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, Proceedings of the Third International Symposium on EELC, september 2006

Questions

- Where does new meaning come from?
- Where does grammar come from?
- How can grammar propagate in a population?
- Why does grammar change?

Functional Linguistics

- 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

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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

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

Modelling the interaction

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

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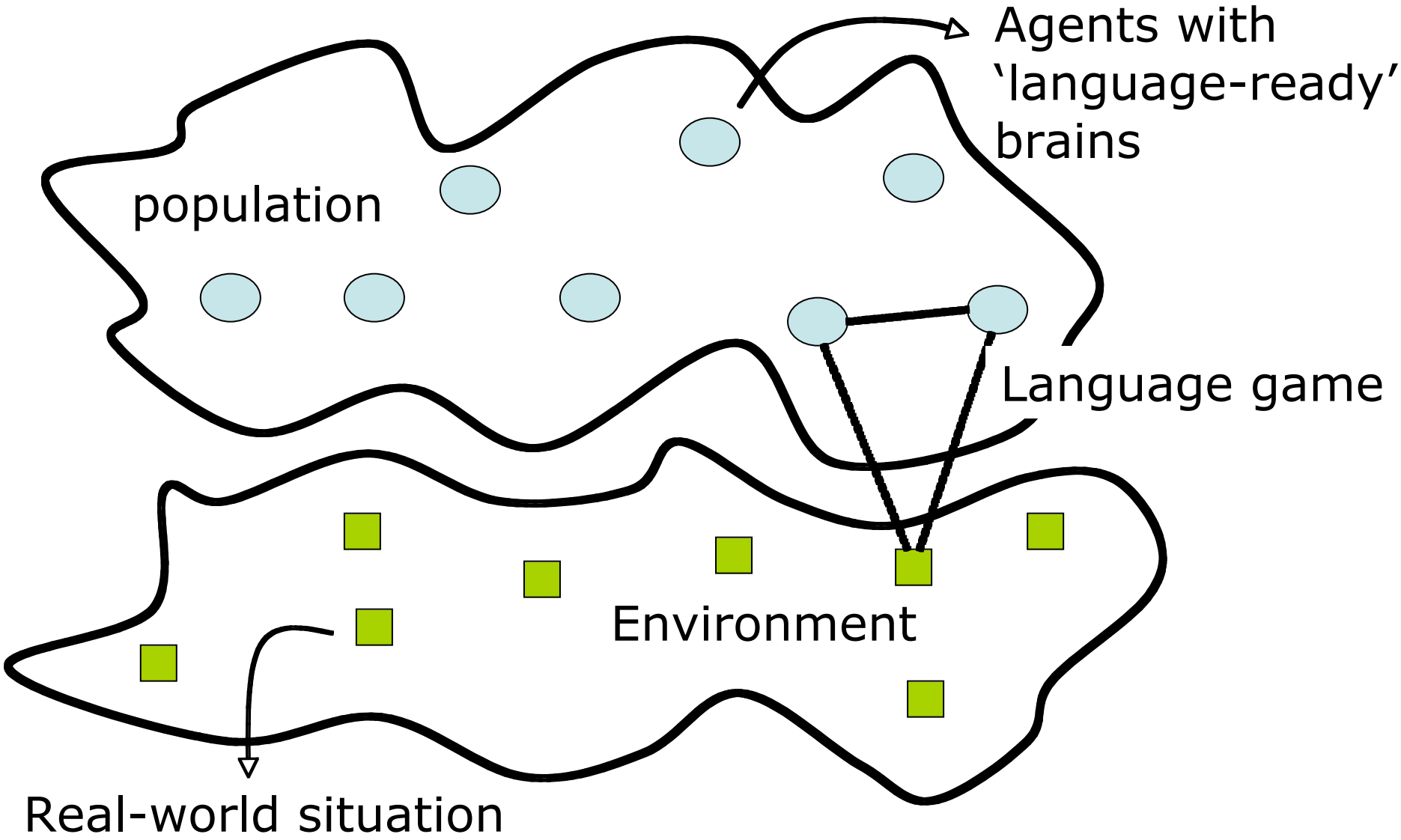
Language games



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 of adopting)

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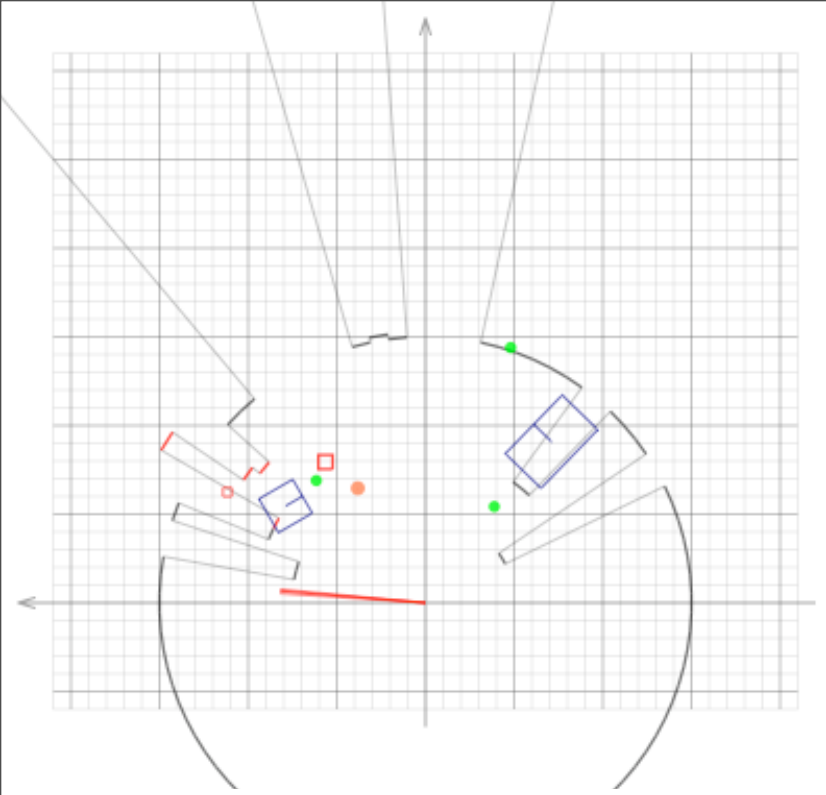

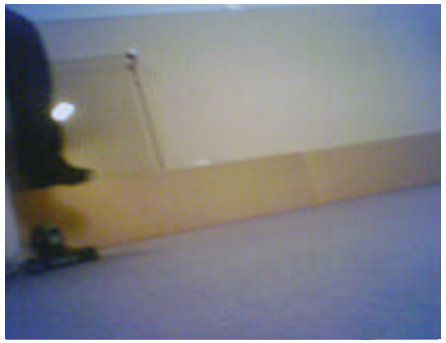

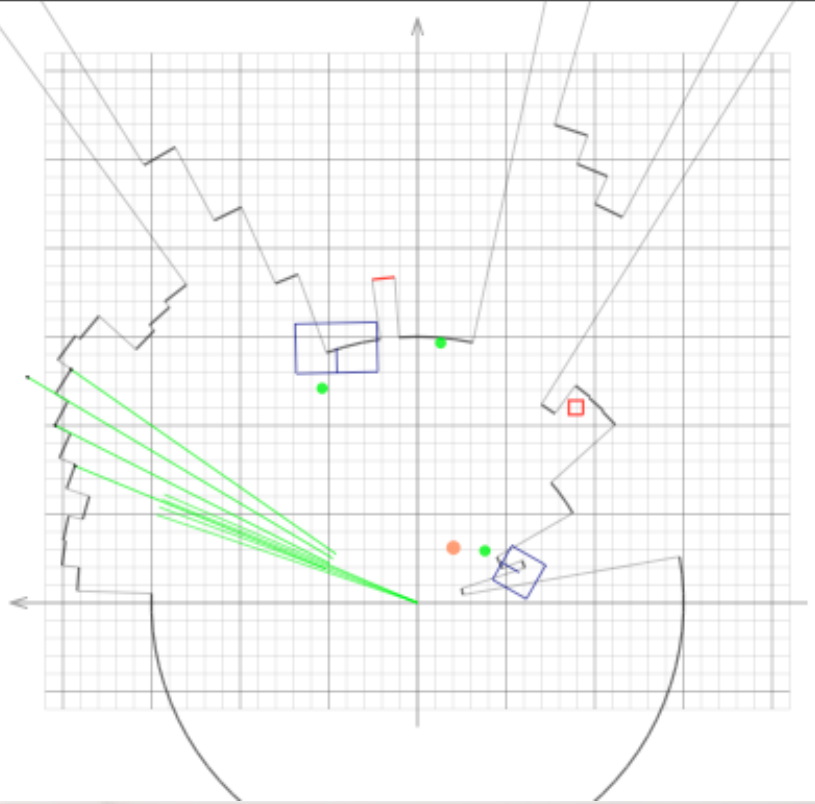


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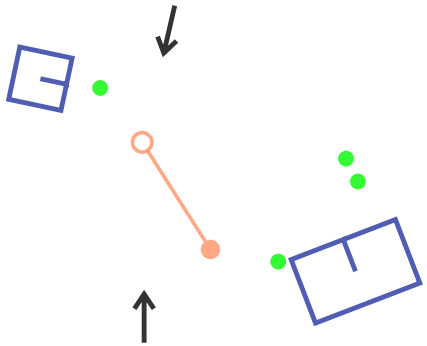

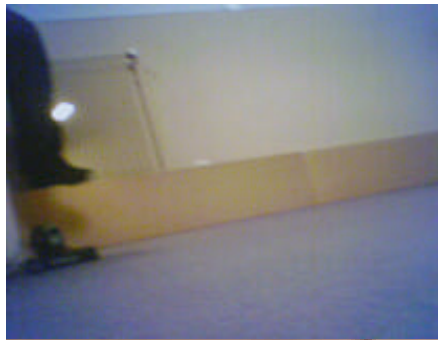

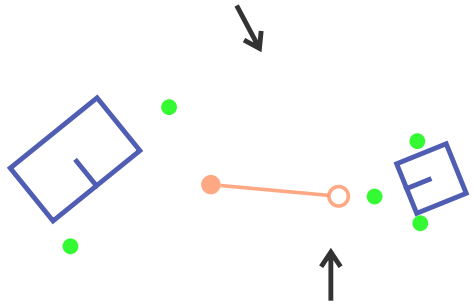


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Experimental Setup

- 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

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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.

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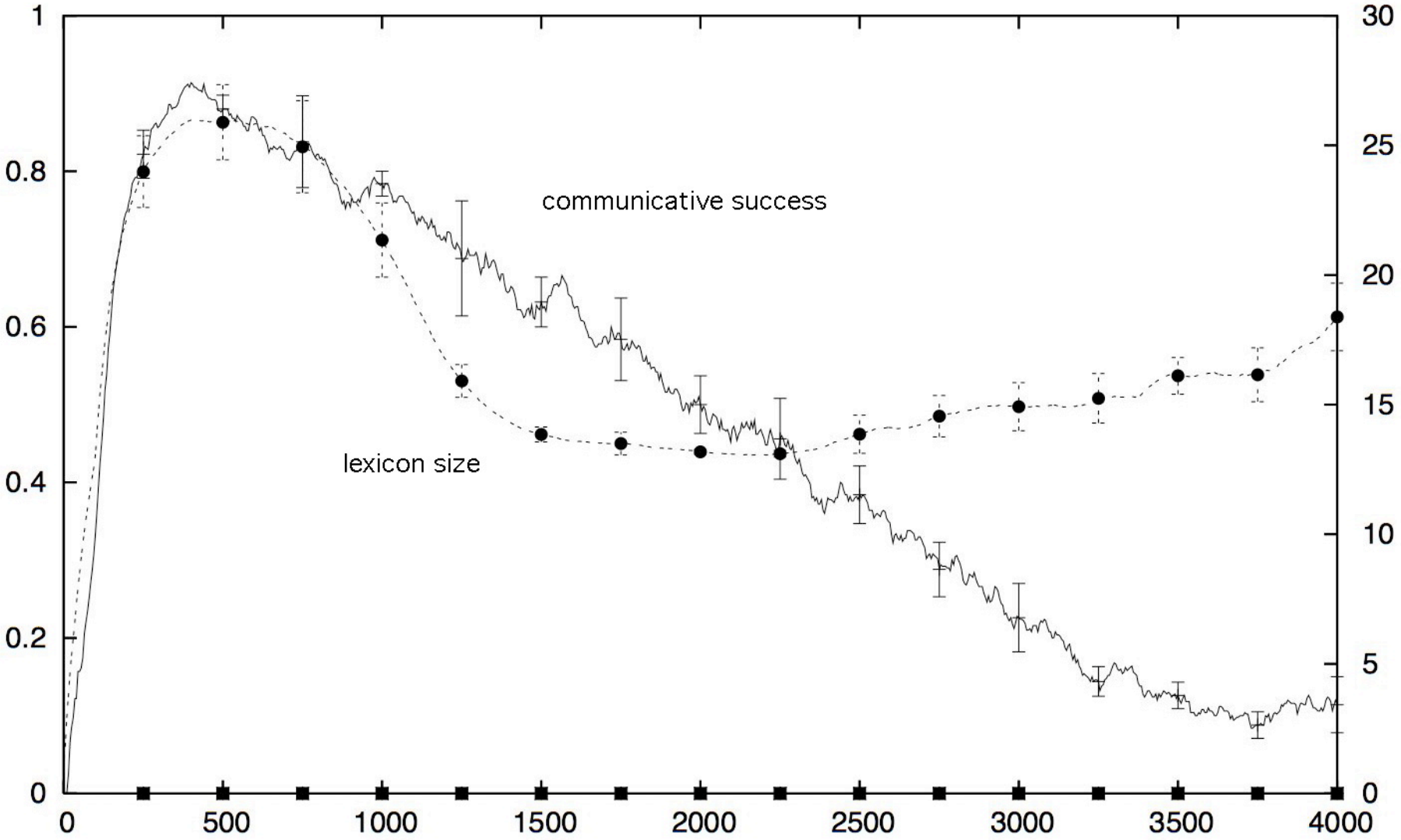
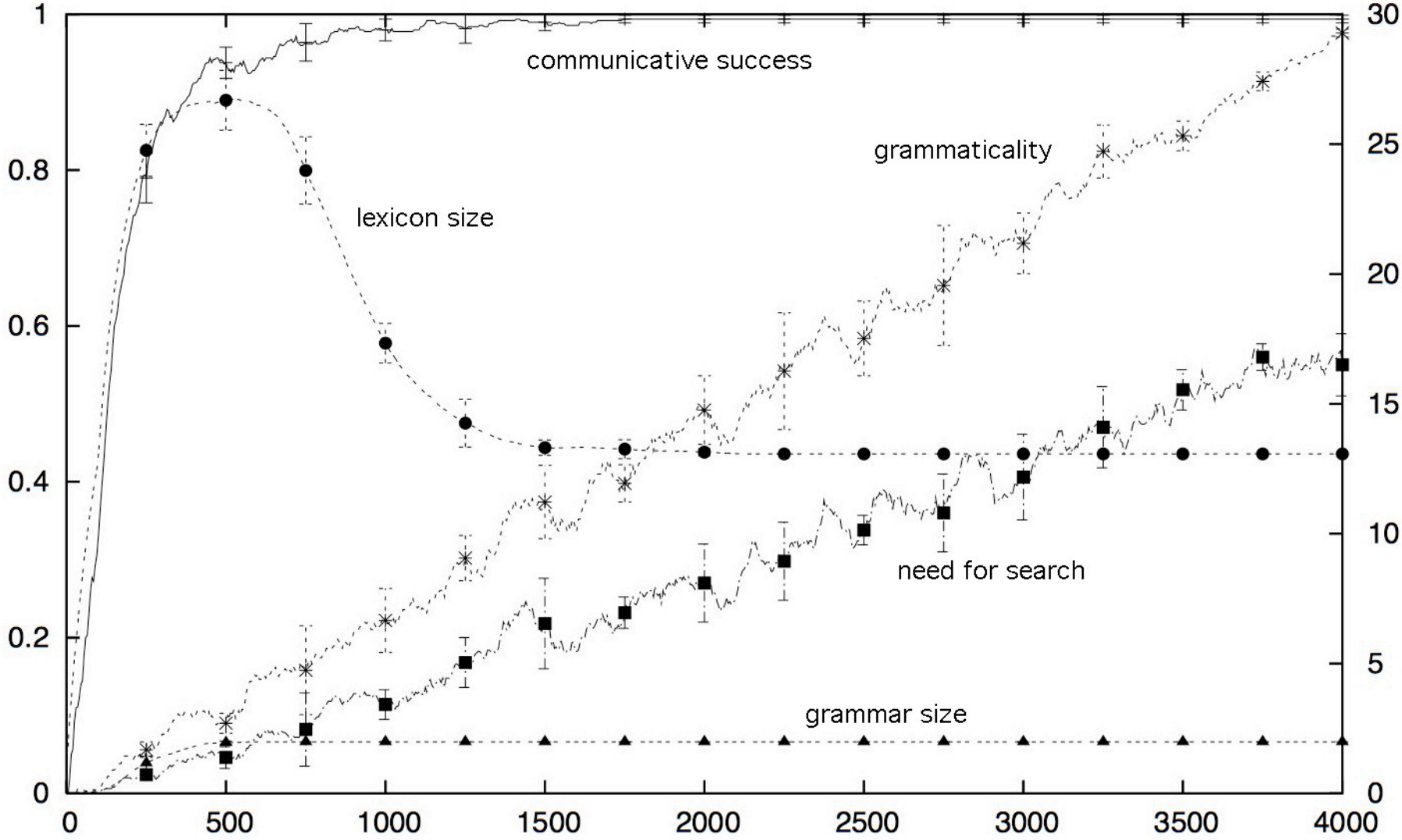
Results: Stage 1



Results: Stage 2



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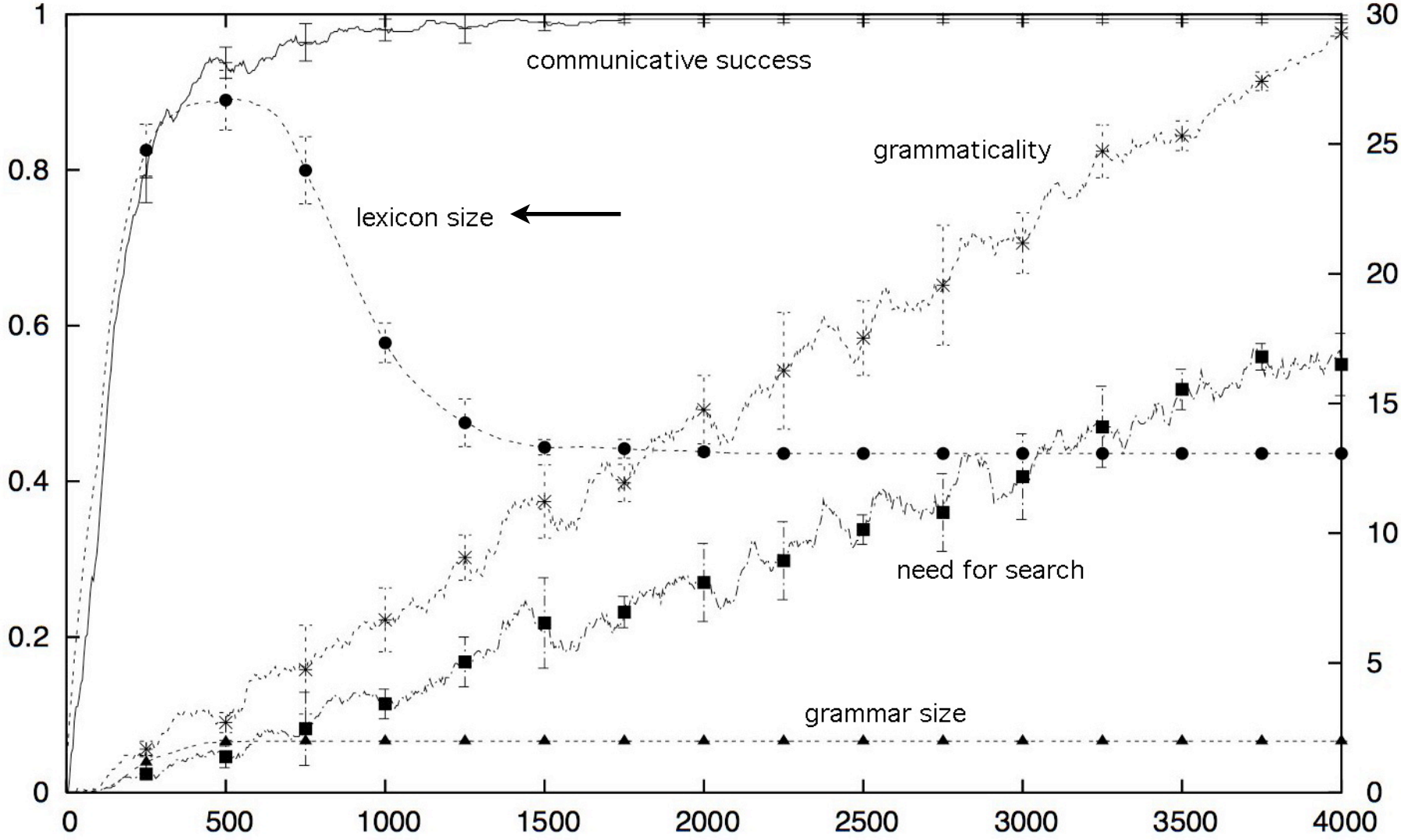

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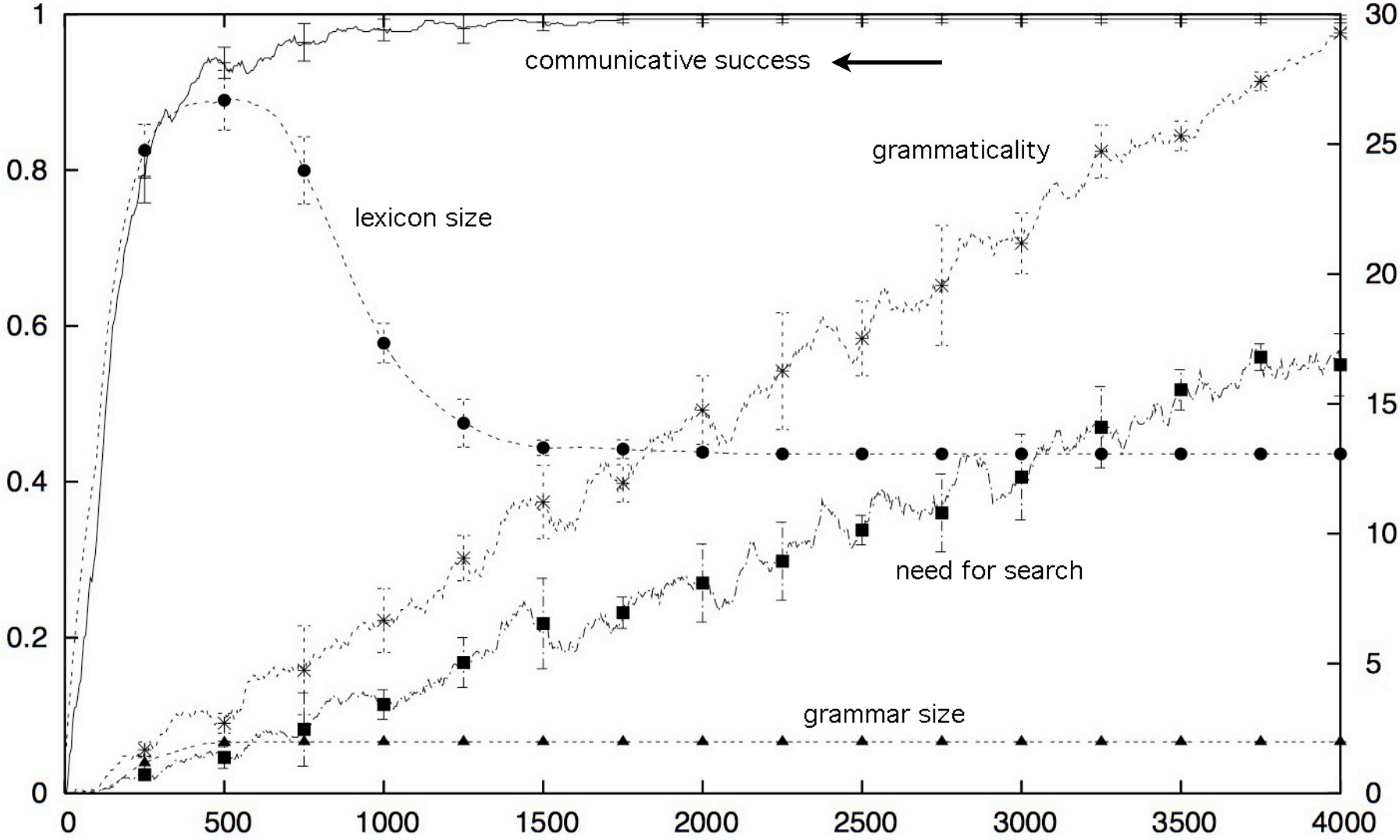

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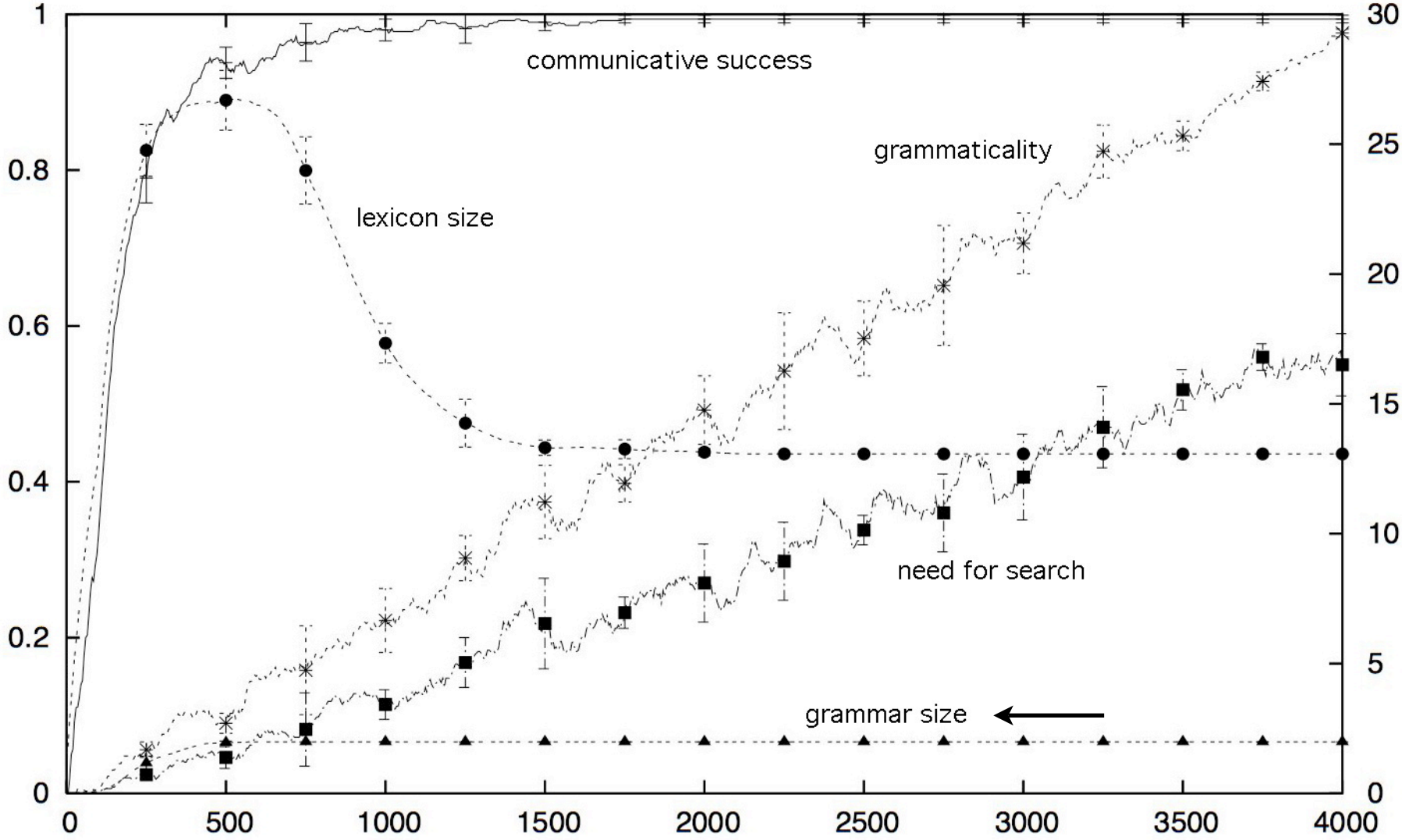

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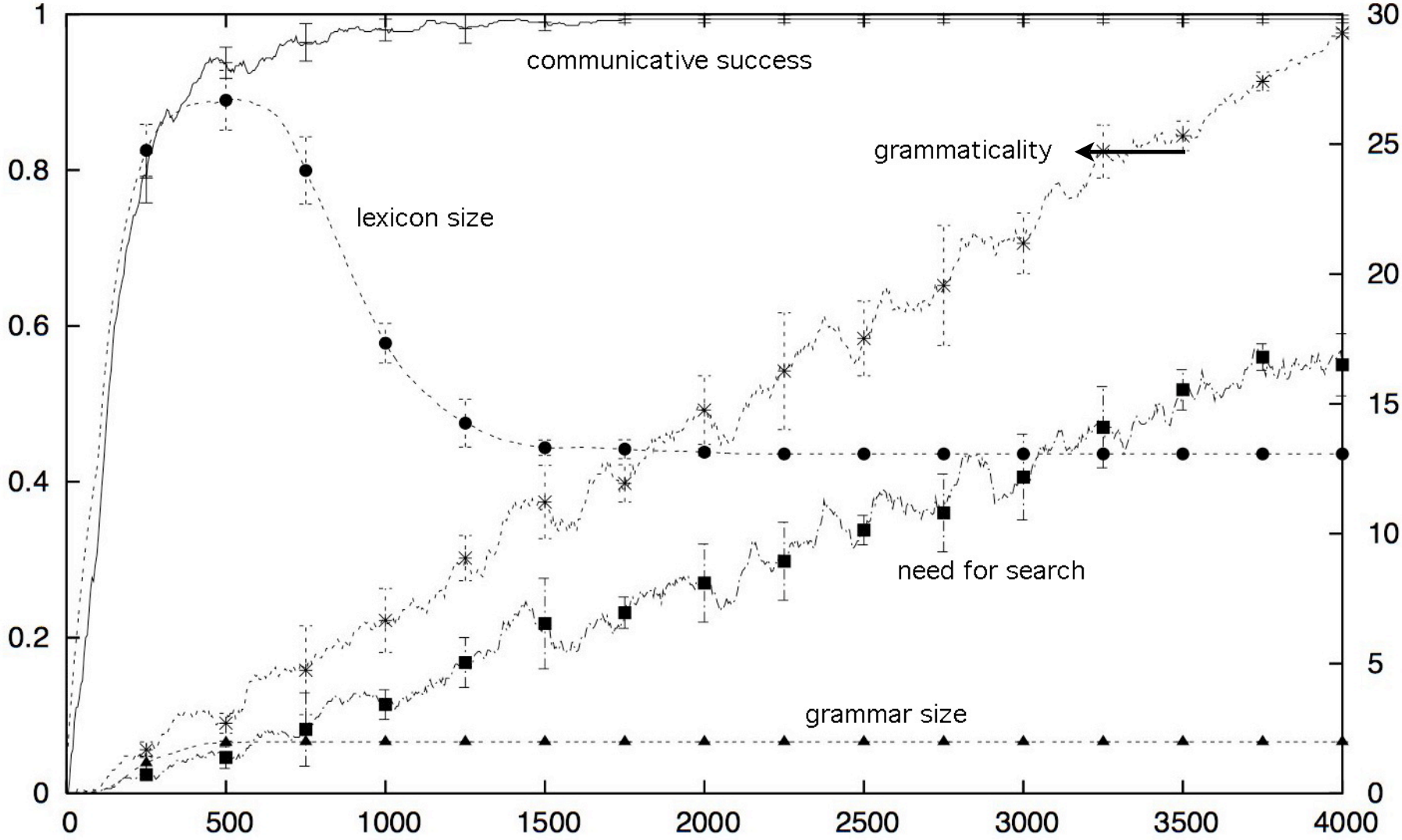

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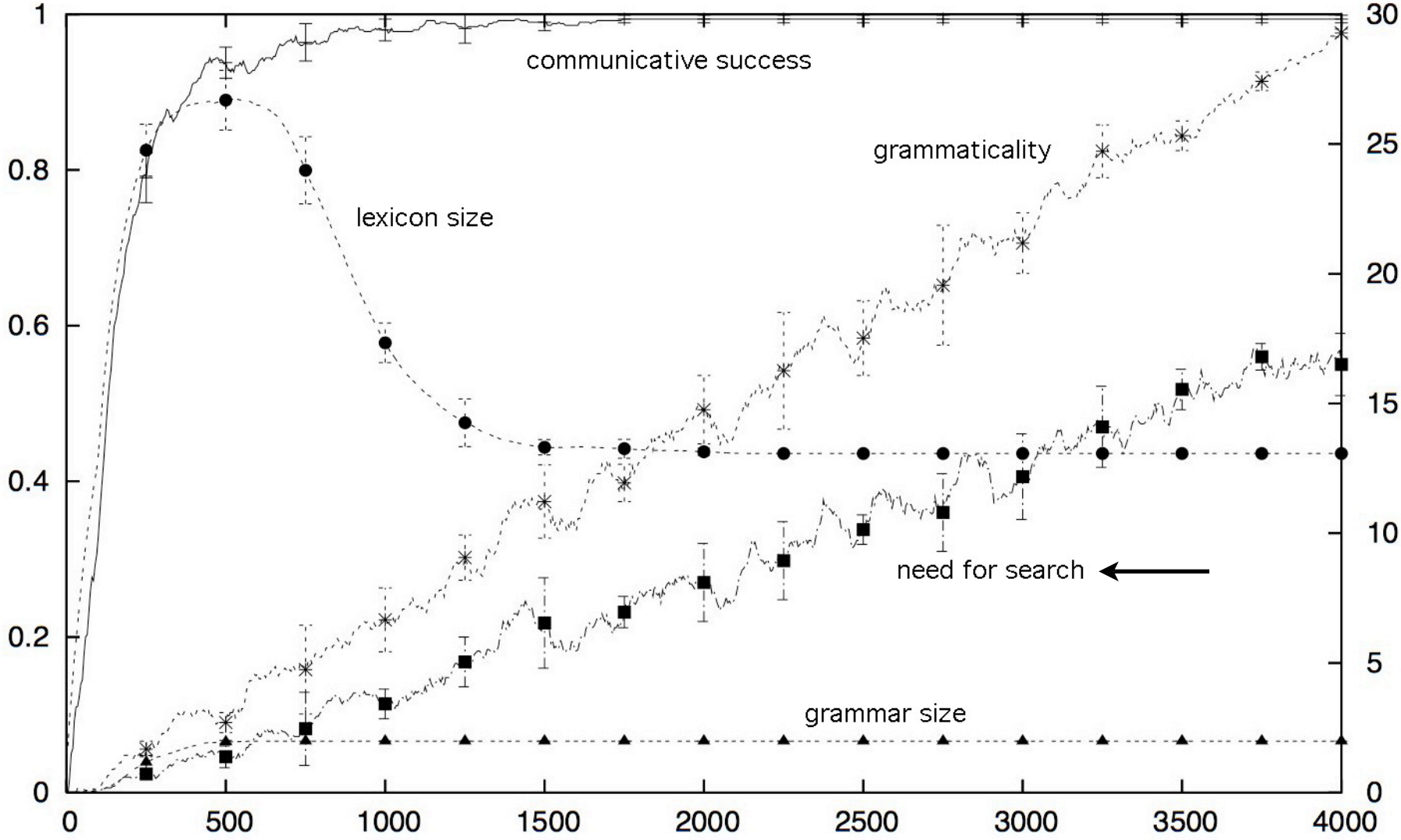
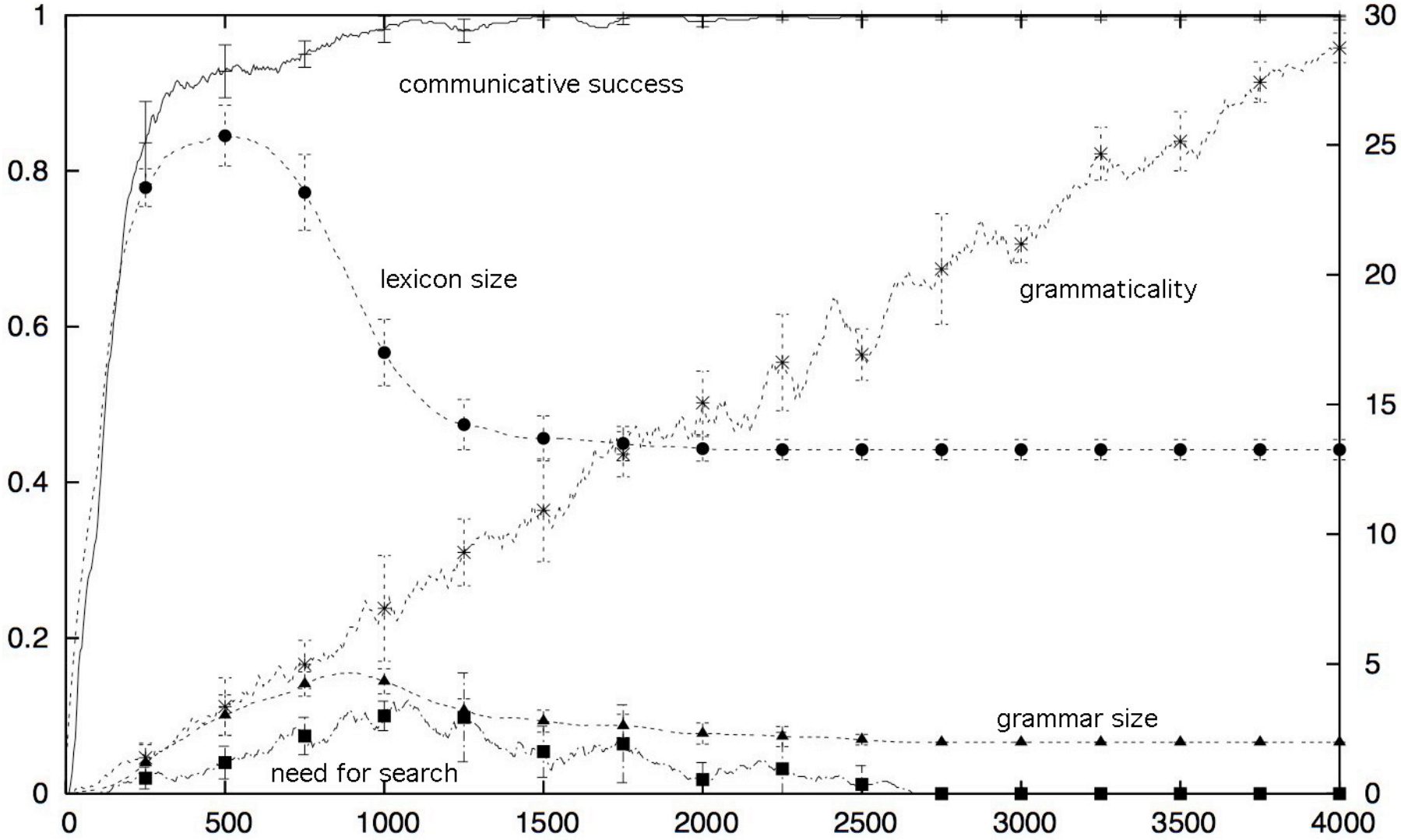
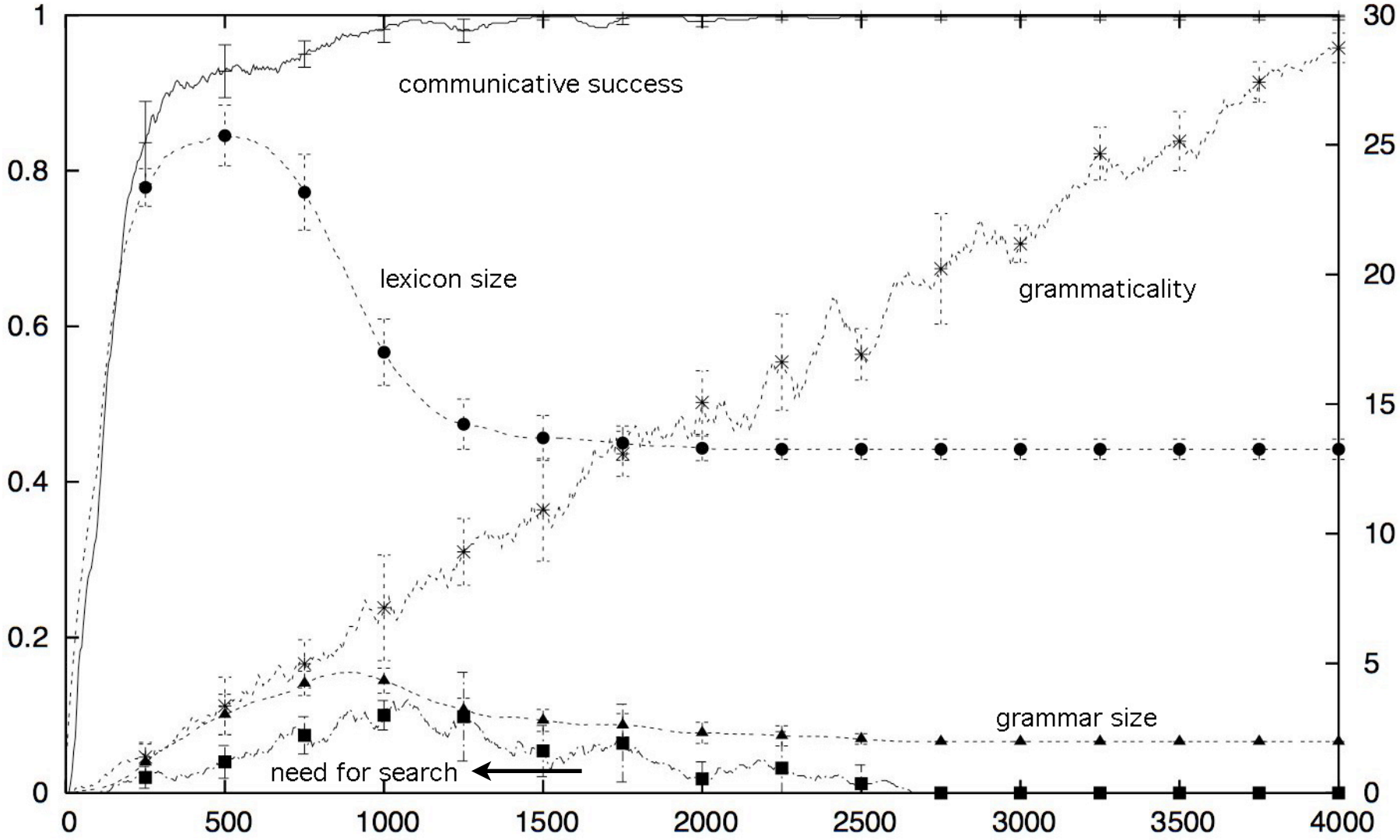


Results: Stage 3



Results: Stage 3



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:
  - Steels L. & Wellens P., How grammar emerges to dampen combinatorial search in parsing, Proceedings of the Third International Symposium on EELC, september 2006
- Links:
  - http://arti.vub.ac.be & http://arti.vub.ac.be/~pieter
  - http://arti.vub.ac.be/FCG/