Cognition

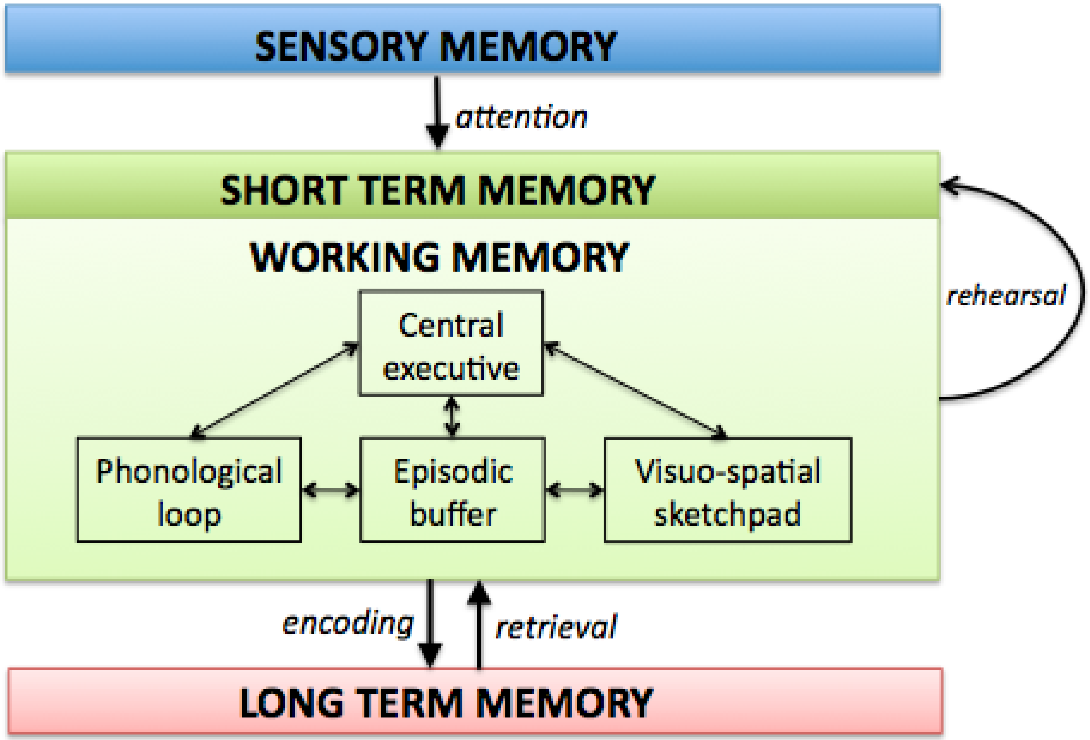
PSYC 2040

W2: Building blocks / memory stores

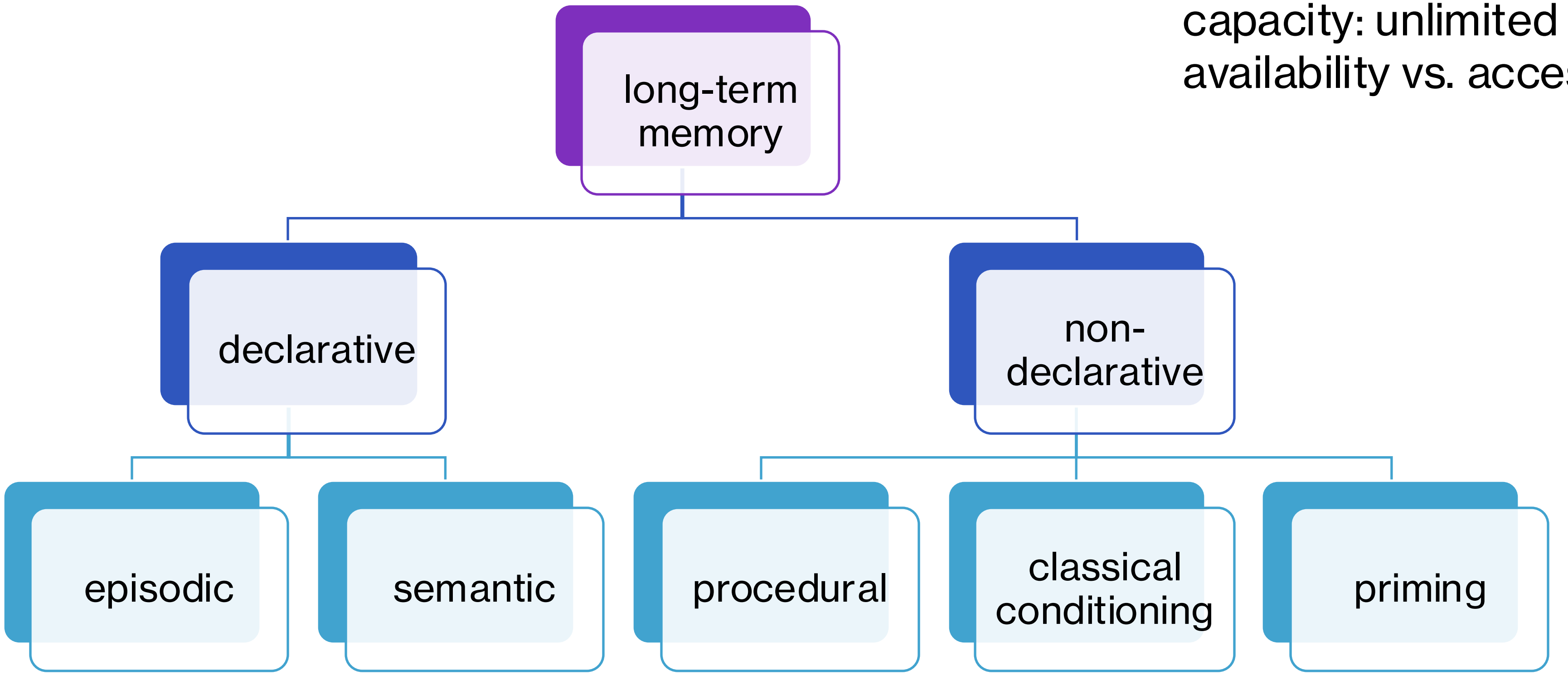
logistics

- my office hours are from 11.45 – 2 pm this Friday

how do we process information?



today’s agenda: long term memory



capacity: unlimited store
availability vs. accessibility

Squire, 1986

episodic vs. semantic memory

episodic

- memory for specific events
- situated in a time and place
- “I remember this”

semantic

- general knowledge about the world and its entities
- decontextualized
- “I know this”

two separate systems or one?

- evidence for separate systems
  - amnesic patients (e.g., KC)
  - neurodegenerative diseases (Alzheimer vs. semantic dementia)
- evidence for single system
  - memory tests are not “process pure”
  - meaning can be “context-dependent”
  - shared neural substrates
  - computational models

Instance theory as a domain-general framework for cognitive psychology

Randall K. Jamieson, Brendan T. Johns, John R. Vokey and Michael N. Jones

Abstract | The dominant view in cognitive psychology is that memory includes several distinct and separate systems including episodic memory, semantic memory and associative learning, each with a different set of representations, explanatory principles and mechanisms. In opposition to that trend, there is a renewed effort to reconcile those distinctions in favour of a cohesive and integrative account of memory. According to instance theory, humans store individual experiences in episodic memory and general-level and semantic knowledge such as categories, word meanings and associations emerge during retrieval. In this Perspective, we review applications of instance theory from the domains of remembering, language and associative learning. We conclude that instance theory is a productive candidate for a general theory of cognition and we propose avenues for future work that extends instance theory into the domain of cognitive computing, builds hybrid instance models and builds bridges to cognitive neuroscience.

measuring episodic memory

free recall

recall!

WOMAN

QUEEN

total correct
intrusions
order

cued recall

WO????

WOMAN

WORK

total
correct
intrusions

recognition

WOMAN QUEEN

OLD NEW

total correct?

recognition task: hits and false alarms

- observing only the correct responses could be misleading if the person simply answers “old” for all items
- hits and false alarms together provide a clearer picture

	item	
response	OLD (WOMAN)	NEW (QUEEN)
OLD	hit	false alarm
NEW	miss	correct rejection

understanding signal vs. noise

- this framing comes from signal detection theory, that has wide applications in decision-making and statistics

	world truth	
your decision	signal	noise
signal	hit	false alarm
noise	miss	correct rejection

activity: understanding signal vs. noise

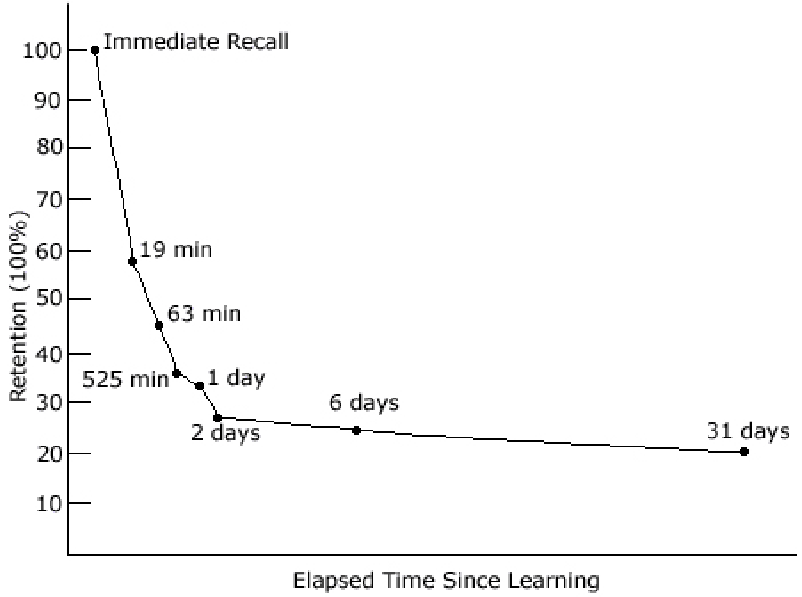
- a researcher hypothesizes that freshman and seniors have different enrolment rates for 8AM classes. apply the signal detection idea and discuss what a hit / false alarm / miss / correct rejection would mean here

	world truth	
your experiment	effect exists	effect doesn't exist
effect found	hit	false alarm
effect not found	miss	correct rejection

the forgetting function

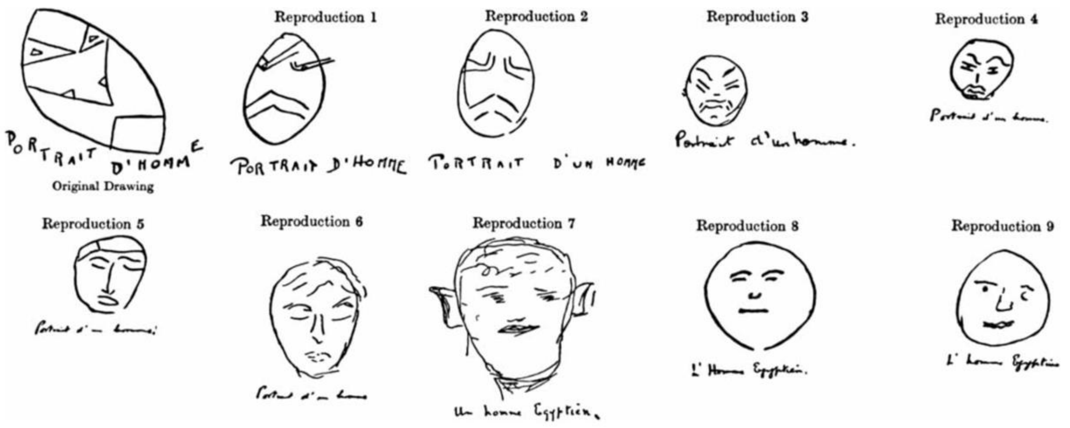
- Ebbinghaus (1885) tested the early claims of association via experimental manipulations within the context of learning and forgetting
    - phase one: learn nonsense syllables and recite to criterion
    - phase two: lists relearned after a delay period
- Murre & Dros (2015) replicated this work
- key idea: forgetting decreases over time, i.e., you forget a lot initially and less and less over time

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	NAK	DEP	KUQ	ZAF	SEK	JIJ	NUG	KEB	XUG	ROJ	RUL	VUH	DUX
2	KUL	NEK	POG	XOQ	XOC	HEV	TAZ	HIF	FUK	QID	ZAL	XAD	LUP
3	RIX	WUN	LOC	YEF	CAG	KUS	QUK	HIZ	TOJ	MUJ	VEL	XAJ	GIM

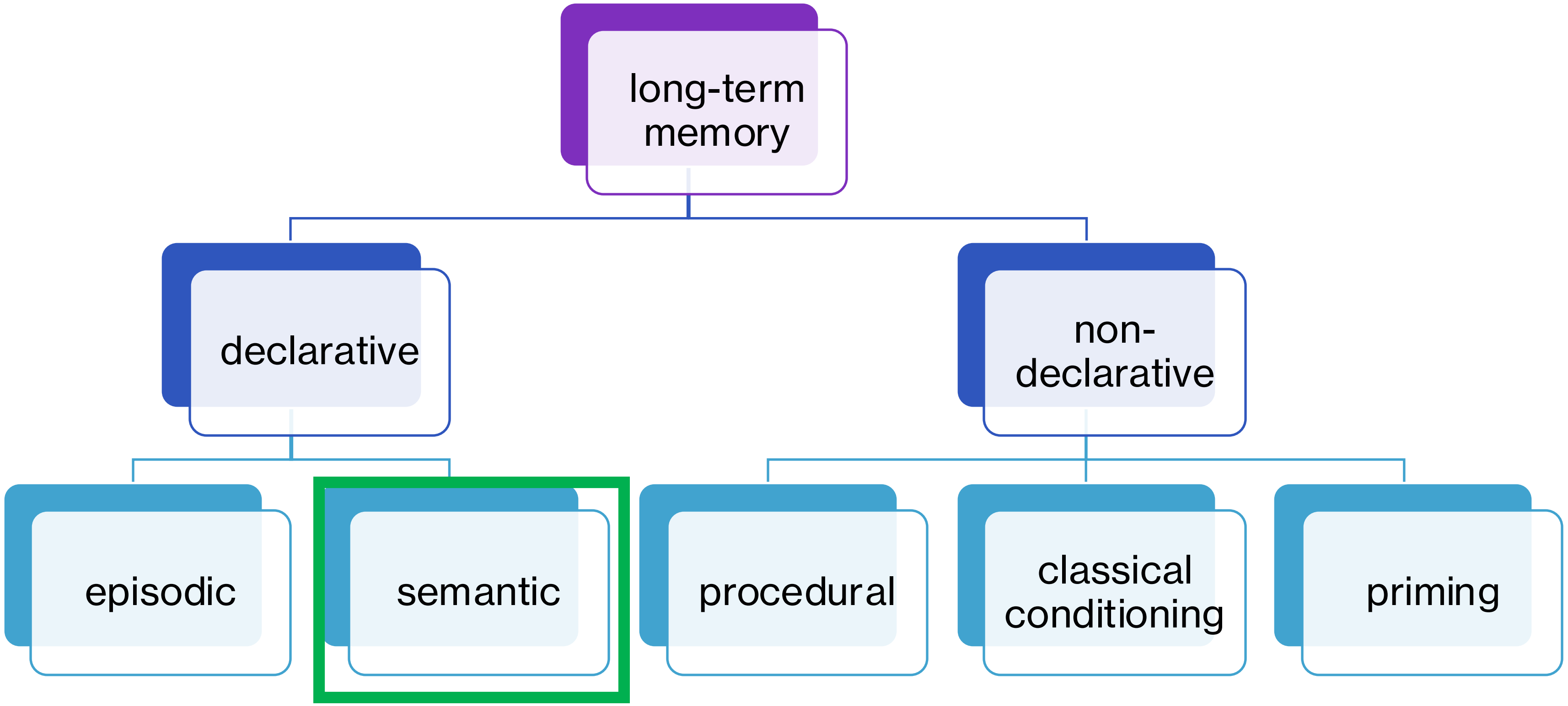


Bartlett's re-membering metaphor

- Bartlett proposed a reconstructive view of memory
- 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?



today’s agenda: long term memory



Squire, 1986

how is semantic memory organized?

- account #1: hierarchical network
- Collins and Quillian (1969)
- principle of cognitive economy: not storing redundant information but organizing taxonomically
- navigating levels in the network takes time

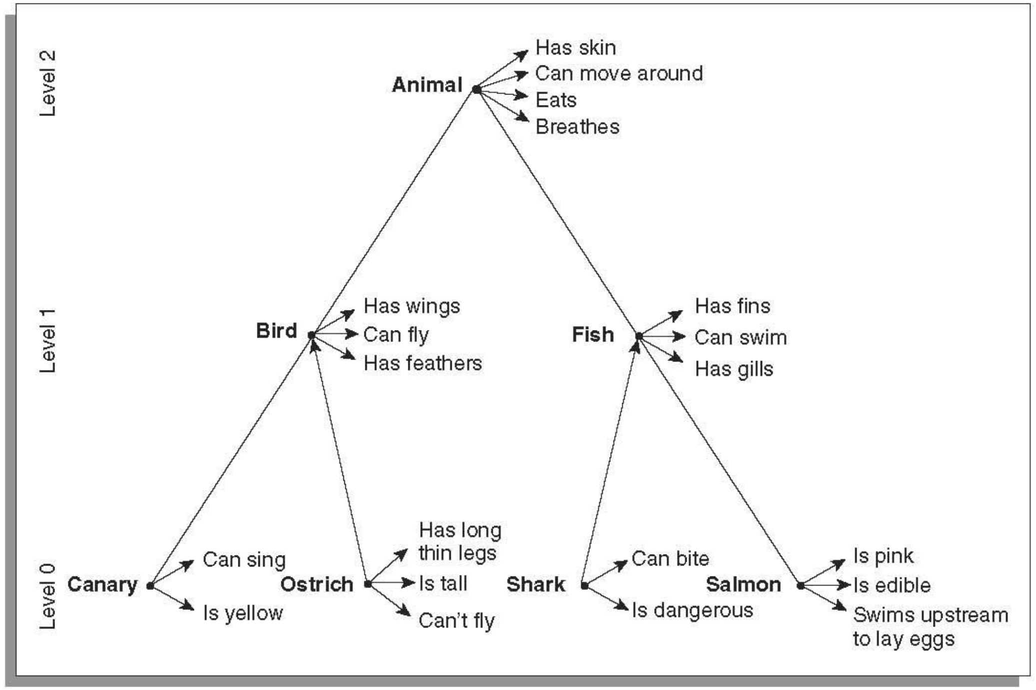
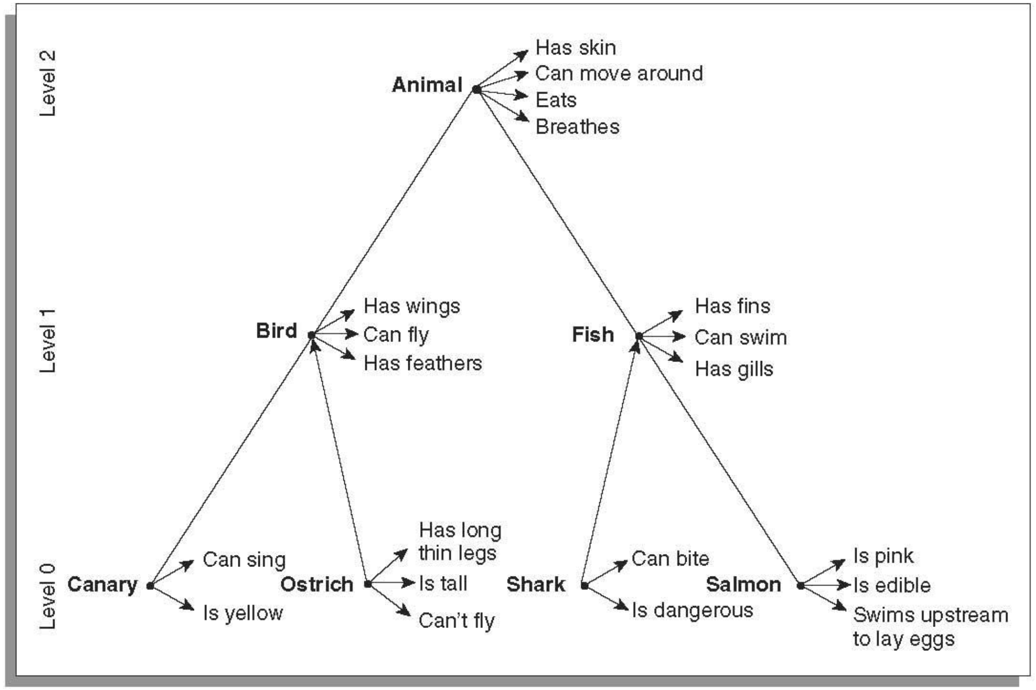


Figure 7.12 A hierarchical network representation of concepts.

SOURCE: From Collins, A. M., & Quillian, M. R., Retrieval time from semantic memory. *Journal of Verbal Learning and Verbal Behavior, 8*, 240-247, copyright © 1969. Reprinted with permission.

account #1: hierarchical network

- testing the model: sentence verification task (yes / no)
- is a canary a bird?
- does a canary sing?
- navigating levels in the network takes time



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account #1: hierarchical network

- response times increased linearly as a function of how many "levels" had to be traveled to retrieve that information

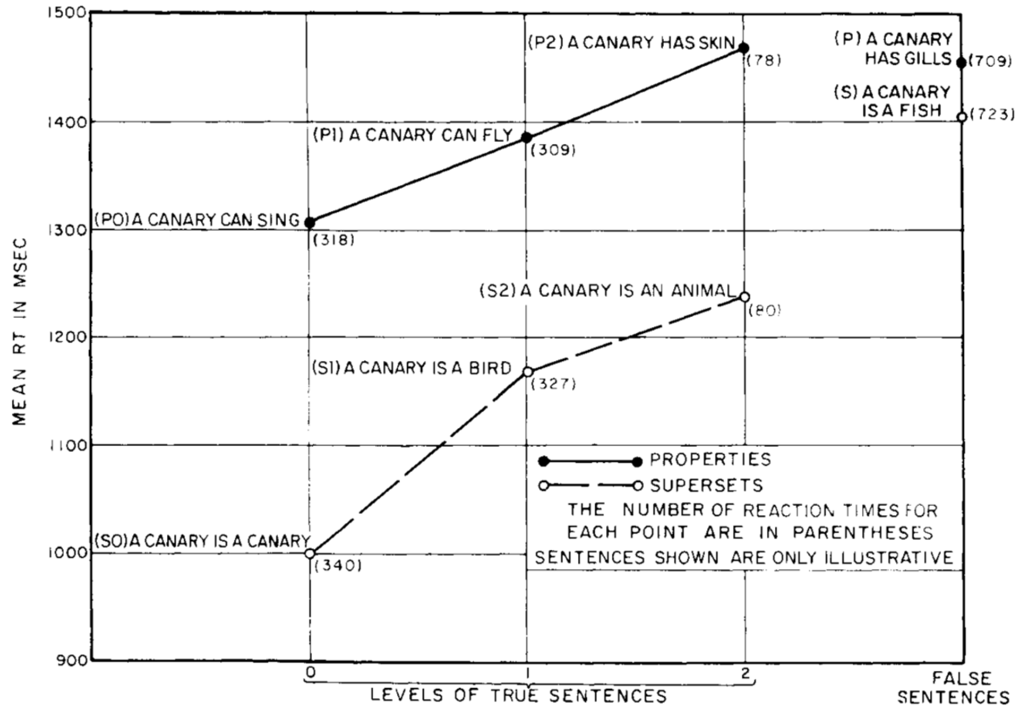


FIG. 2. Average reaction times for different types of sentences in three experiments.

account #1: hierarchical network

- problems:
- typicality effects: people responded faster to “robin is a bird” than “vulture is a bird” when the model predicts no difference in response times
- “no”/false response times were different depending on the items “butterfly is a bird” was slower than “monkey is a bird”

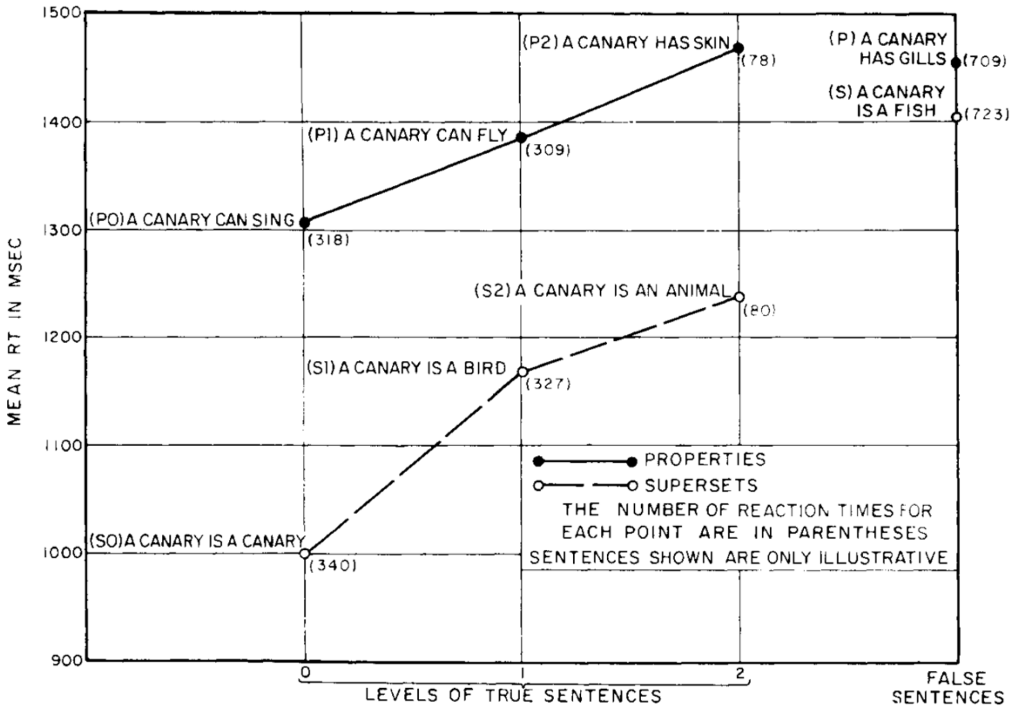
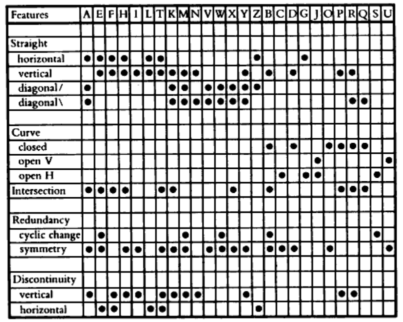
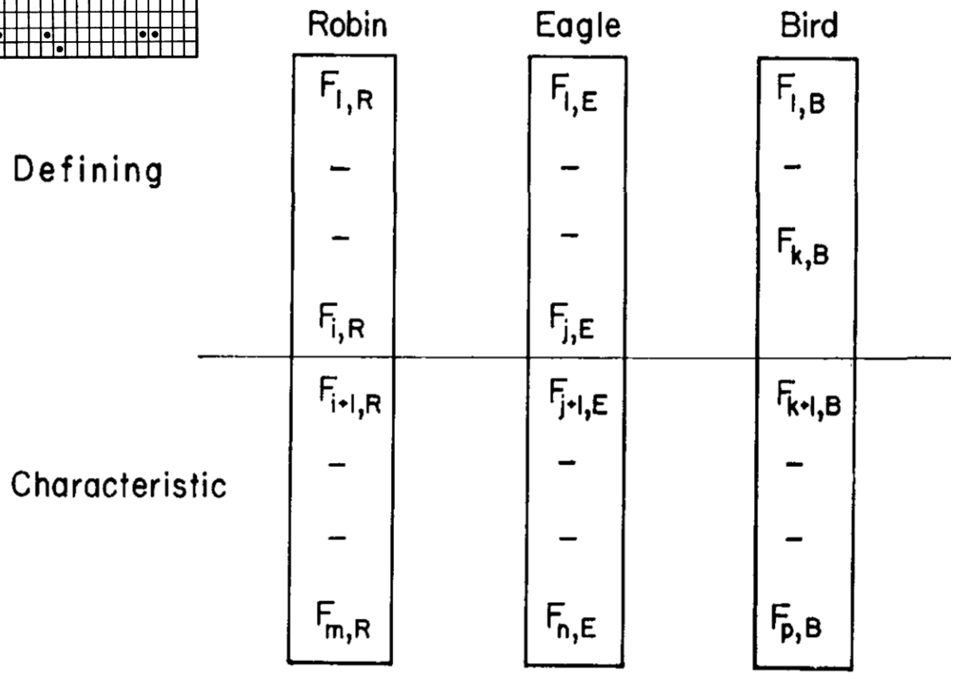


FIG. 2. Average reaction times for different types of sentences in three experiments.

account #2: feature comparison model

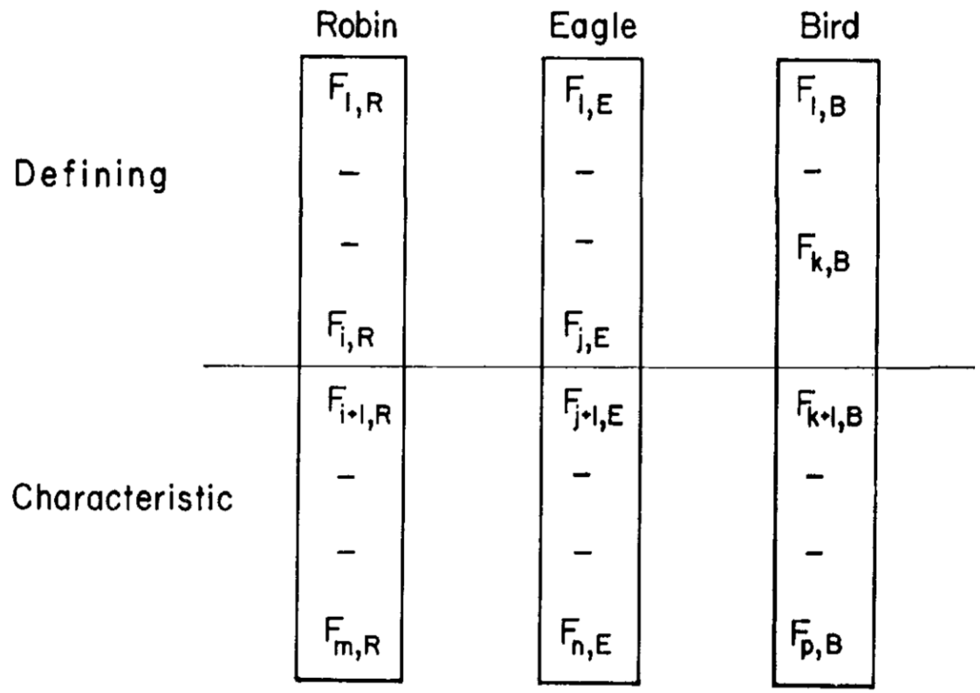
- account #2: feature comparison model
- Smith, Shoben, & Rips (1973)
- distributed representation of each concept along a set of features/dimensions
  - defining features: all birds have wings
  - characteristic features: only some birds fly
- overlap between features determined response times
- was able to explain typicality effects, false RTs, etc.





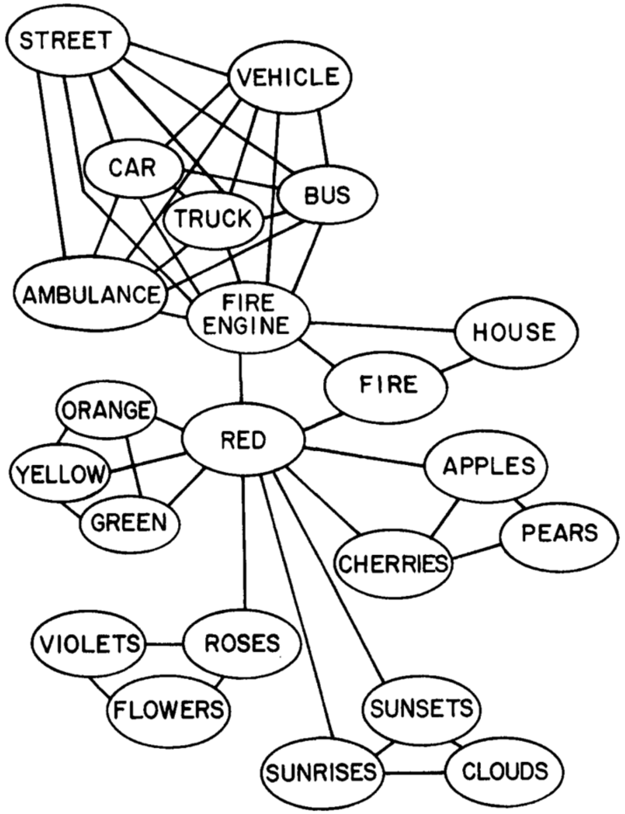
account #2: feature comparison model

- positives:
  - changed how concepts could be represented, i.e., a distributed representation
  - the beginning of mathematical modeling of words, language, neural networks!
- problems:
  - what are the features?!
  - how are they learned?!



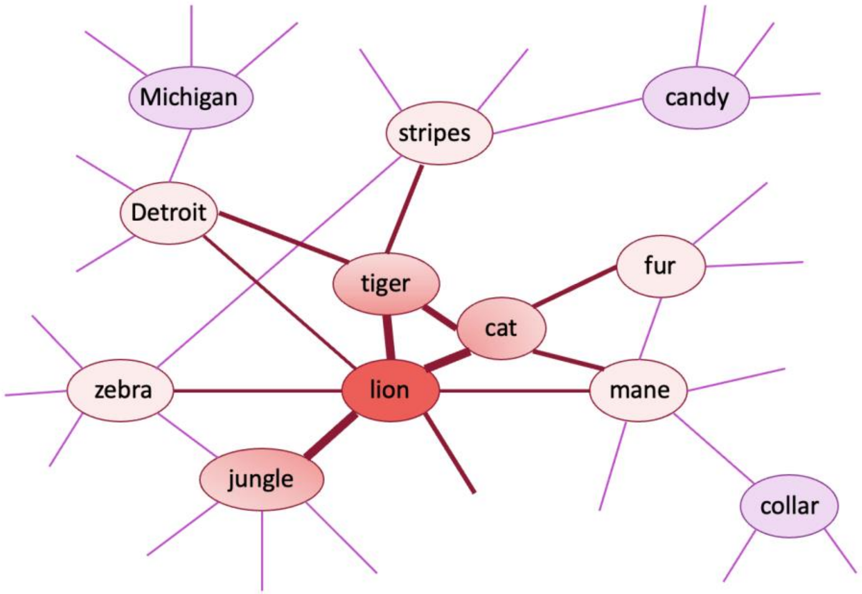
account #3: non-hierarchical network

- account #3: non-hierarchical network
- Collins and Loftus (1975)
- concepts are organized in a semantic network, with connections being weighted by semantic similarity
- less constrained account, but how do we learn these similarities and connections?!



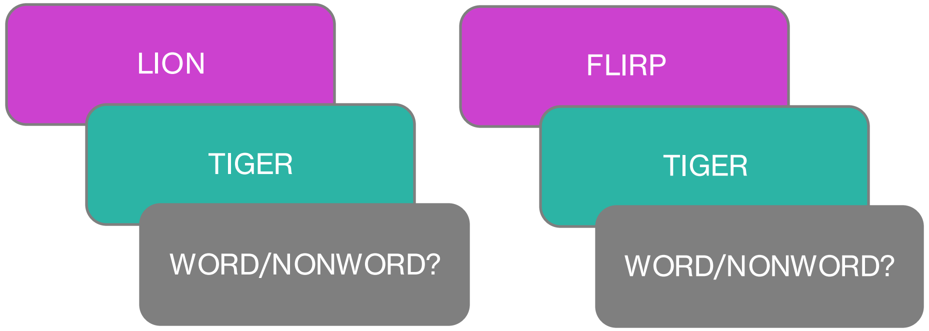
testing semantic knowledge

- the closer two concepts are in semantic memory, the more likely they are to activate one another
- general paradigm: priming = prior processing can influence how information is accessed or retrieved
- semantic priming: when priming tasks are used to test semantic memory



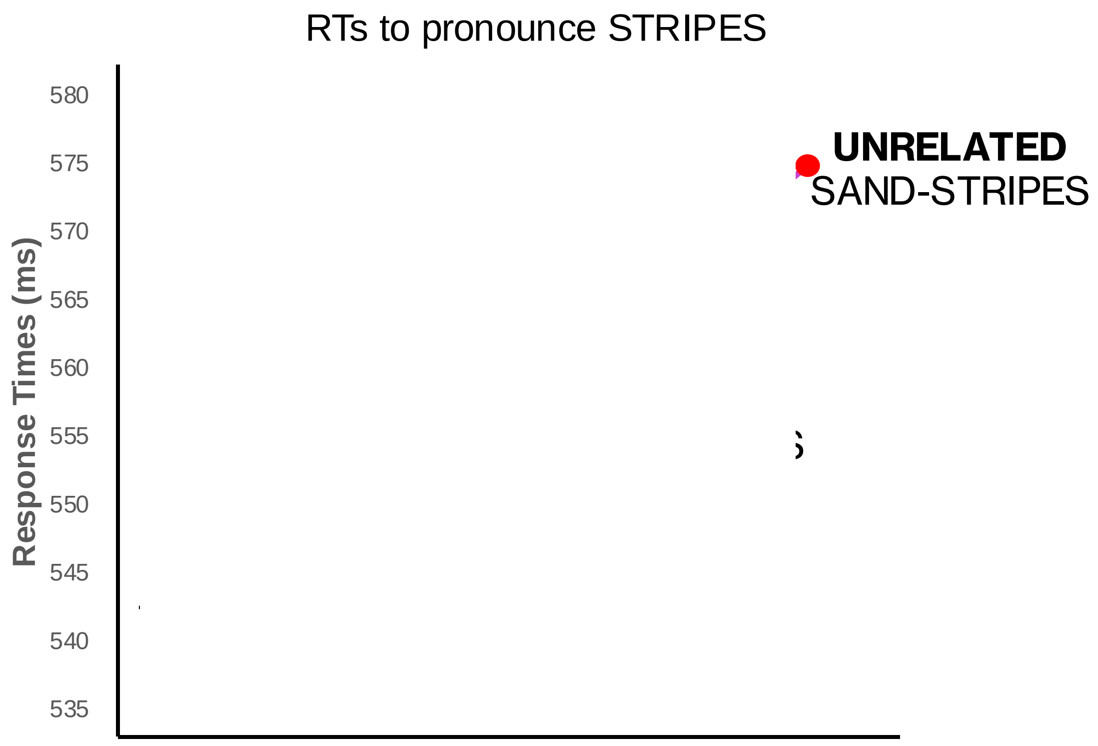
semantic priming

- semantic priming tasks involve presenting a prime that may be related / unrelated to the upcoming target word
  - lexical decision task: deciding whether a target word is a word/non-word
  - relatedness judgment task: deciding whether two words are related or unrelated
- processing a related word speeds up or facilitates processing of the target word



how far does activation spread?

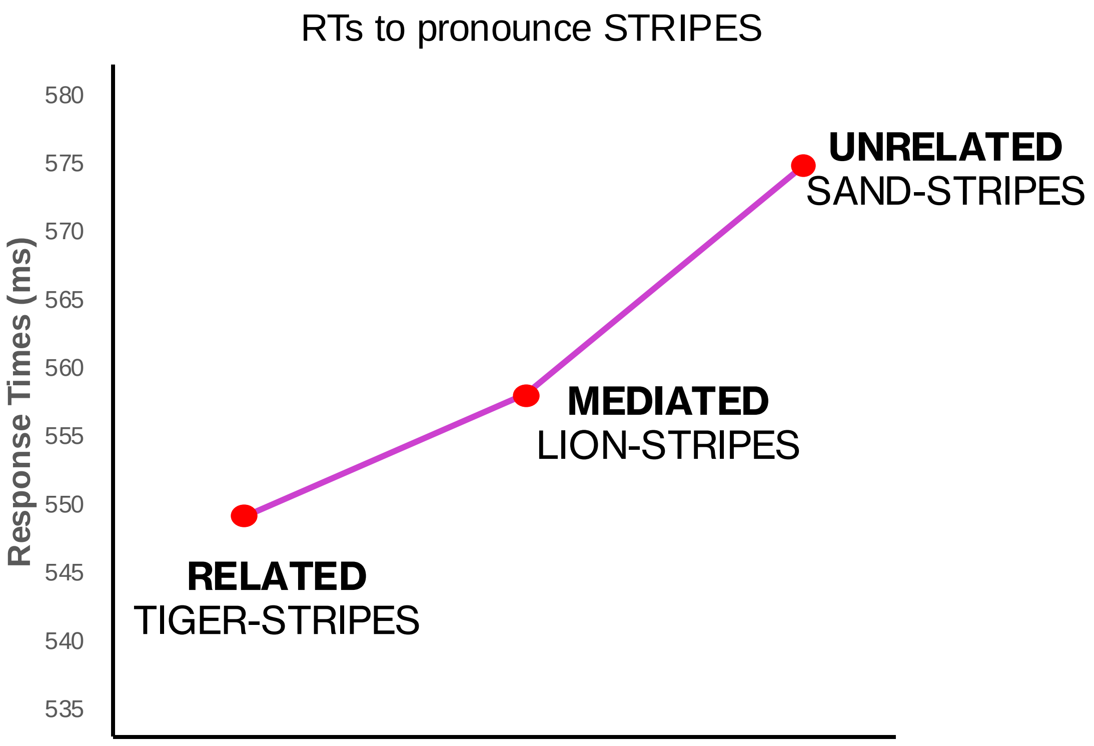
- mediated priming has been shown for items that do not seem to share a direct relationship, e.g., lion-stripes in pronunciation (Balota & Lorch, 1986) and lexical decision tasks (McNamara & Altarriba, 1988)



Balota & Lorch, 1986

how far does activation spread?

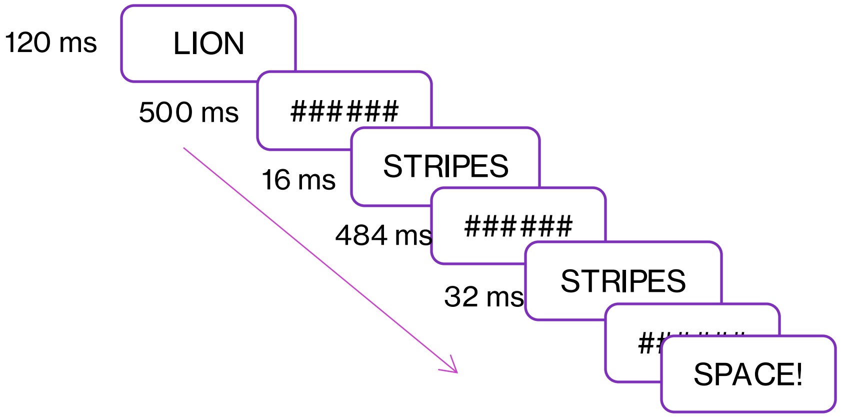
- potential limitations/issues:
- how do we know how close or far concepts are from one another?

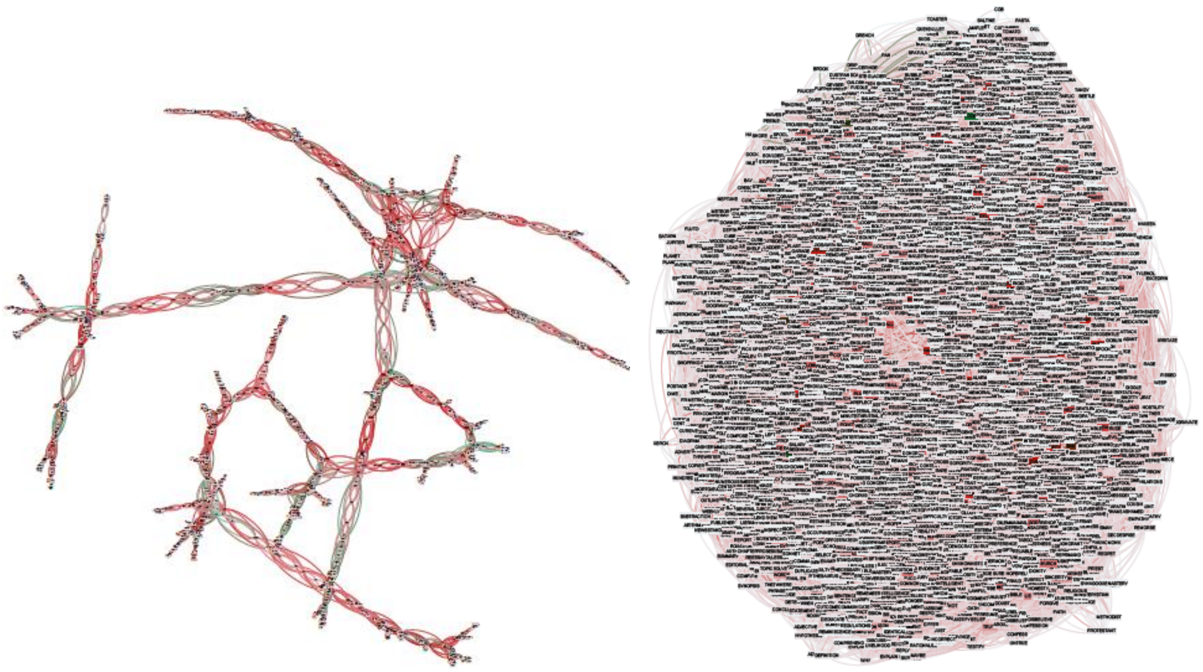


Balota & Lorch, 1986

distant semantic priming

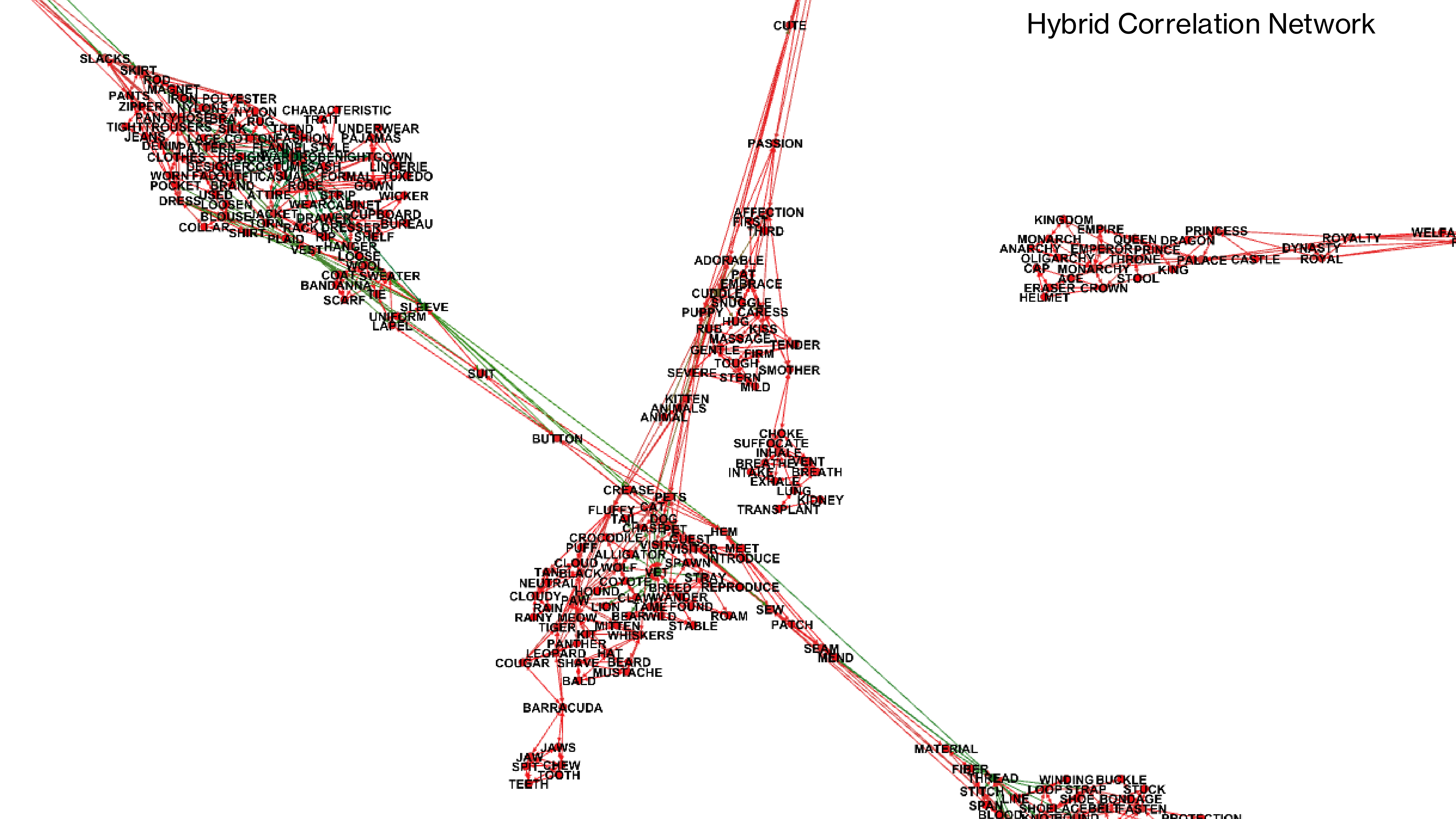
- using computational models of semantic memory to estimate “path lengths” between words

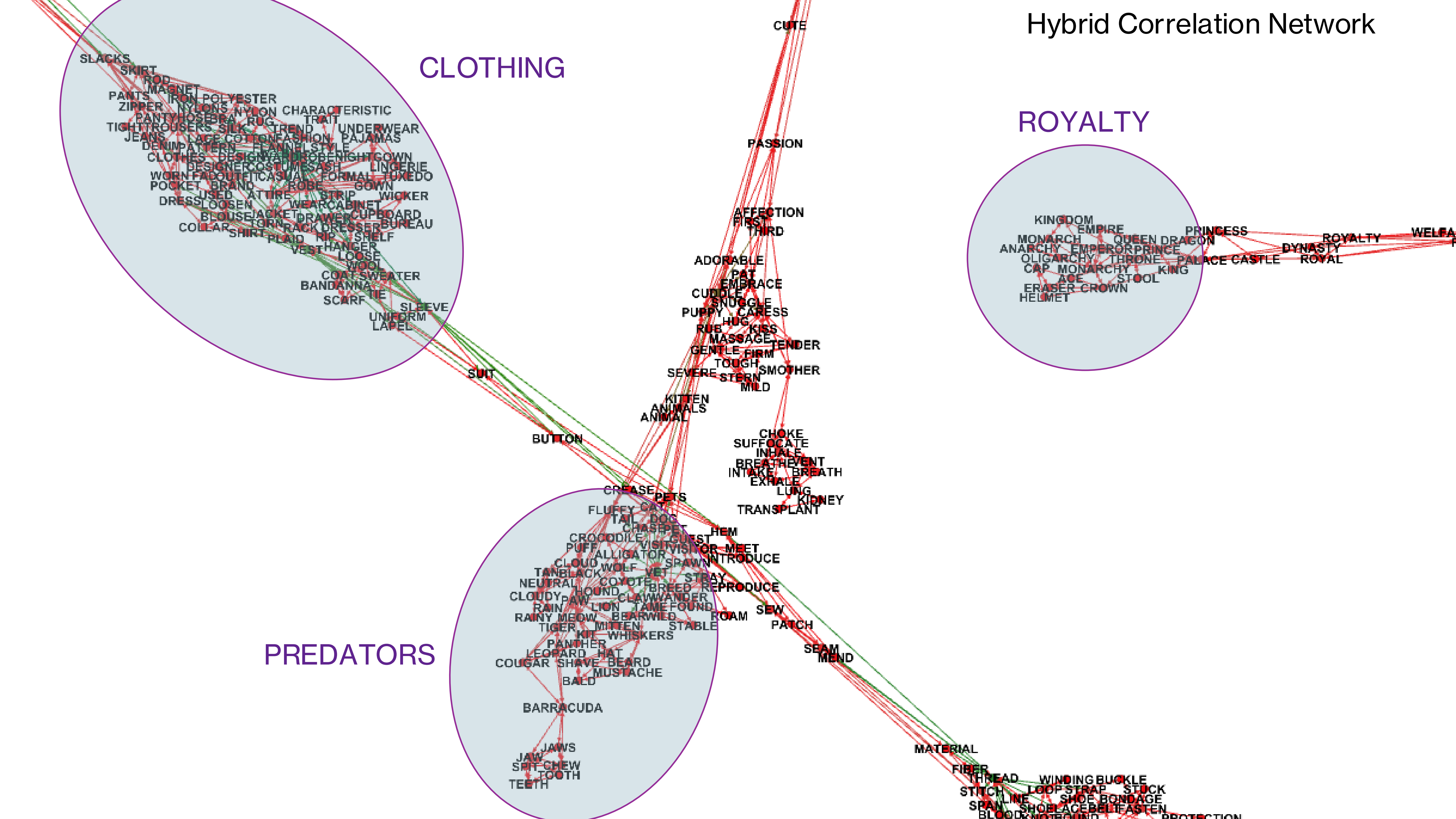




Kumar, Balota, & Steyvers (2021)

Hybrid Correlation Network





Hybrid Correlation Network
CLOTHING
ROYALTY
PREDATORS
CUTE
PASSION
AFFECTION
ADORABLE
SUIT
BUTTON
KINGDOM
EMPIRE
MONARCH
ANARCHY
OLIGARCHY
HELMET
PRINCESS
ROYALTY
DYNASTY
ROYAL
CHOKE
SUFFOCATE
TRANSPLANT
BARRACUDA
JAWS
MATERIAL

next class

- cognitive limitations

Here are the to-do's for the week:

- Week 2 Exit Ticket (due Thursday)
- Week 2 Quiz (due Sunday)
- Project Milestone 1 (Questions of Interest) (due Monday)
- Post any lingering questions here
- Extra credit opportunities:
    - Submit Exra Credit Questions (1 point for 8 submissions)
    - Submit Optional Meme Submission (1 point for winners!)

Before Tuesday

- Complete W3 Activity 1

Before Thursday

- Complete W3 Activity 1

After Thursday

- See the Apply section