Background

- People have different kinds of memory:
  - Sensory memory, short-term/working memory, long-term memory
- Each has different characteristics:
  - Durations, capacities, contents
- Unifying model: Stage theory

Visual sensory memory

- Also called *iconic* memory
  - Auditory sensory memory is called *echoic* memory
- Holds 1 item per spatial location
  - Evidence comes from *masking*: An item presented at a location masks (overwrites) the previous one presented there

Stage theory

Masking

<table>
<thead>
<tr>
<th>80 msec</th>
<th>120 msec</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 7 3 6</td>
<td></td>
</tr>
<tr>
<td>1 0 2 8</td>
<td></td>
</tr>
<tr>
<td>5 7 3 6</td>
<td></td>
</tr>
<tr>
<td>1 0 2 9</td>
<td></td>
</tr>
</tbody>
</table>
Contents and duration

- Contents are unidentified
  - You can know something was there without knowing what it was
  - You identify (encode) items one at a time
- Contents decay over time
  - Last about 1 sec
  - Contents of echoic memory last 2-3 sec

Decay

Subitizing

- We can encode the number of items in iconic memory, up to about 4 or 5, without counting
- For more items, we have to count
  - Or estimate, if items decay before we can count them all

Brain region

- Iconic memory is probably represented in the occipital lobe

Subitizing

Working memory (WM)

- The contents of our conscious awareness
- Has verbal and visual components
  - Often called “buffers”
  - Verbal is the more studied
Example

- You’ll see two numbers
- Multiply them in your head
- While thinking out loud

760 x 93

760 times 93, uh
3 times 760
so 3 times 0 is 0, 3 times 6 is 18, uh
it was 760, so 3 times 7 is 21
plus carry 1 is 22, uh
so 3 times 760 is 22, 2 2 8 0, ok
that’s the first line, the second line is
I was multiplying by 93 I think, times 760
so 9 times 0 is 0, 9 times 6 is 54
[?] the 4, carry the 5, uh
9 times 7 is, um ... 63
plus is 67, so 6 7 4 0
plus ... 2 2 8 0
0 plus 0 is 0, 8, uh
now I’ve lost the second number

Verbal working memory

- Duration is a few seconds
  – Items decay, but can be maintained in an active state using rehearsal
  – Without rehearsal, an item lasts no longer than about 30 seconds
- Capacity is limited
  – Two different estimates:
    • 7 ± 2 chunks
    • As many items as you can rehearse in 2 seconds

Free recall procedure

- You’ll see 15 words, one at a time
  – Half a second apart
- Afterwards, write them down, in any order

Typical accuracy results

(Glanzer & Cunitz, 1966)

- Primacy effect: Better memory for early items
- Recency effect: Better memory for late items
- People counted backwards for 30 sec before recall

Group night thing boy time book face play door car place tree road dog school
**Primacy and recency effects**

- **Primacy:** Early items get more rehearsal
  - *Maintenance rehearsal:* say the item repeatedly
  - *Elaborative rehearsal:* link the item to existing knowledge
- **Recency:** Late items are active because you just encoded them
  - Left alone, they decay
  - So the 30-second delay eliminated recency effect

**Brain regions**

Verbal rehearsal involves the language areas

**Chunking: verbal**

C I A N S A I R S F B I

**Chunking: visual**

**Implications of chunking**

- The more expertise you have, the more you can remember about what you’re working on
  - Experts effectively have large working memories *in their domains of expertise*
  - In other domains, their working memory is no different anyone else’s