Bridging semantics and pragmatics in information-theoretic emergent communication

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word meanings

shaped by **local context** of the interaction

"*the **orange** dress*"

pragmatics

non-contextual

"***orange***"

semantics

Study overview

- How can a shared lexicon emerge from local, context-sensitive interactions?

pragmatics

semantics

- Modeling the **interface between semantics and pragmatics** with information-theoretic emergent communication

- Lexicons with human-like properties emerge from pragmatic interactions if their evolution is shaped by:
    - **context-specific** utility pressures
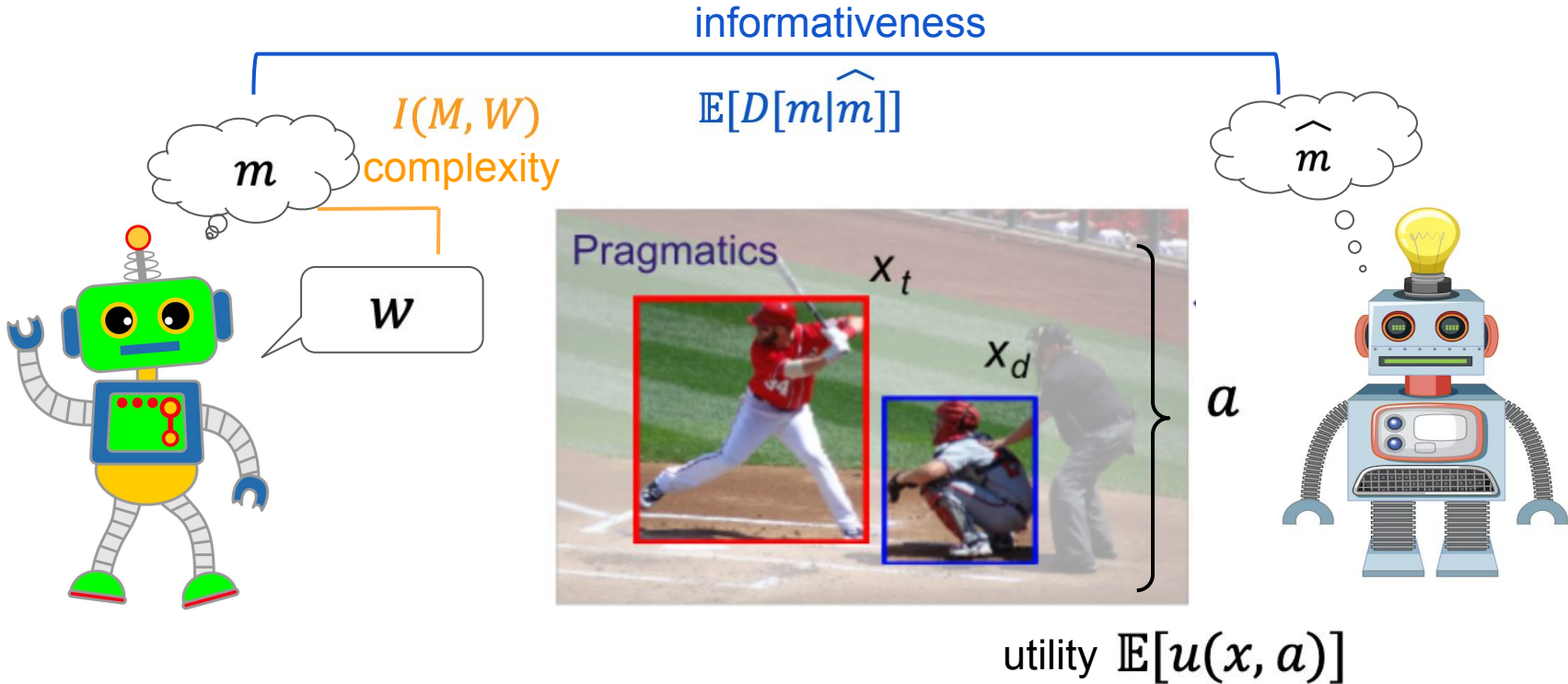   - **general** informational constraints

Information-theoretic emergent communication

informativeness

$$\mathbb{E}[D[m|\widehat{m}]]$$

$I(M, W)$
complexity

m

w

$\widehat{m}$
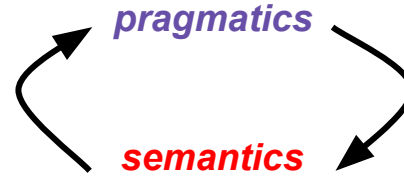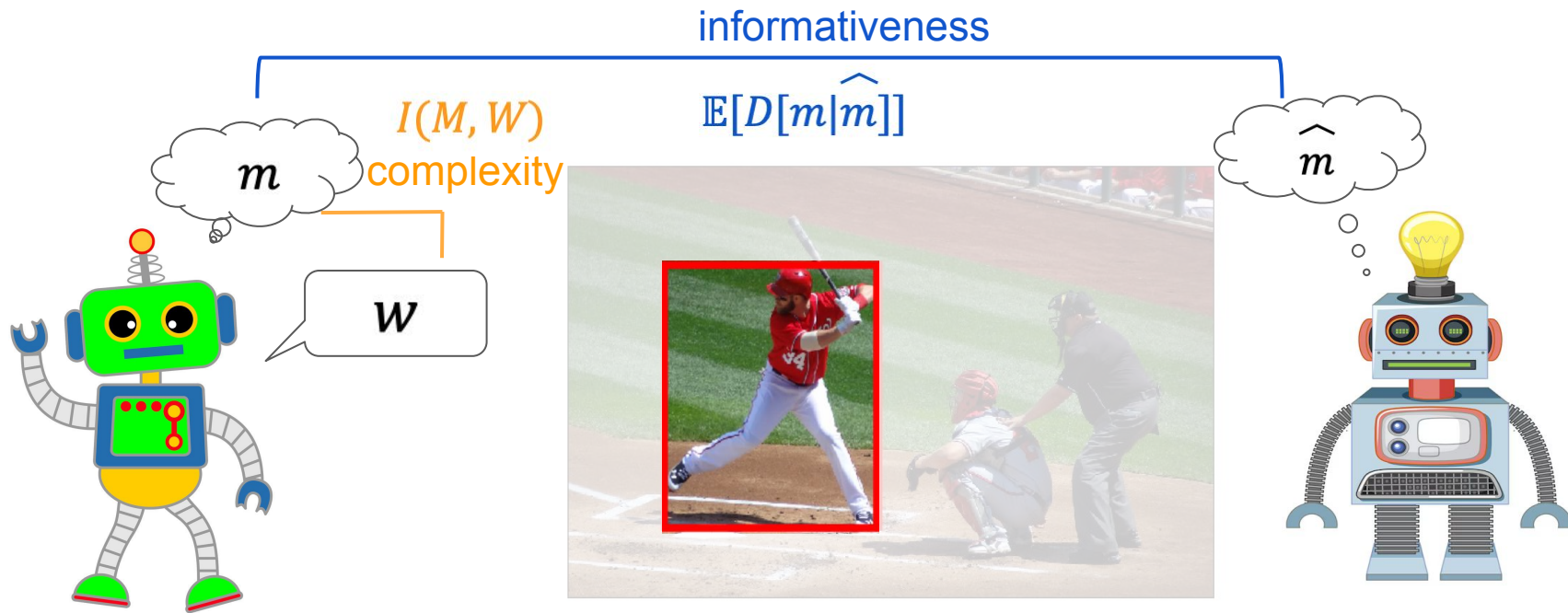
Silberer et al., 2020

task-agnostic pressures for efficient
communication shape lexical systems

Zaslavsky, Kemp, Regier, Tishby, 2018; 2019; Zaslavsky*, Maldonado*, Culbertson, 2021

Information-theoretic emergent communication

informativeness

$I(M, W)$

$\mathbb{E}[D[m|\widehat{m}]]$
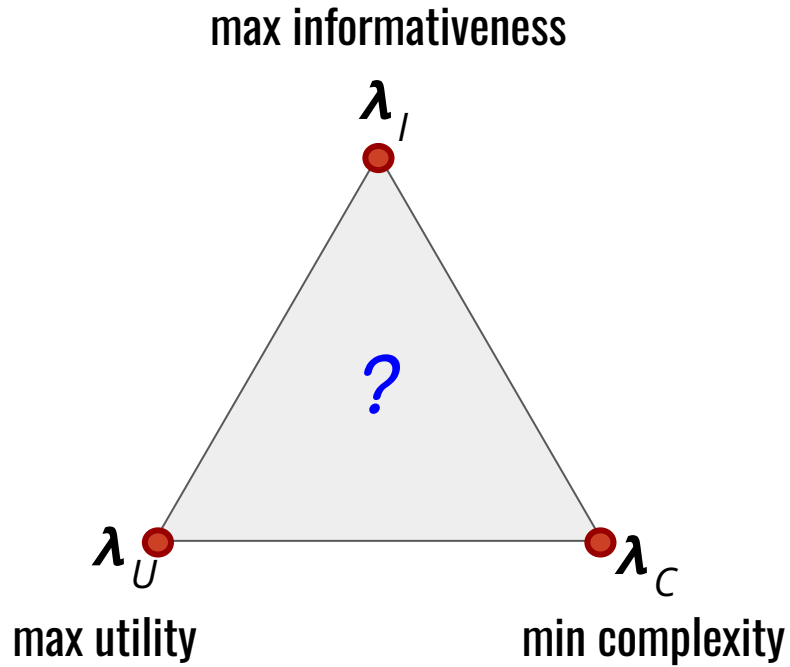
complexity

utility $\mathbb{E}[u(x, a)]$

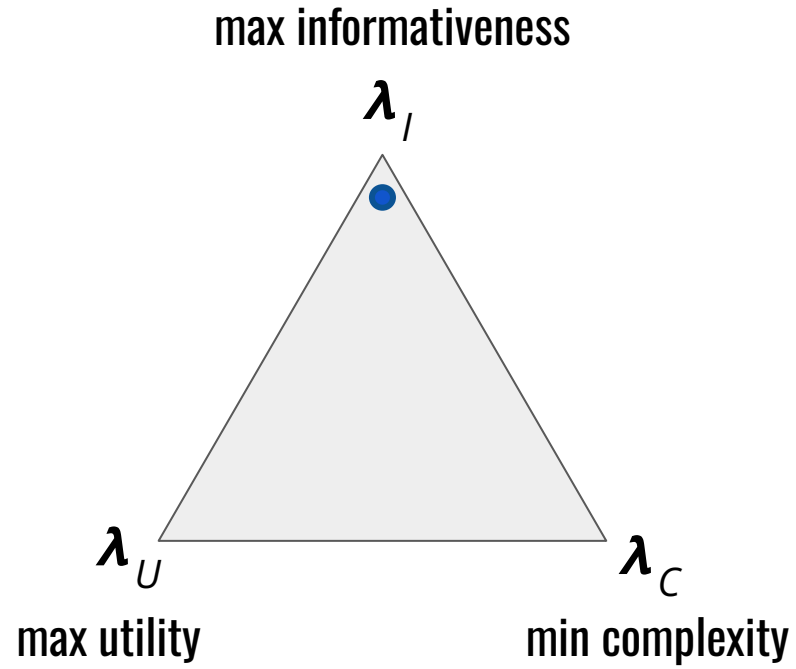**context-specific** utility maximization

Modeling the **interface** between semantics and pragmatics
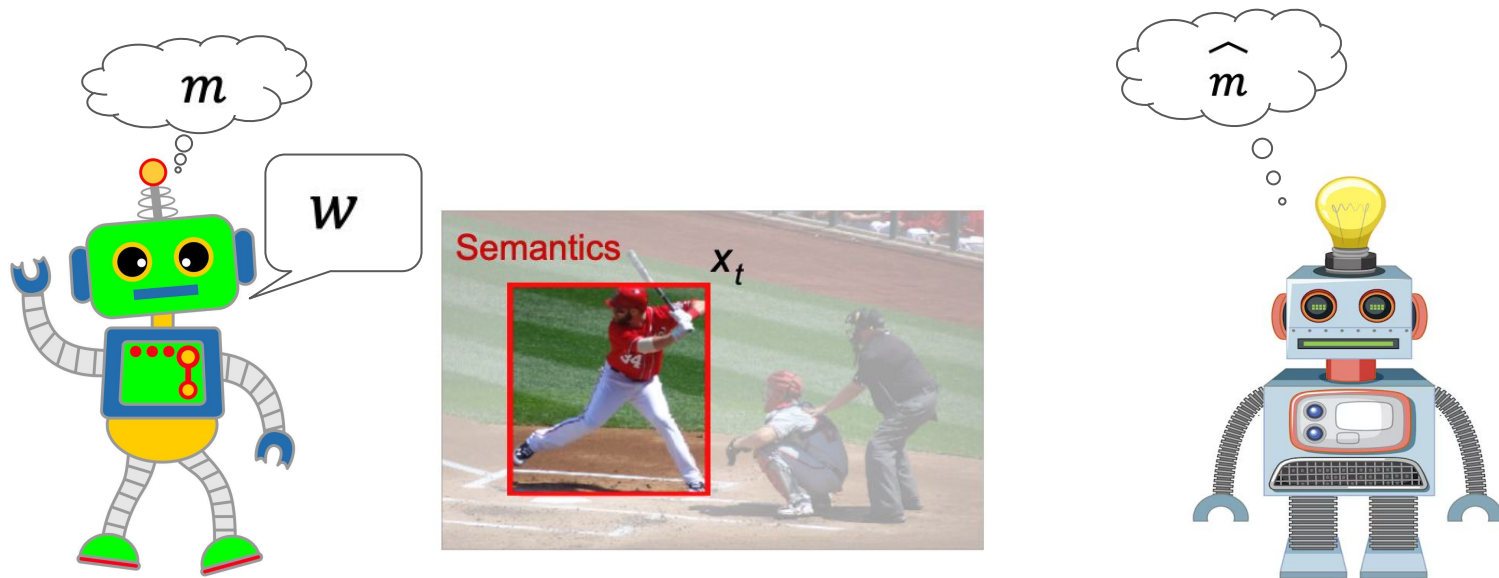
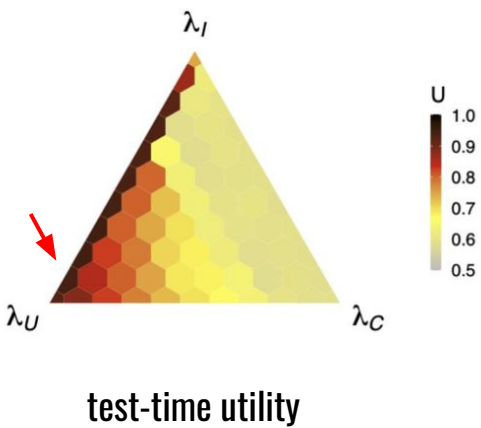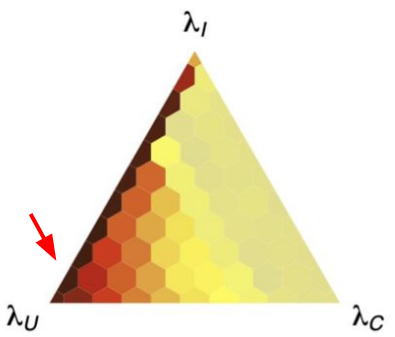We evaluate their emergent lexicon in a **naming** task

max informativeness
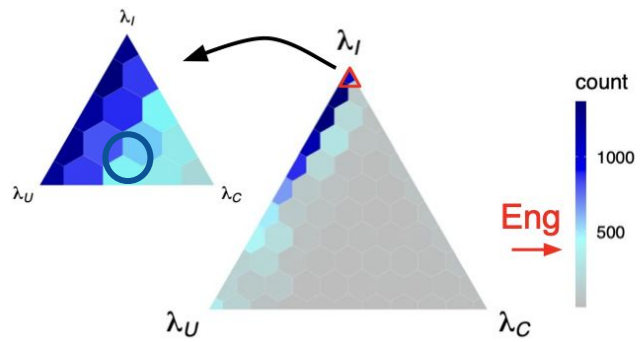
$\boldsymbol{\lambda}_I$

Human-like
solutions?
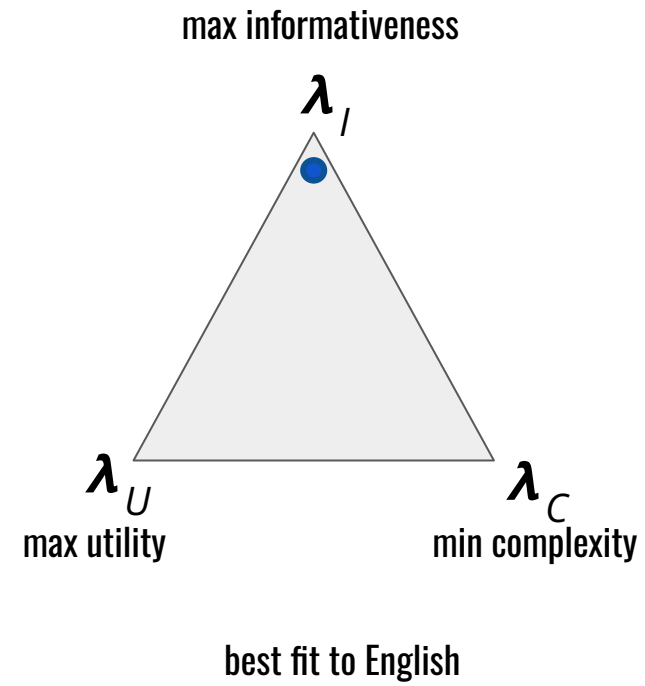
?

$\boldsymbol{\lambda}_U$

$\boldsymbol{\lambda}_C$

max utility

min complexity

max informativeness

$\boldsymbol{\lambda}_I$

$\boldsymbol{\lambda}_U$

max utility

$\boldsymbol{\lambda}_C$

min complexity

λ_I

U
1.0
0.9
0.8
0.7
0.6
0.5

λ_U λ_C

test-time utility

max informativeness

$\boldsymbol{\lambda}_I$

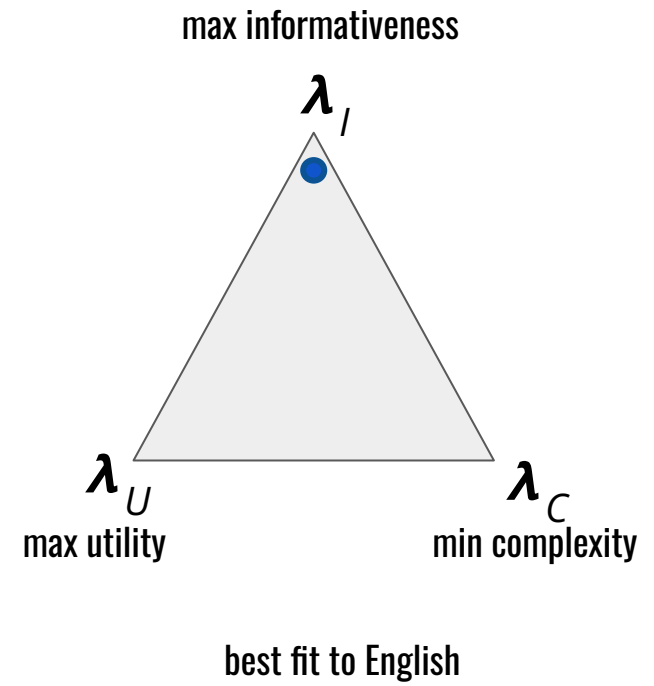$\boldsymbol{\lambda}_U$ $\boldsymbol{\lambda}_C$
max utility   min complexity

best fit to English

test-time utility

lexicon size

max informativeness

$\boldsymbol{\lambda}_I$

$\boldsymbol{\lambda}_U$

max utility

$\boldsymbol{\lambda}_C$

min complexity

best fit to English

test-time utility

lexicon size

max informativeness

$\boldsymbol{\lambda}_I$

$\boldsymbol{\lambda}_U$
max utility

$\boldsymbol{\lambda}_C$
min complexity
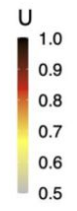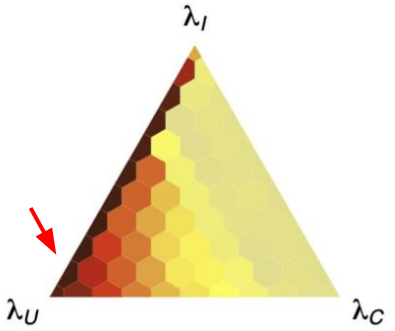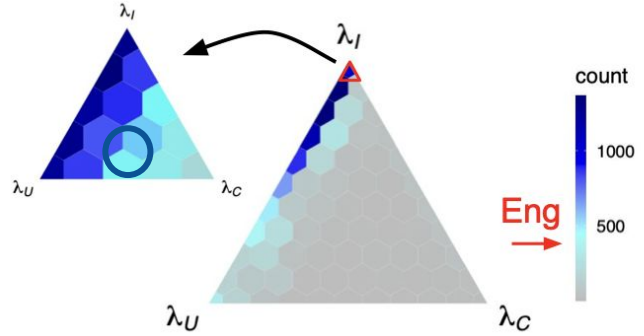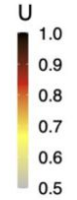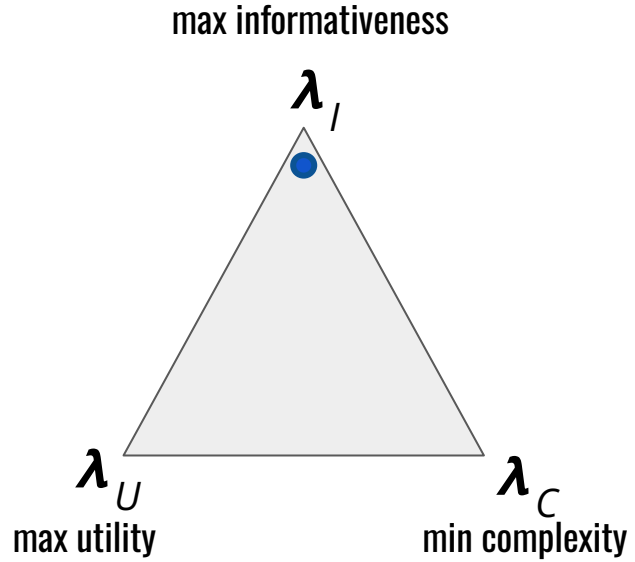
best fit to English

Conclusion

Human lexicons may emerge from trading-off **context-specific utilities** and **general informational constraints**

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