SHORT-TERM MEMORY and/or WORKING MEMORY
Atkinson-Shiffrin Model

- Sensory Memory
- Short Term Memory
- Long Term Memory
- Forgetting

Rehearsal
Transfer
STM vs. WM

**STM:**
- Emphasis on *input*
- Older term
  - remembering phone numbers

**WM:**
- Emphasis on *process*
- Newer term
  - doing math in your head
Classic Research on STM

• Capacity
  – Digit span

• Duration
  – Brown-Peterson Paradigm

• Retrieval and Forgetting
  – Serial Position
Capacity of STM

Magical number 7 (plus or minus 2)

• **Digit Span** (Jacobs, 1887):
  – Presentation of a succession of digits, and subjects has to report them back.
  – Stops when you make an error, and that is your Digit Span
Digit Span

It helps:

– when you recite the numbers **rhythmically**
Digit Span

It helps:

– when you *chunk* the material into groups
Brown-Peterson Task

- Determine how long non-rehearsed information stays in STM
Brown-Peterson Task

- Stimuli given
  - A, B, C 428
- Count backwards in 3s
- Recall the letters
Results - Brown-Peterson Task
Brown-Peterson Task: A Variation

- Stimuli given
  - cat, dog, cow
- Count backwards in 3s
- Recall the words
Results - Brown-Peterson Task

![Graph showing the relationship between recall interval (s) and relative accuracy. The graph illustrates a decreasing trend as the recall interval increases.]
Brown-Peterson Task: Another Variation

- Stimuli given
  - cat, dog, cow 428
  - bear, lion, fox 345
  - rabbit, goose, camel 135
  - cherry, banana, apple 246

- Count backwards in 3s
- Recall the words
Results - Brown-Peterson Task
Serial Position

• Read a list of words
• Remember them in any order you want to
Serial Position

![Graph showing primacy and recency effects](image)
Recency

• Some people say your STM capacity is 4 items
  – Since it is how much you can hold as a result of recency effect
WORKING MEMORY

• Rather than a passive storage of information, working memory is like a *workbench*
  – Information is being combined and transformed continuously.
Evidence for Different Components:

Dual Task Paradigm

Ss remember (and overtly rehearse) sequences of 0-8 digits
At the same time subjects perform a simple reasoning task

A precedes B: AB
(TRUE)
B is not preceded by A: AB
(FALSE)

Reasoning time increases.

Error rate remains at a mere 5%.
The Phonological Loop

– Speech coding
– Rehearsal

• A slave system that takes care of these aspects

• **Evidence from three areas:**
  – Phonological similarity effect
  – Irrelevant speech effect
  – Word length
Phonological similarity Effect

• Errors tend to be phonologically similar to the target item.
  – More errors are observed if similar speech sounds are used in to-be-remembered material

• Exp:
  
  DBCTPJ ➡ harder
  KVYLMH ➡ easier
Irrelevant Speech Effect

• Speech sounds disrupt performance
  – Even if they are in another language

• Non-speech noise does not have an effect
  – Even if it is VERY loud.
Word Length Effect

• Link between word-length and memory performance
  – Easier to recall a list of shorter words than a list of longer words
Testing the Word Length Effect

• Prevent subjects from rehearsal
  – saying “the the the the” outloud while doing the task
• Got rid of the word length effect.
Articulatory Suppression

• Preventing the subjects from rehearsing by making them generate speech repeatedly.
  – Gets rid of
    • Word length effect
    • Phonological Similarity effect
    • Irrelevant speech effect
Phonological Loop

• Considering the evidence at hand, a system that helps us rehearse by sub vocal speech seems to exist.
Individual Differences

- People who speak faster are better rememberers of short-term information

<table>
<thead>
<tr>
<th>Language</th>
<th>Articulation Rate</th>
<th>Digit Span</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese</td>
<td>265ms/digit</td>
<td>9.9</td>
</tr>
<tr>
<td>English</td>
<td>321ms/digit</td>
<td>6.6</td>
</tr>
<tr>
<td>Welsh</td>
<td>385ms/digit</td>
<td>5.8</td>
</tr>
</tbody>
</table>

(Hoosain & Salili, 1988; Ellis & Hennelly, 1980)
Why do we need a PL?

• What is the advantage?
  – Counting
  – Reading
    • More so, when you are first learning to read, or reading difficult-to-understand texts
  – Language Acquisition
Visuo-Spatial Sketch Pad

• Visual Imagery
  – How we store images in our mind.
  – How we manipulate these images.
Imagery and WM

• Study by Brooks (1968):
  – Hold letter F in your mind’s eye.
  – Classify each corner

Top or Bottom  Not Top or Bottom

YES     NO
Say       Point  Say       Point
Imagery and WM

• Study by Brooks (1968):
  – Sentence: “A bird in the hand is not in the bush.”
  – Classify each word

Noun
  YES
  Say  Point

Not Noun
  NO
  Say  Point
Results of Brooks (1968)

Response Mode

<table>
<thead>
<tr>
<th>Task</th>
<th>Pointing</th>
<th>Speaking</th>
</tr>
</thead>
<tbody>
<tr>
<td>sentence</td>
<td>9.8</td>
<td>13.8</td>
</tr>
<tr>
<td>diagram</td>
<td>28.2</td>
<td>11.3</td>
</tr>
</tbody>
</table>

- Pointing interferes with the visual task, since it uses capacity from visuo-spatial sketch pad
Baddeley et al. (1973)

- Tracking a moving light with a laser while engaging in the Brooks task.
  - Great difficulty tracking while engaging in the imagery.
The Central Executive

• Most complex and least understood component of WM
  – A limited-capacity attentional system that controls the other slave systems
  – Relates them to LTM
  – Suppresses irrelevant information
Episodic Buffer

• Temporary storehouse where information in gathered from PL, VS, and LTM and combined
  – Limited capacity
  – Information can be either auditory or visual
Working Memory Span

... is correlated with:

– reading comprehension
– reasoning skill
– speed of processing
THE END