 3 9 0 5 3 5 0 5 2 1 4
6 3 2 8 0 5 4 3 2 1 0 6 3 4 3 7 8 0 2 4
5 9 2 3 5 7 1 8 0 6 3 0 3 5 6 7 0 2 5 8
3 3 5 7 0 7 3 2 9 2 4

How did he do?

- Chunking:
 - Combing the numbers with meaningful sets
 - 3 4 9 2 → 3 hr 49 min 2 sec
 - 8 1 1 0 → almost emergency (9 1 1)
 - 8 9 3 → very old man, 89.3

- (Q4) Is there a relationship between memory capacity and intelligence?

What is short-term memory (STM) for?

- Is STM for transferring information to long-term memory (LTM)?
- Is it a passive terminal for information transfer?

Working memory: Conceptual Background

- Questions:

- From New York to Pittsburgh, it takes about 7 hours and 30 minutes by car. From Pittsburgh to Chicago, it takes about 8 hours and 30 minutes by car. How long does it take from New York to Chicago, if you want to drive through Pittsburgh?

$$8 \times 9 - 10 + (2 \times 6) = ?$$

Summarize the following paragraph.

- Last month, some major banks announced minor changes in their overdraft policies. They were hoping to head off new federal regulation of a business that is designed to ambush ordinary people and siphon off as much money as possible. We were unimpressed with those steps at the time, and a recent study by a nonpartisan research group confirms that the banks have grown addicted to the easy billions they reap from these policies. They clearly will not renounce them unless the government forces them to do so.

Questions

- How did you solve these problems?

Temporary storage of information

- How do we solve these questions?
- In order to answer these questions, you need temporary storage of information.
 - STM → working memory
- Working memory → a buffer for information manipulation

Computer metaphor

- Working memory → Random Access Memory (RAM)
 - 128MB
- Long-term memory
 - Hard disk, Zip disk, USB disk
- After shutting down your computer, you lose the information stored in RAM.
- But the infor. stored in your hard disk is OK.

Do we have RAM (Working memory)?

- Do we have working memory as we have RAM in our computer?

Task 1

- Find the answer to the following question as quickly and accurately as possible.

Lucy came before Jane. Kathy arrived after Jane. Suzy came before Lucy.

Who came first?

Who came second?

Task 2:

- Find the answer to the following question as quickly and accurately as possible. While you are looking for the question, please keep saying “the-the-the-the....”

Tom arrived after Steve. John came before Steve. Mike arrived before John.

Who came first?

Who came second?

Baddeley’s working memory

- short-term memory is not just for transferring information to LTM.
- It is for a working buffer (to manipulate information) for complex cognitive tasks.

Working Memory

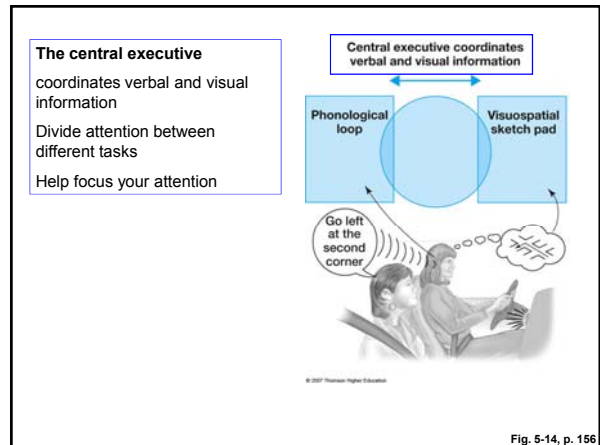
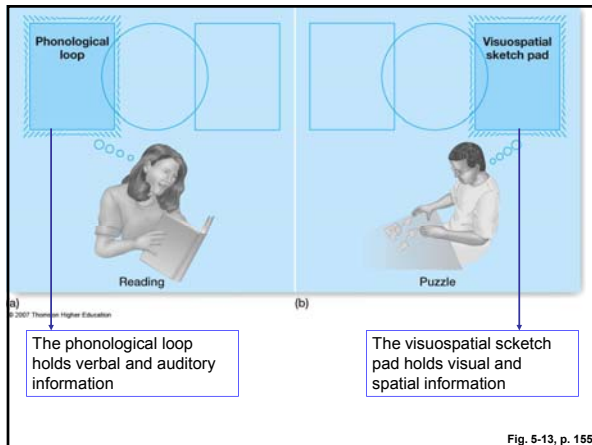
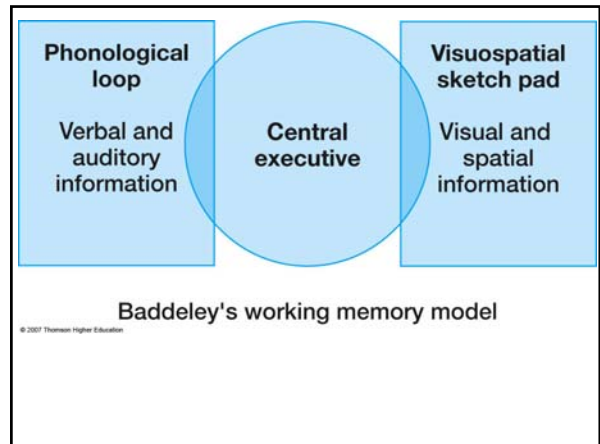
- Working memory (WM): limited capacity system for temporary storage and manipulation of information for complex tasks such as comprehension, learning, and reasoning

Working Memory

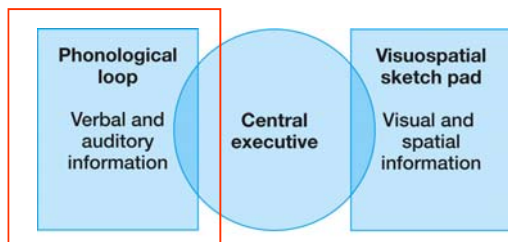
- Working memory differs from STM
 - STM is a single component
 - WM consists of multiple parts

Working Memory

- Working memory differs from STM
 - STM holds information for a brief period of time
 - WM is concerned with the manipulation of information that occurs during complex cognition



The phonological loop



Phonological similarity effect

- Letters or words that sound similar are difficult to memorize.

Demo: Which is more difficult?

- Read the following letters, look away and then count up to 15, and recall
 - g, c, b, t, v, p
- Read the following letters, look away and then count up to 15, and recall
 - f, l, k, s, y, g

Word-Length Effect

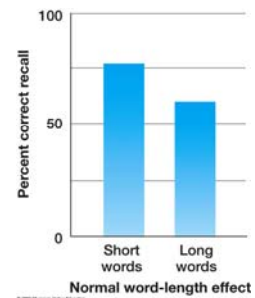
- Memory for lists of words is better for short words than for long words
- It takes longer to rehearse long words and to produce them during recall

Demo: Which is more difficult?

- Read the following letters, look away, count up to 15, and recall.
 - Beast, bronze, wife, golf, inn, limp, dirt, star
- Read the following letters, look away, count up to 15, and recall.
 - Alcohol, property, amplifier, officer, gallery, mosquito, orchestra, bricklayer

The word-length effect

- It takes longer to rehearse long words.
- That's why it is difficult to memorize.

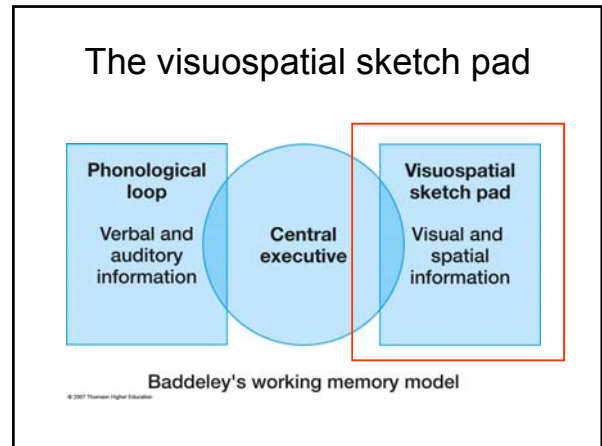
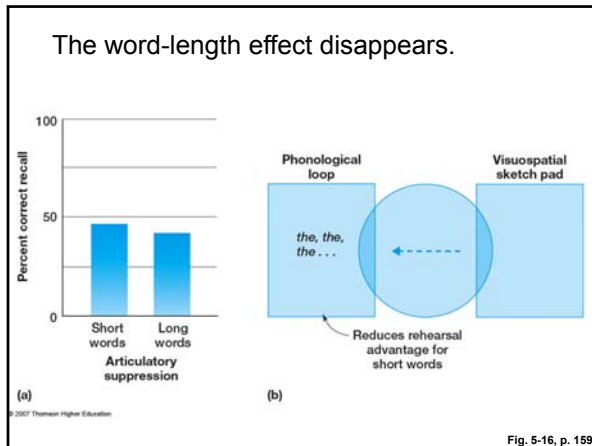


Articulatory Suppression

- Prevent one from rehearsing items to be remembered
 - Reduces memory span
 - Eliminates word-length effect
 - Reduces phonological similarity effect for reading words

Demo: Which is more difficult?

- Read the following letters while repeating the word “the” out loud (the, the, the...), look away, and recall.
 - Beast, bronze, wife, golf, inn, limp, dirt, star



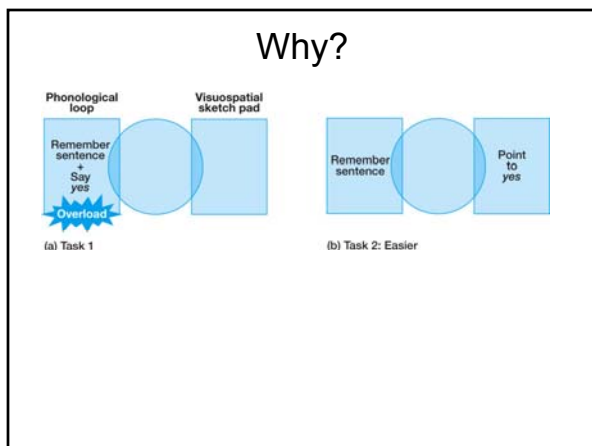
Demo: Which is more difficult?

- Memorize the sentence below, and without looking at it, consider each word and say "yes" if it is a noun and "no" if it isn't a noun.
 - John ran to the store to buy some oranges.

Demo: Which is more difficult?

- Memorize the sentence below, and without looking at it, consider each word and look at "Y" if it is a noun and "N" if it isn't a noun.
 - The bird flew out the window to the tree.

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Demo: Which is more difficult?

- Visualize the F on the right. Look away, and while visualizing F, start at the upper left corner (the one marked with the *) and moving around the outline of the F in a clockwise direction in your mind.
- Point to Y for an outside corner, and N for an inside corner.

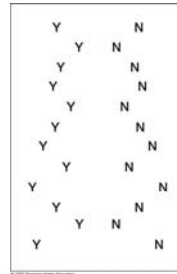
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Demo: Which is more difficult?

- Visualize the F on the right. Look away, and while visualizing F, start at the upper left corner (the one marked with the *) and moving around the outline of the F in a clockwise direction in your mind.
- Say "yes" for an outside corner, and "no" for an inside corner.



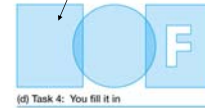
Why?



"yes" "no"



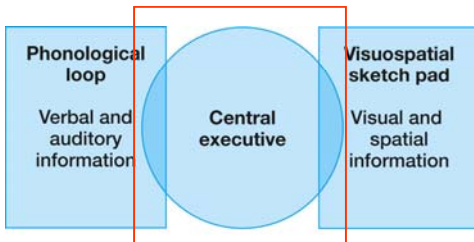
(c) Task 3: You fill in the task and result



(d) Task 4: You fill it in

The central executive

- Switching attention



Baddeley's working memory model

The central executive

- It coordinates the operation of the phonological loop and visuospatial sketch pad.
- It suppresses irrelevant information and maintain relevant information
 - the Stroop task.
 - The Raven test

Read aloud each word

Green	Red
Yellow	Yellow
Red	Green
Orange	
Blue	
Violet	

Read aloud the color of each word

Green	Red
Yellow	Yellow
Red	Green
Orange	
Blue	
Violet	

Raven test: (Carpenter, Just, & Shell, 1990)

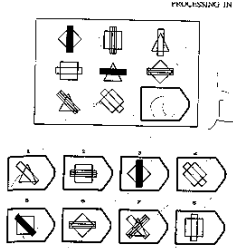
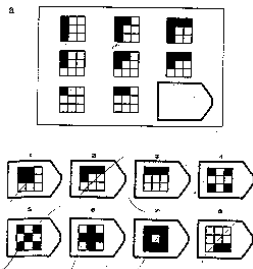
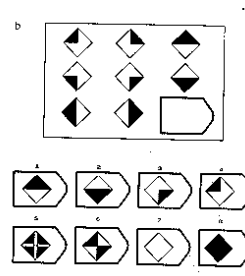
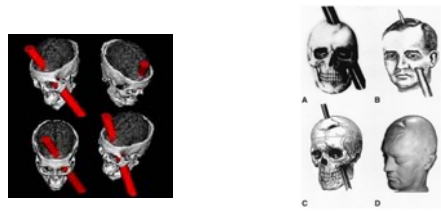


Figure 2. A problem to illustrate the format of the Raven items. (The variation through the three geometric forms (diamond, square, and triangle) and three features of the lines (color, slope, and class) is each generated by a distribution of three values rule. The orientation of the line is generated by a consistent 2-to-1 rule. The correct answer is 3.)



- Marshmallow test (5:15)
- <http://www.youtube.com/watch?v=amsqeYOk--w>
- Phineas Gage
- http://en.wikipedia.org/wiki/Phineas_Gage



- Short term memory loss (9 :45min)
- <http://www.youtube.com/watch?v=wDNDRDJy-vo&feature=related>