Search as a driver for
the refinement of
linguistic constructions

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Steels L. & Wellens P., How grammar emerges to dampen combinatorial search in parsing,
Questions

• Where does new meaning come from?
• Where does grammar come from?
• How can grammar propagate in a population?
• Why does grammar change?
Q: Why is language structure the way it is?
A: Because the language adapts to the needs/constraints of the language users.

These kinds of explanations are called **Usage-Based**.

- economy, clarity, social function, ...
Search during parsing

- Many grammatical features of language can be seen as optimising the parsing process.
Usage-Based explanations

- A usage-based explanation requires us to...
  - ... show that at some stage problems occur that threaten the usability language.
  - ... provide the mechanisms for diagnosing and repairing these problems.
Modelling linguistic communication

- Prerequisites:
  - multi-agent framework
  - language-processing framework
  - conceptualisation framework
  - joint attentional frame, shared motives, shared intentions

Modelling linguistic communication

• Prerequisites:
  • multi-agent framework
  • Fluid Construction Grammar* (FCG)
  • conceptualisation framework
  • joint attentional frame, shared motives, shared intentions

* FCG is open source: http://arti.vub.ac.be/fcg
Modelling linguistic communication

- Prerequisites:
  - multi-agent framework
  - Fluid Construction Grammar* (FCG)
  - Incremental Recruitment Language (IRL)
  - joint attentional frame, shared motives, shared intentions

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Modelling the interaction

• A language game is a formalised interaction pattern between two or more agents.
  • Naming Game
  • Guessing Game
  • Description Game

Language games

Agents with ‘language-ready’ brains

population

Language game

Environment

Real-world situation
Modelling Usage-based learning

- Learning needs motivation
- To reflect the usage-based requirements we split up learning in two phases:
  - diagnosing of a problem
  - repairing (either inventing or adopting)

Experimental Setup

• Description Game:
  • Speaker describes a scene
  • Hearer interprets and forms a “mental representation” of the scene
  • Game is successful when the mental representation is very close to the described scene.

• Scenes become gradually more complex

Experimental Setup

• Three stages:
  1. The agents can only introduce and adopt lexical constructions (words)
  2. 1+ the agents can introduce and adopt simple grammatical constructions.
  3. 2+ the agents can refine their existing constructions to minimize search in parsing.

Results: Stage 1

- Communicative success
- Lexicon size
Results: Stage 2

- Communicative success
- Lexicon size
- Grammaticality
- Need for search
- Grammar size
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Results: Stage 3

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Results: Stage 3

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Conclusion

• We started with a question
  • Why are grammatical constructions shaped the way they are?

• We proposed a hypothesis
  • Language users will optimize the constructions for minimising search during parsing.

• The experiment...
  • ... shows that even in very simple communication systems search in parsing becomes a problem
  • ... presents a model for solving these problems by refining the grammatical constructions.
Thank you
Thank you
Thank you

• The complete paper on the experiment:

• Links:
  • http://arti.vub.ac.be & http://arti.vub.ac.be/~pieter
  • http://arti.vub.ac.be/FCG/