CPSC 532E — Week 12: Seminar

Visual Memory and Imagery

- Iconic memory
- Short-term memory
- Long-term memory
- Visual imagery

1. Visual Memory Systems

Three different kinds of memory systems:

1) sensory register
   - a "copy" of incoming stimulus
   - only lasts for a short time

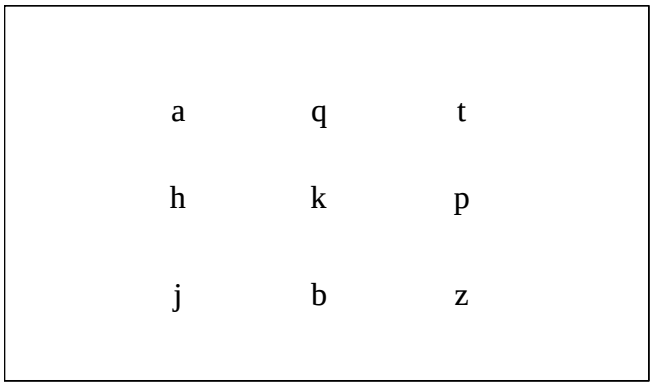
2) short-term memory (STM)
   - a few important "chunks" of information
   - lasts as long as attention is given to it

3) long-term memory (LTM)
   - knowledge about the world (events)
   - lasts indefinitely

1. Iconic memory (Sensory Register)

- total-report technique

a) show observer brief image (array of letters)



b) ask for a report of **all** remembered letters

Result: Observers can report 4-5 items

Does this mean that only 4-5 items can be seen?

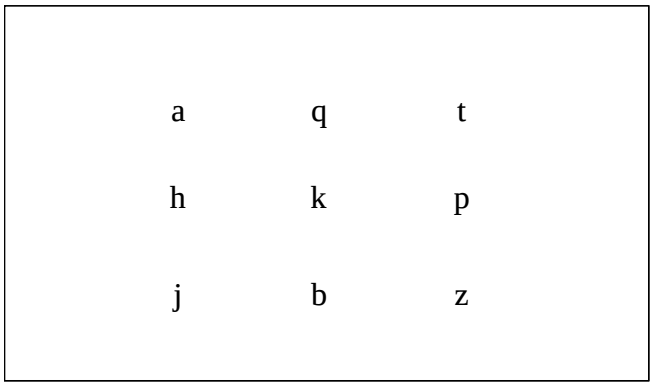
No. May only mean that 4-5 items can be reported, others may be forgotten by the time the response mechanism (attention?) reaches them

How to test for this?

- partial-report technique (Sperling)

a) show observer brief image (array of letters)

b) signal one row via tone (high, medium, low)



c) ask for a report of letters in **signalled row**

Result: Observers can report 4-5 items
from each row

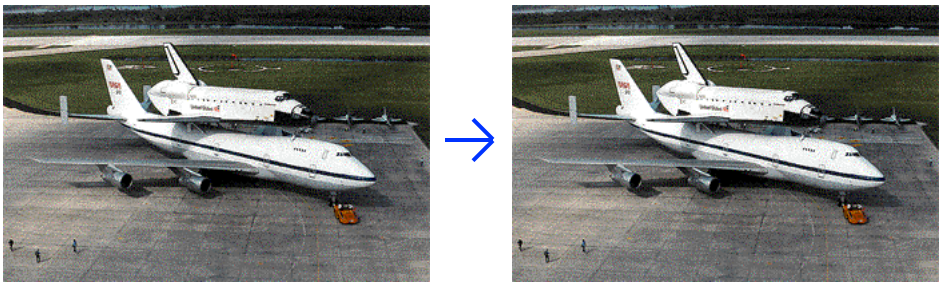
-even when several rows are present

Thus, **capacity of iconic memory is very high**
(perhaps contains all items shown)

- elements fade away rapidly
- can only report 4-5

Iconic memory

Gradually fades away...



Incoming image Iconic image

Iconic memory - a copy (photograph) of input

- format of information: literal copy
- capacity: very high
- entry of information: preattentive (automatic)
- duration of trace: 200-500 ms
- maintenance of information: impossible

2. Visual Short-Term Memory (vSTM)

- observers in total-report task remember 4-5 items

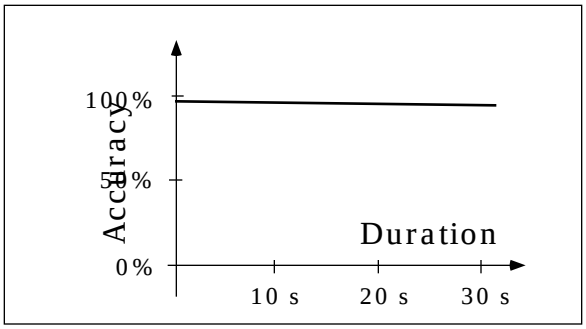
  -> existence of limited amount of memory?

Test: briefly present subject with three consonants

GCH

When light goes on (after several seconds)
say what the consonants were

Result: Observers can report 3 consonants
-accurate as long as rehearsal possible
-duration > 30 seconds



However, information quickly decays
when rehearsal stops...

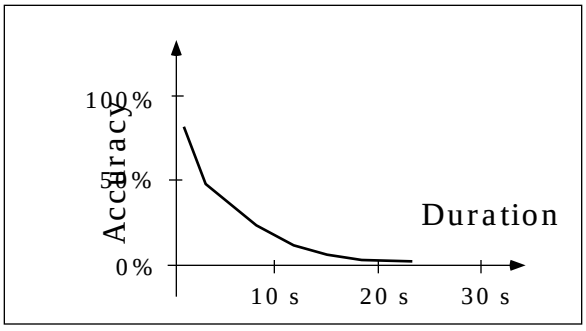
Peterson and Peterson:
Briefly present subject with three consonants

Then have them count backwards by 3s
from given number

504

When light goes on (after several seconds)
say what the consonants were

Result: Performance declines with delay
-essentially zero after 15-20 seconds



Capacity of STM

Look at how recall depends on number of digits:

3 digits:	2 7 3	100%
5 digits:	9 2 6 1 2	100%
7 digits:	4 6 7 8 1 0 4	90%
9 digits:	9 5 4 8 6 7 6 3 2	20%

The number of digits that can be held in STM is called the **digit span**

More generally, the capacity of STM is called the **memory span**

Miller - memory span for digits is 7(±2) items
- for shapes, more like 4-5 items.
- "the magical number 7" (minus 2 or 3)

But... 7 what?

What is an "item"?
What are the units of short-term memory?

The units of STM are "**chunks**"
- groups of items that have a meaning

For example, this sequence is difficult to remember:

FB	IUB	CIB	MUN

(11 letters)

But this sequence is easy to remember:

FBI	UBC	IBM	UN

(11 letters)

Second sequence has same letters
- arranged as chunks - units have meaning

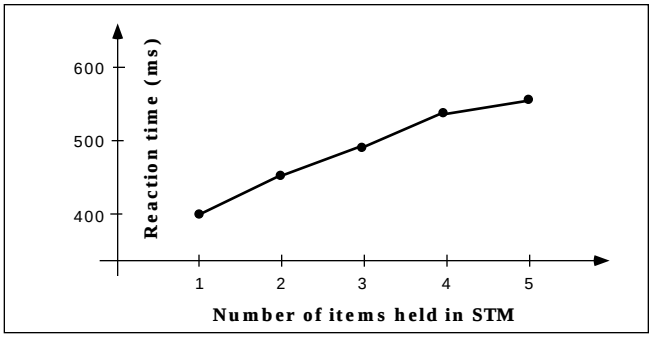
Searching short-term memory (Sternberg)

Have subject remember **2** items in STM (e.g., W X)
- ask whether a test item (e.g. X) was in list
- measure time taken to say "yes" (or "no")

Have subject remember **3** items in STM (e.g., A X U)
- ask whether a test item (e.g. X) was in list
- measure time taken to say "yes" (or "no")

Do same thing for 4 items, 5 items, etc.

Look at **time to say "yes" or "no"** vs
number of items in memory



Average slope = 152 ms/ 4 items = 38 ms/item

Serial item-by-item scan of short-term memory
-each item needs 38 ms to be checked
-scan is **exhaustive** - each item in STM checked

Operation of short-term memory

Used when doing many perceptual/cognitive tasks
- tracking items across space
- doing addition/subtraction
- temporarily remembering phone numbers
- vSTM identified with focussed visual attention?

Specialized STM systems for vision, audition, etc.

Baddeley - these are combined into a general-purpose "working memory" system

2) Short-term memory - data for mental operations

- format of information: "chunks"
- capacity: about 7
- entry of information: requires attention
- duration of trace: >30 seconds
- maintenance of information: continued attention/ rehearsal

3. Long-term memory (LTM)

Separate system from STM

Evidence: damage to medial temporal complex
- -HM (hippocampus removed from both sides of brain)
- -Patients with Korsakov's syndrome (due to chronic alcoholism)

For these, long-term learning is impossible. **But:**
- -normal STM - memory span
- -normal STM - scanning speed

Capacity of LTM

Essentially unlimited: Can always add more

But, this does not mean that everything is remembered

Technique: present subjects with a list of words (or list of facts, etc.)

After a delay, test **recall**

(recall = ability to generate words)

Recall

- e.g., What did you learn in class today?
- need to generate facts, ideas

Recognition

- e.g., Did you learn about LTM in class today?
- need to verify given facts, ideas

Recall is usually more difficult than recognition

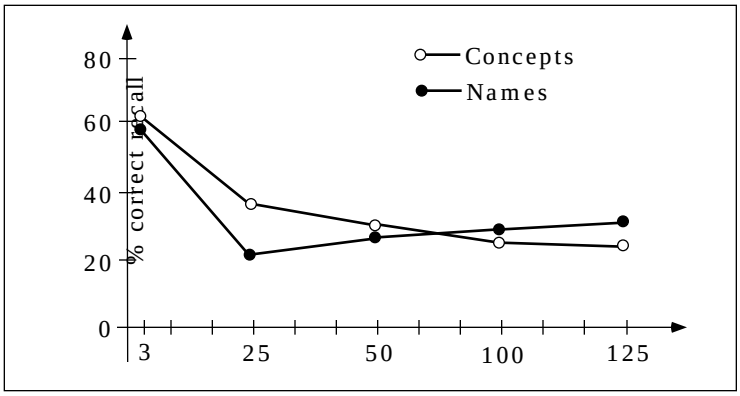
Conway, Cohen, & Stanhope (1991)

Test what was learned in cognition class

-recall of names & concepts

-interval between 3 months - 125 months

Results



-memory for names decays sooner than for concepts

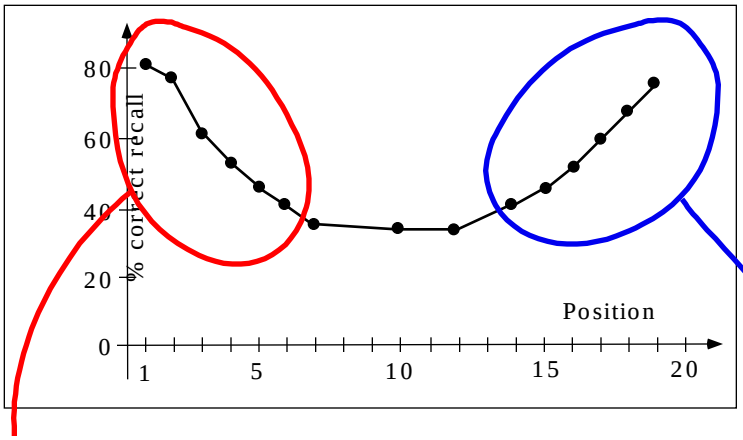
-both average to about 25% retention over long times

Serial Position Effect

Does recall accuracy depend on position in list?

Rundus - list of 20 nouns, one every 5 seconds
- test recall as function of position

Results:



Primacy effect - better recall for words at beginning

Recency effect - better recall for words at end

Primacy effect

- due to greater rehearsal of items
- **the more rehearsal, more chance to get into LTM**
- if rehearsal prevented, primacy effect disappears

Recency effect

- due to items still in STM
- if use of STM prevented (wait a while before testing), recency effect disappears

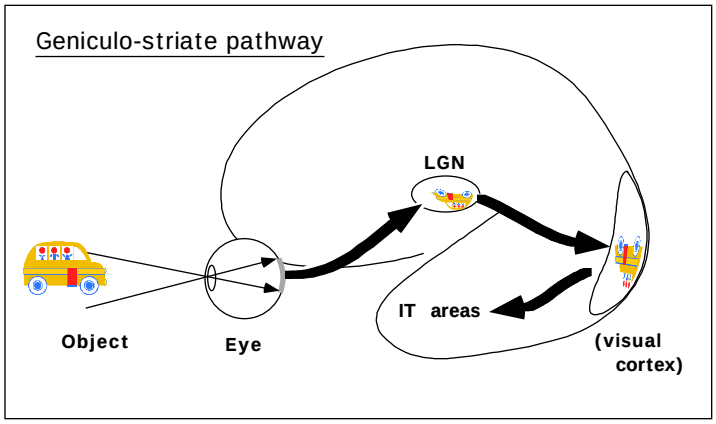
2. Mental Imagery

Internal generation of "images"

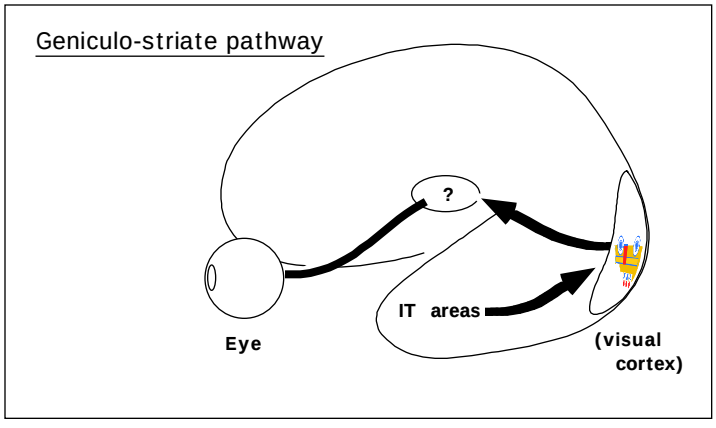
Provides answers to questions about particular things:
e.g., where is the clock tower in relation to the Main Library?

Experiments on brain activity (Kosslyn)
- imagery is vision “run backwards”

- input activates visual cortex (V1)
- this then activates higher centers (IT areas?)



- higher centers (IT areas?) activate V1
- activation of V1 gives “visual impression”



Note: Mental imagery forms basis of technique for enhancing memory ("Method of Loci")

-used by Roman orators to memorize long speeches

1) Pick a place you know well (e.g., your bedroom)

2) Find a path to travel around the room

3) Find items that suggest topics to be remembered
(e.g., wheat -> Canadian prairies
oil well -> Alberta)

4) Place small-scale versions of these along path
- first thing to be recalled is first on path, etc.

5) To recall, imagine walking around room
-items trigger recall of associated topics

More generally, can carry out various transformations on mental images

- 3D rotation (Shepard & Metzler, 1971)
- size scaling (Bundesen & Larsen, 1975)

These abilities may reflect another form of visual intelligence

- perhaps replace/support via appropriate external processing (e.g., Tetris)

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