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

**Implementational Level**: The physical substrate

- Cog Psych
Marr’s Levels of Explanation in Cognitive Science

- **Linguistics**
- **Philosophy**
- **Anthropology**
- **AI**
- **Cog Psych**
- **Cog Neuro**

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

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

**Implementation Level**: The physical substrate
Question 2
How have areas fared within Psychology?
Gibsonian Psychology

Situated Cognition

Perceptual affordances

Embodied Cognition

Perceptual representations; Neural support

Classic Knowledge Representation

Complex Representations

Amodal representations

The Truth is out there...

The Truth is down there...
Gibsonian Psychology

Perceptual affordances

1960’s

1970’s

Situated Cognition

Perceptual affordances
Social supports
Artifacts

1980’s

Influences on Classic Knowledge Representation

• Social/cultural influences
• Environmental scaffolding
• Conservative learning

Embodied Cognition

Perceptual representations;
Neural support

1990’s

2000’s

• Perceptual representations
• Neural underpinning
• Spatial analogies
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 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

**Similarity**

1950s-1960s

**Perceptual closeness**  
      Psych.  Behaviorists

**Mental distance**  
      1962

      Psych.  Shepard

**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**

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### Similarity

**Perceptual closeness**  
1950s-1960s  
*Psych.* Behaviorists

**Mental distance**  
1962  
*Psych.* Shepard

**Feature-set intersection**  
1977  
*Psych.* Tversky

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

**Structural alignment in Learning**  
1990s-2000s  
Abstraction  
Decision-making  
Difference detection
Question 3

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