“Working” memory

- Do the following calculations in your head
  - 7 \times 9
  - 74 \times 9
  - 74 \times 96
- Read the following sentences and construct a mental image
  - The repair person departed.
  - The delivery person that the secretary met departed.
  - The sales person that the nurse despised that the doctor met departed.
Baddeley & Hitch (1974)

Baddeley's working memory model

- Phonological loop
  - Storage (passive)
  - Rehearsal (active)

- Visuospatial sketch pad
  - Visual information
  - Spatial information

Central executive

Working memory

Central Executive

Activities:
- Initiate control and decision processes
- Reasoning, language comprehension
- Transfer information to long-term memory via rehearsal, recoding
- Recency effects

Phonological loop

Activities:
- Recycling items for immediate recall
- Articulatory processes
  (Executive’s resources are drained if articulation task is difficult)

Visuospatial sketchpad

Activities:
- Visual imagery tasks
- Spatial, visual search tasks
  (Executive’s resources are drained if imagery or spatial task is difficult)
Definition of WM

• Temporary maintenance or storage of information during cognitive processing
• Juggling metaphor
• Engle (2002): WM = STM + controlled attention
  • “attention-limited workbench of memory”
• Needed for complex cognitive processes
Method to study WM

• Examine resource sharing between:
  • Phonological loop
  • Visuo-spatial sketchpad
  • Central executive
• Dual-task procedure
  • Examine interference of secondary task
  • Assumption: Disruption suggests using same mental resources
• e.g.: Brown-Peterson task
  • Remember triad and count backwards
  • Phonological loop and central executive
Logie, Zucco, & Baddeley (1990)

- Primary tasks
  - Visual memory span
  - Letter span
- Secondary tasks
  - Mental addition
  - Imaging task
- Double dissociation!
Phonological similarity effect with articulatory suppression

Effect of saying “the, the, the” on reading words

Phonological loop

Visuospatial sketch pad

% correct

Serial Position

- Dissimilar Quiet
- Dissimilar Suppression
- Similar Quiet
- Similar Suppression

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Phonological loop

- Word length effect
  - Without vs with articulatory suppression
Visuo-spatial sketchpad

- Brooks (1968)
- Method:
  - Primary task: Memorize sentence
  - Secondary task: Is each word a noun?
  - IV: “Say” Y/N vs. point to Y/N
Visuo-spatial sketchpad

- Brooks (1968)
- Method:
  - Visualize F: inside or outside corner
  - IV: “say” y/n or point y/n

Say Yes or No

& Point Yes or No
Brandimonte (1992)

- **Method**
  - Study: 6 pictures
  - Task: Subtract a part
    - ID new picture
- **Conditions**
  - Control
  - Verbal suppression
- **Results (# correct)**
  - Control: 2.7 / 6
  - Verbal suppression: 3.8 / 6
- **Conclusion**
  - Visuo-spatial sketchpad better alone for this task
Central executive: Baddeley & Hitch (1974), exp 3

- Reasoning task: e.g. “AB”
  - Task: decide if sentence is true or false
  - IV: Reasoning difficulty
    - Active: “A precedes B”
    - Passive: “A is preceded by B”
    - Negative Passive: “A is not preceded by B”

- Secondary task: Articulatory suppression (AS)
  - “the, the, the”
  - Repeat 1 – 6 over and over
  - Repeat random sequence of digits
  - Control condition (no AS)

Results:
As secondary task increases in difficulty it has to borrow resources from CE ...

Effect: reasoning task is slowed
**Gazzaley et al. (2005)**

**Central executive (CE) and fMRI**

- **CE**: 1 function is to suppress irrelevant info
- **Method**
  - CE condition: remember faces ignore scenes (test: face recg)
  - Passive condition: look at pictures (test: direction of arrow)
Gazzaley et al. (2005)
Central executive (CE) and fMRI

• Result
  • Good suppressors: less brain activity during CE condition - 89% acc for face test
  • Poor suppressors: more brain activity during CE - 67% acc for face test

• Conclusion
  • Ability to suppress irrelevant info increases memory
Baddeley’s episodic buffer

- “Back-up” store
- Communicates with LTM and other subcomponents
- Result: increases duration and capacity compared to just slave systems