

CSP 502: Cognitive Foundations of Behavior

8/9/2019

Wednesday Bushong

Today's class

- General course overview
- What is Cognitive Science?
- ~~Quick intro to Perception~~

Course Overview

- Whirlwind tour of topics in cognitive science
- Broad goal: learn about methods & topics in cognitive science and **how they apply to your own interests in clinical psychology**

Course Structure

- First 1.5-2 hours: discussion of papers
 - Mix of classic papers & new work
 - Each class features some application to clinical psychology
- 0.5-1 hour introductory lecture to next day's topic

- Perception
 - clinical topics: face processing in ASD, influence of video games on visual perception
- Learning & Memory
- Attention / Reasoning & decision-making
 - clinical topics: reasoning and depression, decision-making and suicide
- Language use & understanding
 - clinical topic: review of pragmatics in ASD
- Computational models of cognition
 - clinical topic: a connectionist model of deep dyslexia

Grading & Expectations

- Standard graduate letter grade scheme
- Participation (30%)
- Discussion leading (30%)
- Final paper & presentation (40%)

Participation

- Post 1 discussion question per bolded paper on syllabus in Blackboard discussion forums (due by 3pm each day)
- Can be clarity question, but preferably something more open-ended to spark discussion

Discussion leading

- Prepare 10-15 minute presentation w/ relevant background & main points of the paper
- List of assigned discussion leaders is on Blackboard under Course Materials

Final paper & presentation

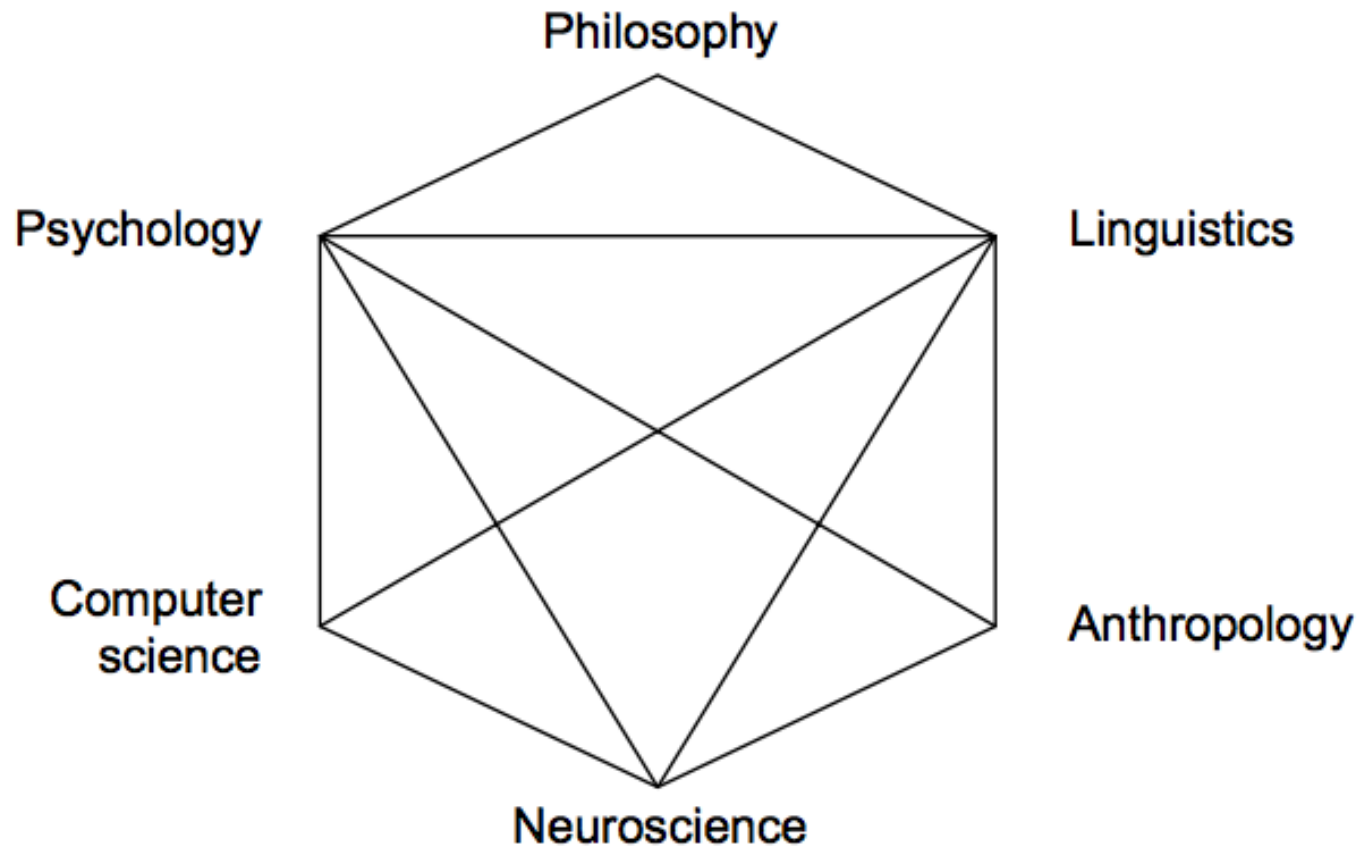
- Very open-ended: be creative!!
- Any topic connecting cognitive & clinical psychology
- Clear topic w/ me by **next Wednesday (8/14)**
- On last day of class, give a 10-minute presentation about your paper

Questions about class structure?

What is Cognitive Science?

“Cognitive science is the interdisciplinary study of mind and intelligence, embracing philosophy, psychology, artificial intelligence, neuroscience, linguistics, and anthropology.”

- Stanford Encyclopedia of Philosophy





Cognitive Science Society logo

A brief history of cognitive science

- 1950-60s: Rejection of behaviorism combined with advancements in computer science and neuroscience; the study of mental representations is embraced!
- 1970s-80s: Marr's 3 levels provide a unifying framework and precipitate a rise in computational modeling
- 1990s-2000s: Advances in human brain imaging bring in a new era of cognitive neuroscience
- 2010s: rational (Bayesian) accounts of cognition

(Radical) Behaviorism

- Understand behavior by only studying directly observable events
 - e.g., Pavlov's dogs
- Ignore the mind and internal representations
- Comes to a head with Skinner's account of language acquisition

Chomsky's scathing review of behaviorism in language

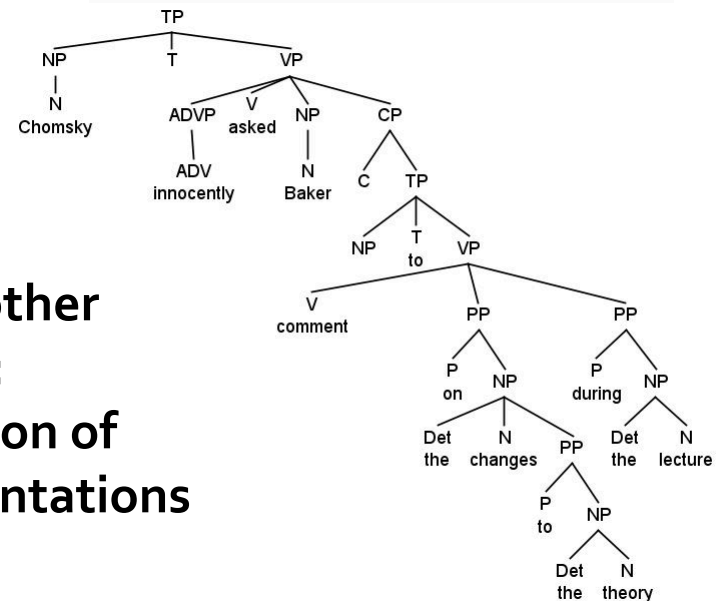
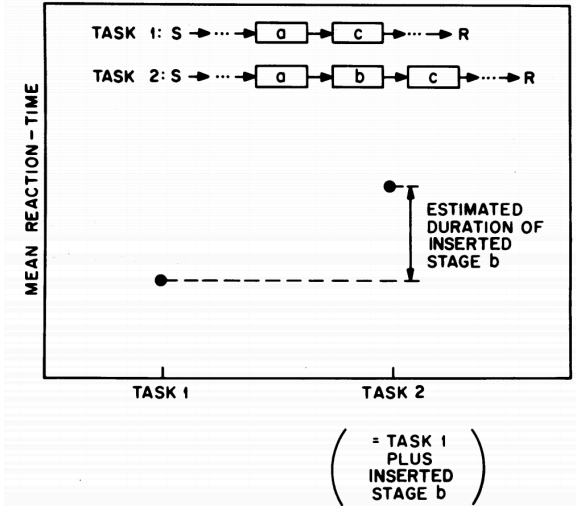
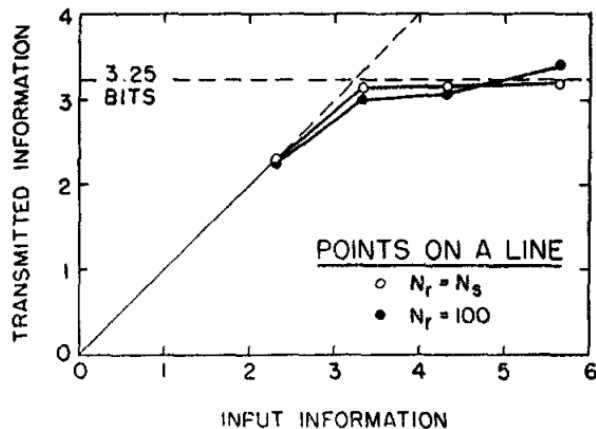
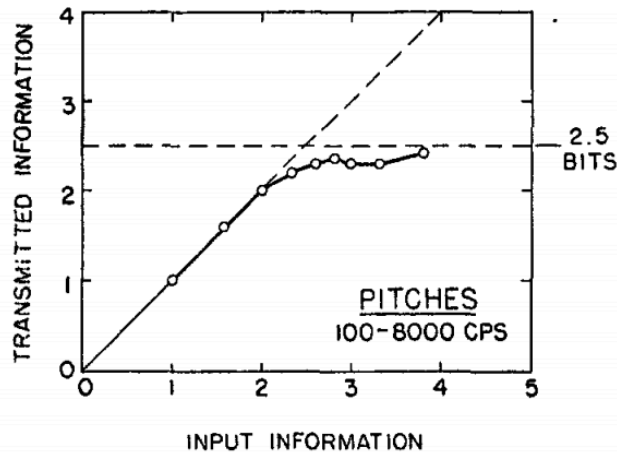
- Relevant stimulus impossible to identify without already knowing the behavior
- How can we characterize what a 'response' is?
- No clear reinforcement structure in language

→ Can't understand language without studying the internal state of the individual: mental representations, attention, social motivation, personal history, etc.

1950s-60s

Sternberg: designing tasks to separate out different mental processes

Miller: human information processing capacity



Chomsky & other linguists:
characterization of
linguistic representations

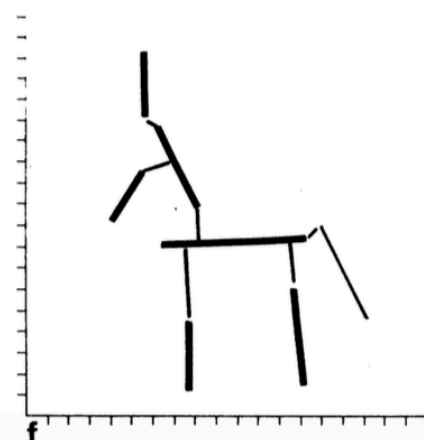
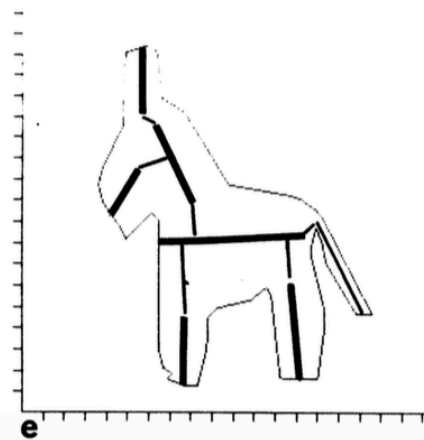
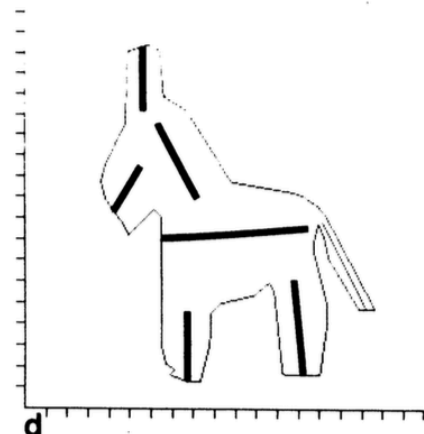
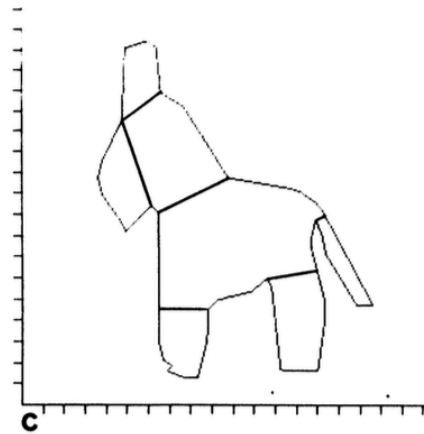
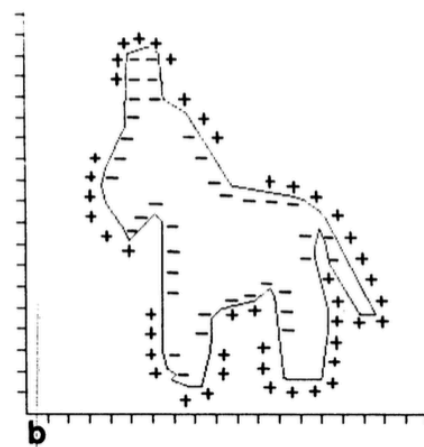
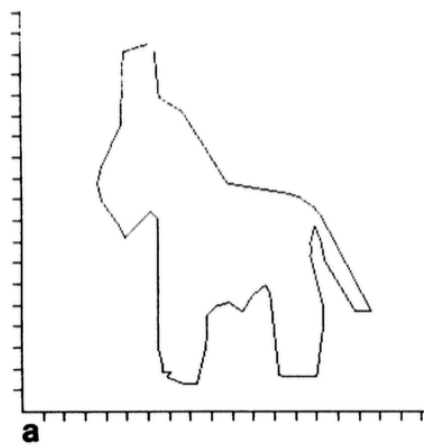
Marr's Famous Levels

- Computational
- Algorithmic
- Implementational

“In general, mechanisms are strongly determined by hardware, the nature of the computation is determined by the problem, and the algorithms are determined by the computation and the available mechanisms.”

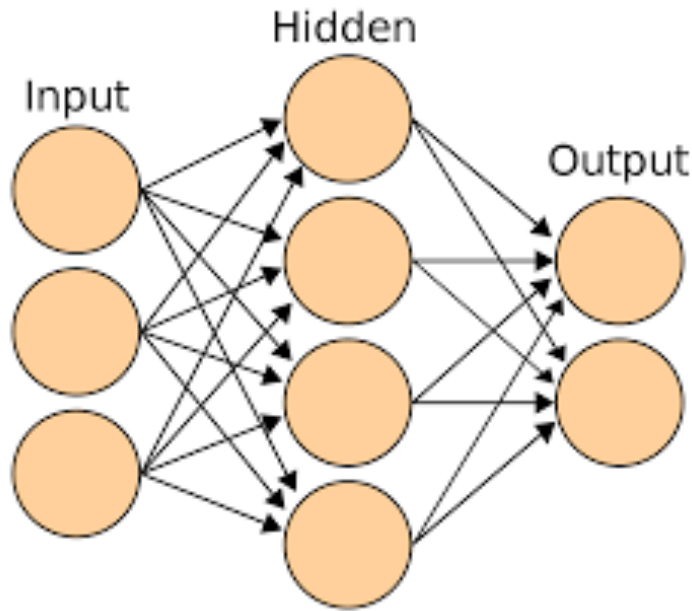
The levels loosely constrain each other

Need to study *all* levels to get a comprehensive picture of the system



1970s-80s: boom in computational and formal theories of cognition

Rumelhart & McClelland: Parallel Distributed Processing (connectionism/neural networks)



formal theories

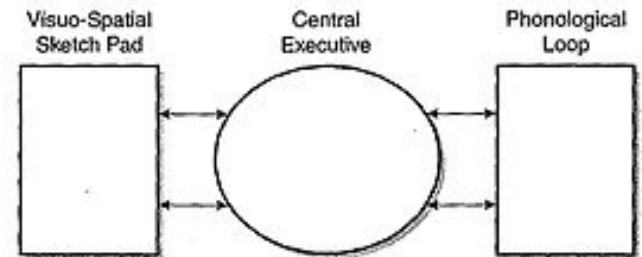
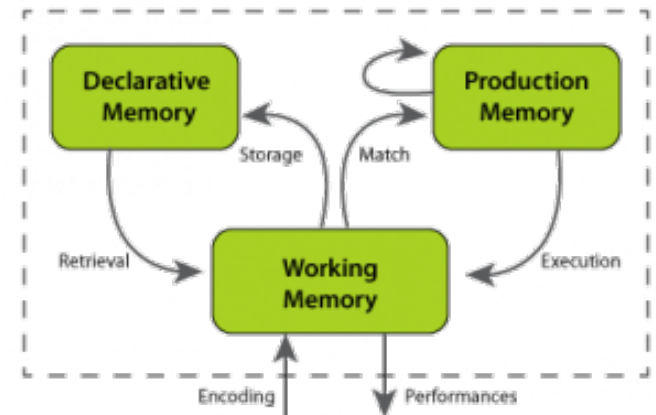


FIGURE 5.1 Baddeley Model of Working Memory

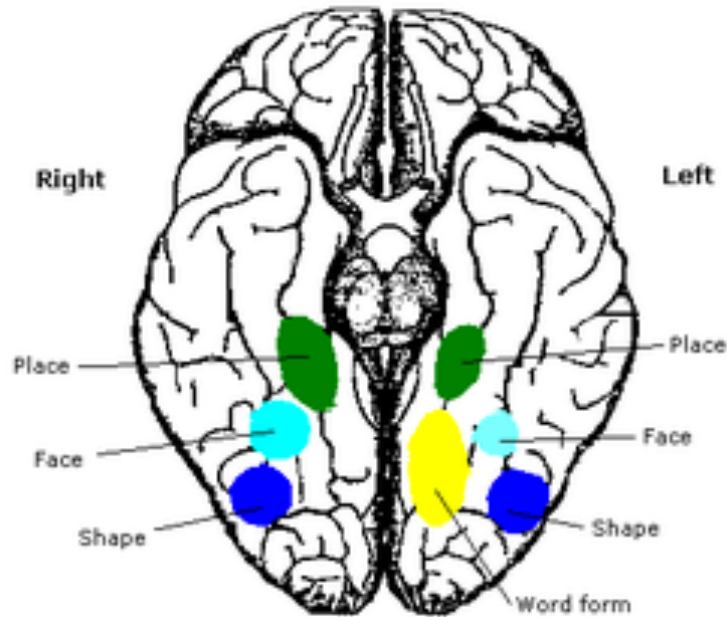
Source: Baddeley, 1986



Outside World

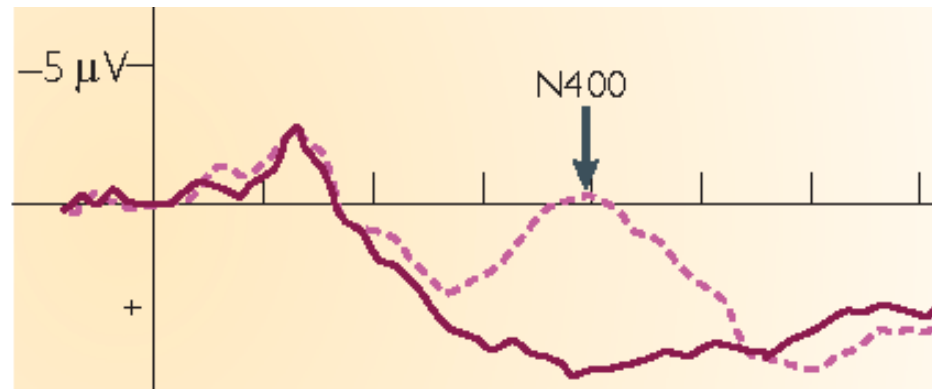
Anderson's ACT-R model

1990s-2000s: brain imaging revolutionizes cognitive neuroscience



Kanwisher

fMRI

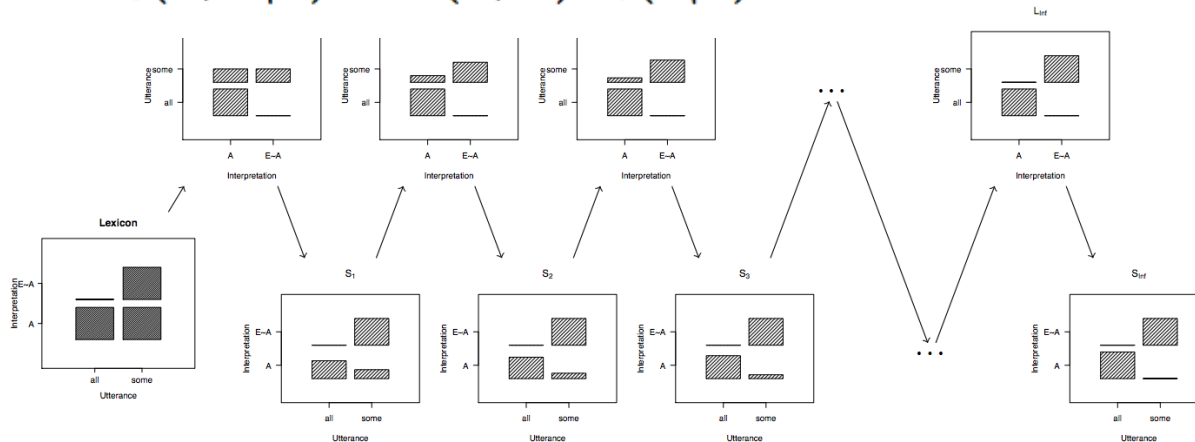


"I like my coffee with cream and dog" (Kutas & Hillyard, 1984)

**ERPs reveal timing of
cognitive processes**

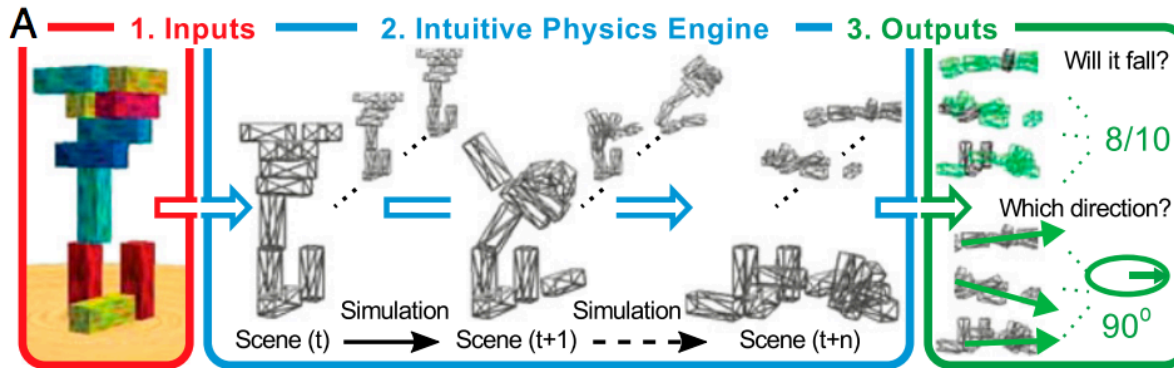
Now

$$L_n(o, w|u) \propto P(o, w)S_n(u|o).$$



rational speech
acts (RSA) model
of pragmatics

Bergen et al. (2016)

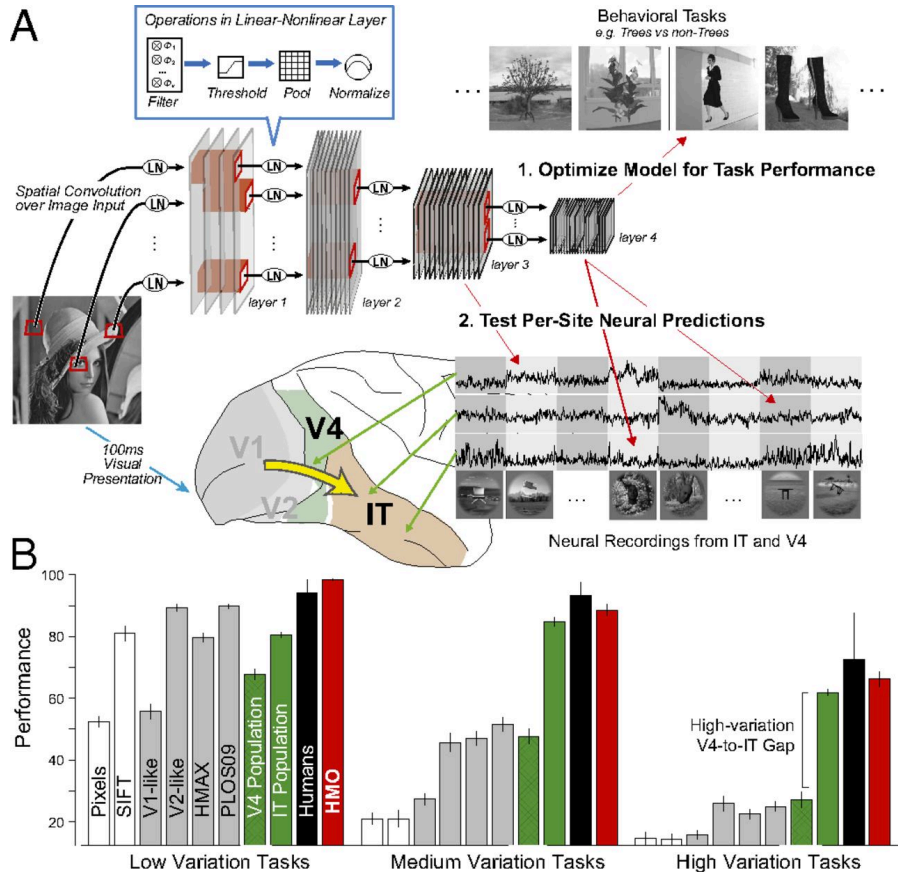


counterfactual
simulation using
symbolic intuitive
physics

Battaglia et al. (2013)

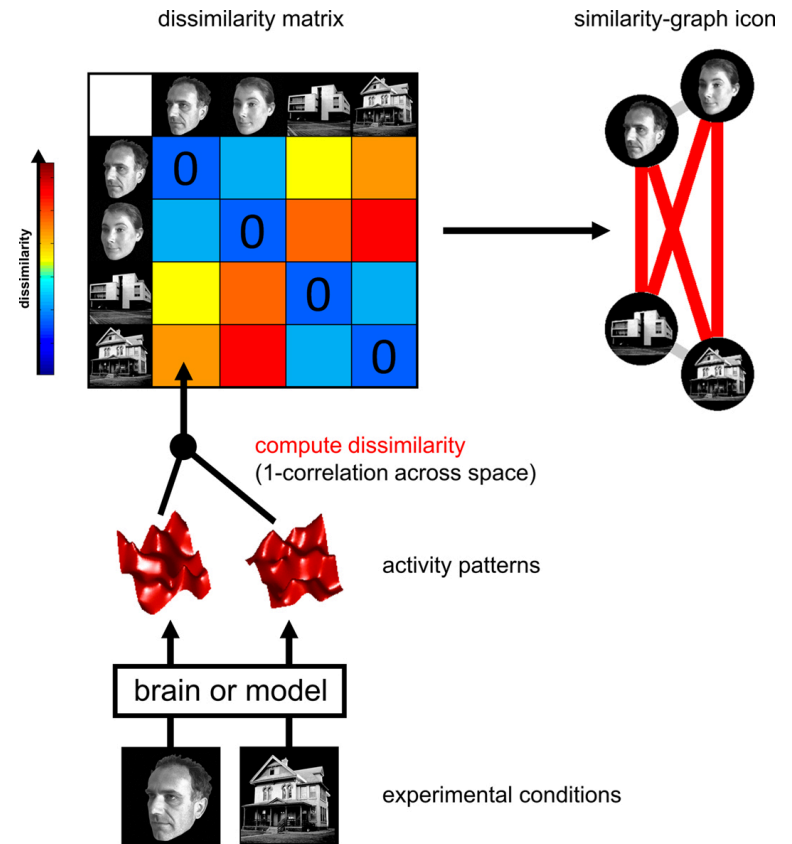
symbolic computational accounts of higher-level cognition

Now



Yamins et al. (2014)

using deep neural networks to
understand the brain



Kriegeskorte et al. (2008)

new computational methods in
human neuroimaging

Next time:

- quick intro to perception
- perception paper discussions
- intro to learning & memory