Working memory

PSY 200

Greg Francis

Lecture 15

Why there is a gate at the first floor stairway in the Psych building.

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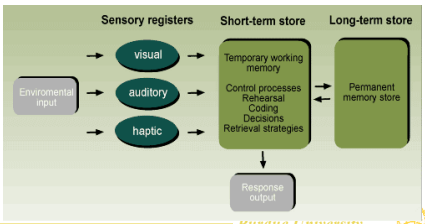
Modal Model of Memory

- Atkinson & Shiffrin (1968)
- Today we focus on the Short-term store (Short term memory)



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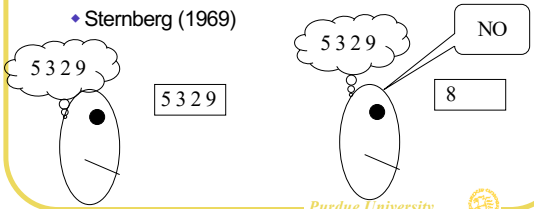
Search of memory

- How is memory searched?
  - Sternberg hypothesized three types of searches
- Explore by varying the number of items in memory set (similar to visual search experiments)
  - measure reaction time
  - Sternberg (1969)



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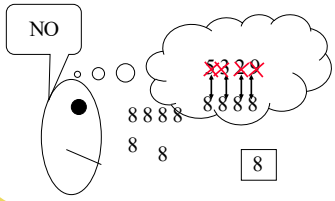
Types of searches

- (1) *parallel*: target item is compared to all the items in memory at the same time
  - the answer (yes or no) is returned after all items have been checked



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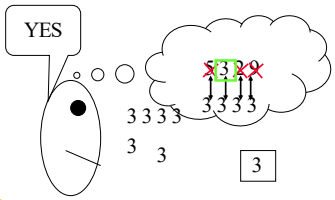

Reaction time is the same for a yes response

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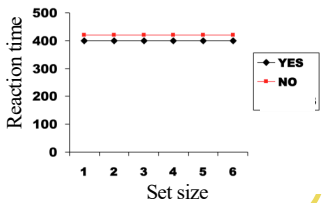
Memory search

- If *parallel search*
  - number of items does not matter
  - Yes and No responses are both flat



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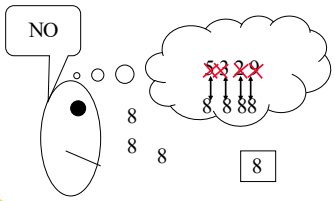
Types of searches

- (2) *serial terminating*: target item is compared to each item one after the other
  - the answer (yes or no) is returned after the target is found or all items are searched



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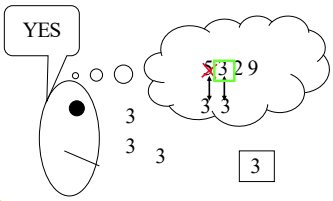

Reaction time is faster for a yes response

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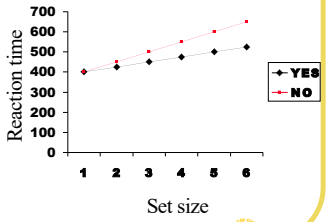
If self-terminating search

- Go through items one-by-one until find target
- RT increases with set size
  - YES RT's shorter than NO RT's
- Lines have different slopes



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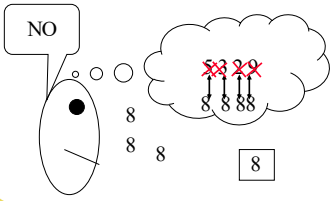
Types of searches

- (3) *serial exhaustive*: target item is compared to each item one after the other
  - the answer (yes or no) is returned after all items are searched (regardless of whether target is found or not)



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Types of searches

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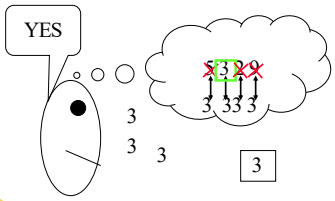

Reaction time is the same for a yes response as for a no response

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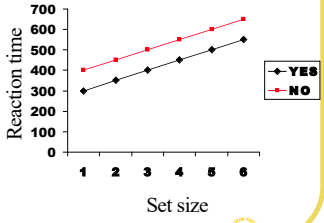
If exhaustive search

- Go through every item and then report answer
- RT's increases with set size
  - YES RT increases the same as NO RT's
- Lines are parallel



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Hypothetical searches

- So, we have three hypothetical ways of searching STM
  - They predict very different patterns of reaction time as a function of memory set size
- Sternberg runs the experiment to see how the data comes out
  - You ran a version of the experiment in CogLab

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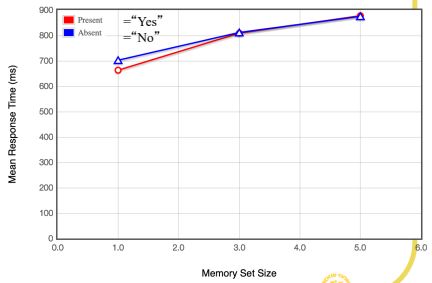
Search of memory

- Sternberg's data support *exhaustive search*
- Here's the CogLab data (153 participants)



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Search of memory

- Implications: Search of STM
  - 1) is serial, one item at a time
    - » and checking each item takes approximately the same length of time
    - » Approximately 40 milliseconds (CogLab data is a bit slower, 49 milliseconds)
  - 2) is exhaustive
    - » search always goes through *all* items

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Search of memory

- These results were a bombshell in 1969
  - finer analysis of cognition than anyone expected was possible
  - used a thought experiment about different types of searches to generate precise testable predictions about cognition
    - » subsequent research found that there were other types of searches that complicate the conclusions
  - counter-intuitive finding
    - » why should search be *exhaustive?*
    - » seems inefficient!

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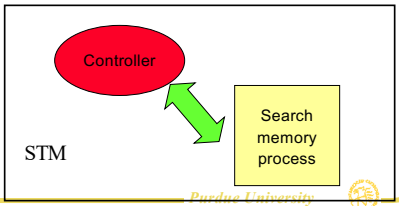
Interpretation

- Exhaustive search makes sense if search of STM is done by some process that is
  - very efficient (can search very quickly)
  - dumb (doesn't bother to stop itself)
  - initiated by some other system (a controller)



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Controller

- Controlling attentional system
  - supervises
  - coordinates
  - starts and stops relatively independent processes
- e.g.
  - Search short term memory
  - Search long term memory
  - walking down stairs
  - gate in psychological sciences building
  - Doors

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Other aspects of STM

- At about the same time, another study indicated important characteristics of phonological and visuo-spatial systems
- Brooks (1968)
  - two types of tasks (visuo-spatial and phonological)
  - two types of responses (visuo-spatial and phonological)
- Identifies two types of systems that are relatively separate

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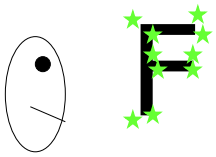
Separate systems

- A complicated experiment
- Part 1: spatial mental task (diagrams)
  - visual imagery
  - classify corners (top or bottom corner?)
  - "yes" if top or bottom
  - "no" if not top or bottom



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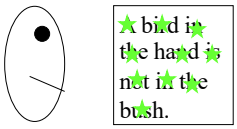
Separate systems

- Part 2: verbal mental task
  - read sentence
  - categorize words (noun or not?)



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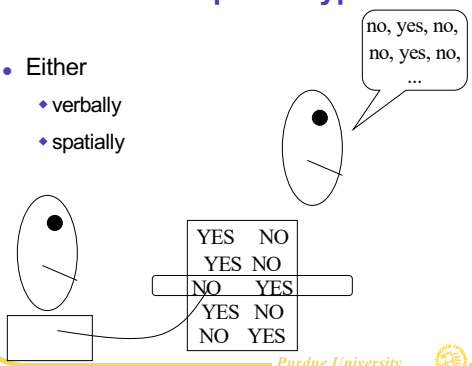
Two response types

- Either
  - verbally
  - spatially



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Results

- Measure time to finish mental task for each response type
  - diagrams -- pointing
  - sentence -- pointing
  - diagrams -- verbal
  - sentence -- verbal

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Results

- Results
  - when you have to respond by pointing, it is easier to work with sentence information than diagram information
  - when you have to respond verbally, it is easier to work with diagram information than sentence information

Response task	Mental task: Diagrams	Mental task: Sentences
Pointing	28.2s	9.8s
Verbal	11.3s	13.8s

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Significance

- The results suggest that there are two relatively separate systems
  - one deals with visuo-spatial information and must do the pointing response and mental diagram task
  - one deals with verbal information and must do the spoken response and the sentence task

Diagrams Pointing | Visuo-spatial information | Verbal information | Sentences Verbal

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Interference

- These system have only limited resources and capabilities
- Asking a system to do two things at once (e.g., pointing and mental diagram) slows down the system
- Splitting responsibilities across the systems (e.g., spoken response and mental diagram) can be done quickly

Diagrams Pointing | Visuo-spatial information | Verbal information | Sentences Verbal

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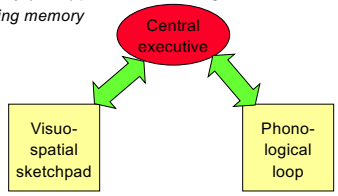
All together now

- Sternberg's study suggests the existence of a "controller" that tells other systems what to do
- Brook's study suggests separate systems that deal specifically with viso-spatial and verbal information, respectively
- Baddley (1986) put these ideas together into a model of *working memory*



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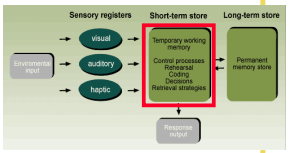
Working memory

- 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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Conclusions

- Sternberg's study
  - controller system
- Brook's study
  - separate visual and verbal systems
- Baddley's working memory model
  - Central executive
  - Visuo-spatial sketchpad
  - Phonological loop

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Next time

- Properties of phonological loop
- Data
  - phonological similarity effect
  - articulatory suppression
  - word length effect
  - irrelevant speech effect
- CogLabs on Memory span and Phonological similarity due!
- *A problem with IQ tests.*

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