Working memory

PSY 200
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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

Language effects
- Some languages are spoken more quickly than others
- Should allow larger memory span
  - If 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
- Subjects 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

B F H N
B G P T

Better recall
Worse recall

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 memory span shows data in agreement with our expectations (190 subjects)

CogLab data

- The CogLab experiment on phonological suppression shows data in agreement with our expectations (190 subjects)
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
  2) background = nonsense words
  3) background = noise bursts

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

Irrelevant speech effect

- 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!

Next time

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