Cognition

PSYC 2040

L7: Memory I

Part 1

logistics

assessment 1

- all scores + stats up on Canvas

office hours

- Wed (today, Kanbar 217): 1.15-2.45 pm
- Thurs (virtual): 2-3 pm, 10-12 pm

story time

- go to this link
- read the story to yourself twice at your normal reading pace
- close the tab when you're done

recap

L0: effective study strategies

L1: what is cognition?

L2: mental imagery

L3: eugenics and intelligence testing

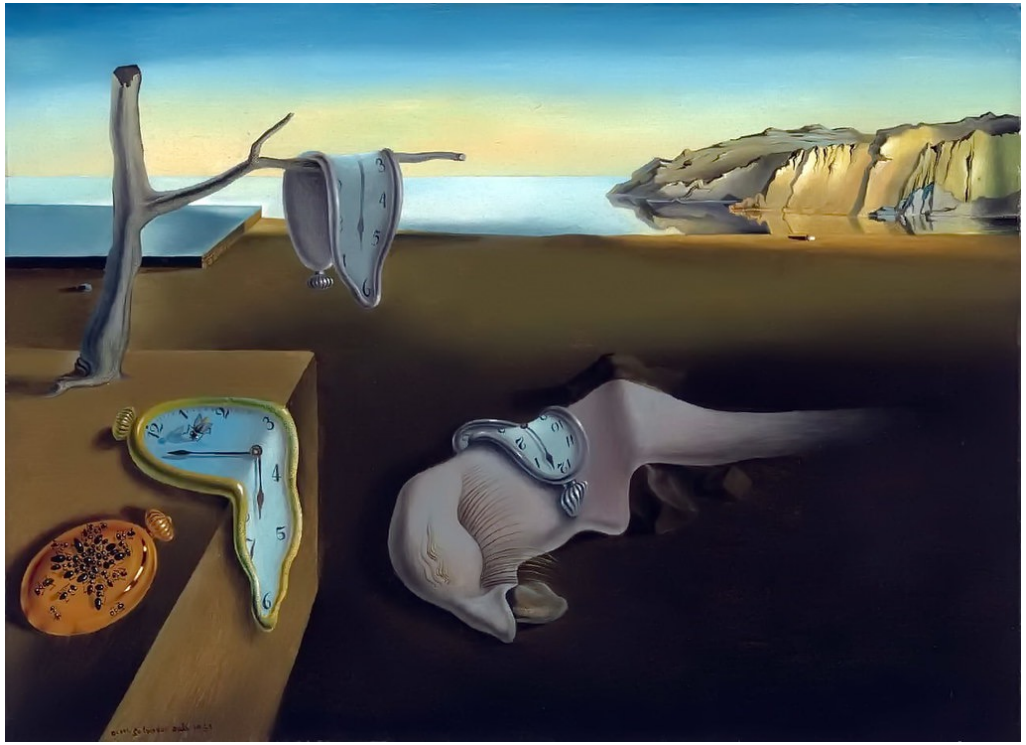
L4: associations

L5: behaviorism

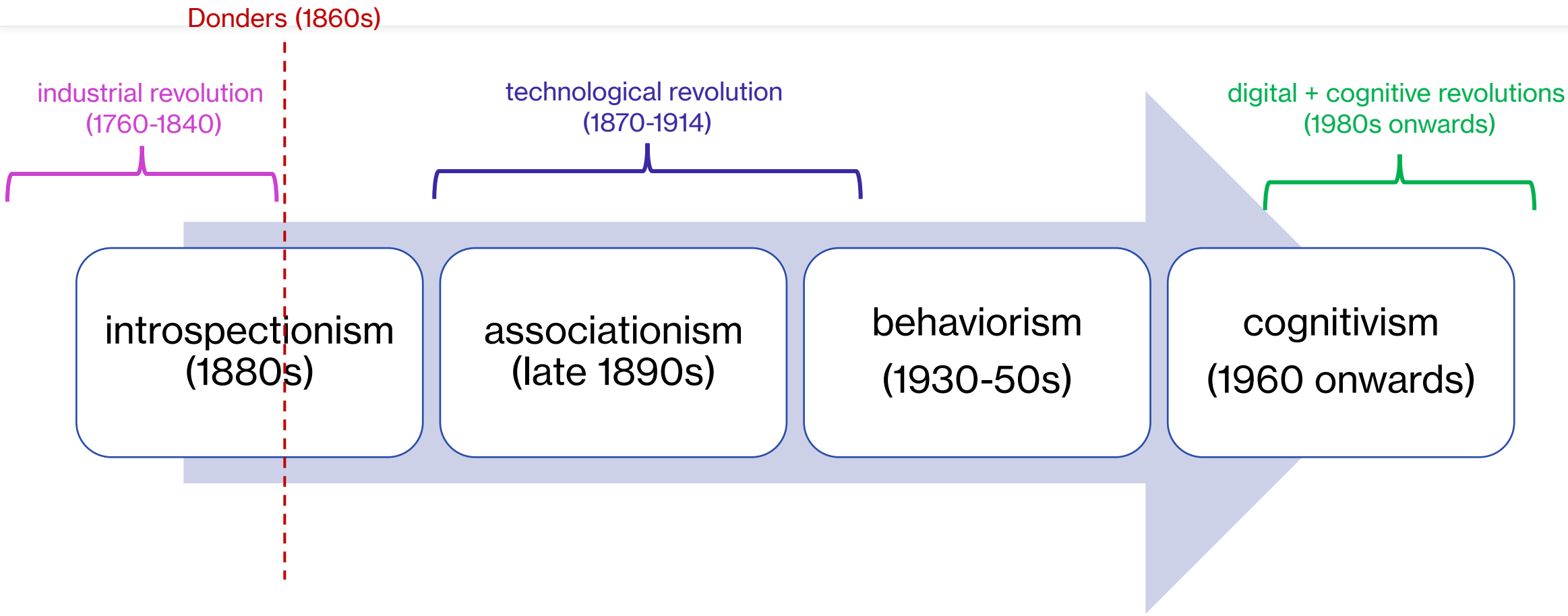
L6: information processing

today’s agenda

- memory
  - information processing
  - remembering and forgetting
  - short-term and long-term memory

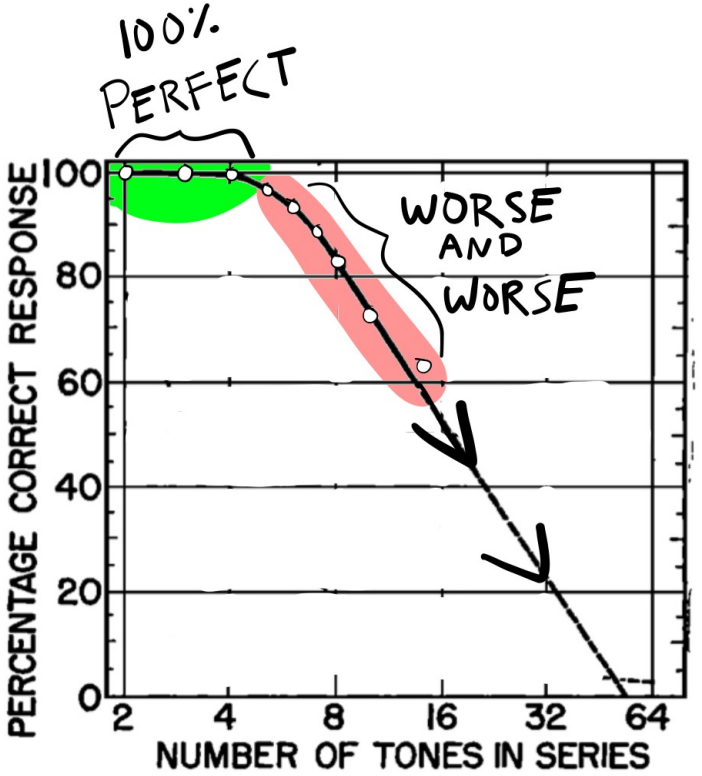


the timeline so far

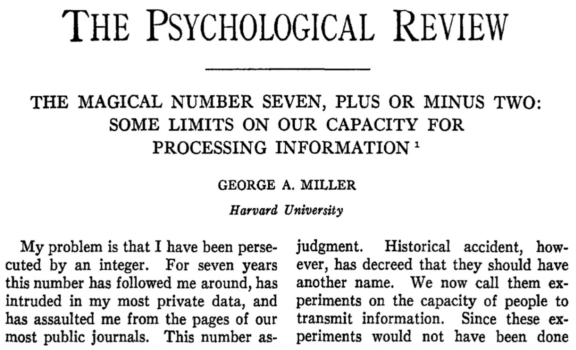


information theory & Miller

- George Miller was interested in the idea of capacity and how it applied to cognitive processing
- he discussed Pollack's (1952) absolute perceptual judgment task where he varied the number of tones in the set and asked people to identify the tone



information theory & Miller



THE PSYCHOLOGICAL REVIEW

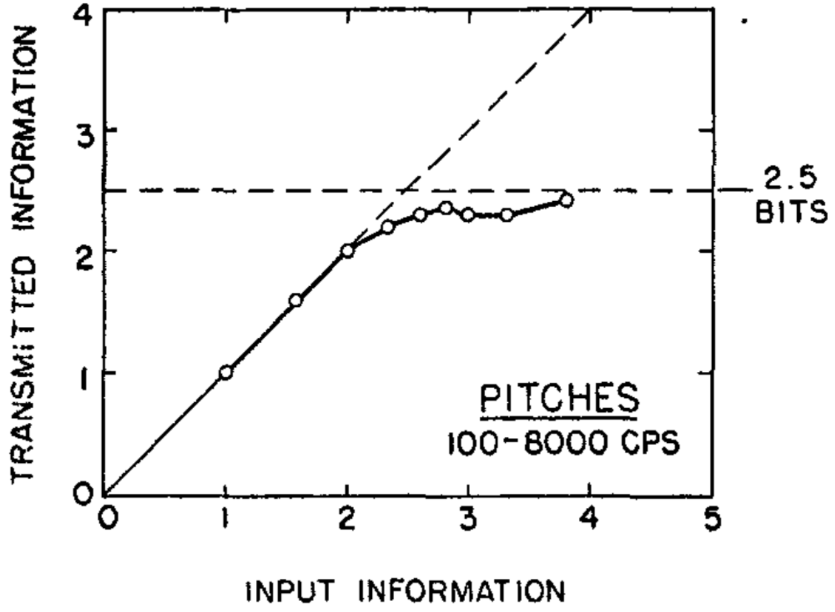
THE MAGICAL NUMBER SEVEN, PLUS OR MINUS TWO: SOME LIMITS ON OUR CAPACITY FOR PROCESSING INFORMATION[1]

GEORGE A. MILLER

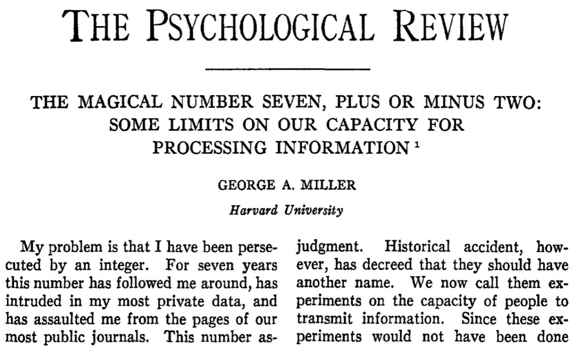
Harvard University

My problem is that I have been persecuted by an integer. For seven years this number has followed me around, has intruded in my most private data, and has assaulted me from the pages of our most public journals. This number as- judgment. Historical accident, however, has decreed that they should have another name. We now call them experiments on the capacity of people to transmit information. Since these experiments would not have been done

- Miller reinterpreted this data by converting the number of tones (alternatives) to bits (as Hick-Hyman did) and also converting accuracy to “transmitted information”
- same data, but different interpretation
- as input information increases, transmitted information reaches a plateau
- the upper bound on transmitted information is called channel capacity ~2.5-2.8 bits = 7



information theory & Miller



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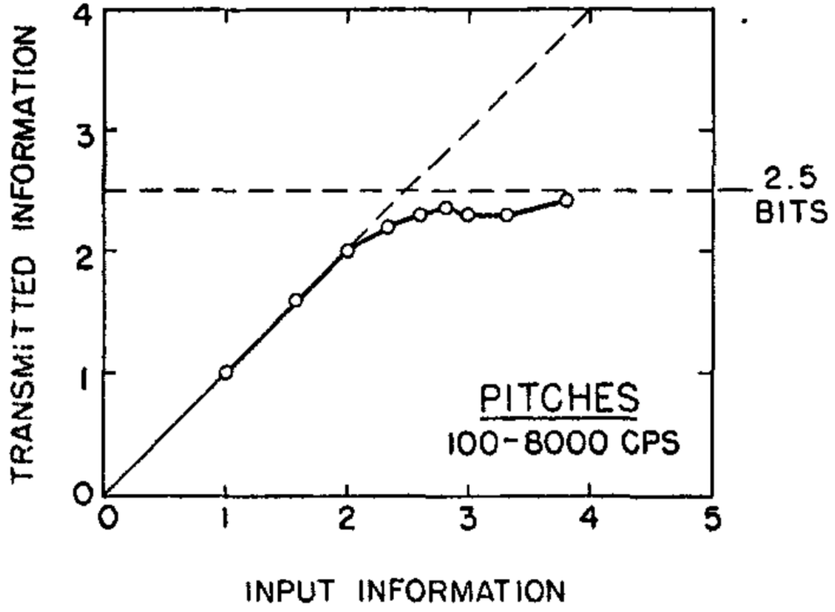
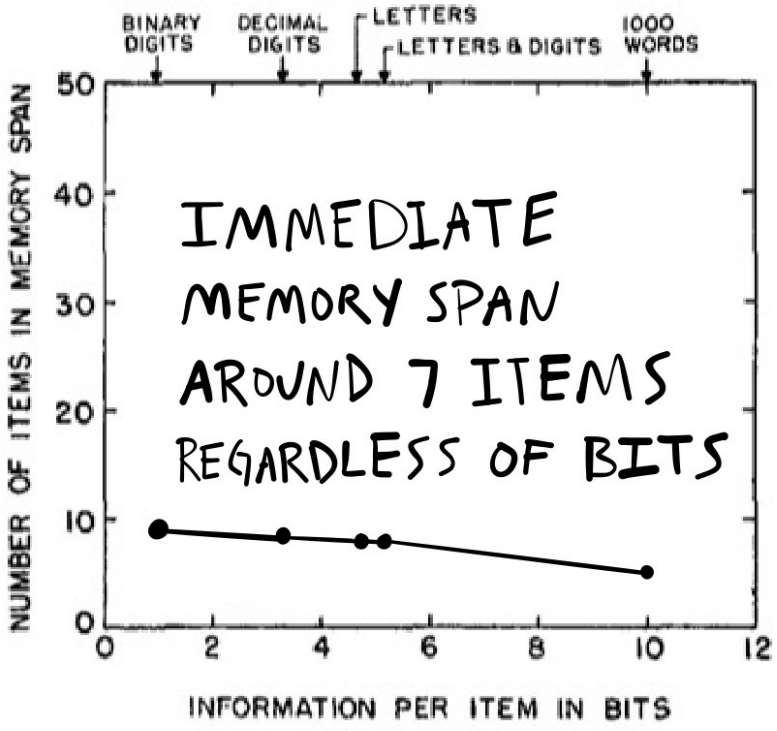
- Miller connected the findings from absolute perceptual judgments to immediate memory span tasks (how many items you can remember over a short period of time) by showing that both tasks seemed to be limited by set sizes of 7
- but…he proposed this idea of limited capacity and then refuted it by showing that chunking enabled us to remember over 7 “things”

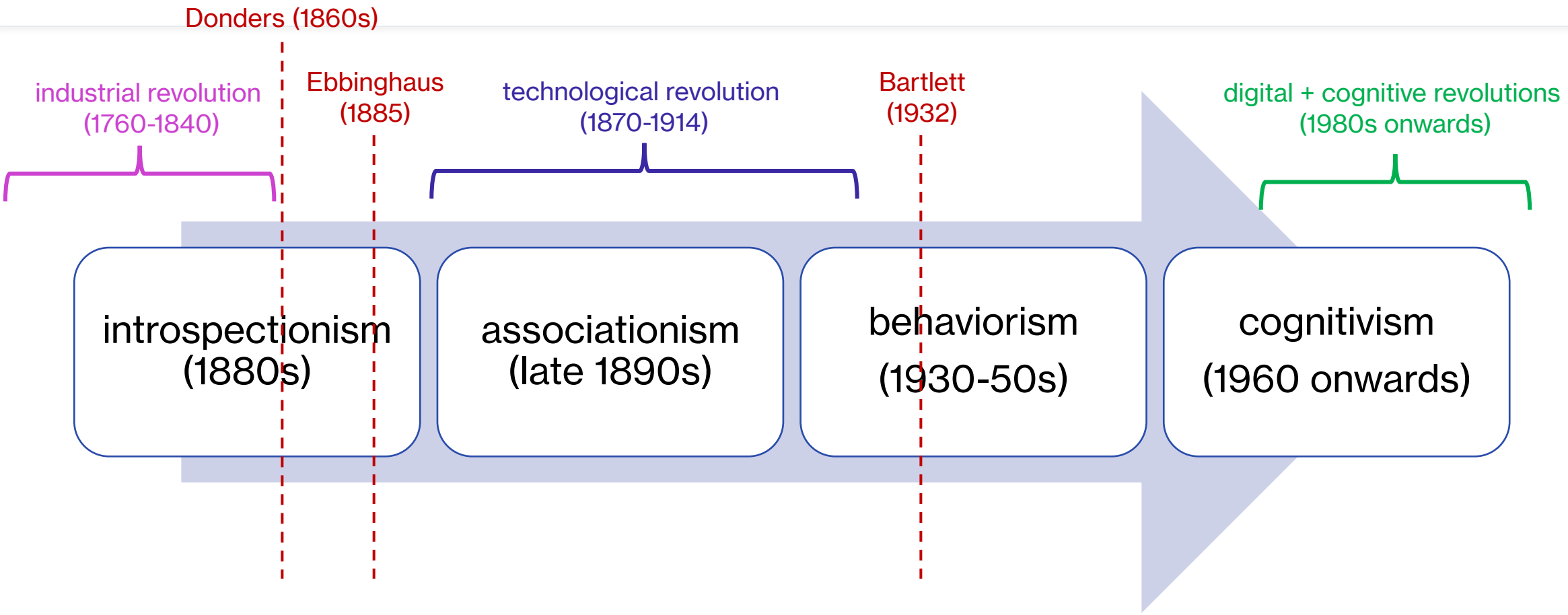


chunks vs. bits

- if bits correctly tracked cognitive capacity, then stimuli with higher number of bits should require higher capacity and lead to poorer memory
  - binary digit (2 possibilities): 1 bit
  - decimal digit (10 possibilities): 3.32 bits
  - letter (26 possibilities): 4.7 bits
- if letters need more bits, then their span should be much lower than binary digits
- but Miller showed that the span remained relatively stable for different stimuli, likely because people recoded stimuli into chunks
- memory capacity was not limited by amount of information but by the number of chunks

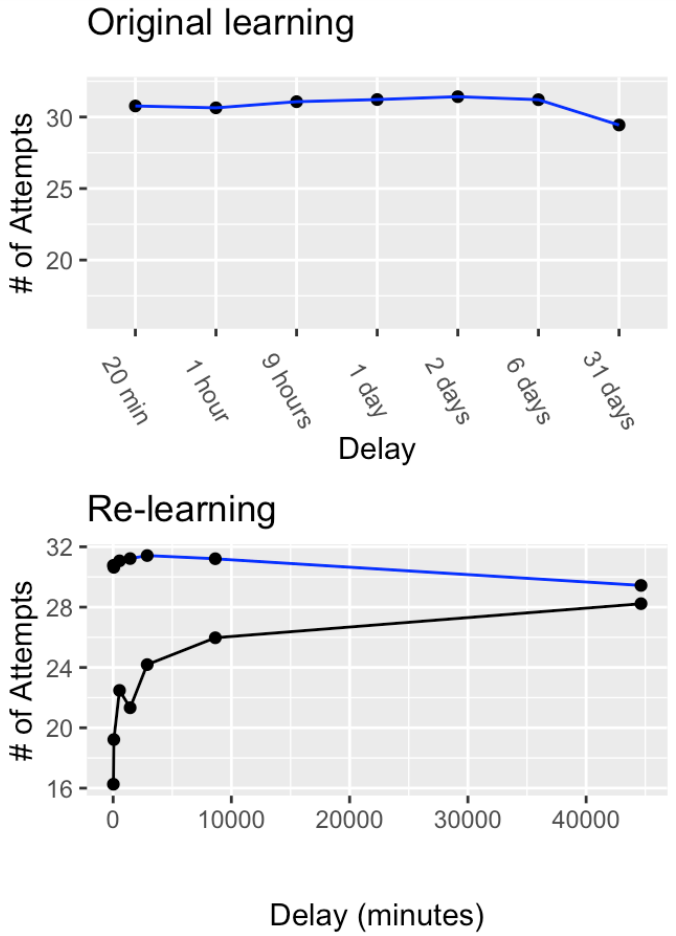


revisiting the timeline



Ebbinghaus' early research

- Ebbinghaus tested the early claims of association via experimental manipulations within the context of learning and forgetting
  - phase one: learn nonsense syllables and recite to criterion
  - phase two: lists relearned after a delay period
- Murre & Dros (2015) replicated this work
- key question: how is forgetting impacted by delay?
- key idea: forgetting decreases over time, i.e., you forget a lot initially and less and less over time
  - form of the function has been debated (exponential vs. power) and recent work favors the power function
  - more in Cognitive Models week!



War of the Ghosts

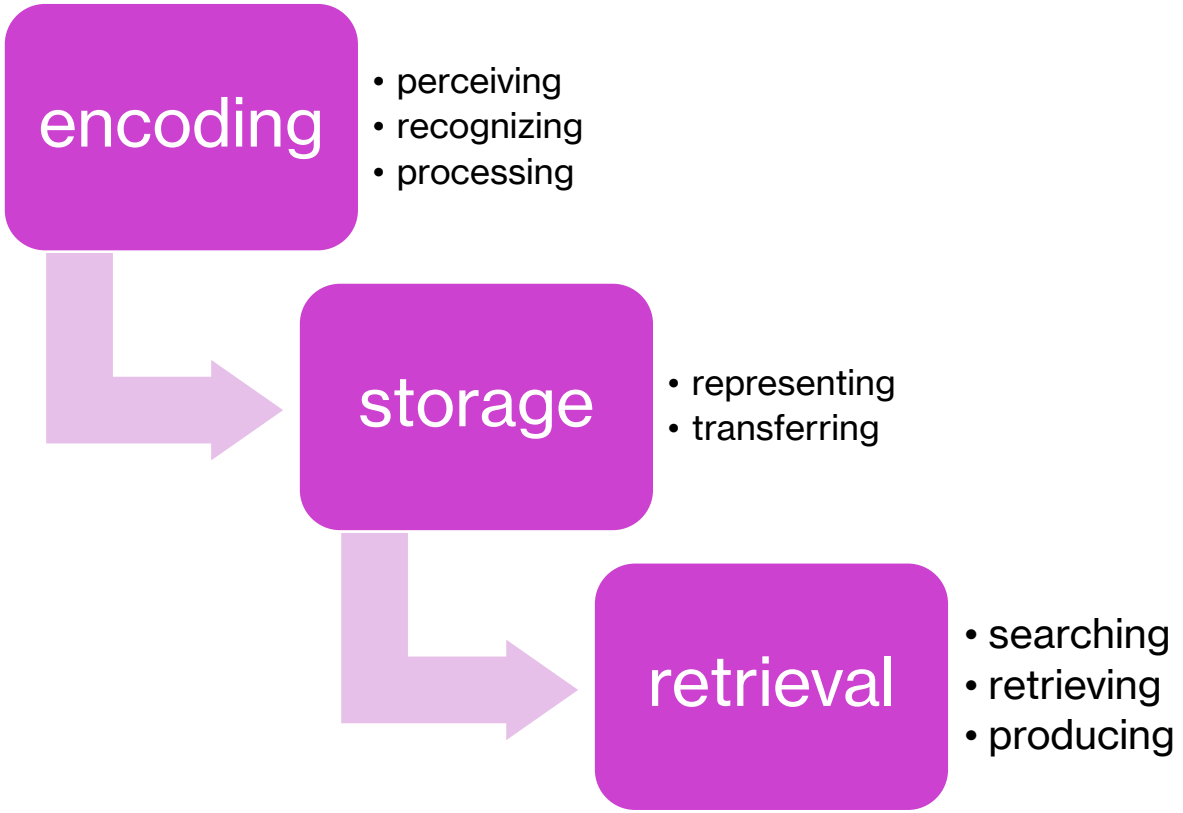
Please write down the story you read earlier as best you can. Please try to reproduce it exactly. It is very important that you be as precise as you can. Try to use exactly the same words as they appeared in the story as much as possible. Where you cannot remember the exact wording, be sure to at least get the facts and events exactly correct. Do not invent facts to make it a better story; imagine that you are giving a statement to a policeman and accuracy is important. If you cannot remember something, don't guess, just leave it blank.

You have about 5 min, should you need it.

Bartlett's re-membering metaphor

- Bartlett proposed a reconstructive view of memory, where memory was not like a camera or a file drawer but instead approximate reconstructions of a past episode
- two tasks, serial reproduction
  - War of Ghosts: participants wrote down a story about indigenous Americans from memory; produced predictable schemas as more time went on
    - Bergman & Roediger (1999) replicated the broad pattern
  - L'Portraite D'homme: participants reproduced a mask drawing from memory; their drawings became more face-like over time
    - Carbon & Albrecht (2012) were unable to replicate this pattern...why?

memory processes



multi-store model

- Atkinson and Shiffrin (1968) proposed a model of memory that explained how memories were encoded, stored, and retrieved
  - environmental stimuli are first converted to representations, which are stored in sensory registers for a brief duration
  - some of this information makes its way to the short-term store, which is also limited in capacity
  - some of the short-term store information is passed down to the long-term store, which has more capacity
- this model was both theoretical as well as mathematical

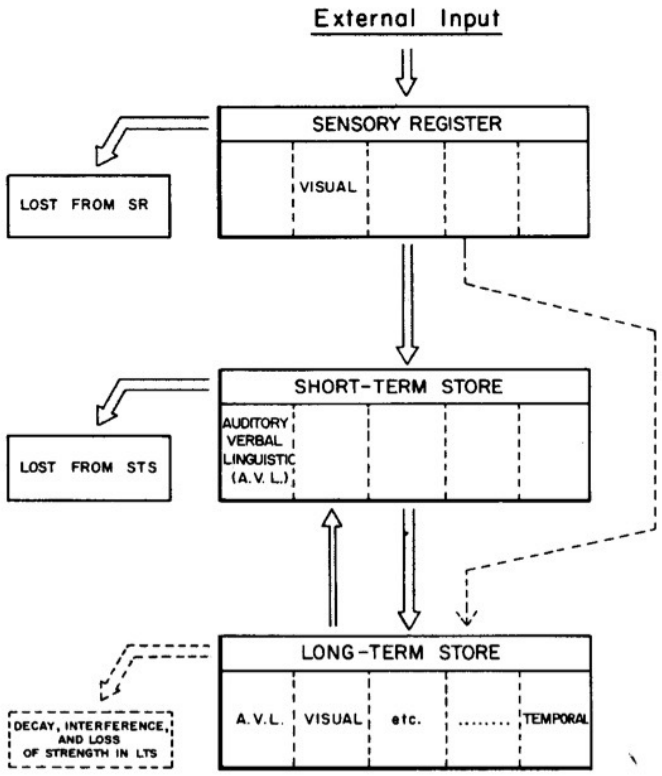


FIG. 1. Structure of the memory system.

multi-store model

- the short-term store is a rehearsal buffer where items can be stored and rehearsed temporarily, and space/capacity is severely limited
- items that stay longer in short-term store have a greater likelihood of being passed to the long-term store
- the long-term store could be affected by decay, interference, etc.

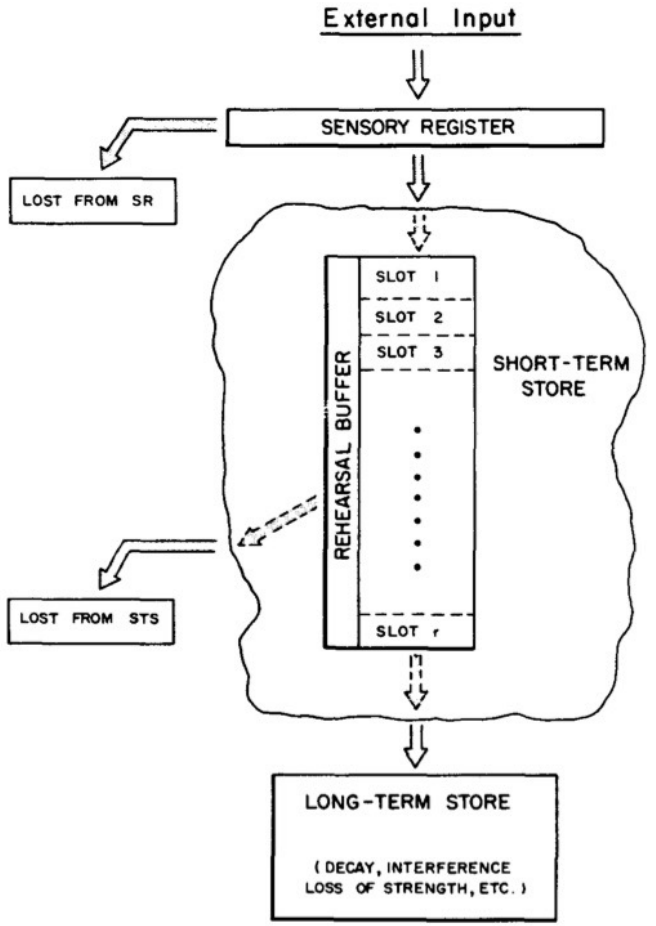


FIG. 2. The rehearsal buffer and its relation to the memory system.

serial position curve

- a serial position curve refers to the U-shaped curve typically obtained from memory experiments where accuracy of recalling words is measured
- serial position effect
  - primacy: recalling first-learned items
  - recency: recalling most recently learned items

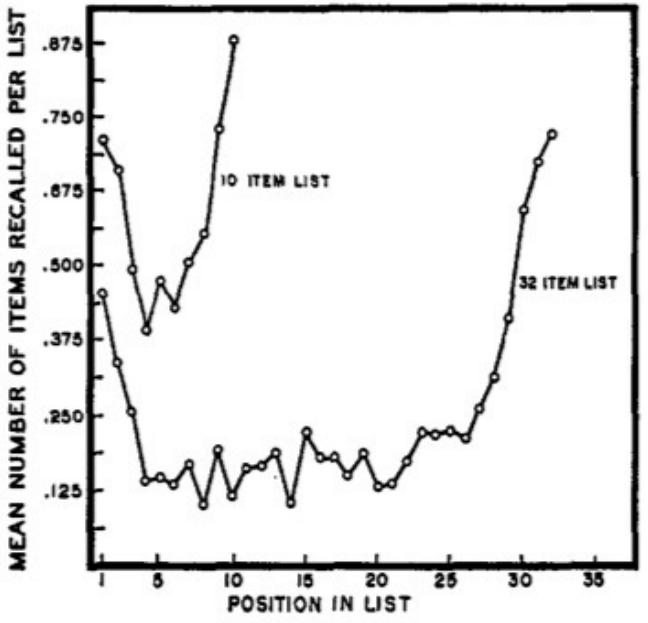


FIG. 1. Mean frequency of recall per list per S for lists of randomly arranged words as a function of position of items in original lists.

multi-store model: serial position effects

- the model provided an explanation for serial position effects
- primacy: the more time items spend in the rehearsal buffer, the more likely they are to be transferred to the long-term store. initially learned items continue to be rehearsed and are more likely to have been transferred to long-term store
- recency: given that the short-term store is limited in capacity, newer items quickly replace older ones, and just before recall, the rehearsal buffer contains the most recently learned items

multi-store model: testable assumptions

- the model provided testable assumptions/predictions
- if rehearsal was eliminated, would you lose the recency effect?
- Postman and Philips (1995) showed that eliminating rehearsal opportunities (by performing arithmetic at the end of the list) removed the recency effect

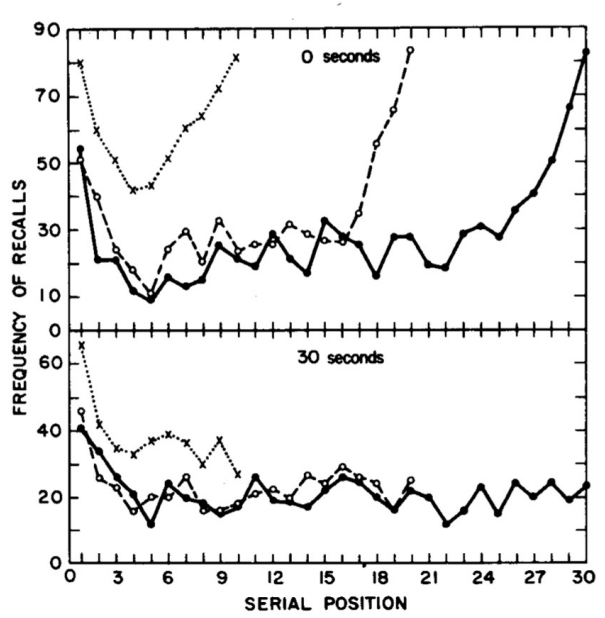


FIG. 28. Probability of correct recall as a function of serial position for free verbal recall with test following 0 seconds and 30 seconds of intervening arithmetic. After Postman & Phillips (1965).

activity: debrief

- you completed a memory experiment before class
- discuss
  - what do you predict your serial position curve to look like?
  - did you use any strategies?

multi-store model: long-term recency

- Tzeng (1973) conducted a memory experiment where participants performed arithmetic after hearing each word
- since rehearsal was prevented, no recency effect should have been observed as per the multi-store model
- the experiment you did was Tzeng's experiment!

your data vs. Tzeng's data

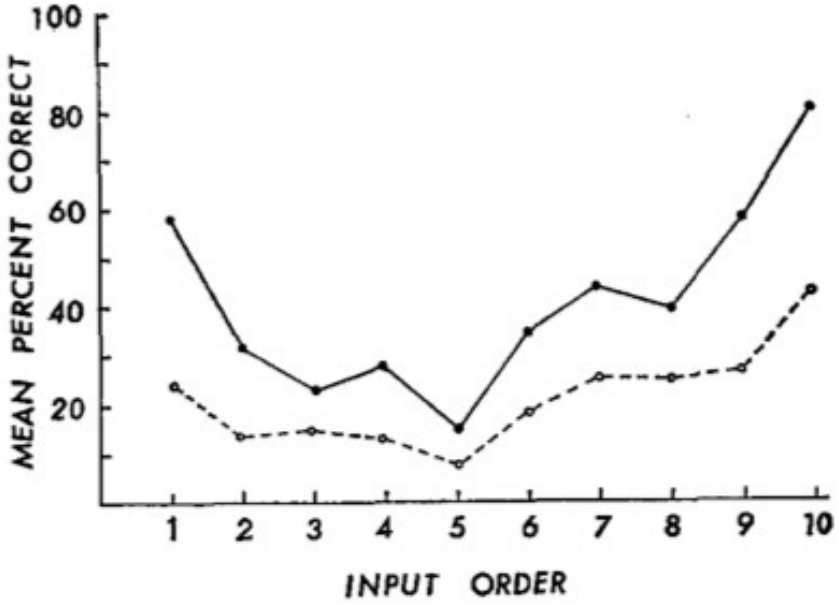


FIG. 1. Mean percent of correct recall on the initial (●—●) and the final (○ - - - ○) free recall as a function of serial positions at input.

math accuracy

multi-store model: long-term recency

- since rehearsal was prevented, no recency effect should have been observed, but it was
- takeaway: short-term rehearsal could not be the only explanation for long-term recency effects
  - strategy, distinctiveness, motivation, context could all influence memory

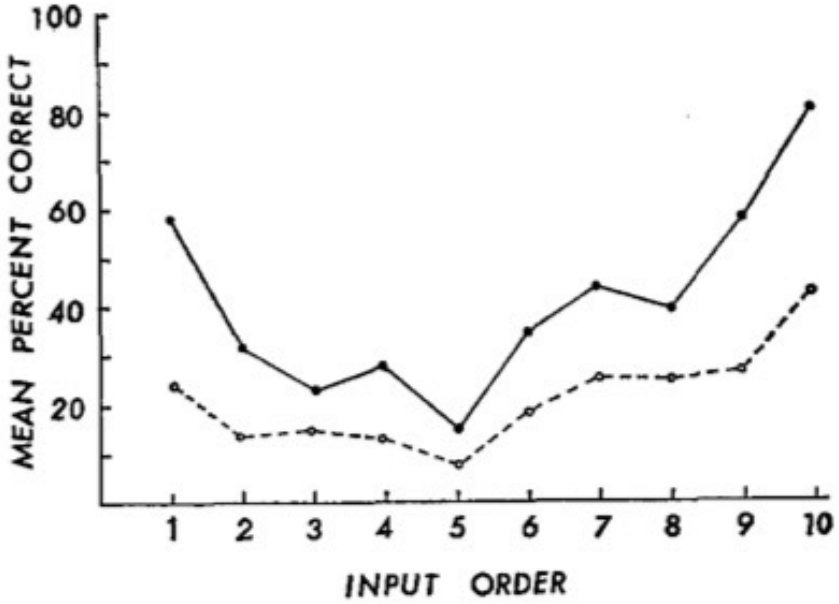
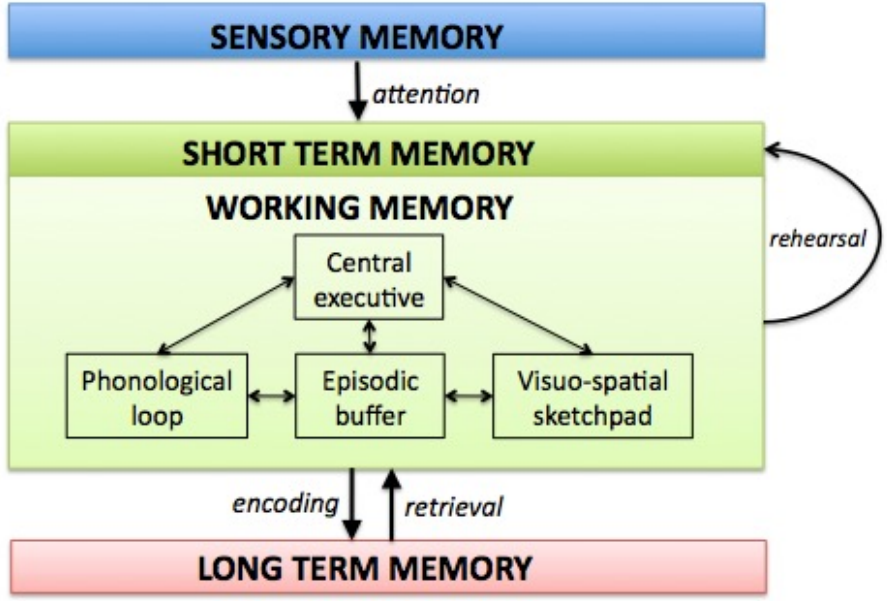


FIG. 1. Mean percent of correct recall on the initial (●—●) and the final (○ - - - ○) free recall as a function of serial positions at input.

newer models of short-term memory

- Baddeley's et al.'s working memory model built upon the multi-store model and expanded on the short-term store via the idea of working memory, which was further broken down into sub-parts
- central executive: responsible for planning and decision-making, inhibiting distracting information
- phonological loop: holding and responding to verbal information
- visuo-spatial sketchpad: maintaining visual and spatial information (e.g., rotation!)
- episodic buffer: integration across the sub-components and connecting with long-term memory



applications?

- ability: performance on working memory tasks (e.g., processing speed) correlates with academic and professional success
- "brain training": limited transfer!
- multitasking: engaging sub-components in multiple tasks may harm productivity
- education: providing information in manageable chunks, with plenty of opportunity for rehearsal and practice
- clinical: targeting specific interventions for impairments to specific components of working memory

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SAGE journals

Do "Brain-Training" Programs Work?

Daniel J. Simons[1], Walter R. Boot[2], Neil Charness[2,3], Susan E. Gathercole[4,5], Christopher F. Chabris[6,7], David Z. Hambrick[8], and Elizabeth A. L. Stine-Morrow[9,10]

Abstract

In 2014, two groups of scientists published open letters on the efficacy of brain-training interventions, or "brain games," for improving cognition. The first letter, a consensus statement from an international group of more than 70 scientists, claimed that brain games do not provide a scientifically grounded way to improve cognitive functioning or to stave off cognitive decline. Several months later, an international group of 133 scientists and practitioners countered that the literature is replete with demonstrations of the benefits of brain training for a wide variety of cognitive and everyday activities. How could two teams of scientists examine the same literature and come to conflicting "consensus" views about the effectiveness of brain training?

Based on this examination, we find extensive evidence that brain-training interventions improve performance on the trained tasks, less evidence that such interventions improve performance on closely related tasks, and little evidence that training enhances performance on distantly related tasks or that training improves everyday cognitive performance. We also find that many of the published intervention studies had major shortcomings in design or analysis that preclude definitive conclusions about the efficacy of training, and that none of the cited studies conformed to all of the best practices we identify as essential to drawing clear conclusions about the benefits of brain training for everyday activities. We conclude with detailed recommendations for scientists, funding agencies, and policymakers that, if adopted, would lead to better evidence regarding the efficacy of brain-training interventions.

https://doi.org/10.1177/1529100616661983

short- and long-term memory

- newer work challenges the idea that short-term and long-term memory is homogenous (may have subcomponents and could be influenced by multiple cues and contexts)
- the idea of short- and long-term memory is a central theme in cognitive science and alludes to a distinct/multiple memory systems approach, similar to biology
- an alternative perspective in the field is that memory is a single system of episodes and all retrieval & knowledge emerges from this store, e.g., "instance-based" theory of memory

big takeaways

- jot down the key ideas and concepts from today **from memory**

next class

- **before** class:
  - *finish:* L7 readings
- **during** class:
  - memory research today!