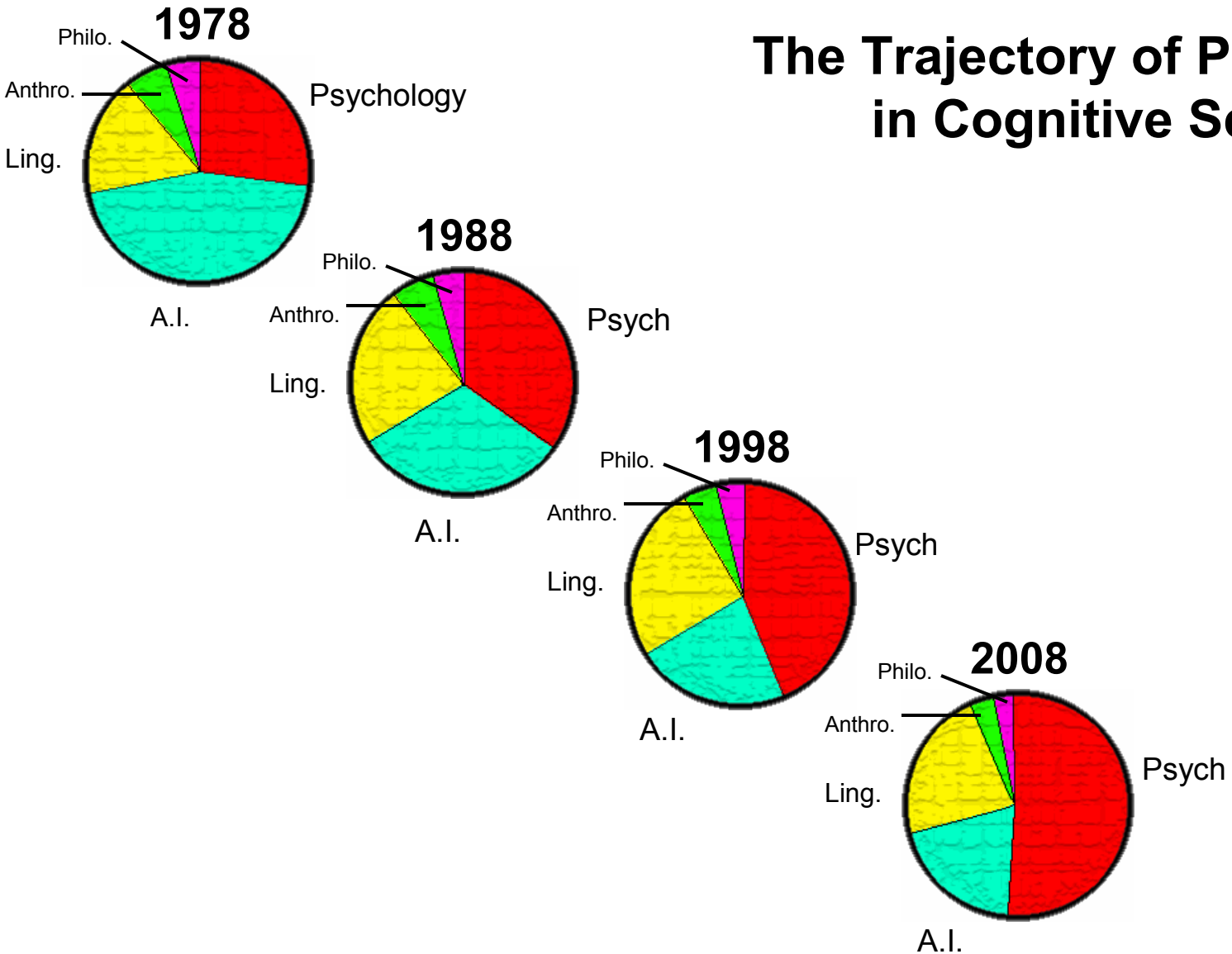


**The Trajectory of Psychology
within
Cognitive Science**

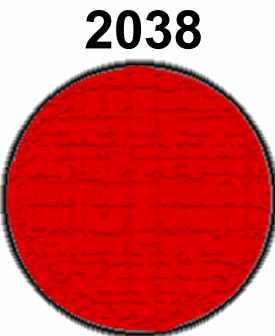
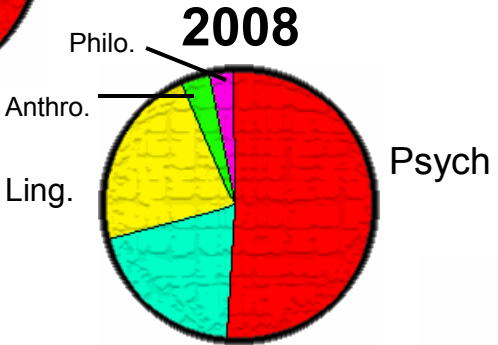
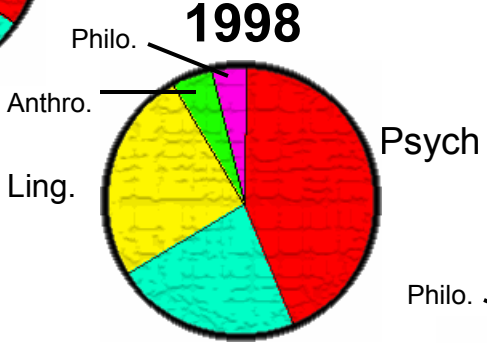
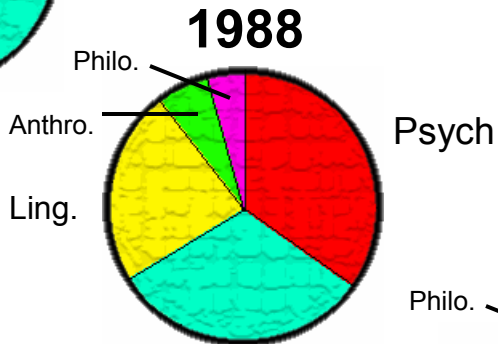
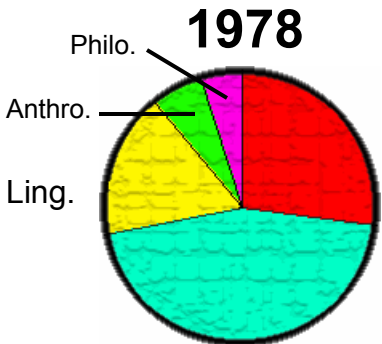
**Dedre Gentner
Northwestern University**

- 1. How has Psychology fared within Cognitive Science?**
- 2. How have areas within Psychology risen and fallen?**
- 3. What about the next 30 years?**

The Trajectory of Psychology in Cognitive Science



The Conquest of Cognitive Science By Psychology



Marr's Levels of Explanation in Cognitive Science

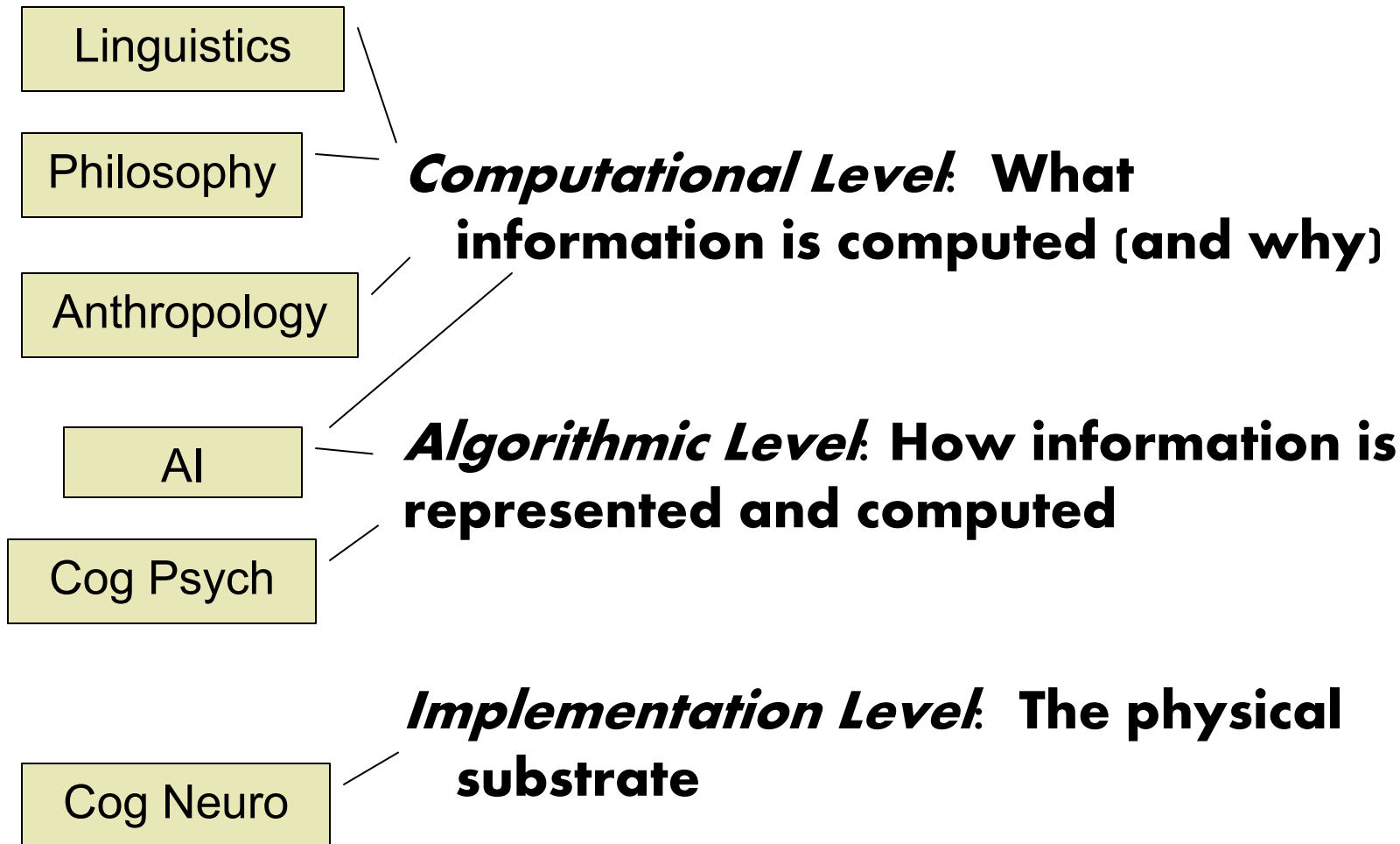
***Computational Level.* What
information is computed (and why)**

***Algorithmic Level.* How information is
represented and computed**

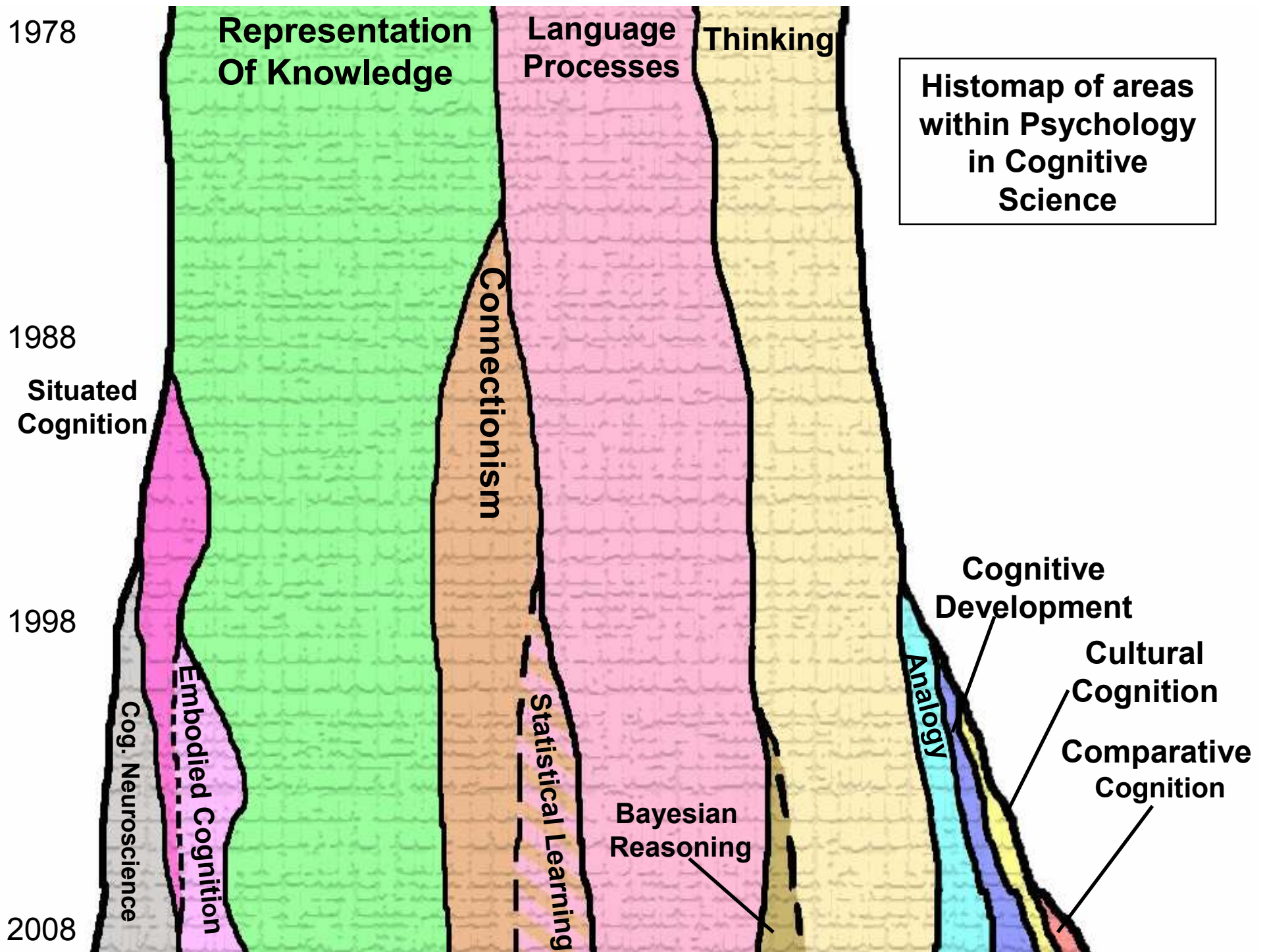
Cog Psych

***Implementational Level.* The physical
substrate**

Marr's Levels of Explanation in Cognitive Science



Question 2
How have areas fared within
Psychology?



1960's

Gibsonian Psychology

Perceptual affordances

Classic Knowledge Representation

1970's

The Truth is out there...

1980's

Situated Cognition

*Perceptual affordances
Distributed social cognition
Artifacts*

Complex Representations

Amodal representations

1990's

The Truth is down there...

Embodied Cognition

*Perceptual representations;
Neural support*

2000's

1960's

Gibsonian Psychology

Perceptual affordances

Influences on Classic Knowledge Representation

1970's

(??)

1980's

Situated Cognition

*Perceptual affordances
Social supports
Artifacts*

- Social/cultural influences
- Environmental scaffolding
- Conservative learning

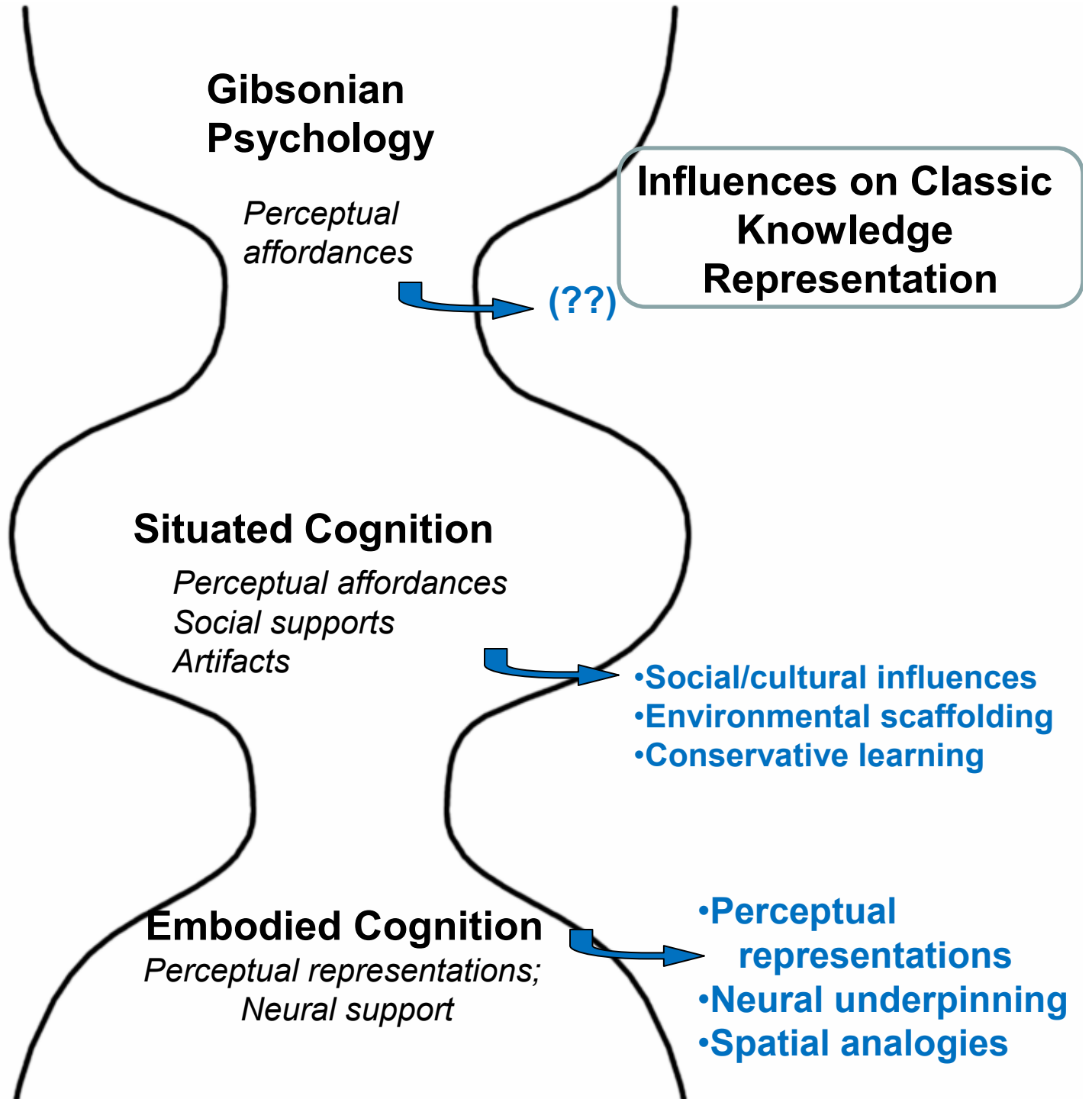
1990's

Embodied Cognition

*Perceptual representations;
Neural support*

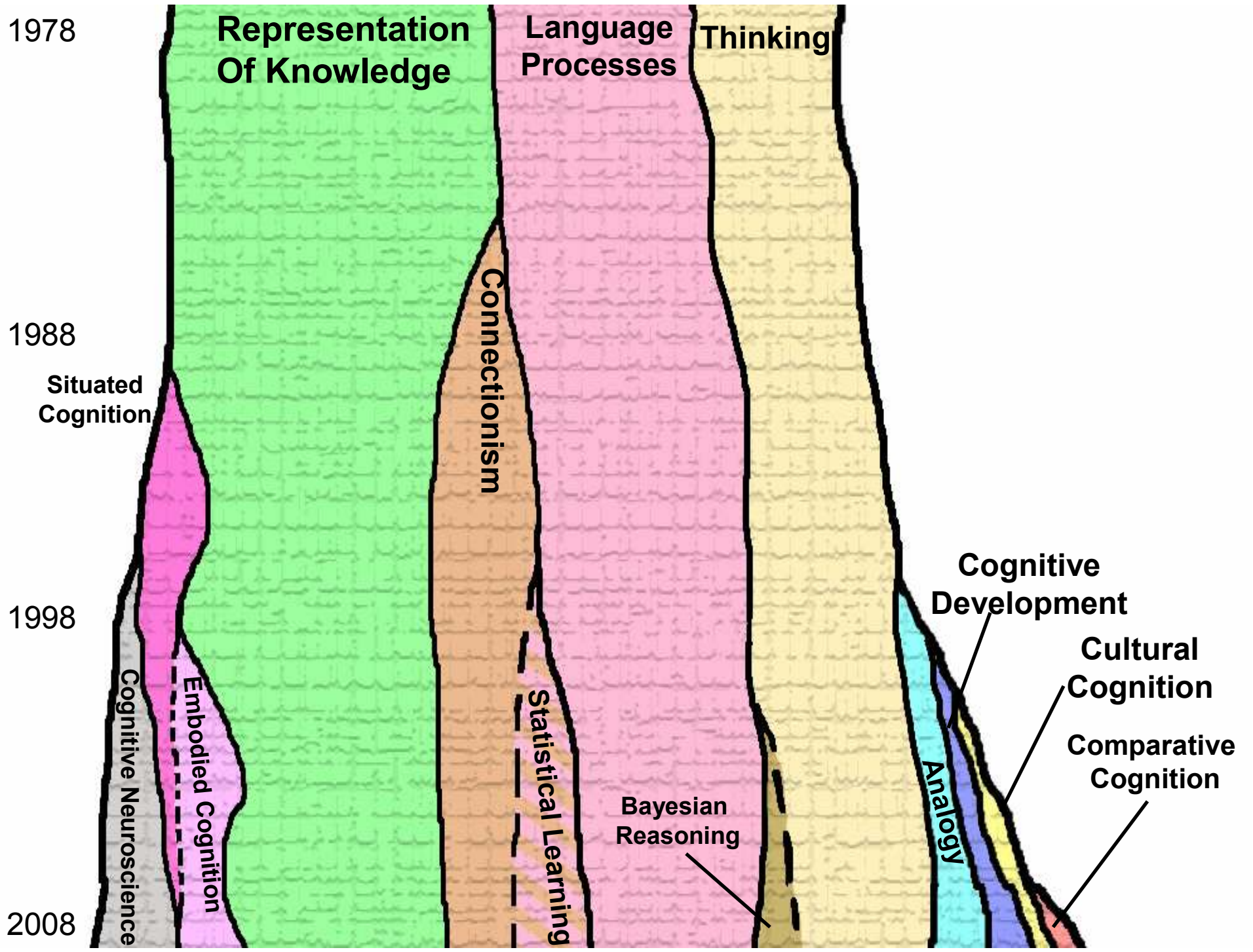
- Perceptual representations
- Neural underpinning
- Spatial analogies

2000's



Gains & Losses for Psychology in Cognitive Science

From 1978 to the present



Big Gains

- **Learning**
- **Cognitive development**
 - **Infant cognition**
- **Cultural cognition**
- **Sociality**

Big Gain: The lifting of former taboos

- **Language and thought**
 - After decades of dismissal, the Whorfian question is open to empirical study
- **Animal minds**
 - Formerly, animals had *instinct* or *association*
 - Now *animal cognition* can be studied
- **Unconscious thinking can be discussed**
 - as long as you call it *implicit*

Big Loss:

Work on Knowledge Representation

Massive amounts of work in 70s & 80s

- **naïve physics**
- **semantic decomposition**
- **belief systems**
- **causal mental models**

Articles from first issue of *Cognitive Science* (1977)

Volume 1, Number 1 contained the following articles:

Collins, A., Why cognitive science?

Bobrow, D. G., & Winograd, T., An overview of KRL, a Knowledge Representation Language

Lehnert, W., Human and computational question answering

Ortony, A. & Anderson, R. C., Definite descriptions and semantic memory

Goldstein, I. & Papert, S., Artificial intelligence, language and the study of knowledge.

Papers from the Cognitive Science Conference 1979

Plenary Talks

Allan Newell - The knowledge level and the symbolic level

Roger Schank – Language and memory

John Searle – Intention and action

Terry Winograd – What does it mean to understand language

[Don Norman – 12 issues for cog sci]

[Herb Simon - cog sci- the newest science of artificial phenomena]

Sample Symposia

Belief systems

*Bob Abelson, Ed Hutchins, Jaime Carbonell, Ken Colby, Paul Kay,
Naomi Quinn*

Cognitive science and education

–mental models, naïve physics, folk beliefs

*Allan Collins, Al Stevens, John Seely Brown, John Anderson, James
Greeno, Ira Goldstein*

Big Loss: Work on Knowledge Representation

Why this loss is a problem:

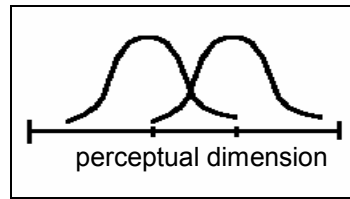
Human cognitive prowess relies critically on richly structured systems of knowledge and on symbolic reasoning abilities that allow us to draw implications, process contradictions, and process counterfactuals.

(If you did not have such abilities, you would not have been able to understand the above sentence.)

**Cognitive Science cross-disciplinary
research can lead to advances in
Psychology**

Case in point: Similarity and analogy

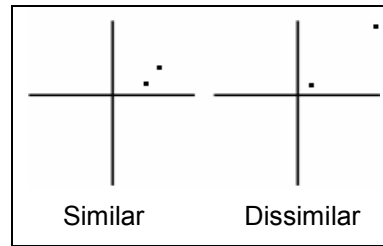
Similarity



Perceptual closeness

Psych. Behaviorists

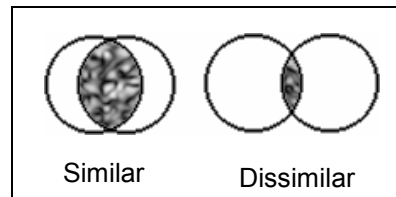
1950s-
1960s



Mental distance

Psych. Shepard

1962



Feature-set intersection 1977

Psych. Tversky

Analogy

1966 **Analogue models in science**

Phil. Hesse

Geometric analogy solver

A.I. Evans

1970s **Structural matching**

A.I. Winston.

1980s **Structure-mapping & related models**

Psych / A.I. **SME**

Falkenhainer, Forbus & Gentner

Psych / Phil. **ACME**

Holyoak & Thagard

A.I. **CopyCat**

Hofstadter & Mitchell

1990s-

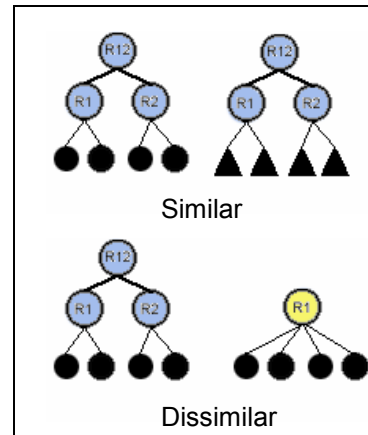
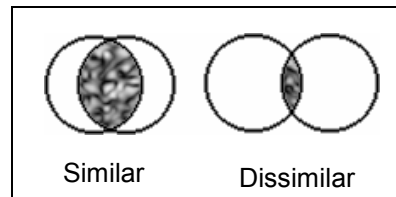
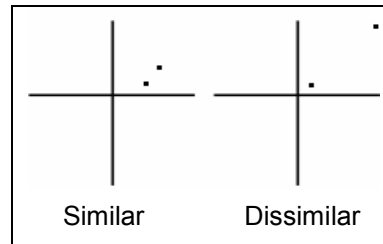
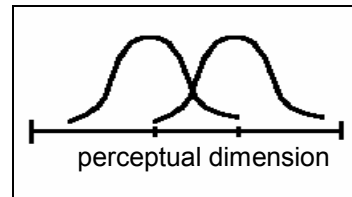
Psych **LISA**

Hummel & Holyoak

2000s

A.I. **IAM, AMBR, TableTalk**

Psych: **SIAM, CAB, EMMA, DORA**



Similarity

Perceptual closeness

Psych. Behaviorists

1950s-
1960s

Mental distance

Psych. Shepard

1962

Feature-set intersection 1977

Psych. Tversky

Analogy

1966 **Analogue models in science**

Phil. Hesse

Geometric analogy solver

A.I. Evans

1970s **Structural matching**

A.I. Winston.

1980s **Structure-mapping & related models**

Psych / A.I. **SME**

Falkenhainer, Forbus & Gentner

Psych / Phil. **ACME**

Holyoak & Thagard

A.I. **CopyCat**

Hofstadter & Mitchell

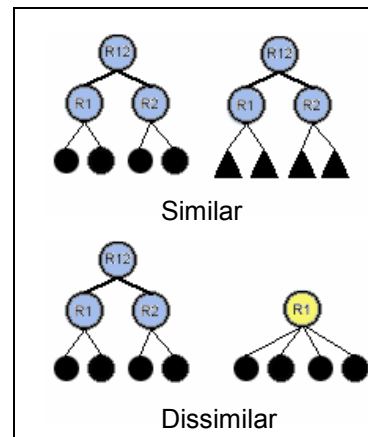
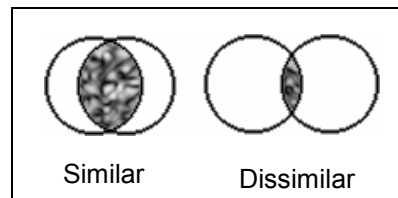
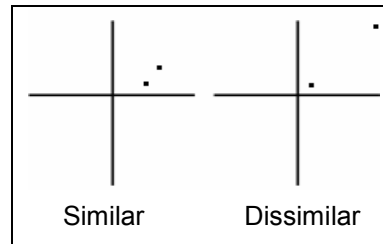
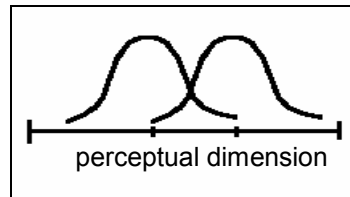
1990s-
2000s

Psych **LISA**

Hummel & Holyoak

A.I. **IAM, AMBR, TableTalk**

Psych: **SIAM, CAB, EMMA, DORA**



Similarity

Perceptual closeness

Psych. Behaviorists

1950s-
1960s

Mental distance

Psych. Shepard

1962

Feature-set intersection 1977

Psych. Tversky

Structural alignment models of similarity

Psych Gentner, Medin,
Goldstone, Markman

1980s

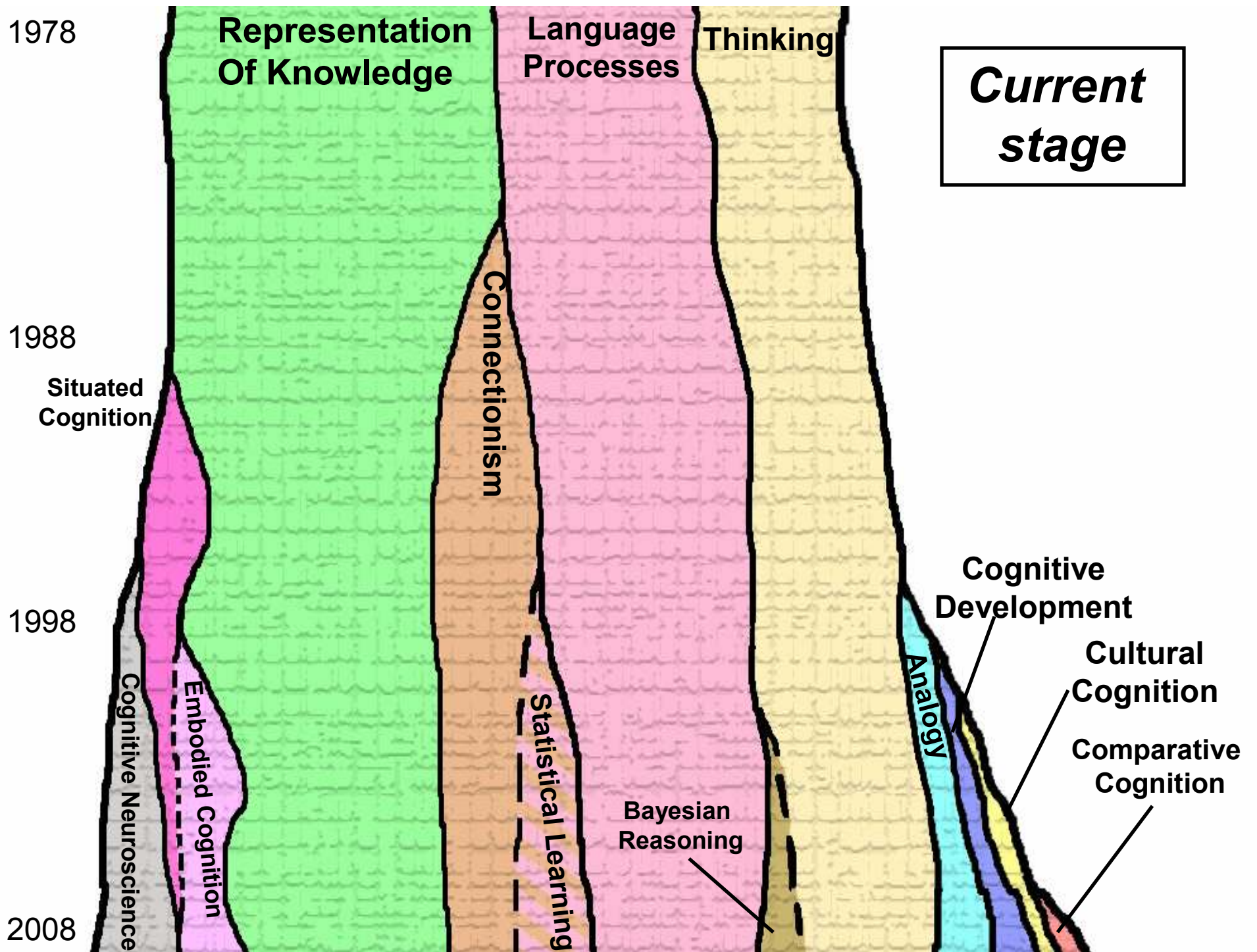
Structural alignment in

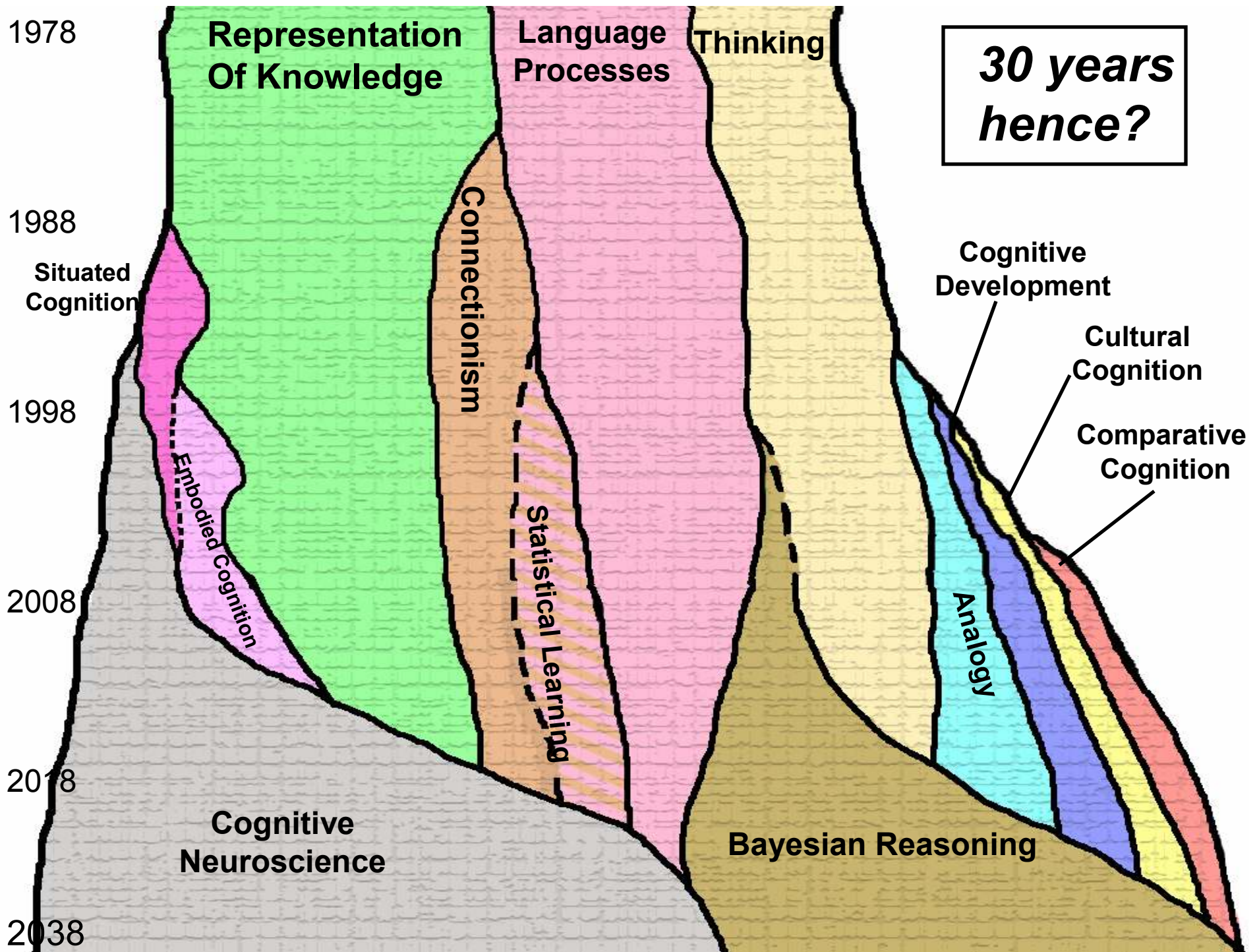
Learning
Abstraction
Decision-making
Difference detection

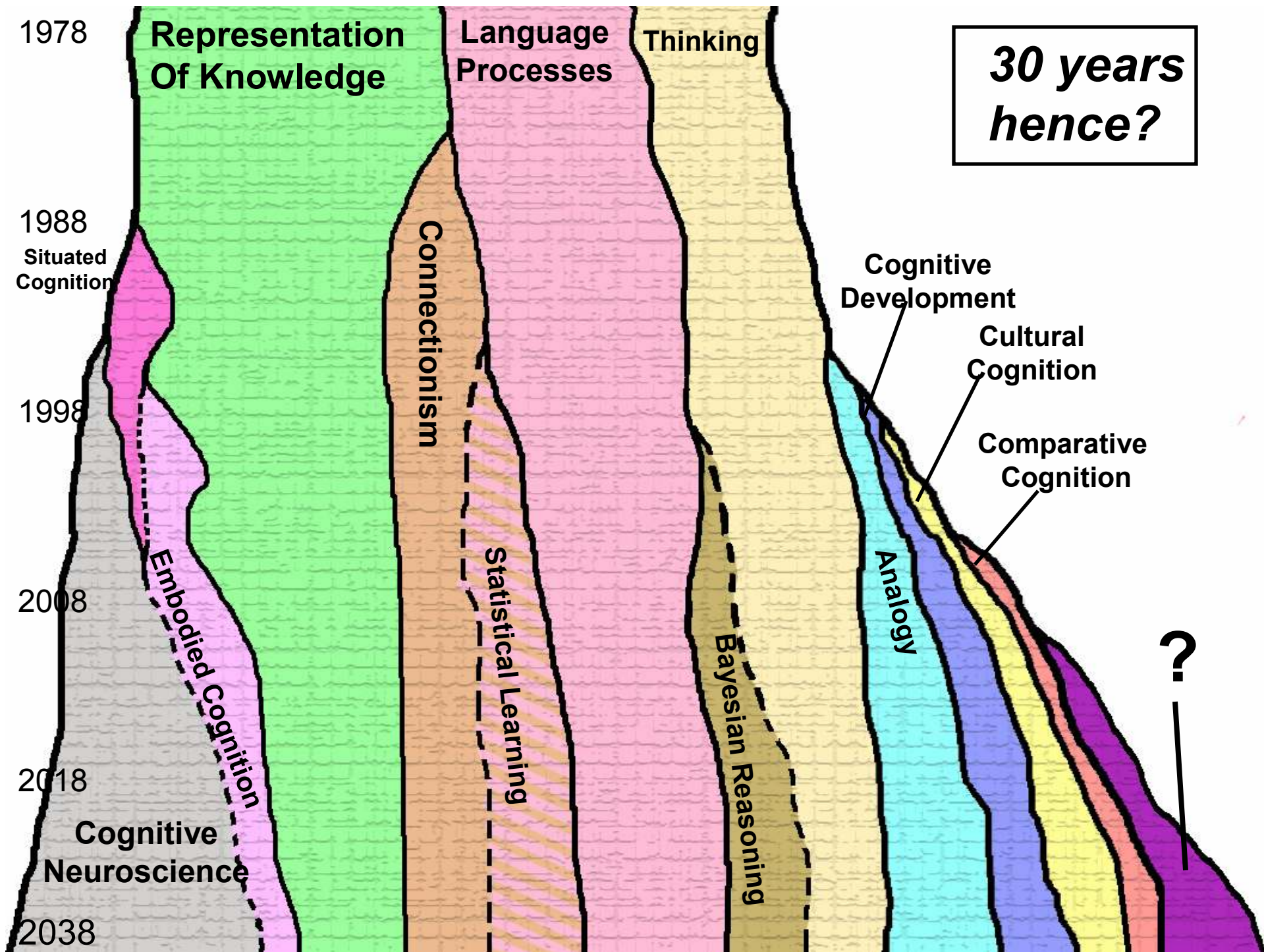
1990s-
2000s

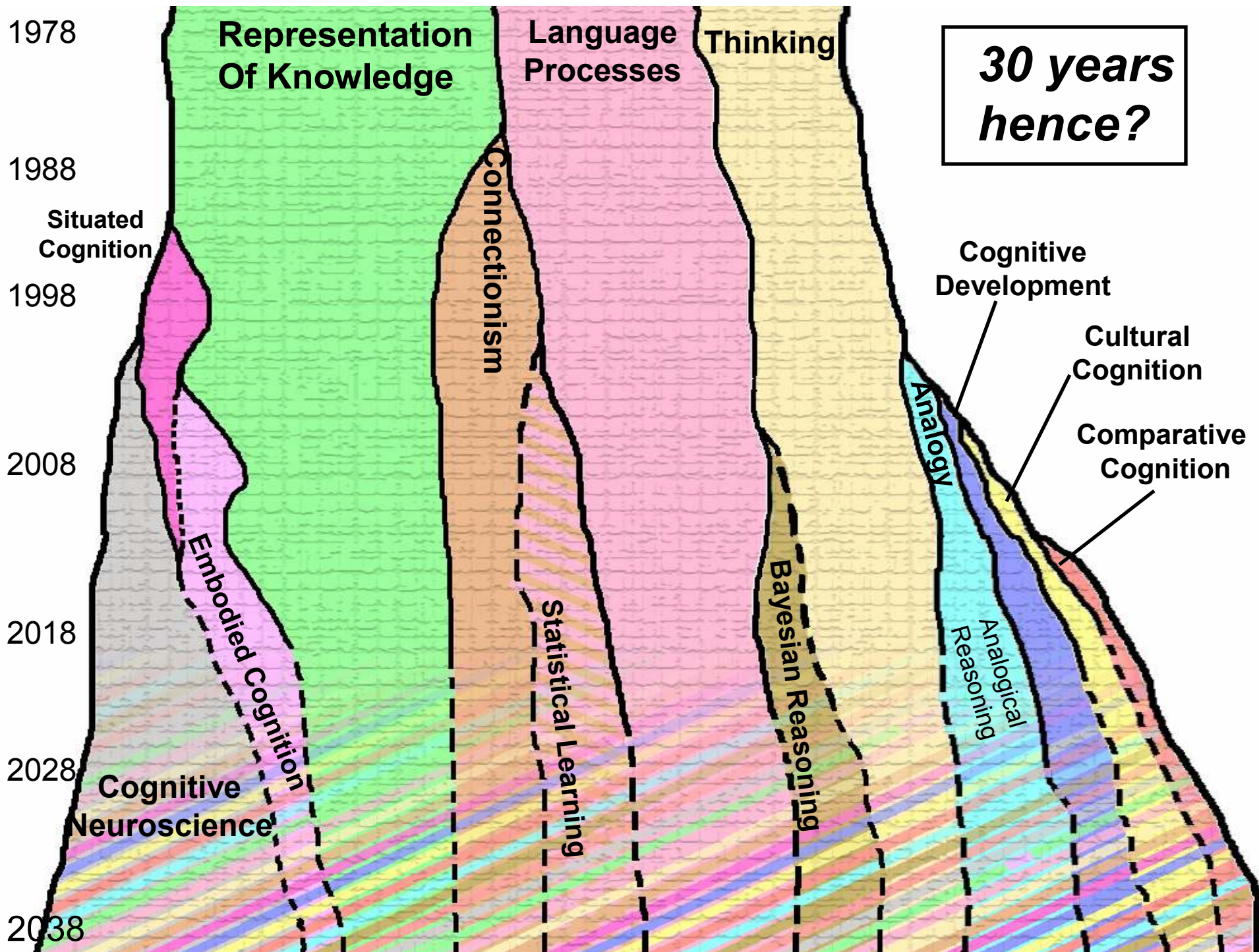
Question 3

Where will we be in 30 years?









The End