Working memory

PSY 200
Greg Francis
Lecture 16

A problem with IQ tests.

Current thought, awareness
- extension of short-term memory
- small capacity
- rapid forgetting
- Processor of information
  - not a storage device
  - hypothesizes mechanisms that lead to memory properties

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Phonological loop

Two components
- Articulatory control process (ACP)
  - converts non-speech information into speech code
  - rehearsal / refresh
- Phonological store (PS)
  - similar to how we first described STM (items decay from memory)
  - Refresh restarts the decay process

Loop capacity

How many items can be kept in the phonological loop?
- Depends on two factors
  - Duration before decay from PS
  - Speed of rehearsal
  - Spinning coins!

Magic number?

- We earlier noted that memory span was about 7 items (+/- 2)
- The phonological loop suggests that it is not the number of items but their rehearsal duration
- To recall a list of items you must rehearse them all before any of them fade
  - The duration of decay in the PS
- Memory span should follow the equation
  - Span = (Rehearsal Rate) X (PS decay time)
- Measure memory span (s): around 7 items
- Measure verbal rehearsal rate (r): around 4 items per second for English speakers
- Estimate duration of decay in PS (d)
  - d=1.75 seconds

Effect of rehearsal rate

- Capacity of the phonological loop depends on the rate of rehearsal (r)
- A set of items that takes longer to rehearse should be harder to remember
  - more likely that some items will drop out before you get back to the first item
Effect of rehearsal rate

- Explains differences across groups of people
- Age effects in children
- This implies that it is not the loop size that changes with age, but the rate of rehearsal

\[ \text{Span} = 1.68 \times \text{Oral Reading Rate} + 0.71 \]

Word length effect

- Memory span is related to the length of words
  - Number of syllables
- Nicely matched by changes in reading speed
  - Rate of rehearsal

CogLab data

- The CogLab experiment on memory span shows data in agreement with our expectations (169 subjects)

Language effects

- Some languages are spoken more quickly than others
- Should allow larger memory span
  - it does

Relation to IQ

- Ellis & Henley (1980)
  - investigated complaints about WISC intelligence scores
  - Welsh children tended to score lower than English children
- Part of the exam checks memory span
  - and the slower rate of speech in Welsh partly explains the difference
  - bilingual Welsh students tested in English got better scores than when tested in Welsh

Articulatory suppression

- Subject sees (hears) a list of phonemes
- Also repeats a phrase over and over
  - e.g., "tippy-toe, tippy-toe, tippy-toe,..."
- Recall is worse
  - True for both auditory and visual presentation
  - (Recall for visual may be better than auditory because there is some information in the visuospatial sketchpad as well)
Articulatory suppression
- Repeating phrase ties up the ACP
  - Without rehearsal more forgetting occurs

Phonological similarity
- Memory of a list of items is worse when the items sound the same

Phonological similarity
- All items are stored in phonological loop
  - Similar sounding items interfere with each other in the phonological loop
  - Two possibilities:
    » 1) harder to rehearse (effect in the ACP)
    » 2) fade more quickly (effect in the PS)

Locus of similarity effect
- Studies find a phonological similarity effect for auditory stimuli under articulatory suppression
  - We suggested two possibilities:
    » 1) harder to rehearse (effect in the ACP)
    » 2) fade more quickly (effect in the PS)
  - Since the phonological similarity effect is there even when the ACP is not involved, it must be possibility 2 (in the PS)

CogLab data
- The CogLab experiment on phonological similarity shows data in (somewhat) agreement with our expectations (161 subjects)
  - Ideally want parallel lines
Irrelevant speech effect

- Does irrelevant “background” sound affect memory?
  - E.g., studying with the TV on
- Three groups of subjects recall consonants
  - 1) no background  ▶️ best
  - 2) background = nonsense words  ▶️ worst
  - 3) background = noise bursts

The presence of phonemes in the background is critical to the effect
- strong effect when background is spoken in German, even for English speakers
- Suggests that background phonemes interfere in the PS
- Study with classical music if you need something!

Conclusions

- Data accounted for by phonological loop
  - word length effect
  - phonological similarity
  - articulatory suppression
  - irrelevant speech effect
- Don’t listen to lyrical music while studying
  - Classical music is fine

Next time

- Review for Exam 2
- After exam 2
- Encoding specificity
- CogLab on Encoding specificity due
- What to do if you are drunk while studying for an exam.