Cognition

PSYC 2040

L4: Associations

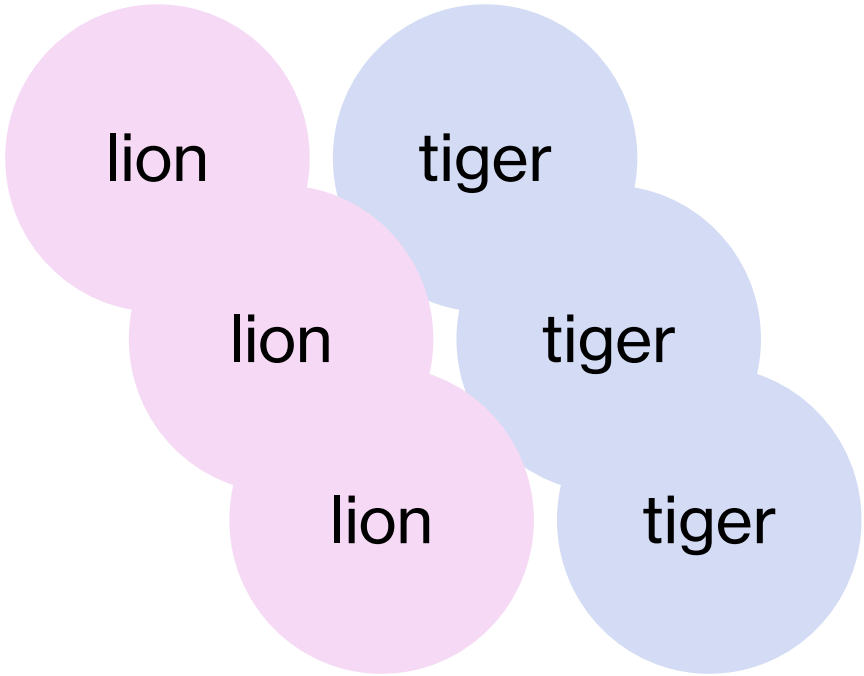
Part 1

recap

- what we covered:
  - L2: mental imagery
  - L3: the eugenics movement & intelligence testing
- your to-dos were:
  - *complete:* L2/L3 quiz
  - *explore:* L2/L3 writing assignments
  - *read:* L4 (Associations) chapter

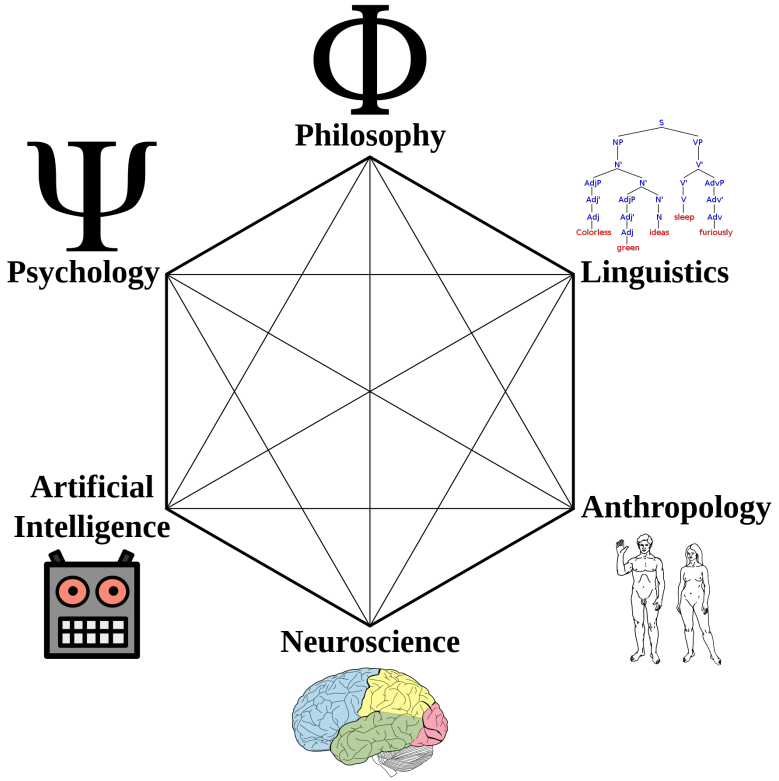
today's agenda

- origins of associationism
- Cattell's reaction time studies
- Thorndike's puzzle boxes
- associative learning today



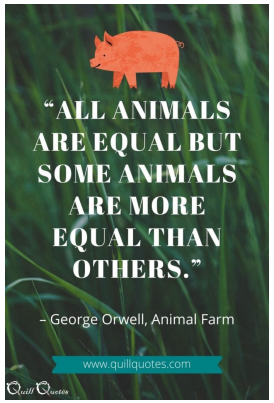
origins: what came before psychology?

- psychology was born out of other attempts to understand human and animal nature in different fields, such as philosophy, natural science, and evolutionary biology
- even today, “cognitive science” is considered a largely interdisciplinary effort to understand the mind



origins: animism/anthropocentrism

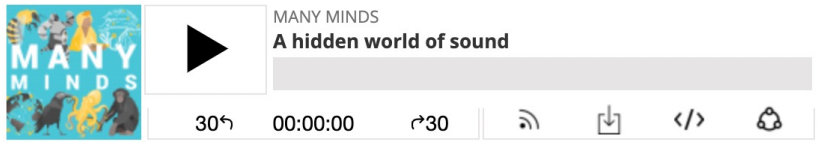
- anthropocentrism
  - Ancient Greek origins
  - humans are the most important entity in the universe
  - wide implications for how we live: environment, religion, human/animal rights, science
- animism
  - spiritual essences to things
  - can animals be understood as humans?



On anthropomorphism in science

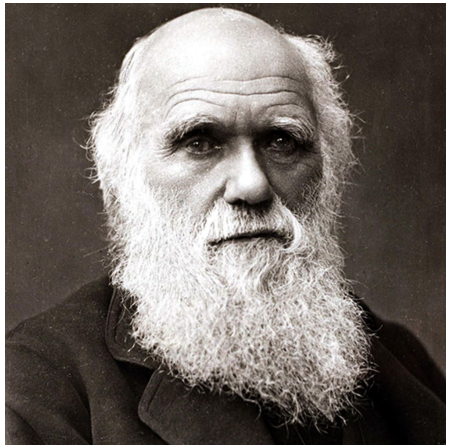
(Delivered at The Philosophers' Lunch, 25 September 1985)

Dijkstra, 1985



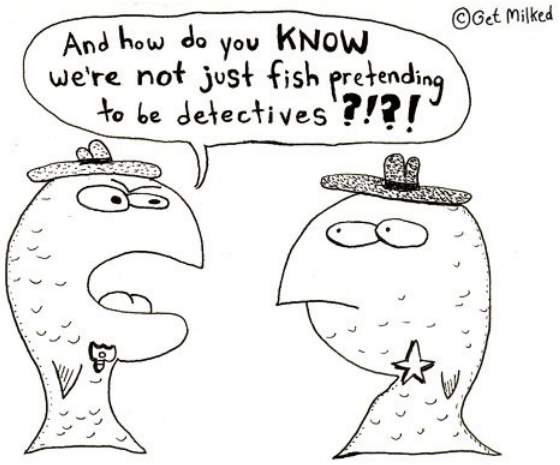
origins: natural science/evolution

- Robert Hooke
  - came up with the word “cell”
  - proposed a model of human memory that worked as a physical system with some influence of immaterial forces
- evolution
  - Charles Darwin’s theory of evolution
  - proposed the “crazy” idea that humans = animals



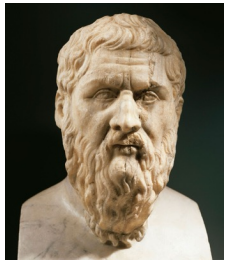
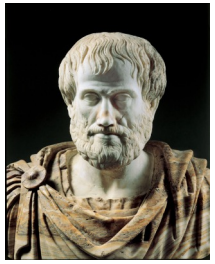
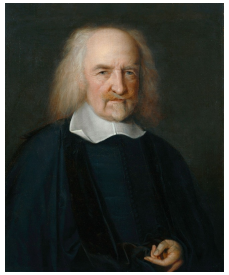
origins: philosophy

- epistemology: how do we **know** things?
- rationalism: knowledge is based on logic & reasoning
  - Descartes (“I think therefore I am”)
- empiricism: knowledge is gained from observation
  - people collect evidence to form knowledge structures
  - how do we process incoming information?



origins: associationist ideas

- prominent thinkers:
  - Plato: briefly discusses this in *Phaedo* about how ideas are recalled in connection to others
  - Aristotle: talks about the “act of reminiscence” in On Memory
  - Thomas Hobbes: what is already on our mind influences what comes next
  - John Locke: “association of ideas”, somewhat arbitrary
  - David Hume: “treatise on human nature”: alluded to certain principles that govern what comes to mind
- Associationist School: a collection of thinkers who contemplated on the nature of mental processes and associations

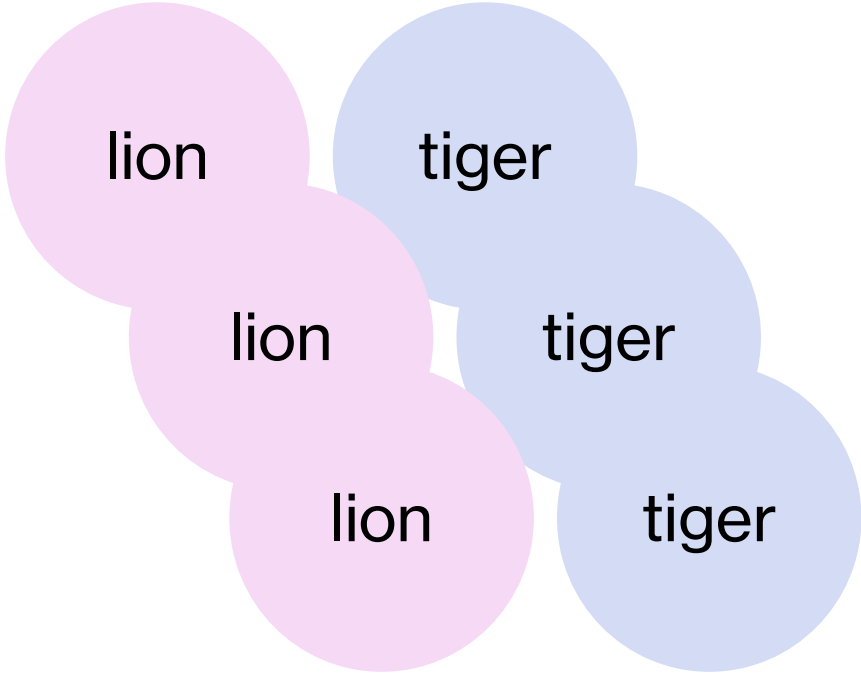
what is association?

Nobody has responded yet.

Hang tight! Responses are coming in.

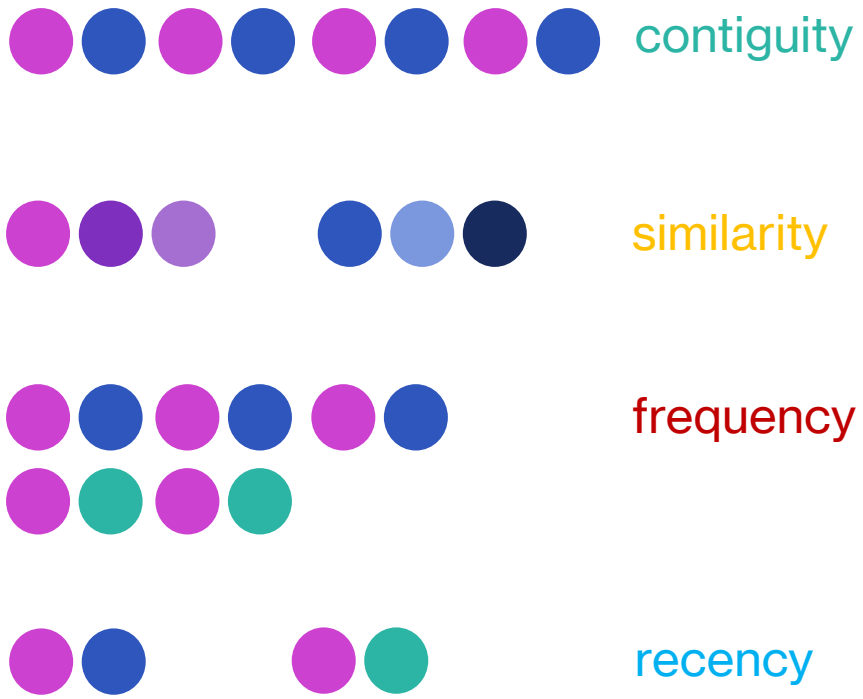
what is association?

- association is simply the relationship between any two entities
- these entities could be events, things, concepts, ideas, people, etc.
- philosophers came up with several laws/principles that provided intuitions for why some things tend to be associated or bring other things to mind



principles/laws of association

- contiguity: if events occur in proximity to each other in space/time, then the reoccurrence of one event will bring to mind the other event
- similarity: the more characteristics events share, the more likely they are to develop stronger associations
- frequency: the more frequently events co-occur, the stronger the association
- recency: the more recent an event is, the stronger is its association

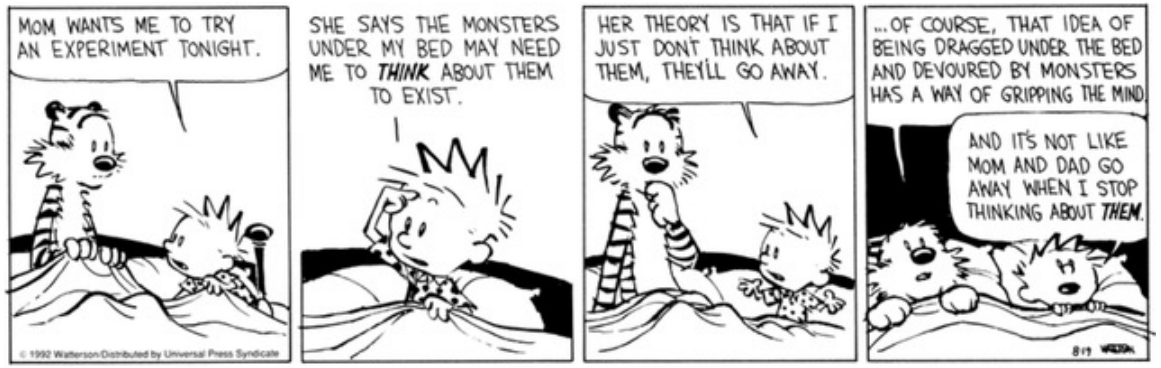


activity: brainstorm some examples

- in pairs, think about 1-2 examples for each type of law/principle
  - contiguity: if events occur in proximity to each other in space/time, then the reoccurrence of one event will bring to mind the other event
  - similarity: the more characteristics events share, the more likely they are to develop stronger associations
  - frequency: the more frequently events co-occur, the stronger the association
  - recency: the more recent an event is, the stronger is its association
- come back and debrief

testing ideas about associations

- the laws/principles were hypothesized by early philosophers but not actually put to the test
- but you could evaluate these claims
  - people have associations
  - you can learn associations
  - some associations are stronger than others
- how do the laws/principles map onto these claims?

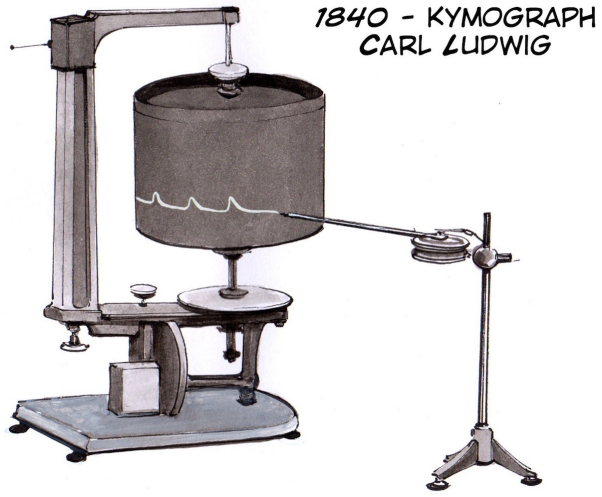


measuring associations via reaction times

- James Cattell (from intelligence tests)
  - was broadly interested in the use of experiments to test theories
  - mental chronometry: how long it takes to complete a mental operation or task
    - Cattell, J. M. (1886). The time it takes to see and name objects. Mind, 11(41), 63–65. https://doi.org/b6fr5r
    - Cattell, J. M. (1887). Experiments on the association of ideas. Mind, 12(45), 68–74. https://doi.org/d9bv2m
- how does this connect to association?
  - identifying and naming an object involved an association between the perception of that object (what it looks like) and the action required to name it (moving the vocal tract): faster you are, stronger the association

seeing and naming objects (Cattell, 1886)

- study 1:
  - modified a kymograph to present words/letters through a slit in a screen and measured naming time
  - 1 cm slit: 200 to 333 ms
  - wider slit: shorter times based on how many letters are in view
- inferences about associations:
  - previous letters can "trigger" associations and lead to faster recognition



This shows that while one idea is in the centre, two, three or four additional ideas may be in the background of consciousness. The second letter in view shortens the time about $\frac{1}{40}$, the third $\frac{1}{60}$, the fourth $\frac{1}{100}$, the fifth $\frac{1}{200}$ sec.

seeing and naming objects (Cattell, 1886)

- study 2:
  - had participants read sentences with words that have “connextion” vs. not and read letters that have “connextion” vs letters that do not make words
  - “no connexion” takes twice as long (250 ms vs. 125 ms)
- inferences about associations:
  - learning associations between letters and vocal outputs: “word superiority effect” (Reicher, 1969)
  - learning associations between surrounding context and words

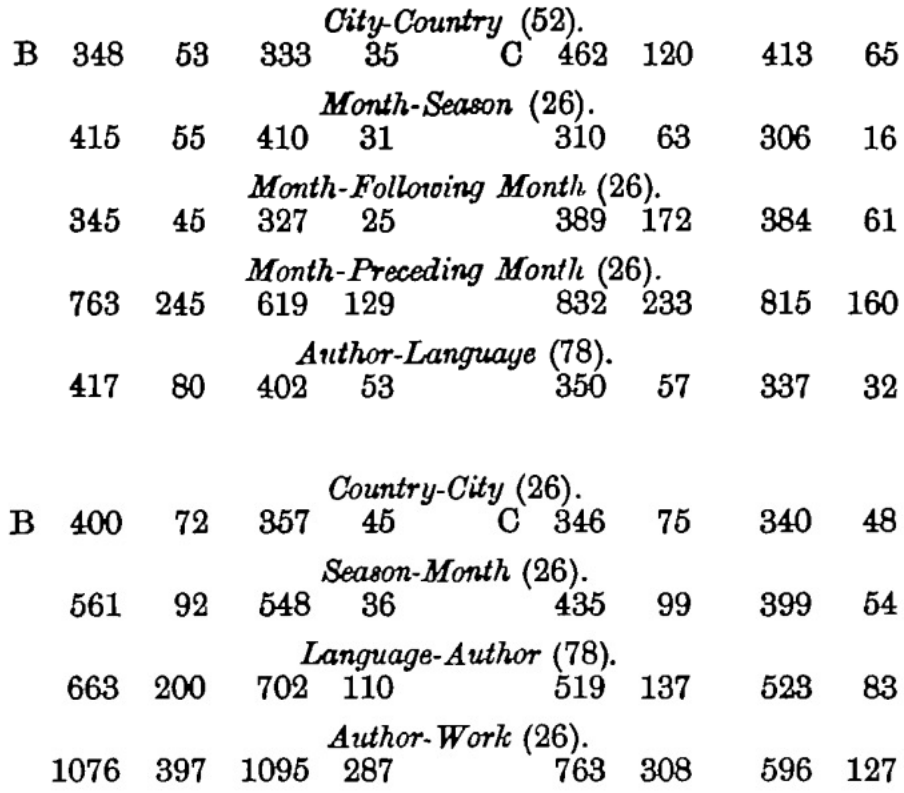
to apple Marta gave Betty the

Betty gave the apple to Marta

make words. When the words make sentences and the letters words, not only do the processes of seeing and naming overlap, but by one mental effort the subject can recognise a whole group of words or letters, and by one will-act choose the motions to be made in naming them, so that the rate at which the words and letters are read is really only limited by the maximum rapidity at which the speech-organs can be moved. As the result of a

association of ideas (Cattell, 1987)

- did a series of experiments where naming times were measured
- some key findings:
  - reading a foreign language takes longer due to weaker associations
  - cue-based recall (city – country vs. month-following/preceding month) showed patterns consistent with what might be expected due to stable vs. weak associations
- key takeaway so far: experiments can provide valuable information about existing associations and the factors that influence them



City-Country (52).

B	348	53	333	35	C	462	120	413	65

Month-Season (26).

415	55	410	31	310	63	306	16

Month-Following Month (26).

345	45	327	25	389	172	384	61

Month-Preceding Month (26).

763	245	619	129	832	233	815	160

Author-Language (78).

417	80	402	53	350	57	337	32

Country-City (26).

B	400	72	357	45	C	346	75	340	48

Season-Month (26).

561	92	548	36	435	99	399	54

Language-Author (78).

663	200	702	110	519	137	523	83

Author-Work (26).

1076	397	1095	287	763	308	596	127

Thorndike's work with animals

- Edward Thorndike, student of Cattell
- applied experimental techniques to study animal cognition
  - view #1: animals = humans
  - view #2: animals = 'simple reflex machines'
- leader in eugenics movement

Thorndike's puzzle boxes

- Thorndike, E. L. (1898). Animal intelligence: An experimental study of the associative processes in animals. *The Psychological Review: Monograph Supplements*, 2(4), i–109. https://doi.org/10/bk48z2
- mini escape rooms where animals (cats, dogs, chicks) were placed in a box and had to figure out a way to get out of the box
- two key findings:
  - animals were able to figure a way out
  - animals improved with practice

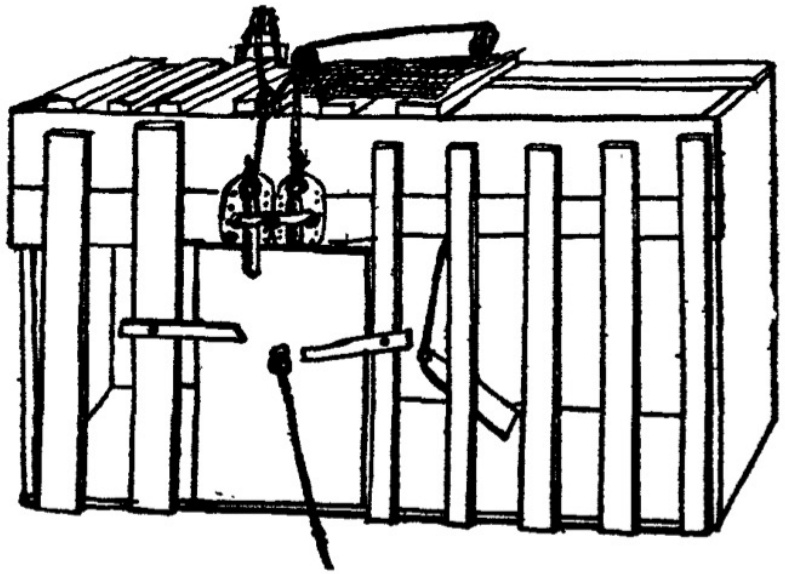


FIG. 1.

how are animals doing it?

- claim: there must be some kind of association being formed between different features (internal and external) of the environment
- later experiments modified some critical aspects of the puzzle box

Before describing the experiments which justify these statements, it will be worth while to recall the somewhat obvious facts about the composition of one of these associations. There might be in an association, such as is formed after experience with one of our boxes, the following elements:

1. Sense-impression of the interior of the box, etc.
2. (*a*) Discomfort and (*b*) desire to get out.
3. Representation of oneself pulling the loop.
4. Fiat comparable to the human "I'll do it."
5. The impulse which actually does it.
6. Sense-impression of oneself pulling the loop, seeing one's paw in a certain place, feeling one's body in a certain way, etc.
7. Sense impression of going outside.
8. Sense-impression of eating, and the included pleasure.

Also between 1 and 4 we may have 9, representations of one's experience in going out, 10, of the taste of the food, etc.

testing hypotheses for learning

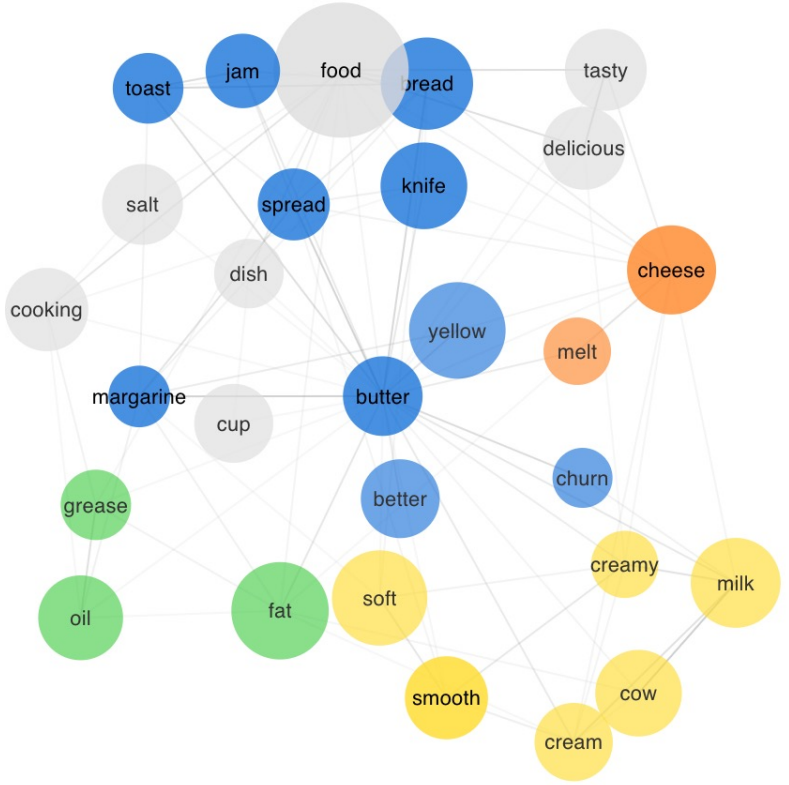
- imitation learning
  - can you learn by watching someone else escape?
  - cats, dogs, and chicks did not benefit from imitation learning
- general(ized) concept learning
  - can you generalize learning to newer contexts?
  - animals escaped faster when newer boxes were similar to older boxes
  - learning abstract concepts vs. specific details?
- mental representations
  - do animals have mental representations?
  - A (clap hands) – 10 seconds – B (walk up & give fish) – C (climb and get fish)
  - cats did show tendency to perform C when only A was presented

reviewing associationist claims

- people/animals have associations
  - what is the evidence?
- you can learn associations
  - what is the evidence?
- some associations are stronger than others
  - what is the evidence?

associative learning today

- the learning of language and speech
  - free association / what comes to mind
  - speech signals in babies
  - modern language AI
- associations in memory
  - false memories / eyewitness testimonies
  - computational models of memory
- social learning in animals
  - crows, apes, etc.



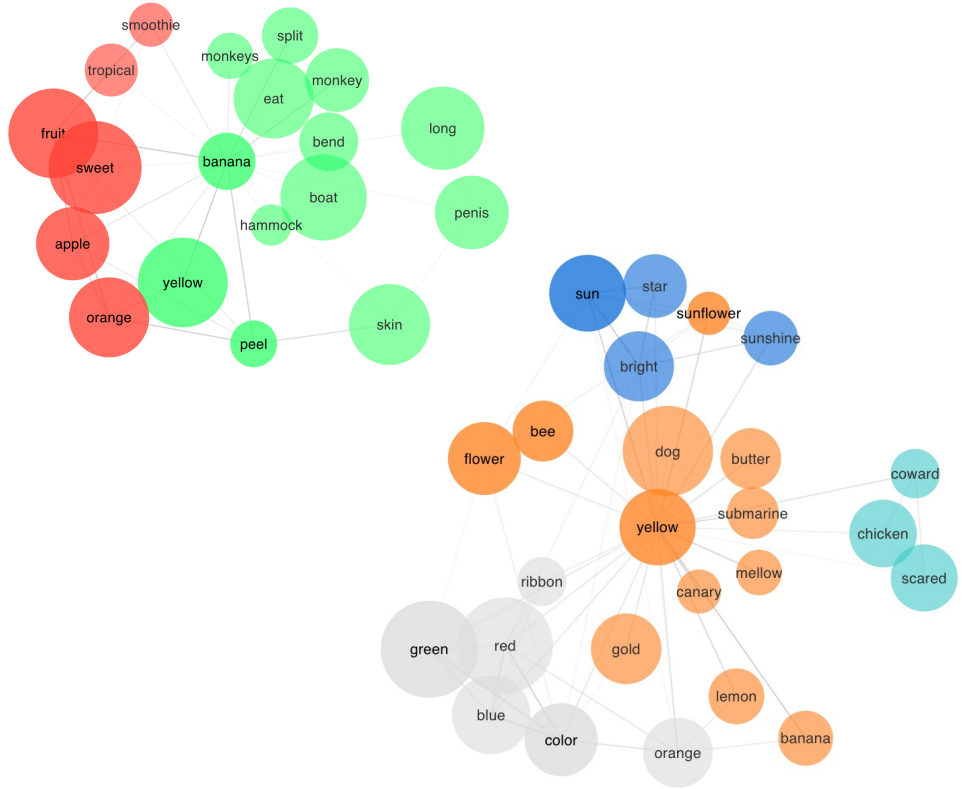
https://smallworldofwords.org/en/project/visualize

free association

- try the small world of words task
- discuss what factors may influence your word associations

explaining free associations

- word associations tend to resemble a “small-world” network (Steyvers & Tenenbaum, 2005; De Deyne & Storms, 2008)
  - highly clustered neighborhoods
  - short distances between concepts
- when a word comes to mind, it “activates” other words close to it (“spreading activation mechanism”, Collins & Loftus, 1975)
- word associations are likely a combination of many factors: relatedness of concepts, frequency, imagery, emotion, etc.



an activity

- think about the first number that comes to mind when I say X

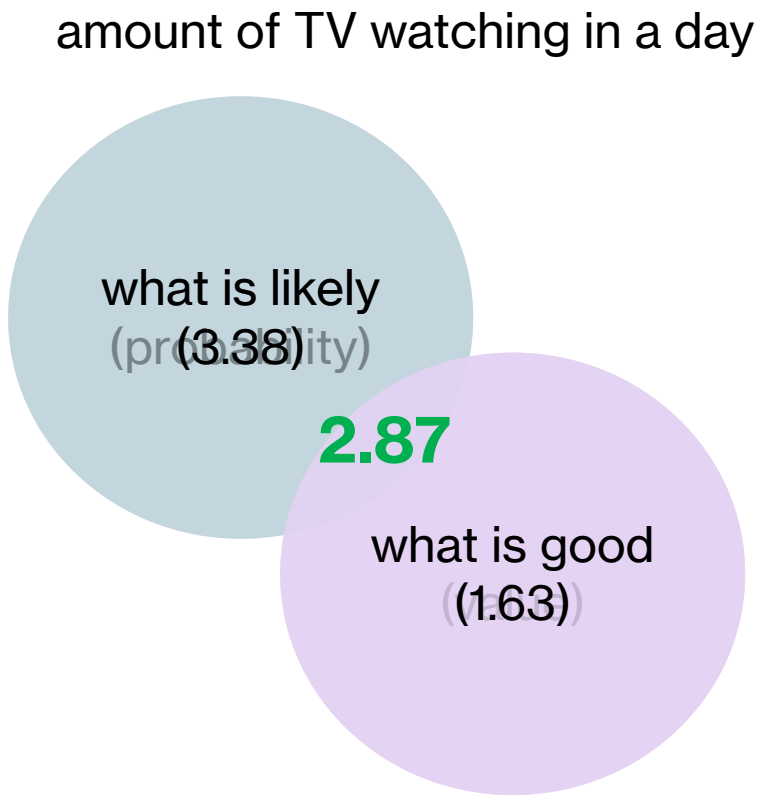
hours of TV watching in a day

Nobody has responded yet.

Hang tight! Responses are coming in.

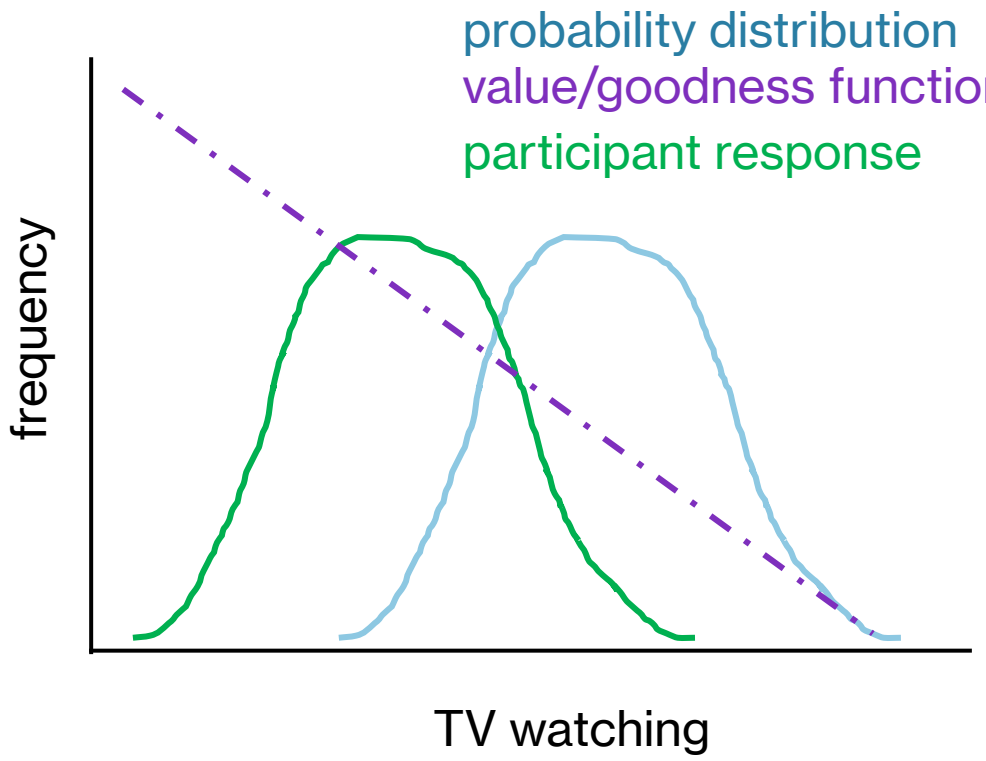
what comes to mind?

- Bear et al., 2020 have recently investigated this question
- "what comes to mind" depends on:
  - what is most likely (probability)
  - what is generally good (value)



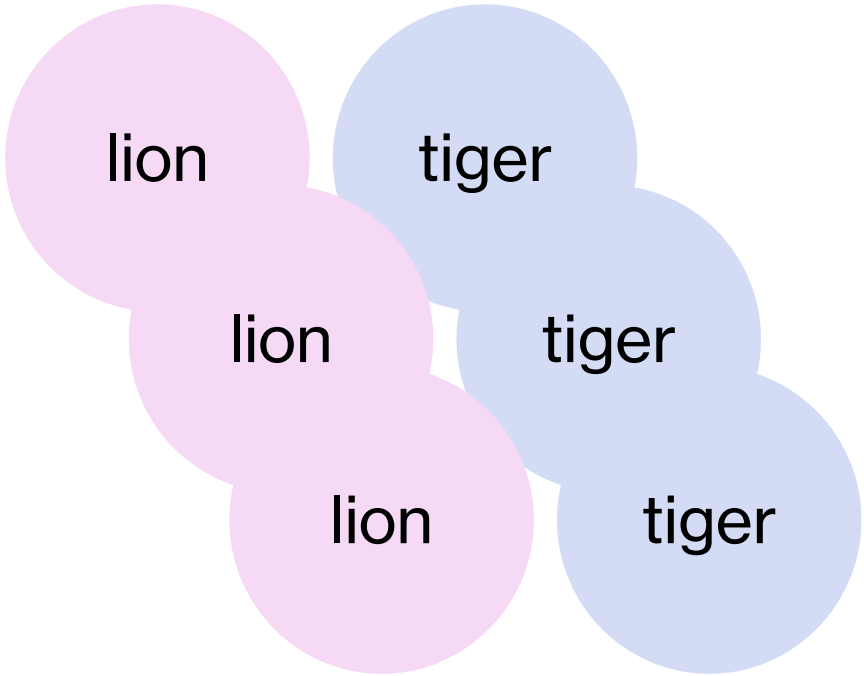
what comes to mind?

- Bear et al., 2020 have recently investigated this question
- "what comes to mind" depends on:
  - what is most likely (probability)
  - what is generally good (value)
- a multiplicative function



big takeaways

- association is a key idea in the study of cognition with roots that go back to before cognition was an established field
- many classic ideas of association continue to be actively studied even today via experiments, computational models, and field research
- animal cognition has provided invaluable insights into the nature of associations



next class

- **before** class:
  - *finish:* L4 (Associations) chapter
  - *explore:* L4 writing assignments
- **during** class:
  - associations and classical conditioning