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Language (Re)modelling: Towards Embodied Language Understanding

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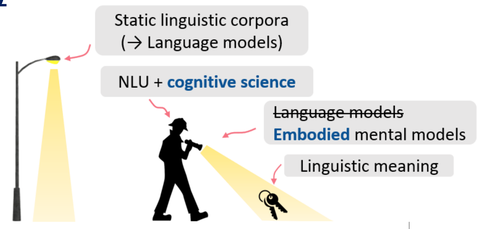
Streetlight Effects in Natural Language Understanding (NLU)

- Current NLU focused on language corpora which are conveniently available, but what are we leaving out?
- Contemporary cognitive science: much linguistic meaning is not in the words, rather in neural systems for embodied, social action & perception



Challenges for Current NLU Systems

1) Open-domain Literal Language
Humans understand "on-the-fly" using mental simulation – still far beyond current AI systems

"John entered the living room. John put down the candle and picked up the axe. He went to the great hall. He dropped the axe. He then entered the kitchen."
Q: Where did John find an axe?
GPT-3: In the great hall*

*Yoav Goldberg Tweet

2) Non-literal Language
In humans, non-literal language mapped (through metaphor) to more easily simulatable literal concepts

"Napoleon, head of the French Army, attacked the Russian fort."

"John's career hopes shattered."

Embodied Cognitive Linguistics (ECL): Key Concepts

(Lakoff & Johnson, 1980; Feldman & Narayanan, 2004)

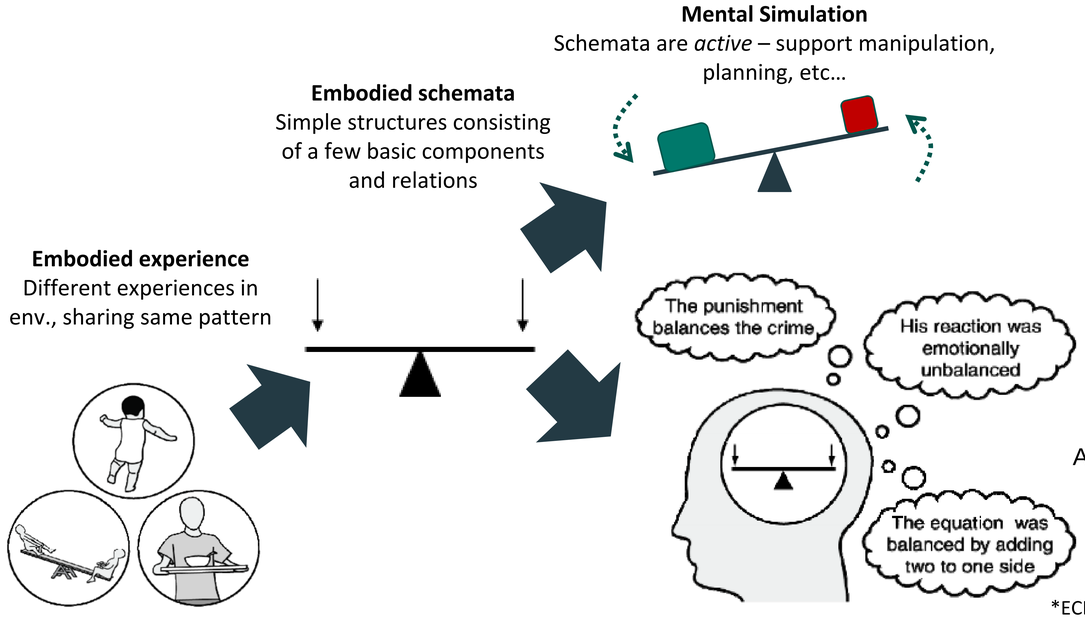
Simulation Hypothesis: Understanding language involves inferring and running the best fitting simulation

Metaphoric Interpretation Hypothesis: Humans express abstract concepts through compositions of more literal ones

Mental Simulation
Schemata are *active* – support manipulation, planning, etc…

Embodied schemata
Simple structures consisting of a few basic components and relations

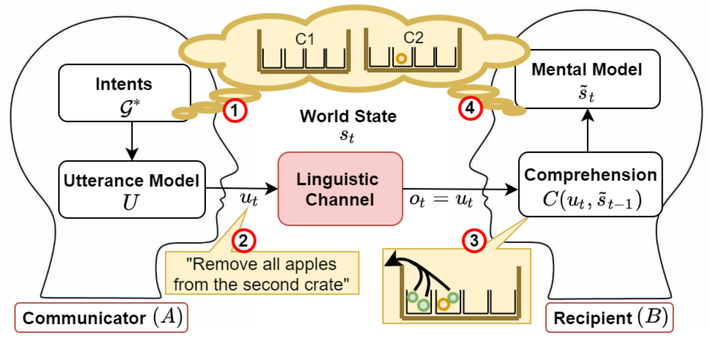
Embodied experience
Different experiences in env., sharing same pattern



Embodied metaphors
Applications of schemata when reasoning about abstract domains

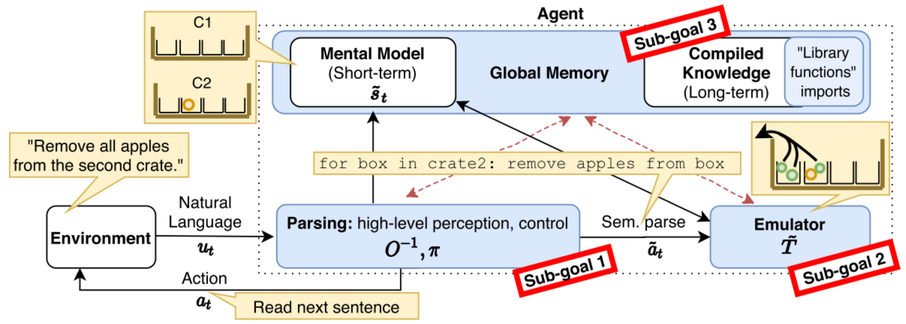
*ECL figures based on Antle (2009)

Embodied Language Understanding Model



- Narrow linguistic bandwidth controls high-dimensional mental models
- Language as cue to mental simulation
- "Meeting of minds" objective

Architecture Sketch & Implementation Roadmap



- Difference with executable semantic parsers: our arch. built around internal, learned, general domain executor vs. hard-coded, external, task specific executor

Conclusions

- Human-like NLU requires tighter integration between NLU and embodied AI/cog-sci
- Shift away from static text-based corpora to diverse simulation frameworks, both embodied and more abstract
- Beyond scope of any single lab; invites large-scale collaborative efforts!

Thoughts? Ideas? Possible collaboration? Please reach out!

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