Embodiment vs. Memetics

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Really:

Embodiment and Memetics

Where do word meanings come from?
Quick Definitions

• **Embodiment:** human intelligence is based on categories derived from our physical existence and experience. Language understanding requires sharing these categories.

• **Memetics:** language (and other cultural behavior) evolves independently of human understanding.
Outline

Where do word meanings come from?

• Why is this a question?
• Who believes in Embodiment?
• What evidence is there for Memetics?
• Ramifications for development.
• Ramifications for language evolution.
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Only semantics?

- Both Embodiment and Memetics are theories in opposition to “the Logical hypothesis.” (help wanted!)

- Intelligence must be bounded (Gigerenzer and Todd 2000, Chapman 1987, Simon...), but how?

- Implications for the nature of human reasoning, behavior, and development.

- Therefore implications for AI.
A Brief History of AI

• Founded in the 1950s.


• 1990s: Robots for Language.
The Practical Question

Will embodiment solve natural language?
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Experiments in Embodied Cognition

- Cog: MIT AI lab / CSAIL 1993-present.
- Build human 2-year-old in 5 years (Brooks & Stein 1993; Bryson 2006 Minds & Machines).
- RobotCub: EU (Genoa+15 others) €8.2M 2005-2010.
- Build 12 human 2-year-olds in 3 years, give to psychologists to do science in 2 years.
Other Believers

• George Lakoff and Mark Johnson *Metaphors We Live By* 1980; *Philosophy in the Flesh: The embodied mind and its challenge to Western thought* 1999.

• And evidence!

  Michael Ramscar (e.g. Boroditsky & Ramscar 2002). Arthur Glenberg (e.g. Glenberg & Robertson 2000).
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Evidence for Memetics

- Real memetics: full theory of culture evolving (requires replicators, selection, etc.)
- In this talk/paper: “meaning” acquired as it would be in a memetic process.
- Neither through embodied experience nor through reasoning, but by automatic perception of the social environment.
Memetic Semantics

• Human semantics can be replicated by statistical learning on large corpora (Finch 1993, Landauer & Dumais 1997, McDonald & Lowe 1998, Bilovich (and I) 2006).

• Only information gathered on each word’s ‘meaning’ is what words occur in a small window before and after it.

• Normally just choose 75 fairly frequent words to watch out for.
Is this enough?

• Possible both reaction times and clustering give only a “shadow” of real semantics (Lowe’s belief.)

• Bilovich & Bryson set out for further tests.

• Goal: replicating Banaji implicit language bias data. RTs show implicit correlation between black, left, bad, violence, etc.

• Prejudice in a corpus-based agent?
text: bible
Implications

- Analysis not done, but...
- Strong indication you can track conceptual change through memetic-like analysis of text.
Semantics is how a word is used?

- Statistical acquisition of associative regularities (see further Quine, Wittgenstien).

- Great news for ‘New AI’ — semantics just like the rest of perception (not logic).
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Deacon’s (1997) Theory of Semantics
Bryson’s (2006) Theory of Semantics
Bryson’s Theory of Semantics (1 of 2)

- **semantics**: how a word is used.
- **plant**: any part of an agent that might directly impact or be impacted upon by the agent’s environment.
- **expressed behaviour**: behaviour that impacts the environment; externally observable.
- **grounded**: linked to, part of, or associated with a representation that determines an expressed behaviour.
• **understand**: connect a semantic term to a grounded concept.

• **embodiment**: having a plant. (Note: could be virtual.)

• By these definitions, you can’t understand something if you aren’t embodied, because understanding requires grounding.

• But you can talk sensibly about things you don’t understand. (e.g. justice, semantics.)
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Evolutionary Psychology

• If memes look out for themselves, why do only humans have language? (c.f. Čače at 4pm, on the adaptive advantage of sharing knowledge.)

• **Culture**: everything you get from conspecifics non-genetically (what’s missing if you’re raised by wolves.)

• Why do only humans have escalating culture?
Culture in non-human primates

- Exists.
- Macaques (de Waal & Johanowicz 1993).
Why is ours better?

- Humans are the only species who can do precise vocal imitation (Fitch 2000). Other primates do program-level imitation. (Byrne & Russon 1992, Bryson & Wood 2005).

- Vocal imitation includes volume, pitch, timbre and (possibly most importantly) time. Humans can precisely imitate temporal sequence events of up to 3 seconds — length of phrases? (Pöppel 1994).

Warning: Speculation starts here.
Why should temporal imitation matter?

• More information contained in the ‘genetic’ substrate.

• Allows for more variation while providing redundancy, robustness.

Why Don’t Birds Talk?

• They can’t hold 2\textsuperscript{nd} order representations!
• Primates have uniquely complicated social organisations. (Harcourt 1992).
  • Almost all species remember how group-mates behave with respect to themselves (tit-for-tat).
  • But only primates behave as if they keep track of each other’s social behaviour.
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<th>Thelma</th>
<th>Eunice</th>
<th>Harry</th>
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Hypothesis: These 2\textsuperscript{nd} order representations are the basis of compositionality in language.
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Conclusions

- Human semantics can be replicated without embodiment.
- May explain some of the hard questions of language learning.
- Memetics may provide useful intelligence without understanding.
- Humans may be uniquely well-adapted memetic hosts.
Thanks!

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Why is Social Learning Interesting?

- It provides information to the agents faster than they can get it themselves.
- It is a second evolutionary system (besides genetics) that determines where behaviour comes from.
- A culture can learn far faster than the average individual.
Learning from Past Mistakes

- Logic is **not** the language of thought.
- **Intelligence without representation can’t learn.**
  - *Representation* is just the means of storing information you retain when you learn something.
- Embodiment?