The Trajectory of Psychology within Cognitive Science

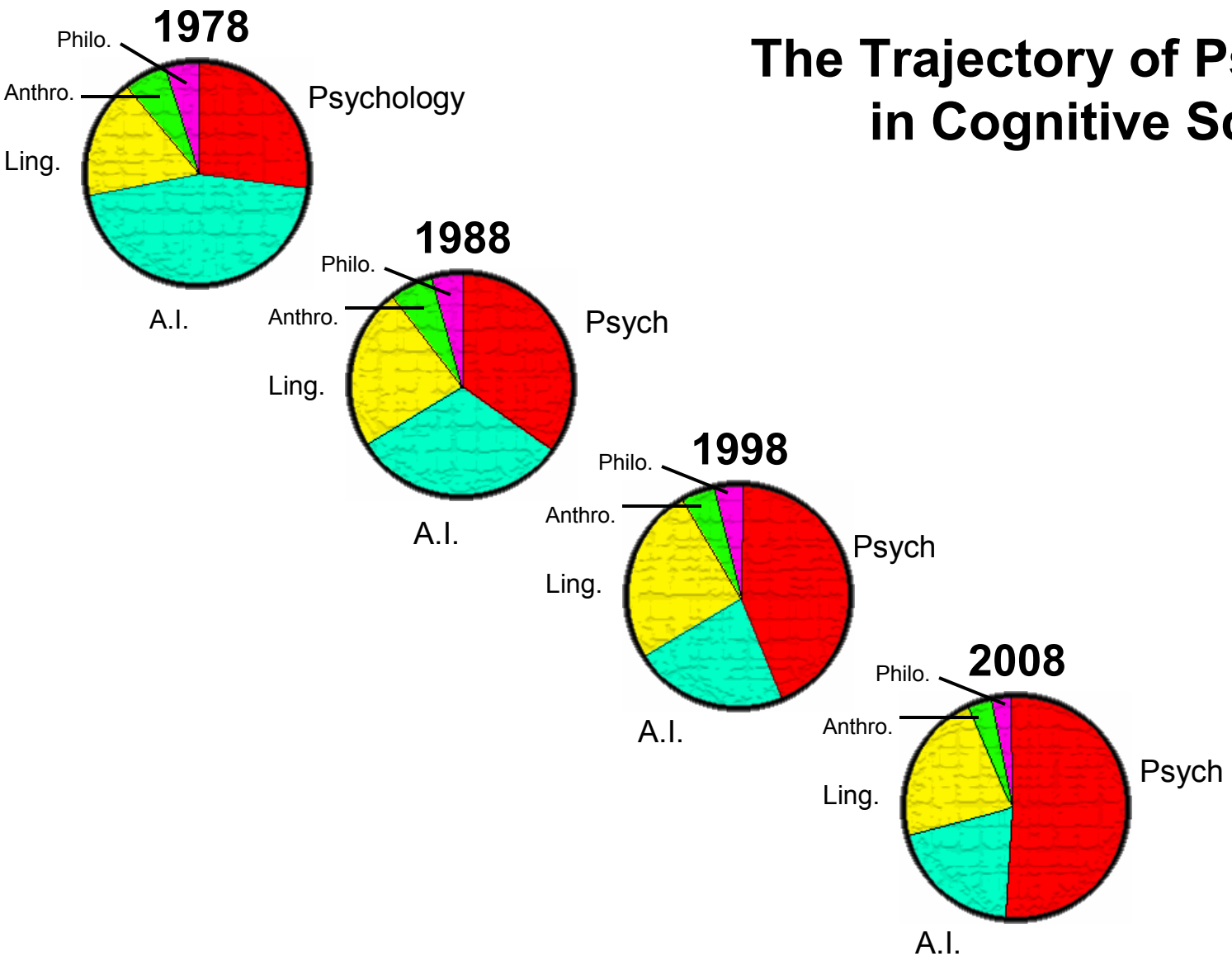
Dedre Gentner
Northwestern University

1. **How has Psychology fared within Cognitive Science?**

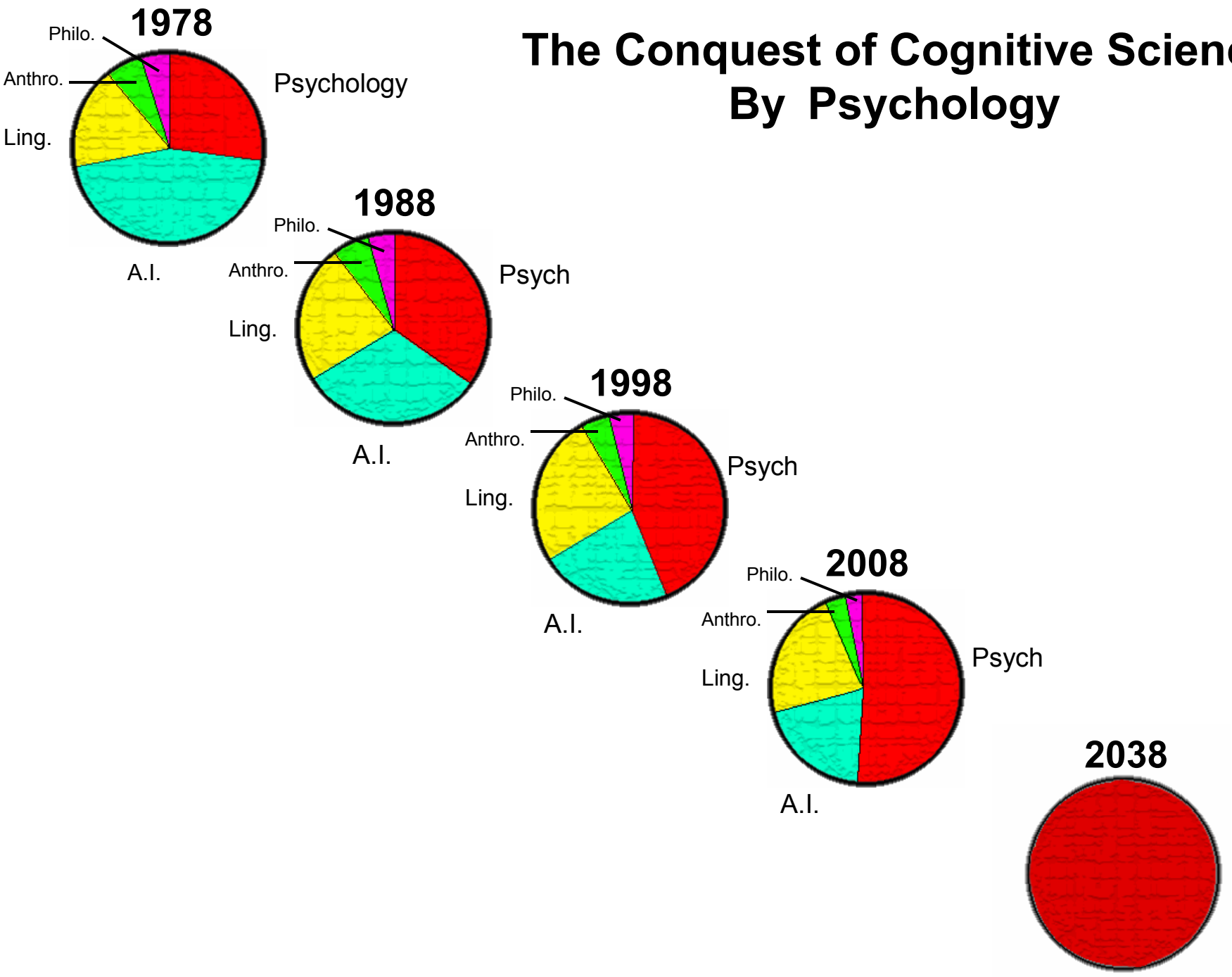
2. **How have areas within Psychology risen and fallen?**

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

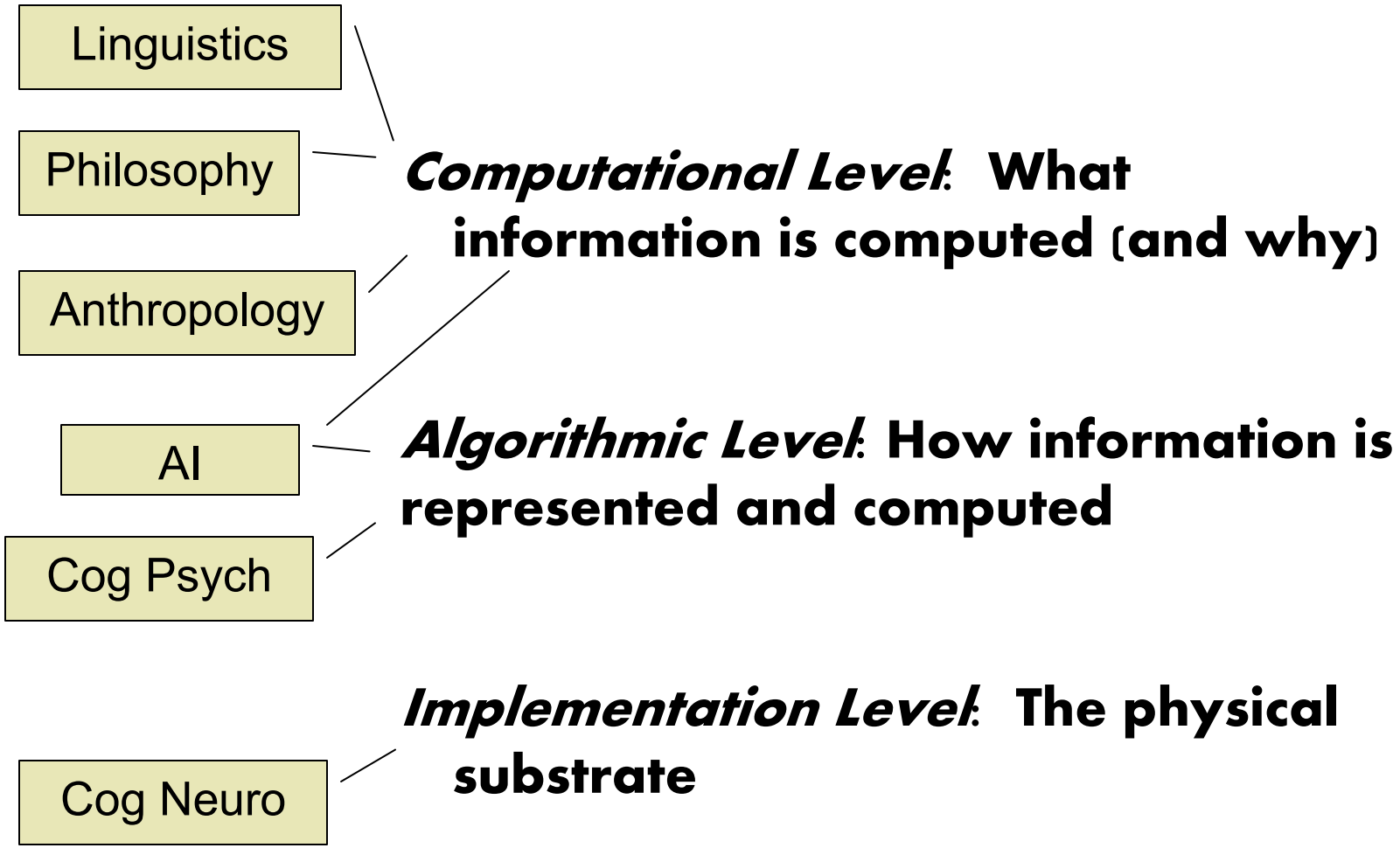
Computational Level: **What information is computed (and why)**

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

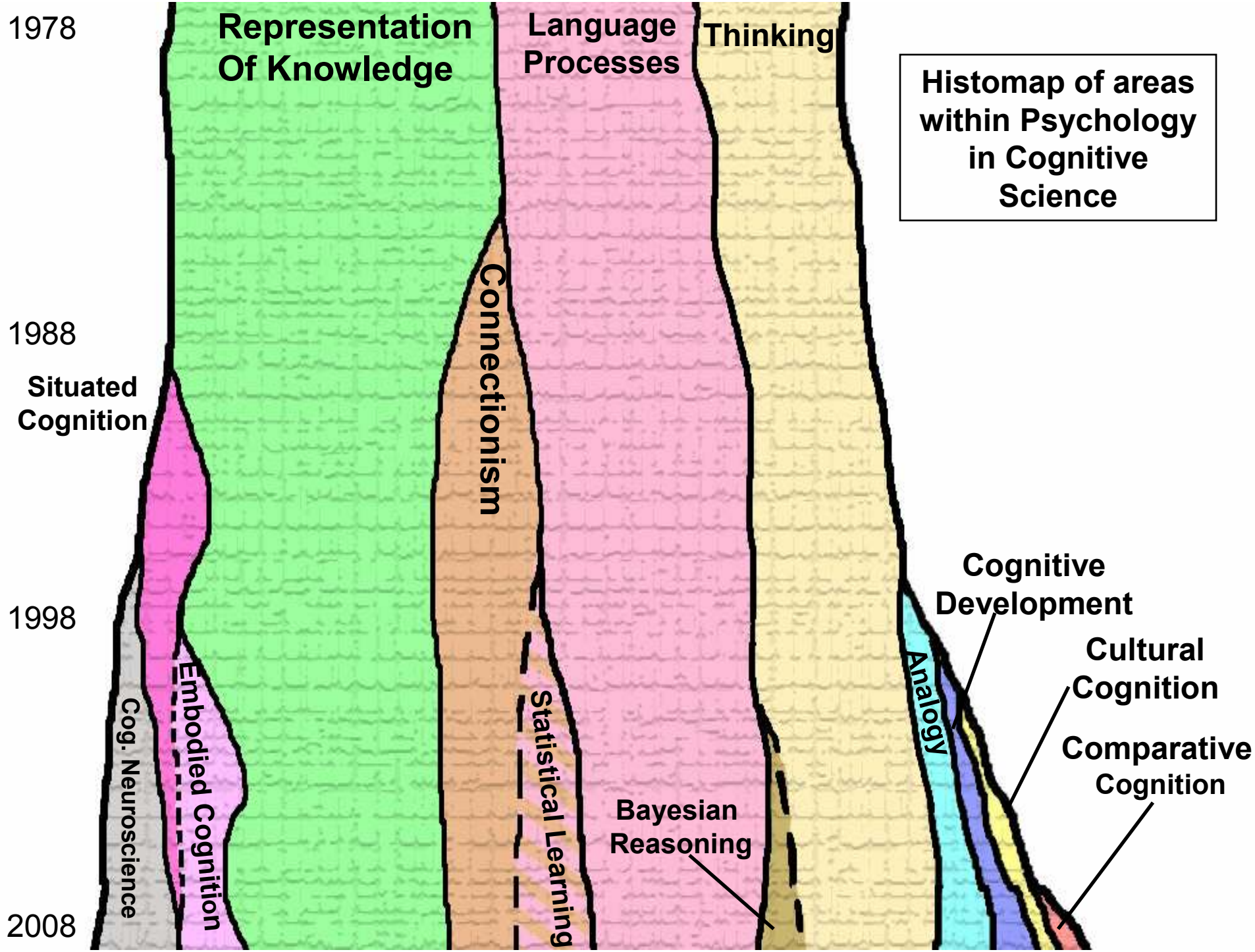
Cog Psych

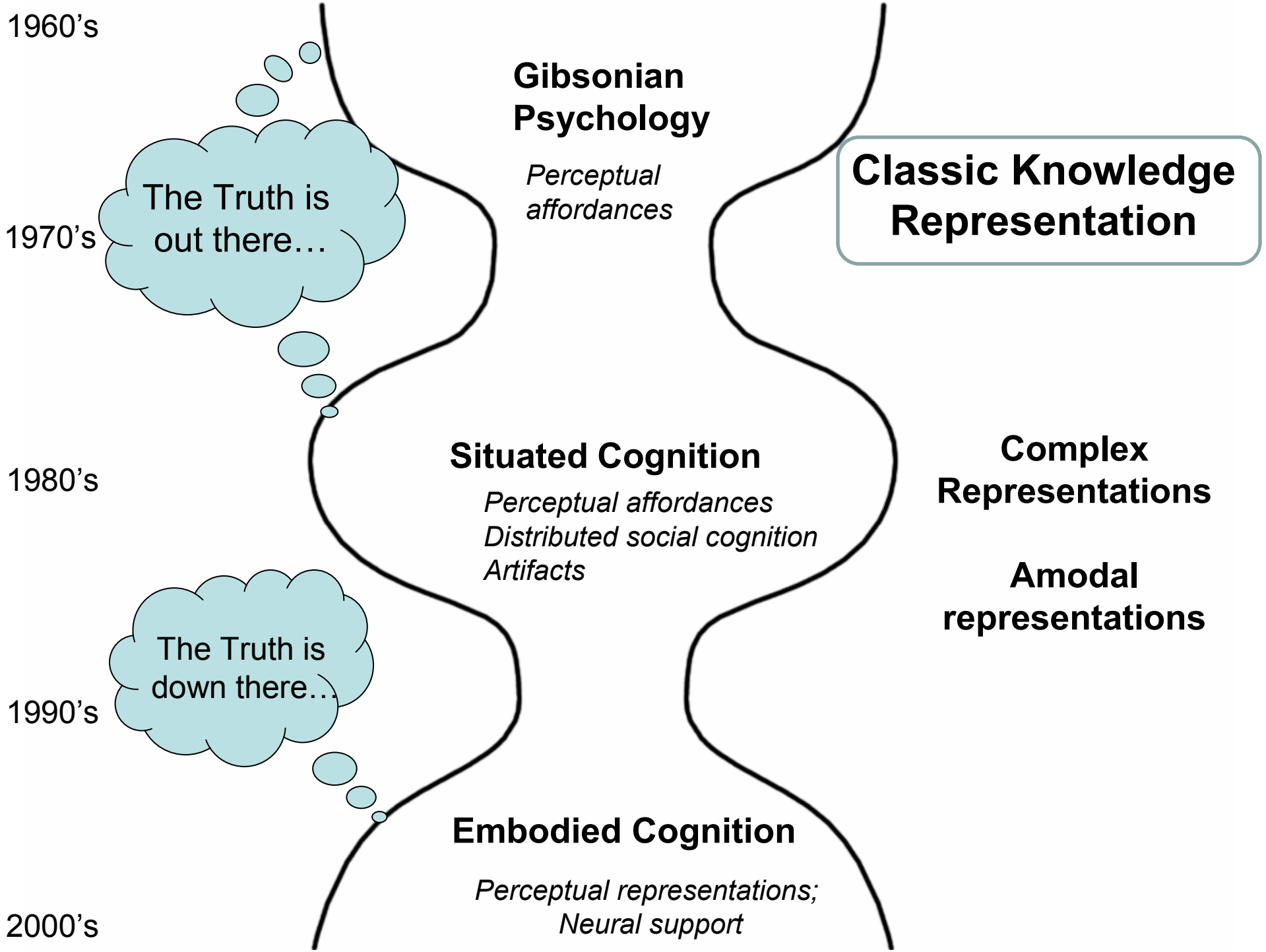
Implementational Level: **The physical substrate**

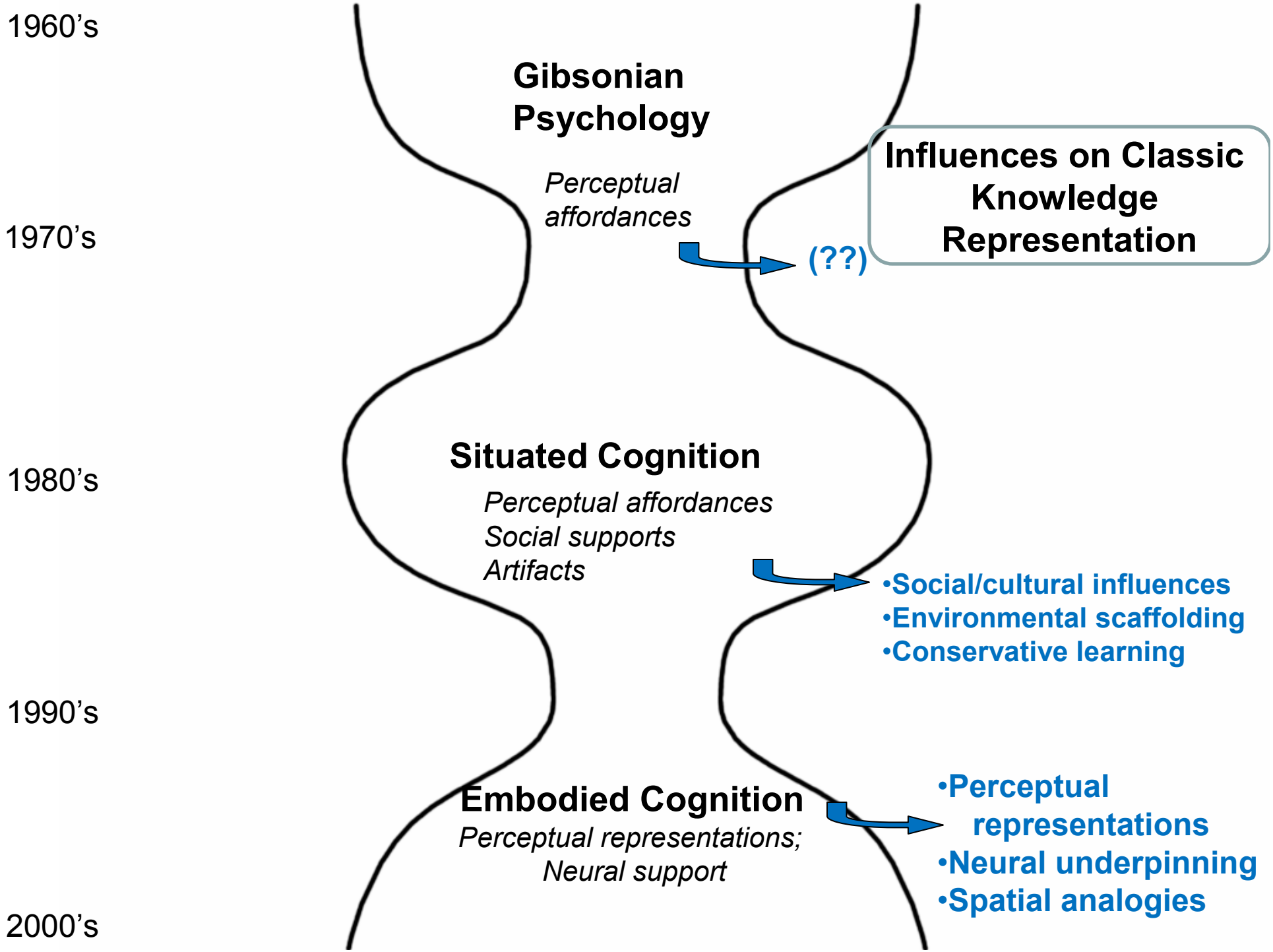
Marr's Levels of Explanation in Cognitive Science



Question 2
How have areas fared within Psychology?

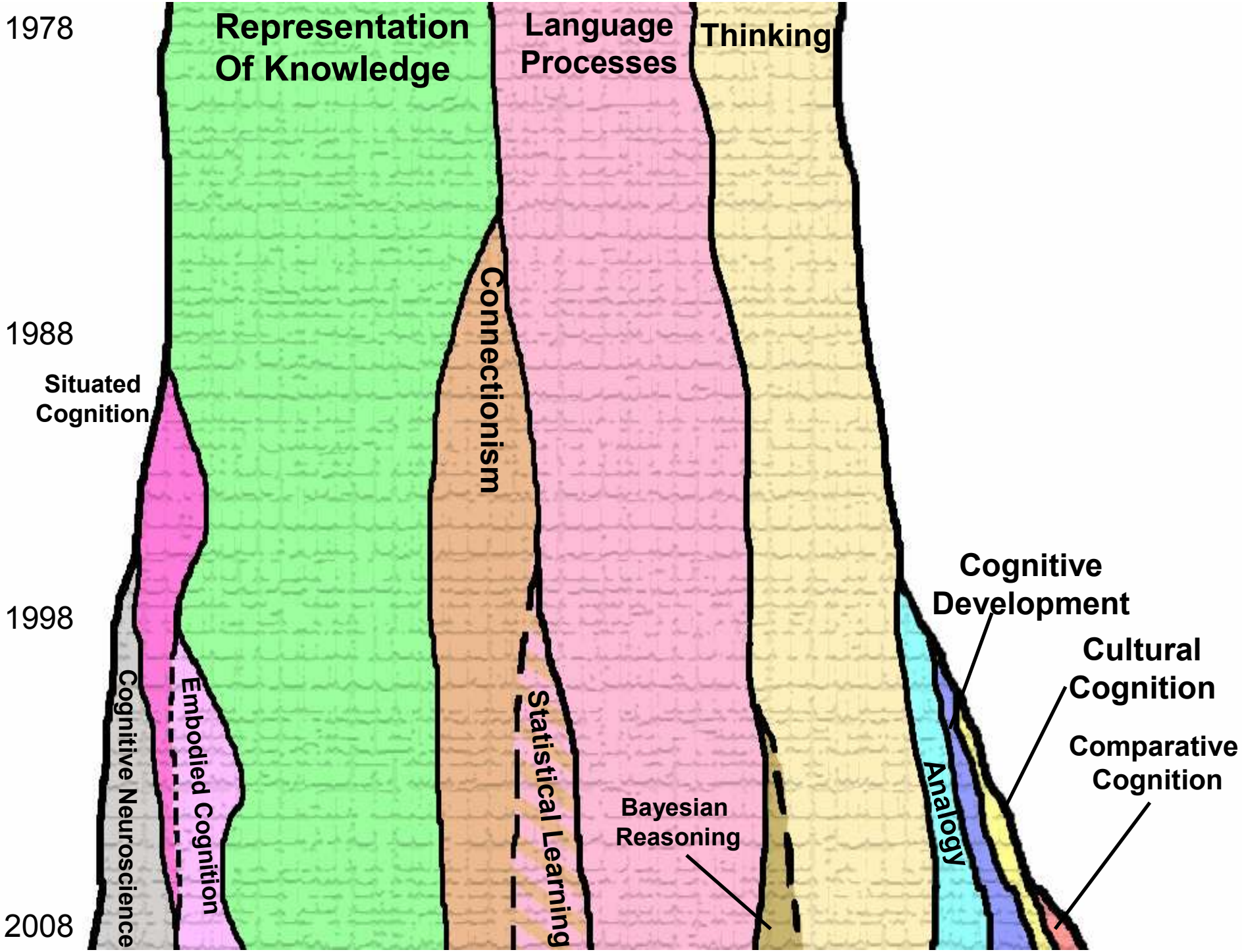

1978
1988
1998
2008
Representation Of Knowledge
Language Processes
Thinking
Histomap of areas within Psychology in Cognitive Science
Connectionism
Situated Cognition
Embodied Cognition
Cog. Neuroscience
Statistical Learning
Bayesian Reasoning
Analogy
Cognitive Development
Cultural Cognition
Comparative Cognition


1960's
1970's
1980's
1990's
2000's
The Truth is out there…
The Truth is down there…
Gibsonian Psychology
Perceptual affordances
Classic Knowledge Representation
Situated Cognition
Perceptual affordances
Distributed social cognition
Artifacts
Complex Representations
Amodal representations
Embodied Cognition
Perceptual representations;
Neural support


1960's
1970's
1980's
1990's
2000's
Gibsonian Psychology
Perceptual affordances
(??)
Influences on Classic Knowledge Representation
Situated Cognition
Perceptual affordances
Social supports
Artifacts
•Social/cultural influences
•Environmental scaffolding
•Conservative learning
Embodied Cognition
Perceptual representations;
Neural support
•Perceptual representations
•Neural underpinning
•Spatial analogies

Gains & Losses for Psychology in Cognitive Science

From 1978 to the present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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**
- **<u>Unconscious thinking</u> 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:

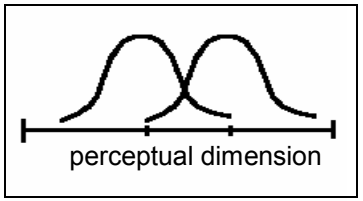
Human cognitive prowess relies critically on richly structured systems of knowledge and on symbolic reasoning abilities that allow us to draw implications, process contradictions, and process counterfactuals.

(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

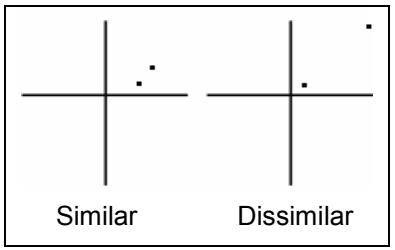
Case in point: Similarity and analogy

Similarity



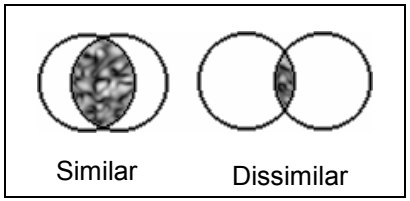
Perceptual closeness 1950s-1960s

Psych. Behaviorists



Mental distance 1962

Psych. Shepard



Feature-set intersection 1977

Psych. Tversky

Analogy

1966 **Analogical 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

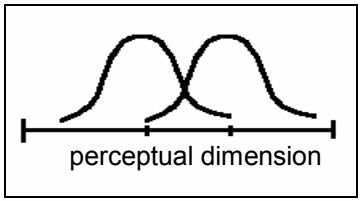
Psych / Phil. **ACME**
Holyoak & Thagard

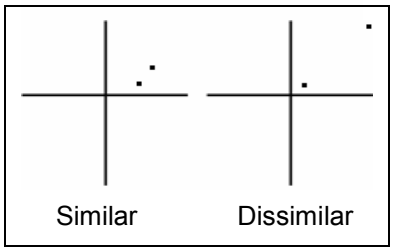
A.I. **CopyCat**
Hofstadter & Mitchell

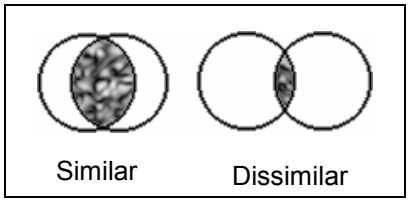
1990s-2000s *Psych* **LISA**
Hummel & Holyoak

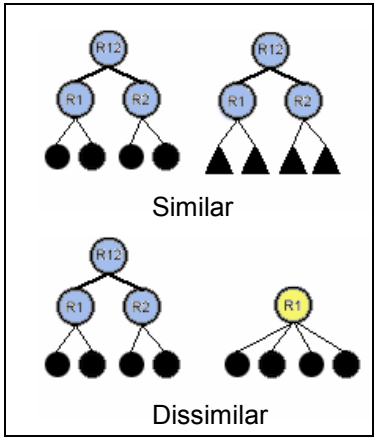
A.I. **IAM, AMBR, TableTalk**

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









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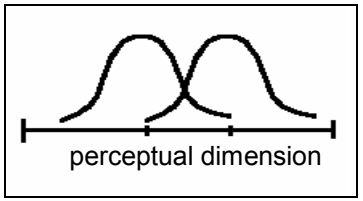

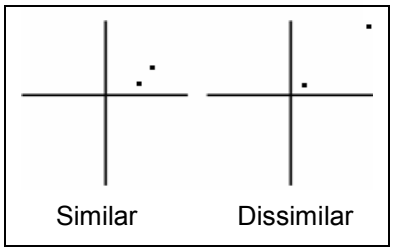

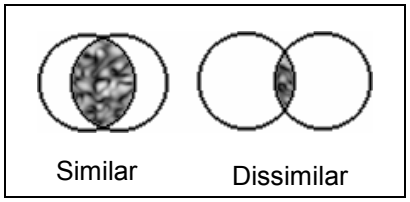

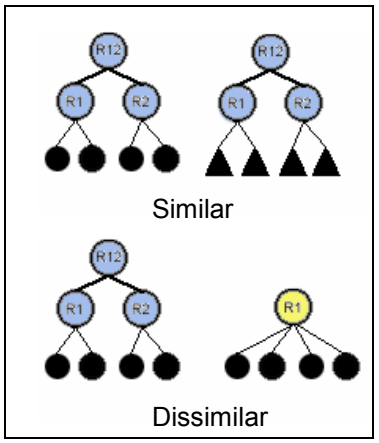

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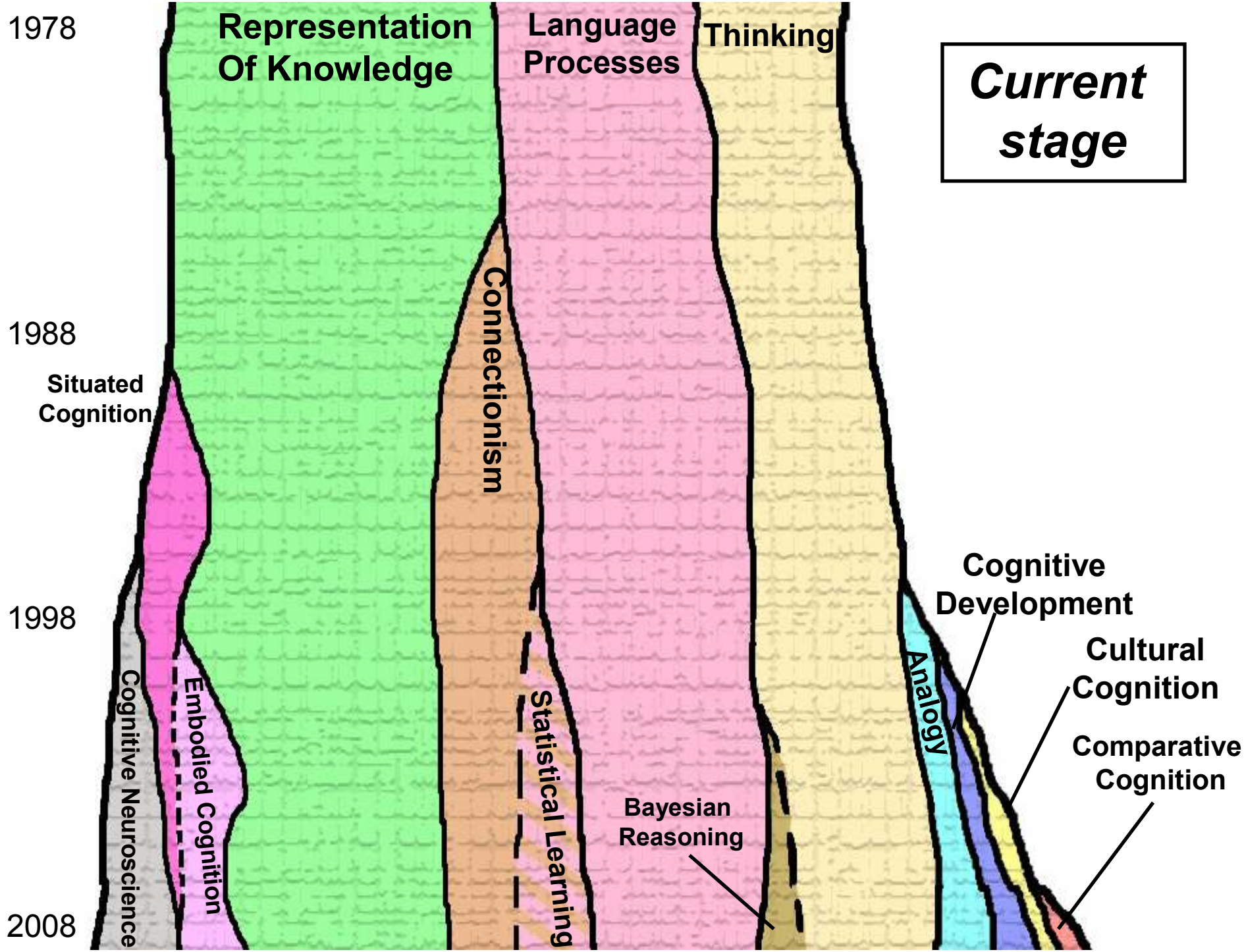
Psych. Tversky

1980s
Structural alignment models of similarity
Psych Gentner, Medin, Goldstone, Markman

Structural alignment in 1990s-2000s
Learning
Abstraction
Decision-making
Difference detection

Question 3

Where will we be in 30 years?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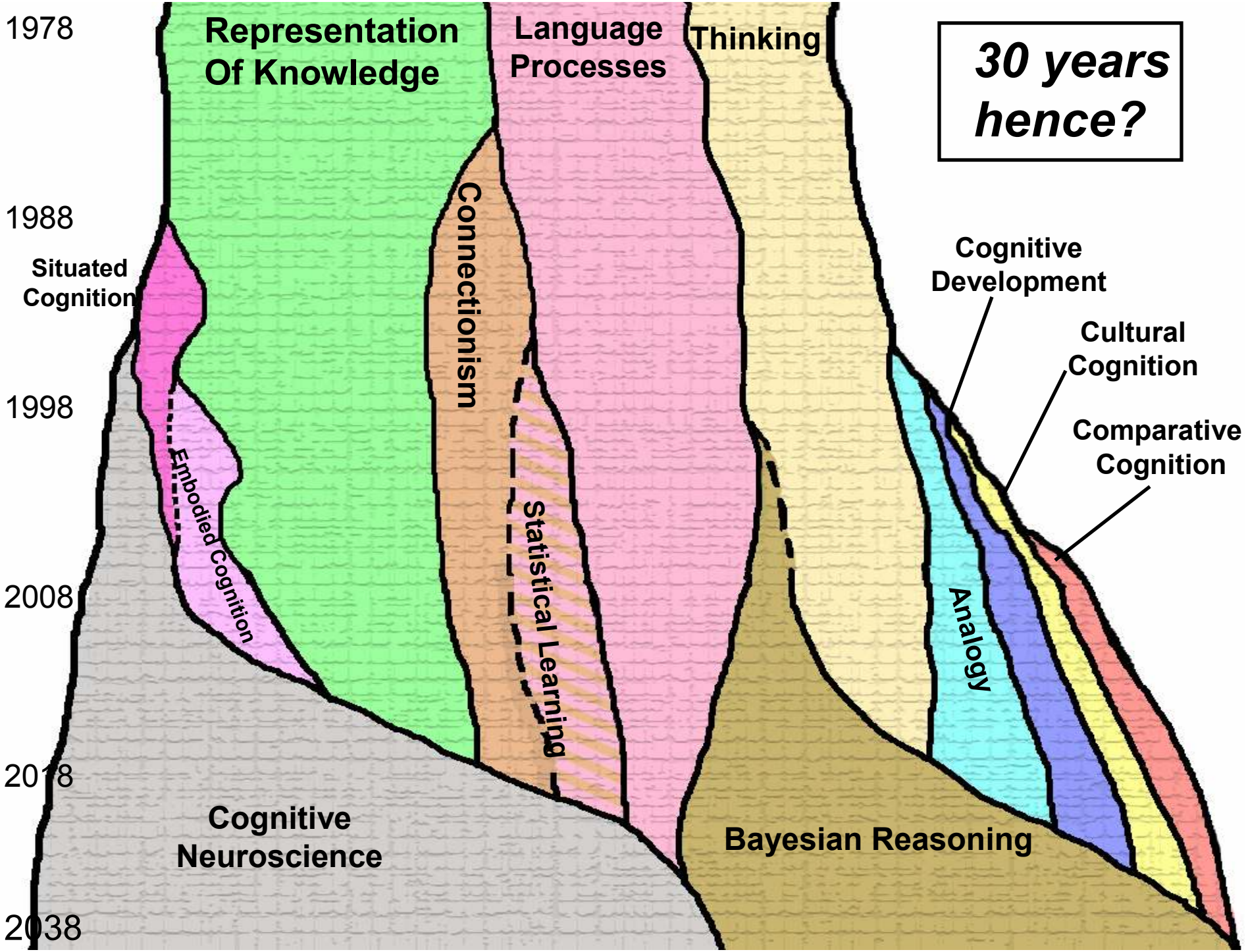
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2018
2038
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30 years hence?
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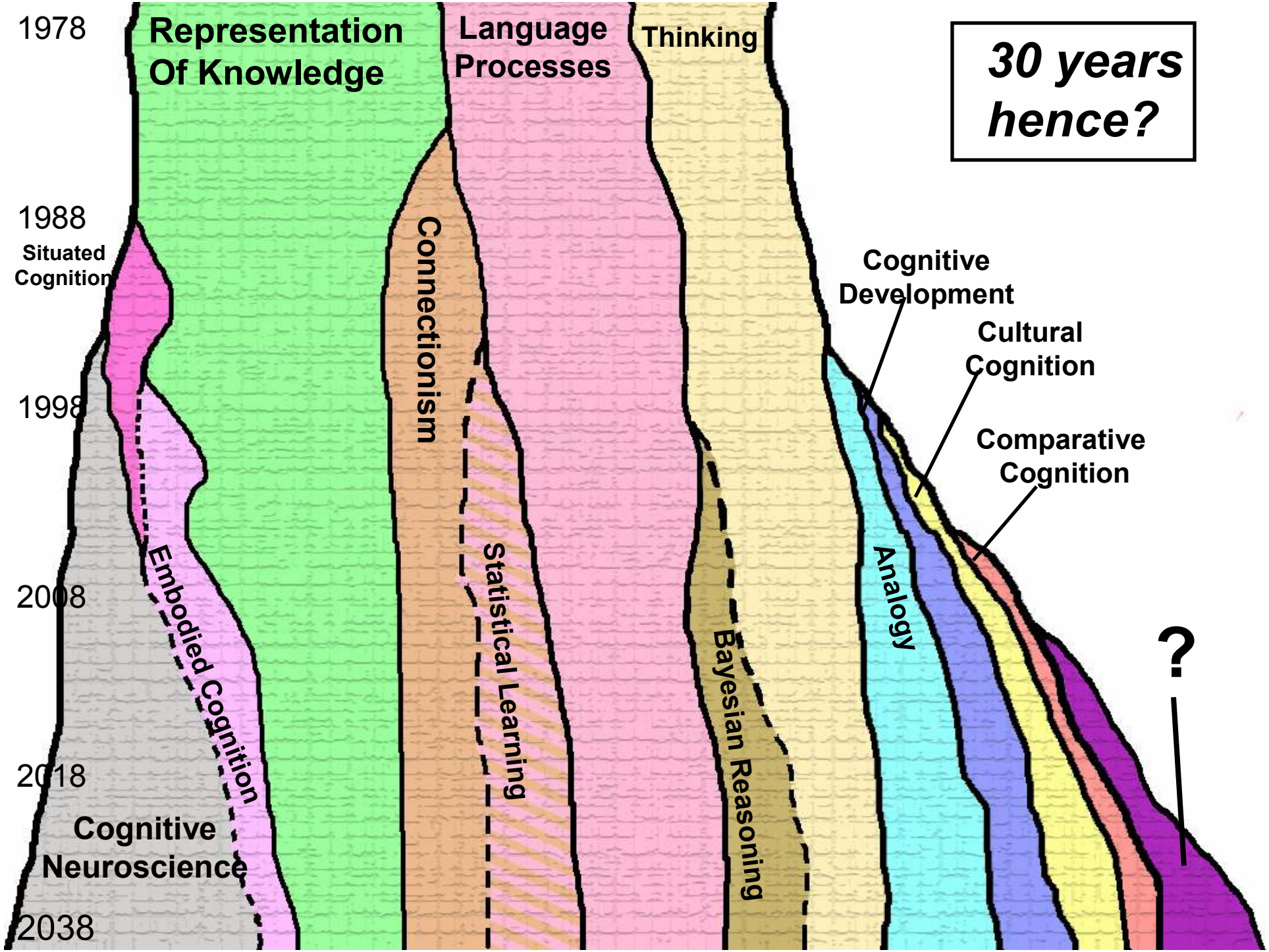
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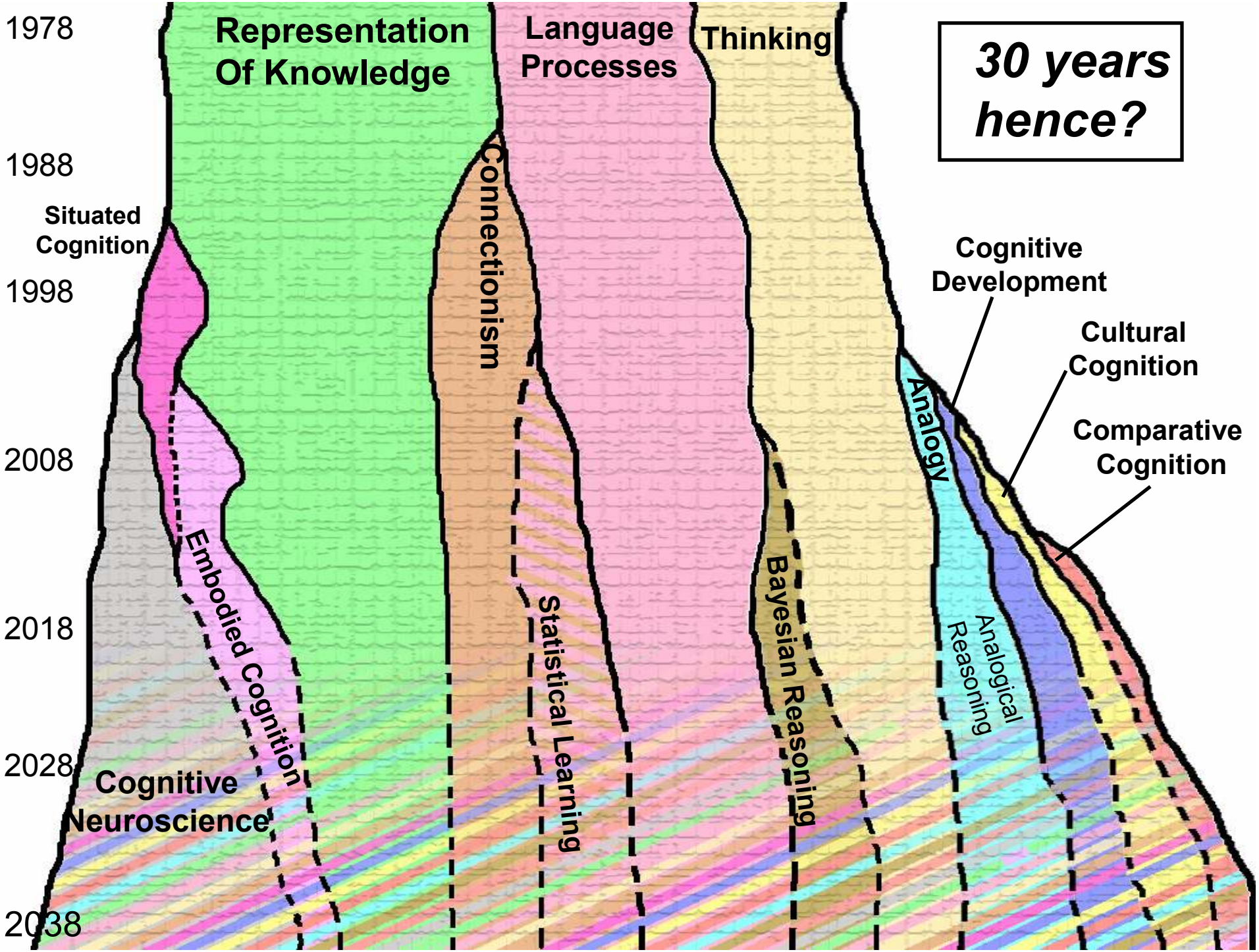
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The End