Cognition: Methods and Models

PSYC 2040

L7: Memory I

Part 1

story time

- read the story to yourself twice at your normal reading pace
- turn the sheet over when you are done

logistics: March survey (1 extra credit)

- fill out: https://forms.gle/S7NqBMmSqEbzpXA37
  - submit completion code on Canvas
- due March 29 (Wed), 10 am
- very short (5 questions)
- a jumping-off point for discussion with Katie Byrnes on Thursday

project milestones overview

milestone #1: project & partner selection	milestone #2: instance of cognition	milestone #3: article QALMRI	milestone #4: project plan/outline	milestone #5: project first draft	milestone #6: final submission
Feb 12 individual reflection, jointly written contract	Feb 19 joint selection, individual reflection	Mar 5 jointly written QALMRIs of articles	Apr 2 jointly written plan/outline for project	Apr 30 jointly created first draft	May 14 jointly created final project

logistics: project milestones

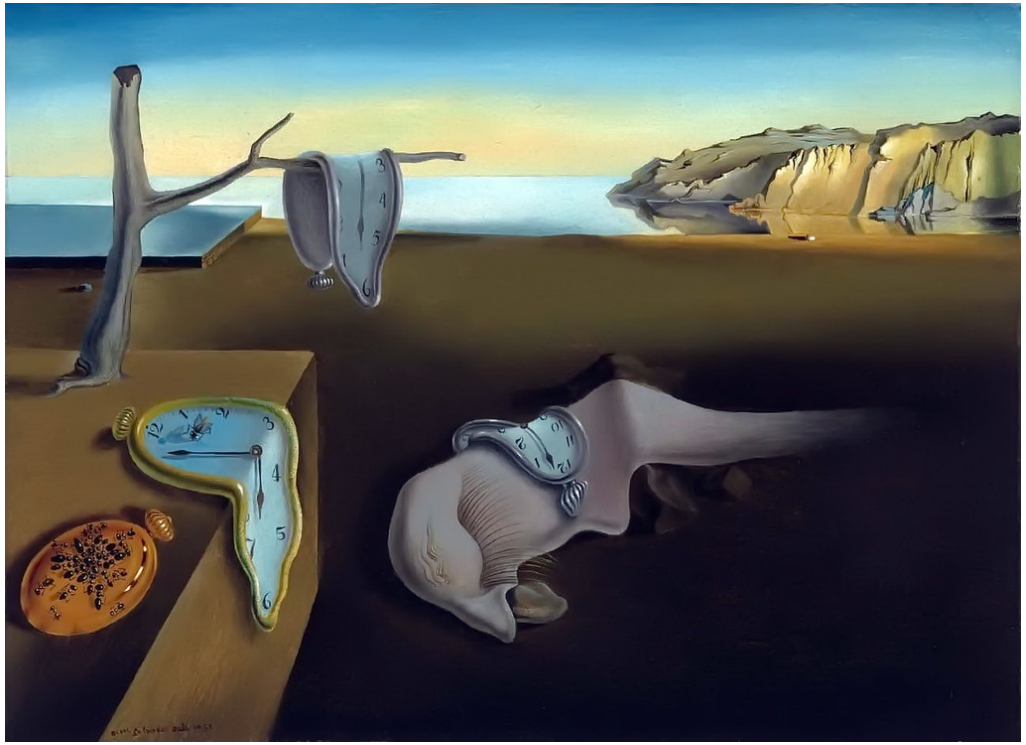
- milestone #3
  - feedback has been provided on chosen articles
  - some groups had disproportionate work assessments
  - please make sure you communicate openly and reach out if you are struggling
- milestone #4
  - due April 2, midnight
  - requires a plan for your project, refer to Google Doc
    - most projects require a big and specific question
    - some projects require design / visualization
  - self/peer assessment

recap: before break

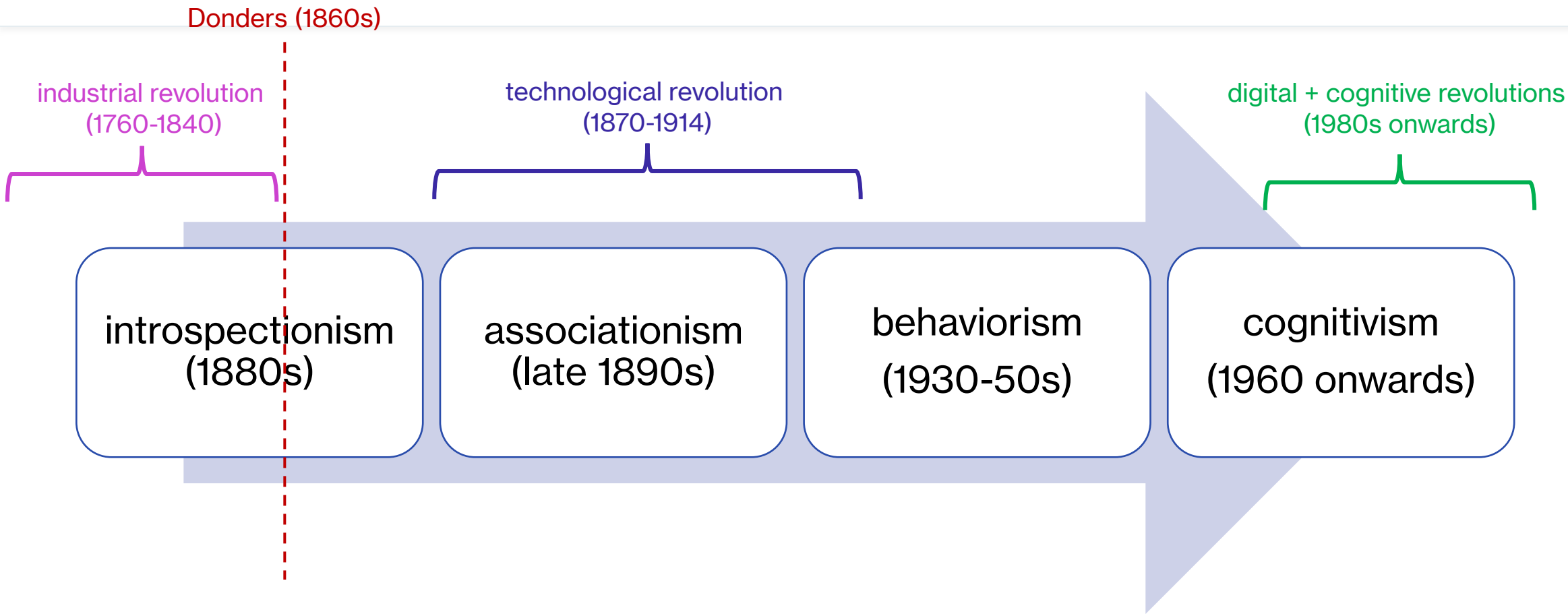
- what we covered:
  - L0: getting started
  - L1: what is cognition
  - L2: mental imagery
  - L3: eugenics and intelligence
  - L4: associations
  - L5: behaviorism
  - L6: information processing

today’s agenda

- memory
  - information processing revisit
  - remembering and forgetting



the timeline so far



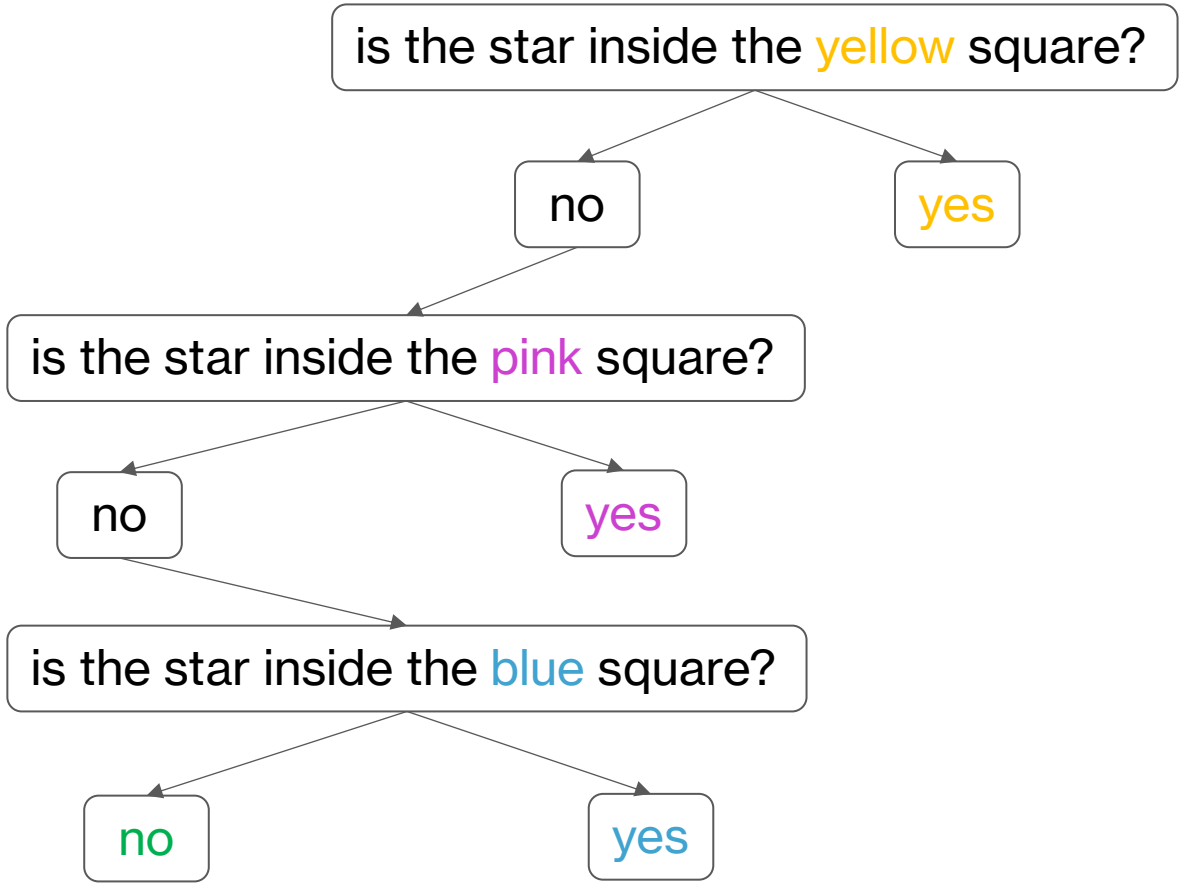
information theory recap

- before the break, we discussed how information theory influenced the study of cognition through the telephone/channel metaphor
- we first discussed the idea of entropy
  - what is entropy?
  - how is entropy related to the probability of an event happening?
- next, we discussed the idea of bits
  - how is entropy related to bits?
  - how are bits related to cognition?

the return of the bit

- let's play a game in groups of 3 (knower, asker, recorder)
  - earliest (knower) to latest (recorder) birthday in the year
  - each group will be presented with a sheet of paper with 4 or 8 squares
- knower:
  - one of the squares will have a star
  - only you know the location of this star (go to this sheet, KNOWERS ONLY!)
- asker
  - you will not know which of the squares contains the star
  - you can ask N yes/no questions to determine where the star is
- recorder
  - record whether or not N yes/no questions were sufficient to determine the star's location
  - record what would have happened if the answer to one of the yes/no questions would have been different

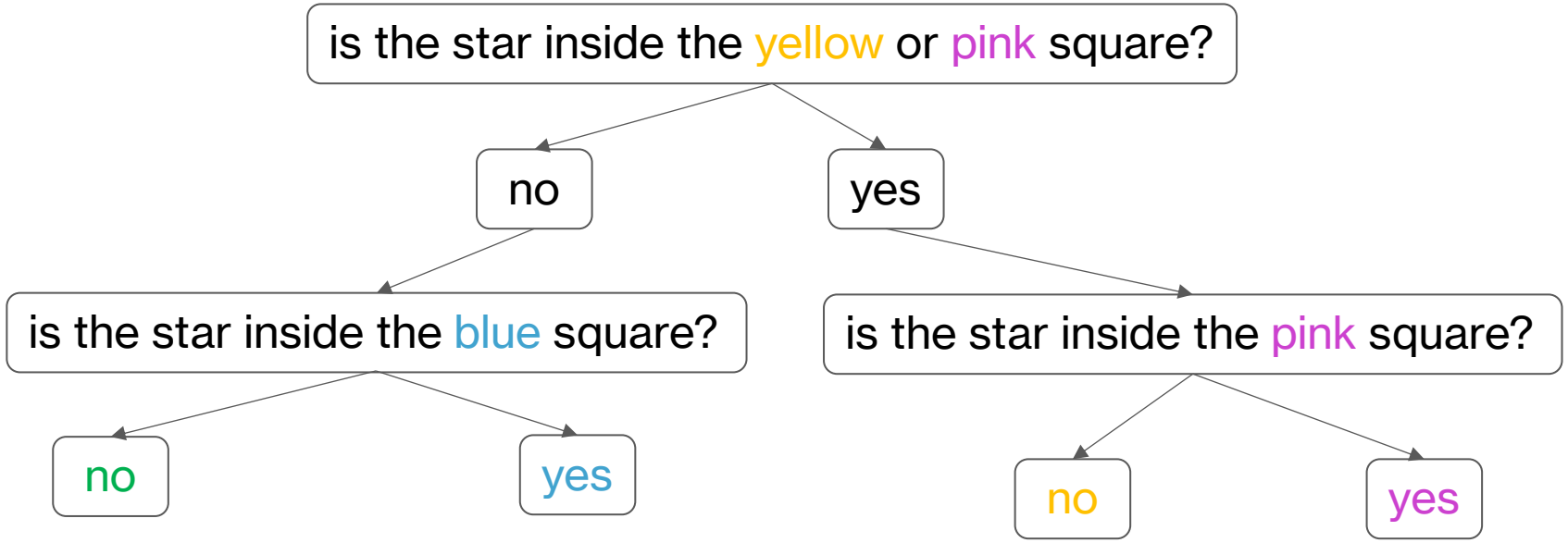
activity inspired from https://www.youtube.com/watch?v=6HCFOyZI9tA



3 yes/no questions for a certain answer to the star's location

can we reduce this number??

activity inspired from https://www.youtube.com/watch?v=6HCFOyZI9tA



we can achieve the answer by asking only 2 yes/no questions!
this is called binary logic (which is also one of the explanations for how people may identify stimuli in a choice reaction time task: Hick Hyman)

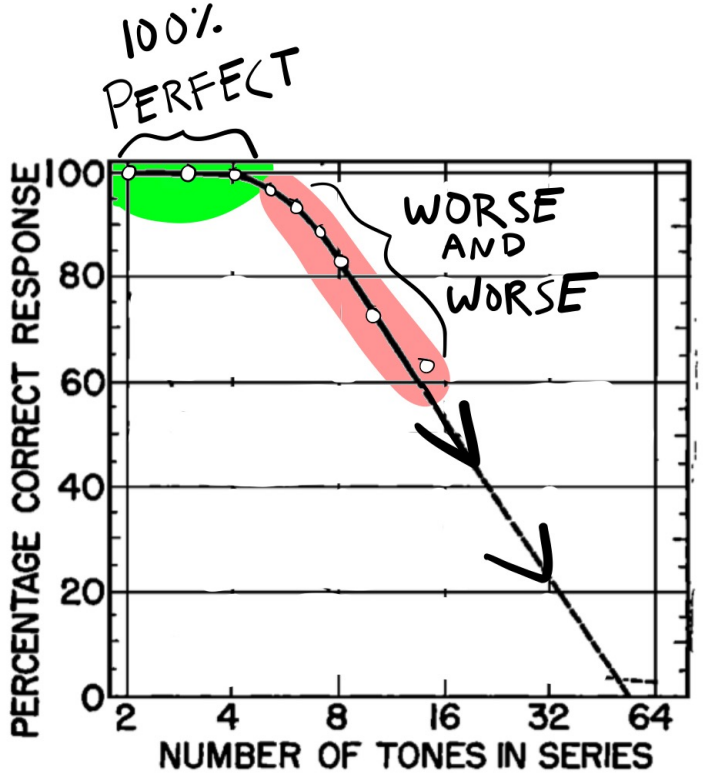
activity inspired from https://www.youtube.com/watch?v=6HCFOyZI9tA

bits activity: debrief

- the “squares” in this game could be considered “events” with equal probability
  - the star is equally likely to be in any one of the squares
  - 1 bit is equivalent to 1 yes/no question
  - #events = $2^{\#bits}$; 4 squares need 2 bits
  - bits represent a lower bound on how many “questions” need to be asked to fully reveal a message
- in communication, we want to know how many bits are needed to convey a particular message because channel capacity (how many bits can be used) is limited
  - if you had a channel capacity of 2 bits, you could only ask 2 yes/no questions
- internet/broadband speeds are encoded in bits!
  - “mbps” stands for megabits per second (1 million bits per second)
  - this refers to the channel capacity, i.e., how many bits can be transmitted in one second
- bits in cognition: “information” contained in a set of stimuli

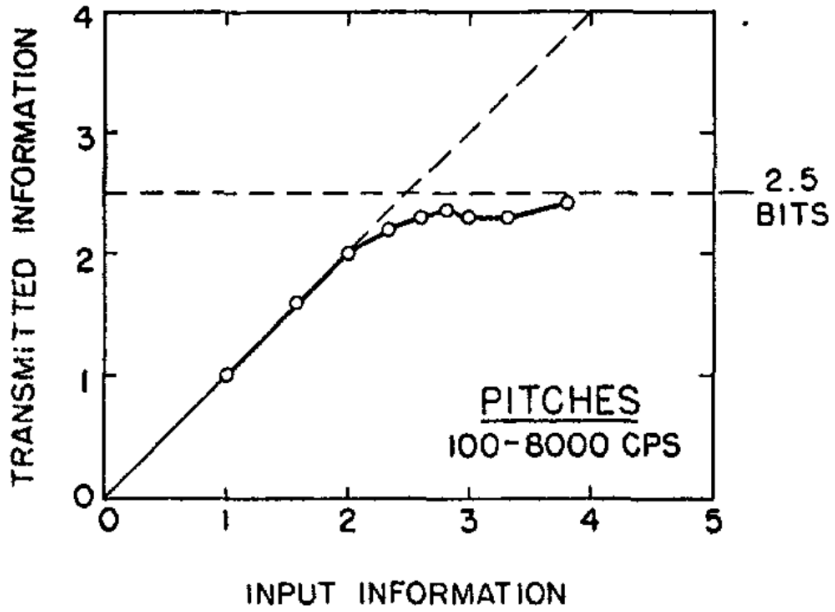
information theory & Miller

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



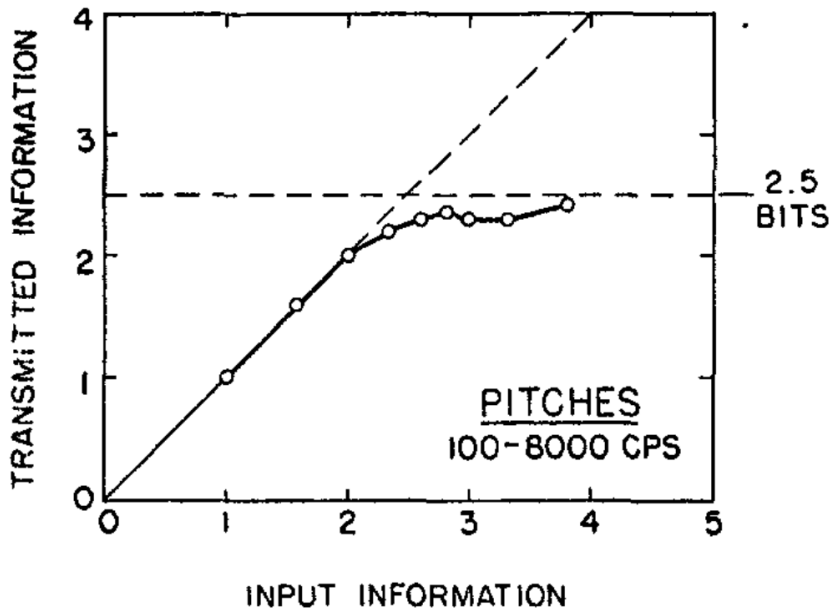
information theory & Miller

- 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



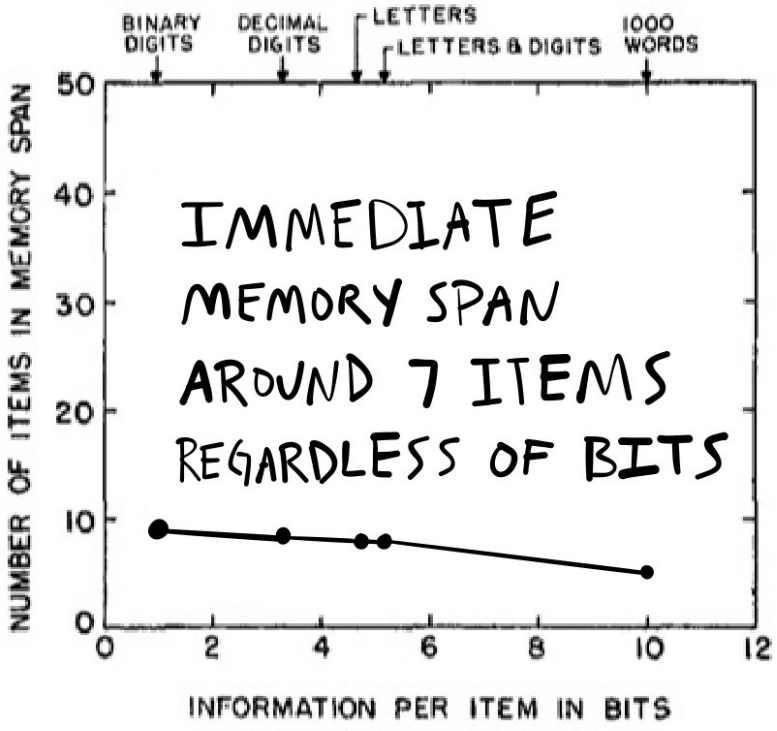
information theory & Miller

- 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”

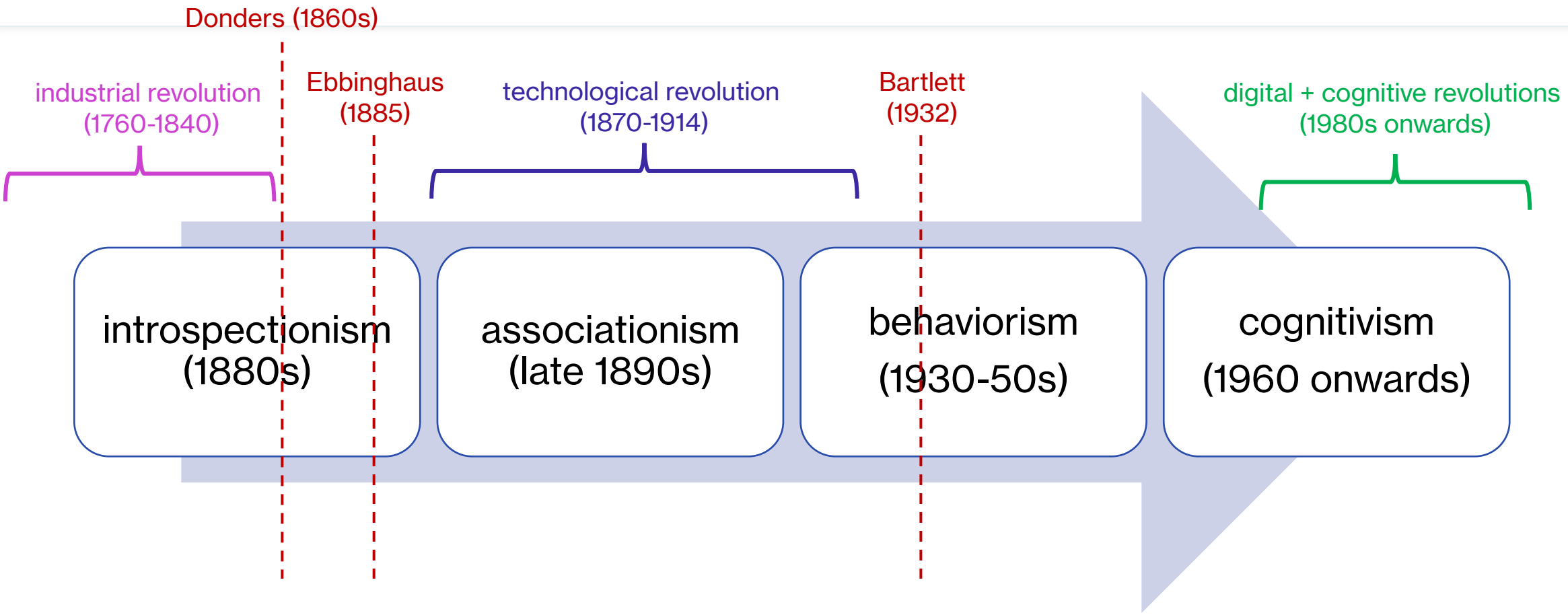


chunks vs. bits

- 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

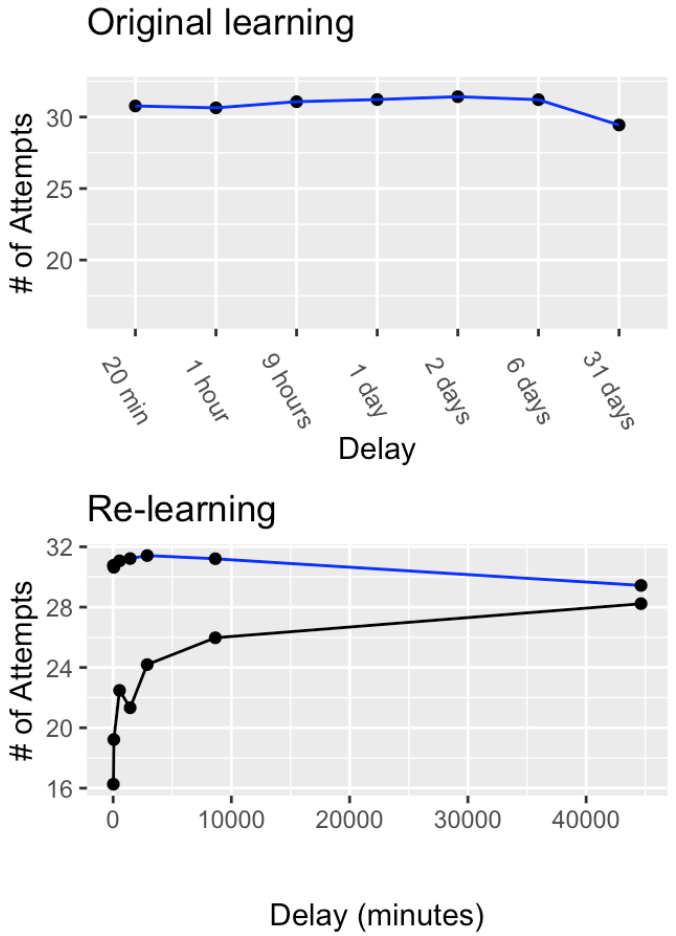


revisiting the timeline



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.

Turn in or email me your story

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?

big takeaways

- bits are the smallest unit of information
- Miller drew parallels between the absolute perceptual judgment task (varied number of tones) and the immediate memory span task (varied stimuli) and showed that memory capacity was not limited by information (bits) but by the number of chunks
- the study of memory has early roots in associationism and researchers continue to remain interested in the mechanisms underlying remembering (reconstructive) and forgetting (high initial loss, lesser loss over time)

next class

- **before** class:
  - *fill out*: short march survey (extra credit)
    - https://forms.gle/S7NqBMmSqEbzpXA37
    - there will be more active discussion with Katie Byrnes (BCLT)
  - *finish:* L7 readings
  - *post*: conceptual question
  - *work on:* project milestone #3 feedback + milestone #4
- **during** class:
  - short and long-term memory
  - Katie Byrnes visits!