Negotiating lexical uncertainty and speaker expertise with disjunction

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Stanford Linguistics

Paper, code, data: https://github.com/cgpotts/pypragmods

Roger Levy

Communicating in language about language

Communicating in language about language

1. fruits like the persimmon

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2. synagogues and other churches

Communicating in language about language

1. fruits like the persimmon
2. synagogues and other churches
3. superb but not outstanding
4. outstanding but not superb

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Lexical side-effects from disjunction

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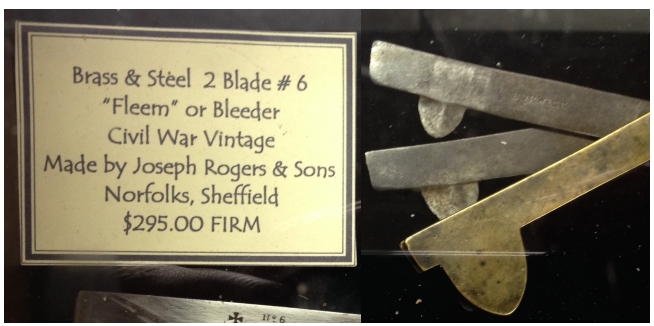

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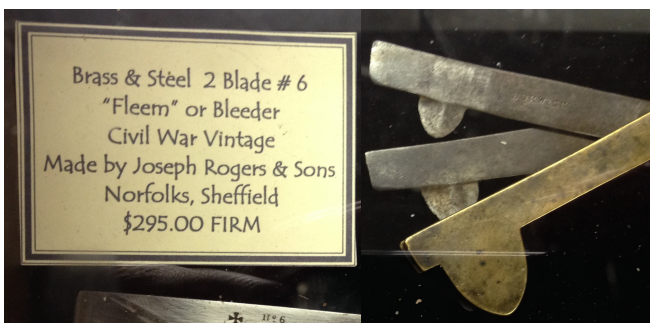

8. Press the pound or hash sign

Pragmatic model

Communication under uncertainty about world and language between sophisticated listeners and opinionated speakers.

$L_k(world, Lex \mid msg)$ synthesizes

- the world information contained in *msg* given its model of S_k
- the degree to which *msg* discriminates among lexica

$S_{k+1}(msg \mid world, Lex)$ synthesizes

- the best way to identify *world* given its estimation of L_k
- its views about the preferred lexicon
- costs on messages

Plan

1. Lexical side-effects from disjunction
2. Modeling communication with expert speakers
3. Analysis of disjunction
4. Implicature blocking

Lexical side-effects from disjunction

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   Exclusivization generalization *X or Y* usually conveys that the speaker is using a lexicon in which $[\![X]\!]$ and $[\![Y]\!]$ are disjoint, or it addresses a speaker concern that the listener is using such a lexicon.

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Hurford's constraint

"The joining of two sentences by *or* is unacceptable if one sentence entails the other; otherwise the use of *or* is acceptable."

(12) Ivan is an American or a Russian.
(13) That painting is of a man or a woman.
(14) The value of x is greater than or equal to 6.
(15) *John is an American or a Californian.
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(20) Inmates may smoke or_1 drink, or_2 both.

Apparent counterexamples to Hurford's constraint

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1. "...and we trust that some of our American or Californian friends will tell us something of its growth of flower and fruit in its native habitats"
2. "It doesn't matter if you ask a boy or a man or a bachelor or even a husband"
3. "...the effect was greater than, or not equal to, the cause."

Apparent counterexamples to Hurford's constraint

From Ben Russell's thesis:

4. "We also rent only the most modern limos to our customers, because we believe that when you look for a limo service in Northern California or San Francisco, you want the best limousine service possible."
5. "By the time I've gone in I've had to pull out an animal or a cat that's on the verge of dying."
6. "Every now and again, people tend to change their surroundings. We update wall colors, change the drapes. Have new flooring installed. Sometimes we purchase new furniture or chairs."

Apparent counterexamples to Hurford's constraint

From our corpus:

7. "Stop discrimination of an applicant or person due to their tattoos."
8. "Promptly report any accident or occurrence."
9. "The anchor will lie on the bottom and the canoe or boat will be held by the stream's current."
10. "After the loss of the animal or pet, there are further coping strategies available for the grieving individual."
11. "Bush was captured slyly removing a candy or gum from his mouth."
12. "Heroic is not a word one uses often without embarrassment to describe a writer or playwright . . . "

Lexical uncertainty

Our corpus	
Disjunct order	Examples
[general] or [specific]	79
[specific] or [general]	90

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- No clear evidence for ordering restrictions or preferences deriving from the entailment relation.
- But: judgments about lexical entailment are inherently messy because of flexible refinement in context.
- Thus: there often isn't an objective answer to the question of whether two disjuncts stand in an entailment relation.

Hurfordian perceptions and intentions

Exclusivization generalization *X or Y* usually conveys that the speaker is using a lexicon in which $[\![X]\!]$ and $[\![Y]\!]$ are disjoint, or it addresses a speaker concern that the listener is using such a lexicon.

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Implicature blocking

- Q-implicature: *cheap or free*
- I-implicature: *boat or canoe*

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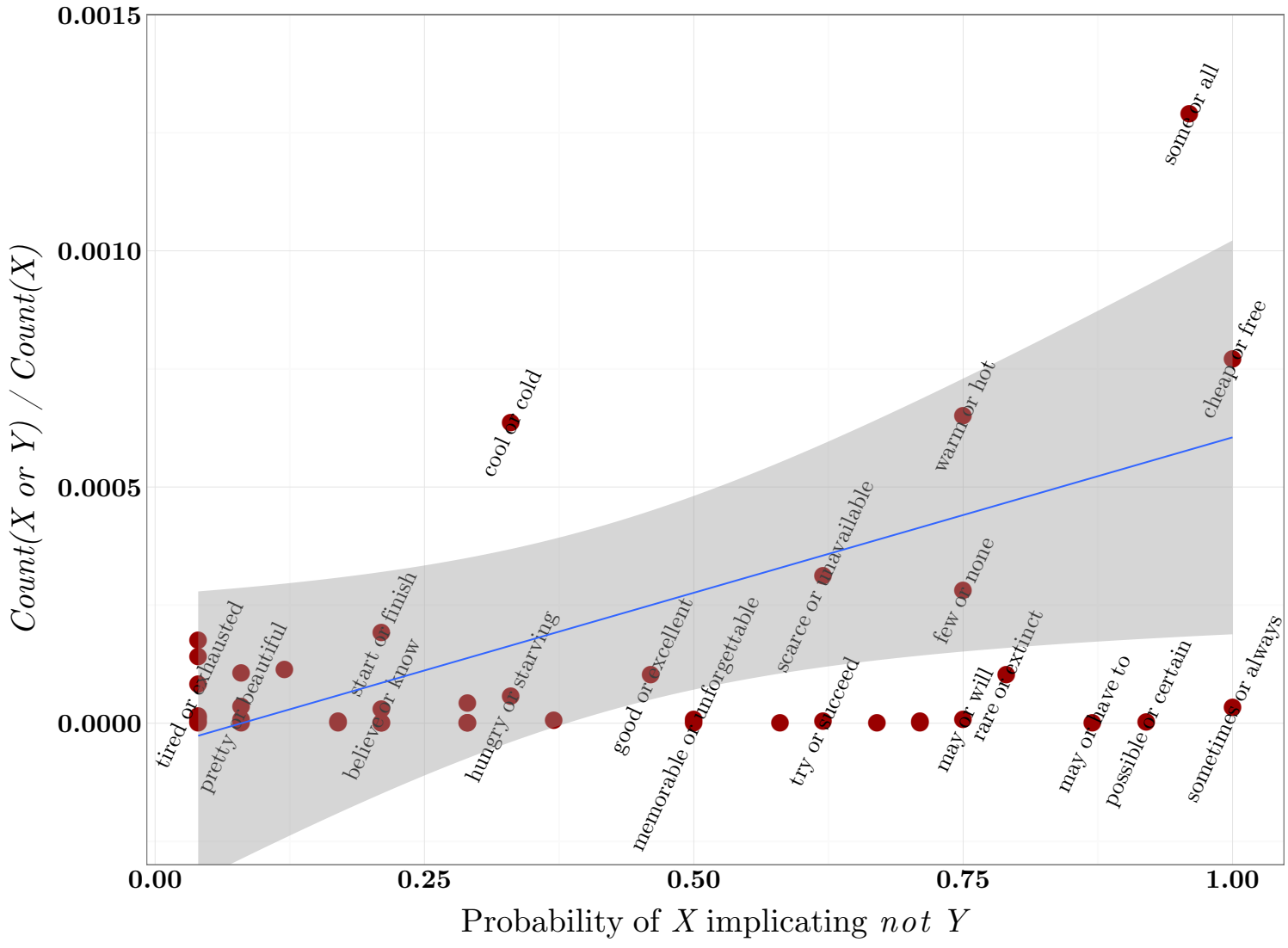
All of this more or less follows from Hurford's constraint. Our model derives the effects with no need for an independent constraint.

Chemla's method: corpus evidence for Q-blocking



Definition and identification

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Modeling communication with expert speakers

The Rational Speech Acts (RSA) model

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$$l_0(\textit{world} \mid \textit{msg}, \textit{Lex}) \propto \textit{Lex}(\textit{msg}, \textit{world})P(\textit{world})$$

← semantics with priors

The Rational Speech Acts (RSA) model

$$s_1(msg \mid world, Lex) \propto \exp\left(\alpha \log l_0(world \mid msg, Lex) - C(msg)\right)$$

← ambiguity avoidance

$$l_0(world \mid msg, Lex) \propto Lex(msg, world)P(world)$$

← semantics with priors

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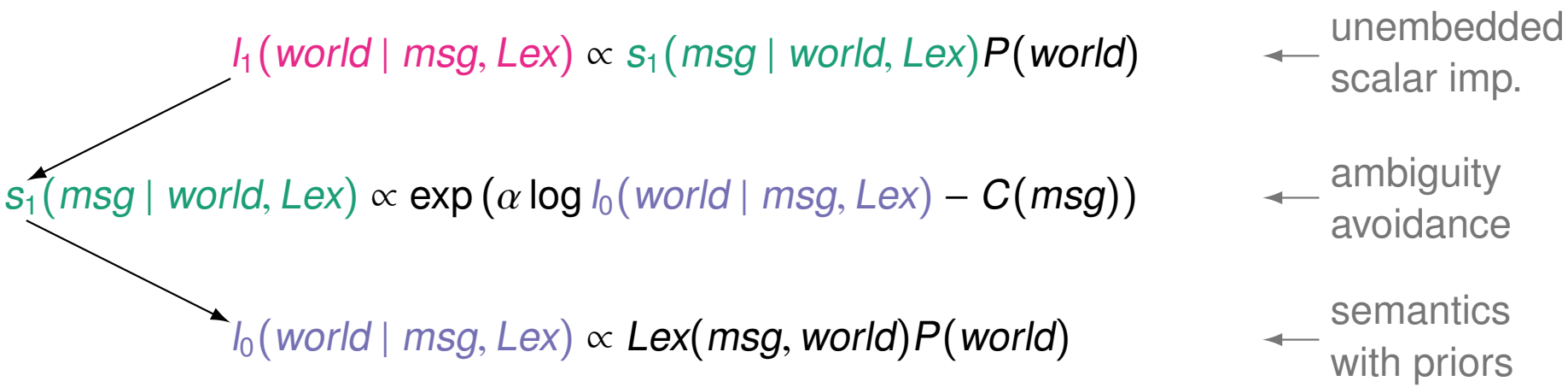

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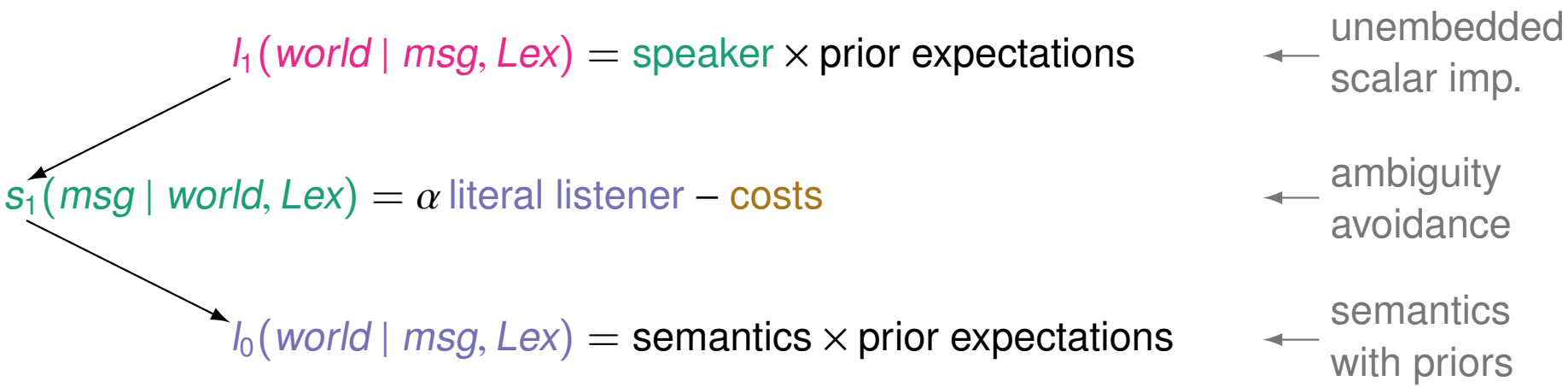


Basic scalar implicature

Lex^*	w_1	w_2	w_3
p	1	1	0
q	1	0	1
$p \,\&\, q$	1	0	0
$p \,or\, q$	1	1	1

$\longleftarrow$

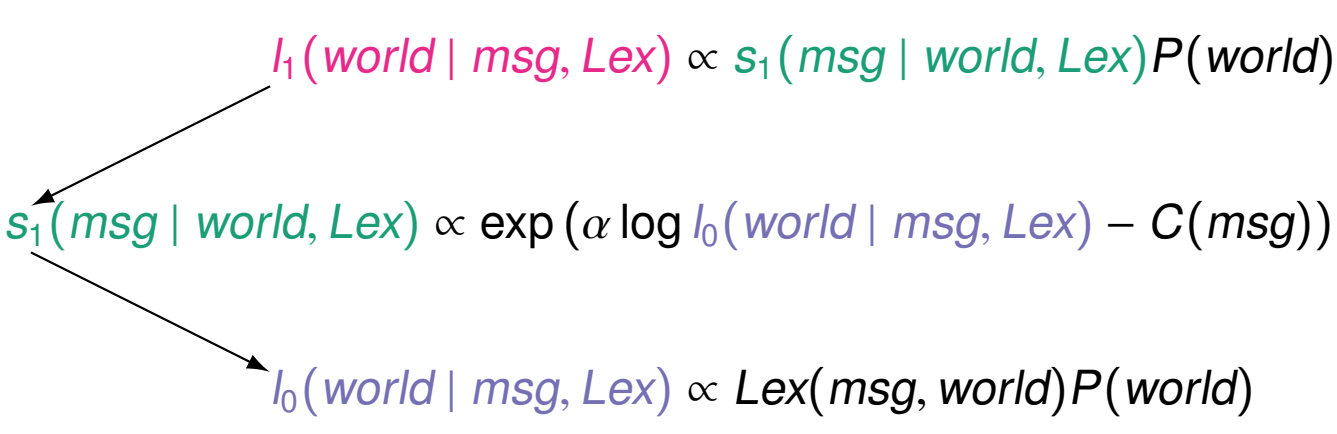
l_0	w_1	w_2	w_3
p	.5	.5	0
q	.5	0	.5
$p \,\&\, q$	1	0	0
$p \,or\, q$	.33	.33	.33

l_1	w_1	w_2	w_3
p	.3	.7	0
q	.3	0	.7
$p \,\&\, q$	1	0	0
$p \,or\, q$	.17	.41	.41

s_1	p	q	$p \,\&\, q$	$p \,or\, q$
w_1	.33	.33	.25	.08
w_2	.8	0	0	.2
w_3	0	.8	0	.2

Figure: $P(world_i) = 1/3$; $C(or) = C(and) = 1$; $\alpha = 1$. The recursive process separates disjunction and conjunction, and it also separates disjunction from each of its disjuncts.

Joint reasoning about world and language



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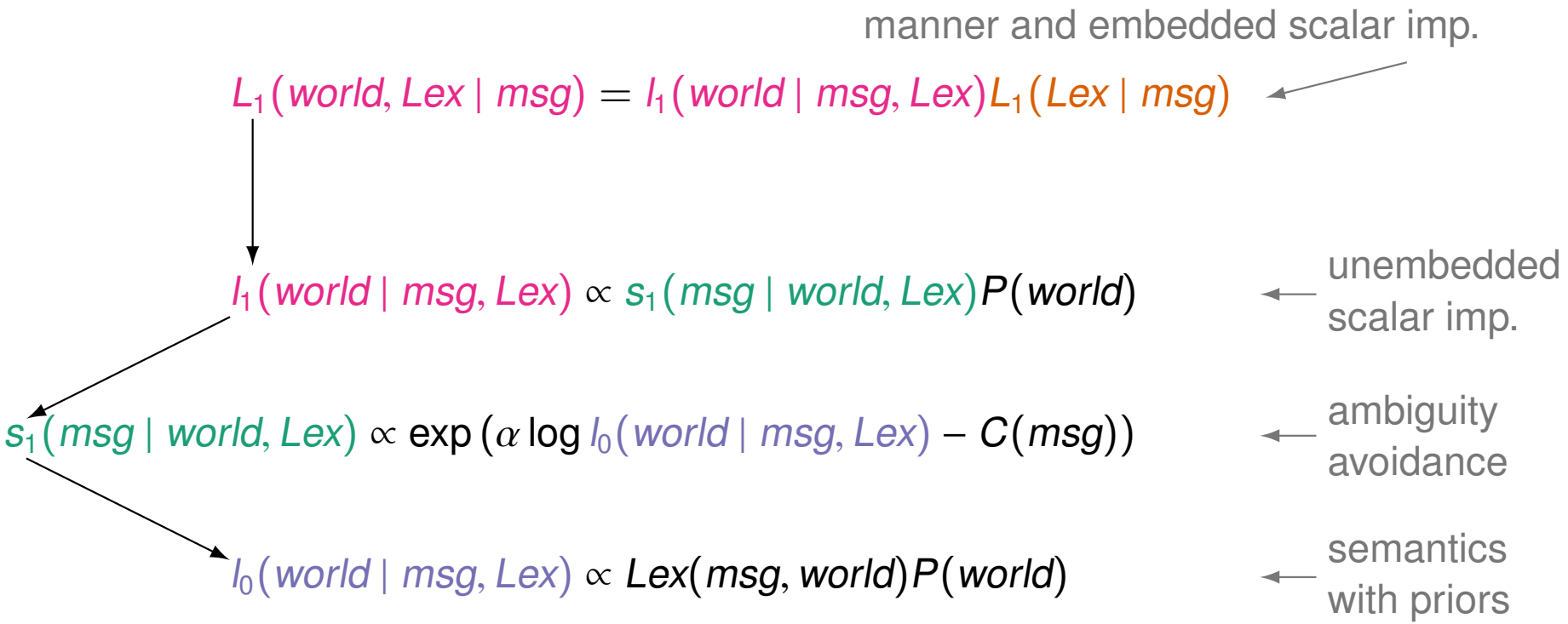

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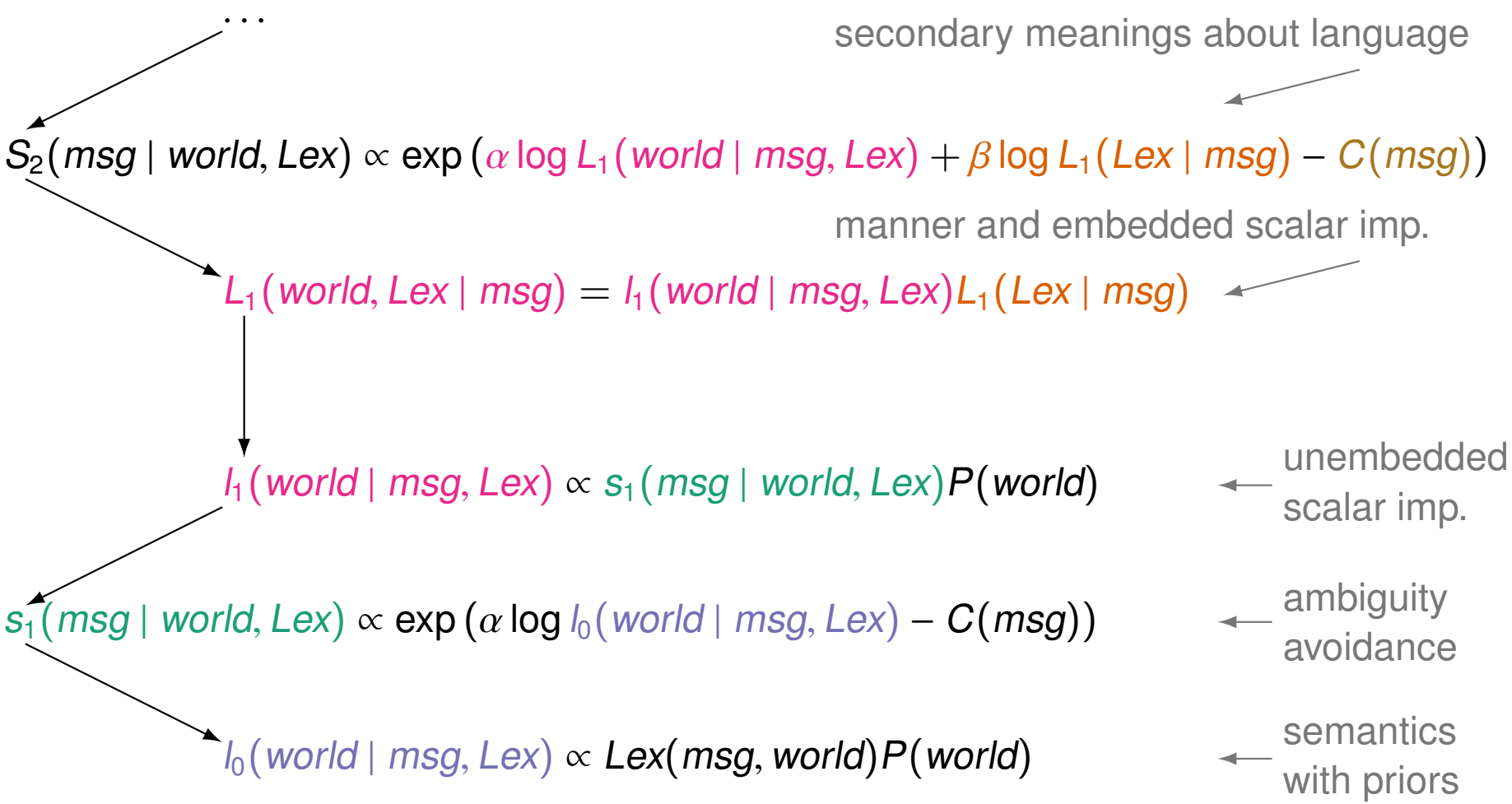

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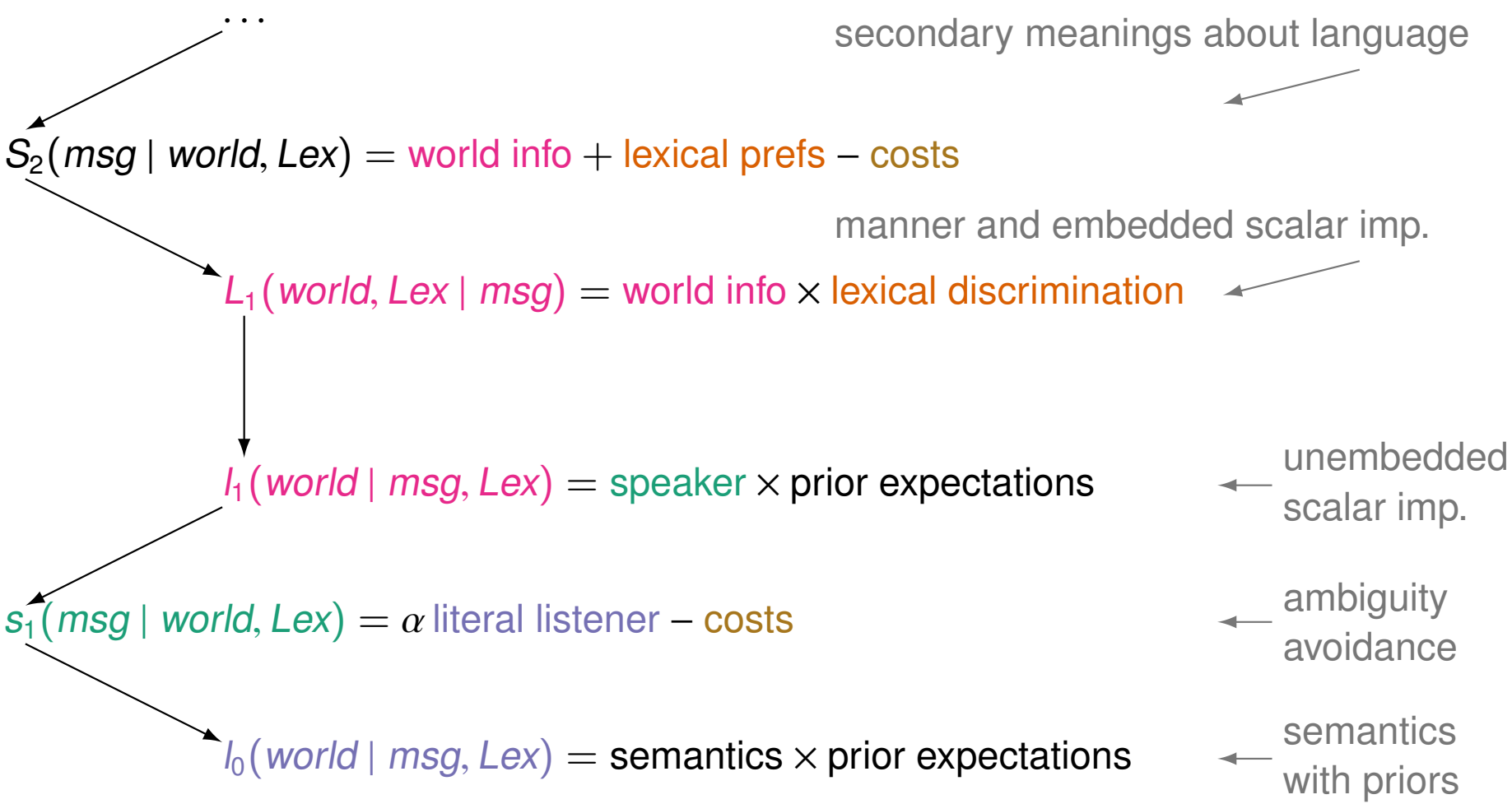

Joint reasoning about world and language

- $S_k(msg \mid world, Lex) =$ world info $+$ lexical prefs $-$ costs
- $L_{k-1}(world, Lex \mid msg) =$ world info $\times$ lexical discrimination

Scalar implicature with compositional lexical uncertainty

	w_1	w_2	w_3	$w_1 \vee w_2$	$w_1 \vee w_3$	$w_2 \vee w_3$	$w_1 \vee w_2 \vee w_3$
p	1	1	0				
q	1	0	1				
p & *q*							
p or q							

Table: Compositional lexicon with join closure

Scalar implicature with compositional lexical uncertainty

	w_1	w_2	w_3	$w_1 \vee w_2$	$w_1 \vee w_3$	$w_2 \vee w_3$	$w_1 \vee w_2 \vee w_3$
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q	1	0	1				
$p \,\&\, q$	**1**	**0**	**0**				
p *or* q	**1**	**1**	**1**				

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p	1	1	0	**1**	**0**	**0**	**0**
q	1	0	1	**0**	**1**	**0**	**0**
p & q	**1**	**0**	**0**	**0**	**0**	**0**	**0**
p *or* q	**1**	**1**	**1**	**1**	**1**	**1**	**1**

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p	1	1	0	**1**	**0**	**0**	**0**
q	1	0	1	**0**	**1**	**0**	**0**
p & *q*	**1**	**0**	**0**	**0**	**0**	**0**	**0**
p or q	**1**	**1**	**1**	**1**	**1**	**1**	**1**

Table: Compositional lexicon with join closure

	w_1	w_2	w_3	$w_1 \vee w_2$	$w_1 \vee w_3$	$w_2 \vee w_3$	$w_1 \vee w_2 \vee w_3$
p	.25	.51	0	.24	0	0	0
q	.25	0	.51	0	.24	0	0
p & *q*	1	0	0	0	0	0	0
p or q	.04	.06	.06	.18	.18	.28	.21

Table: L_2 inferences as $L_2(world \mid msg) = \sum_{Lex} L_2(world \mid msg, Lex)$

Analysis of the side-effects of disjunction

1. Lexical side-effects from disjunction
2. Modeling communication with expert speakers
3. Analysis of disjunction
4. Implicature blocking

To make a long story short . . .

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Contextual parameters

- α: importance of world information
- β: importance of linguistic information
- C: the costs of messages

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Definitional readings

- Require large β relative to α
- Require low $C(or)$

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Contextual parameters

- α: importance of world information
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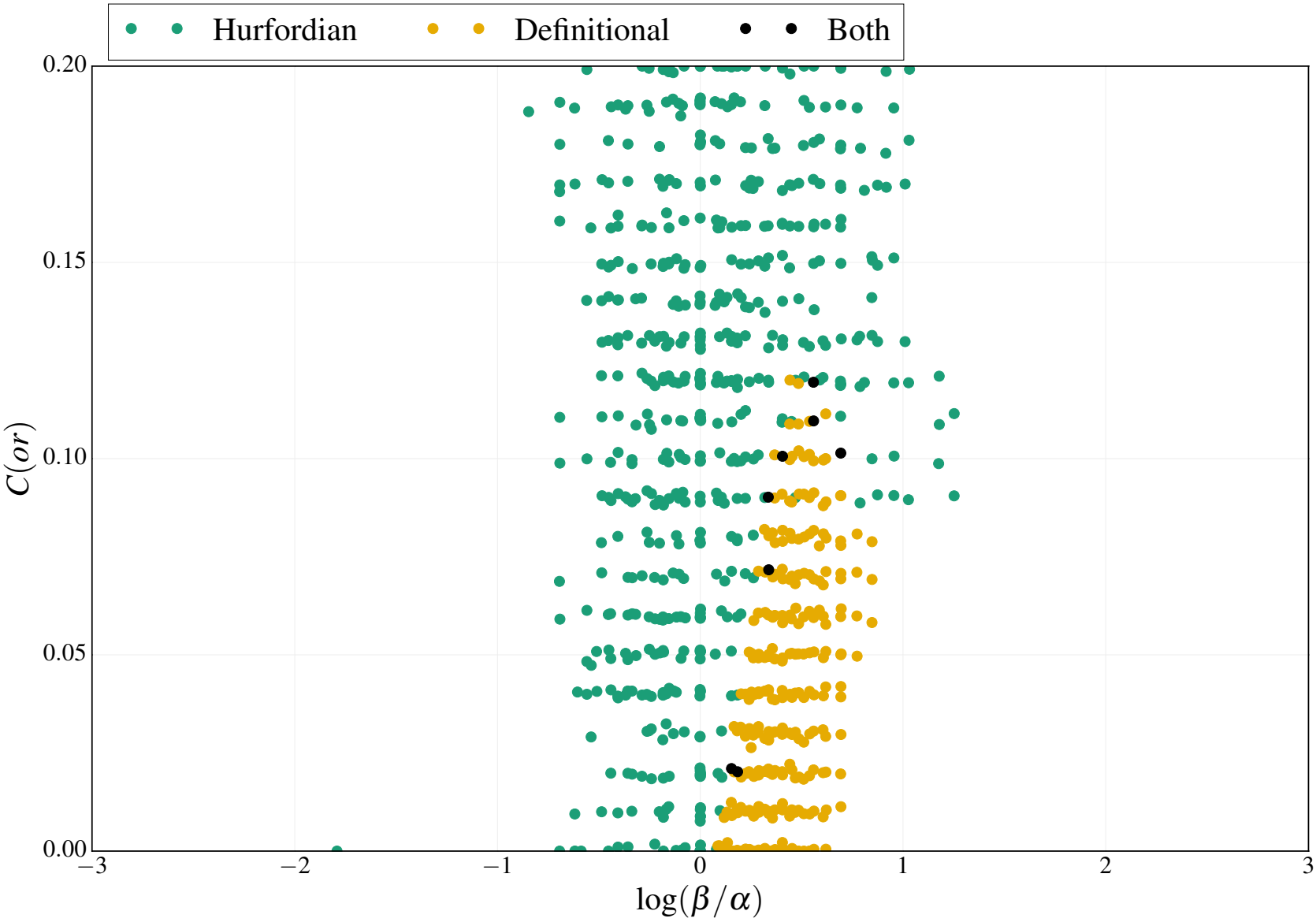
Exclusivization readings

- Require α to be at least near β
- Require non-negligible $C(or)$

Parameter-space exploration



The shape of the computations

$$\frac{\vdots}{S_2 \;\; msg_1 \;\; \cdots \;\; msg_n}$$

observed $\langle Lex_0, w_1 \rangle$
observed $\langle Lex_0, w_2 \rangle$
$\vdots$

L_1 heard msg_1	w_1	w_2	$w_1 \vee w_2$	$\cdots$
Lex_0				
Lex_1				
Lex_2				

L_1 heard msg_2	w_1	w_2	$w_1 \vee w_2$	$\cdots$
Lex_0				
Lex_1				
Lex_2				

$\ldots$

$l_1(world \mid msg, Lex_0)$	$l_1(world \mid msg, Lex_1)$	$l_1(world \mid msg, Lex_2)$
$s_1(msg \mid world, Lex_0)$	$s_1(msg \mid world, Lex_1)$	$s_1(msg \mid world, Lex_2)$
$l_0(world \mid msg, Lex_0)$	$l_0(world \mid msg, Lex_1)$	$l_0(world \mid msg, Lex_2)$

Definitional and Hurfordian listener inferences

L_2 hears *A or X*	w_1	w_2	$w_1 \vee w_2$
$Lex^*\left[A \mapsto \{w_1\}, B \mapsto \{w_2\}, X \mapsto \{w_1, w_2\}\right]$	0	0	.08
$Lex_1\left[A \mapsto \{w_1\}, B \mapsto \{w_2\}, X \mapsto \{w_2\}\right]$	.01	0	.08
$Lex_2\left[A \mapsto \{\mathbf{w_1}\}, B \mapsto \{w_2\}, X \mapsto \{\mathbf{w_1}\}\right]$	.77	0	.06

Table: Definitional inference: $\alpha = 5; \beta = 7; C(or) = 0.01$

Definitional and Hurfordian listener inferences

L_2 hears A *or* X	w_1	w_2	$w_1 \vee w_2$
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$Lex_2\left[A \mapsto \{\mathbf{w_1}\}, B \mapsto \{w_2\}, X \mapsto \{\mathbf{w_1}\}\right]$	.77	0	.06

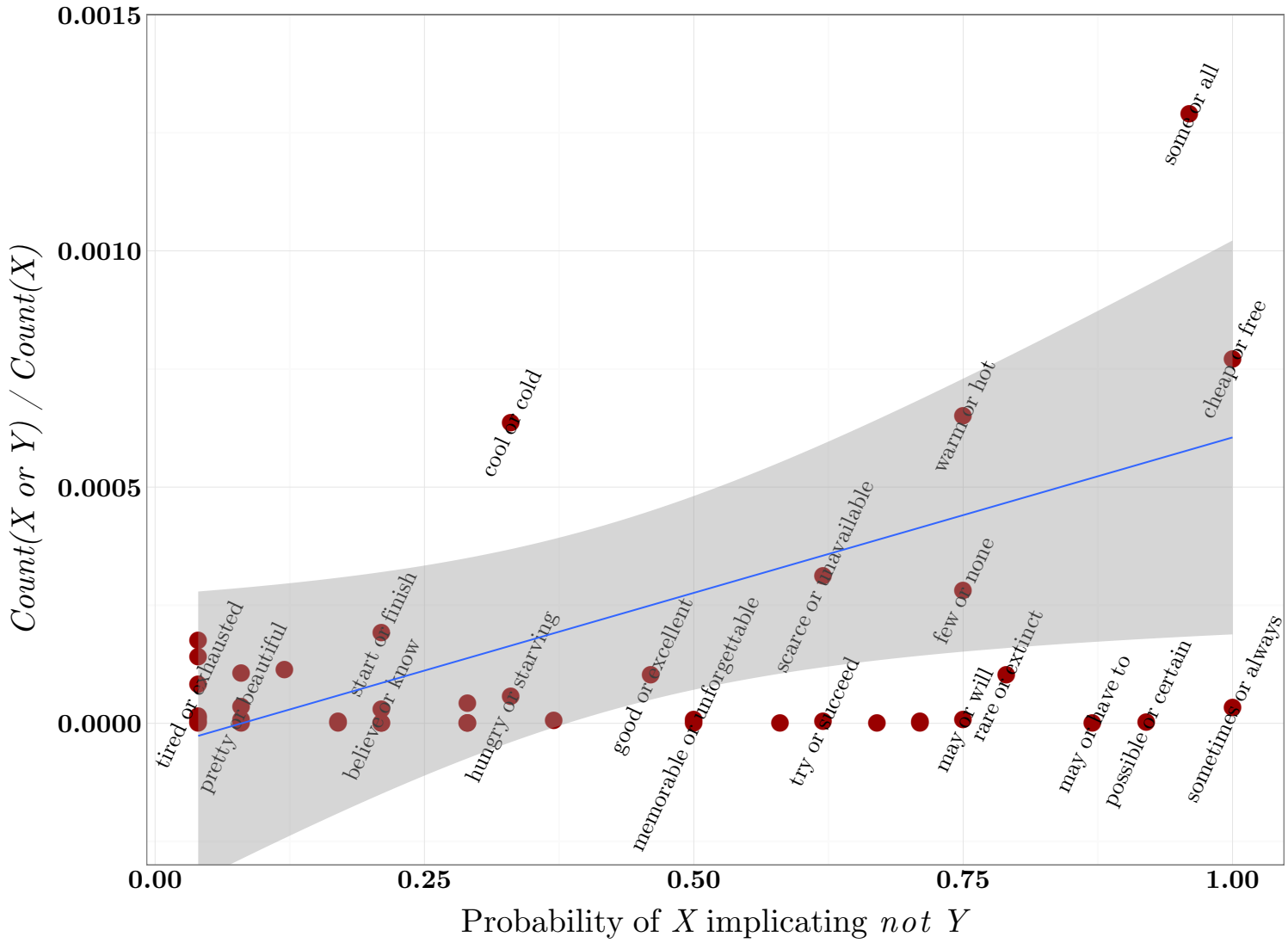
Table: Definitional inference: $\alpha = 5; \beta = 7; C(or) = 0.01$

L_2 hears A *or* X	w_1	w_2	$w_1 \vee w_2$
$Lex^*\left[A \mapsto \{w_1\}, B \mapsto \{w_2\}, X \mapsto \{w_1, w_2\}\right]$	.02	0	.32
$Lex_1\left[A \mapsto \{\mathbf{w_1}\}, B \mapsto \{w_2\}, X \mapsto \{\mathbf{w_2}\}\right]$	.04	0	.45
$Lex_2\left[A \mapsto \{w_1\}, B \mapsto \{w_2\}, X \mapsto \{w_1\}\right]$	.03	0	.14

Table: Hurfordian inference: $\alpha = 2; \beta = 1; C(or) = 1$

Implicature blocking

Chemla's method: corpus evidence for Q-blocking



Defensive speakers: Q-implicature blocking

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The speaker observes

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so *cheap* holds,

Defensive speakers: Q-implicature blocking

The speaker observes

so *cheap* holds,

but the listener might infer

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so hedge with *cheap or free*.

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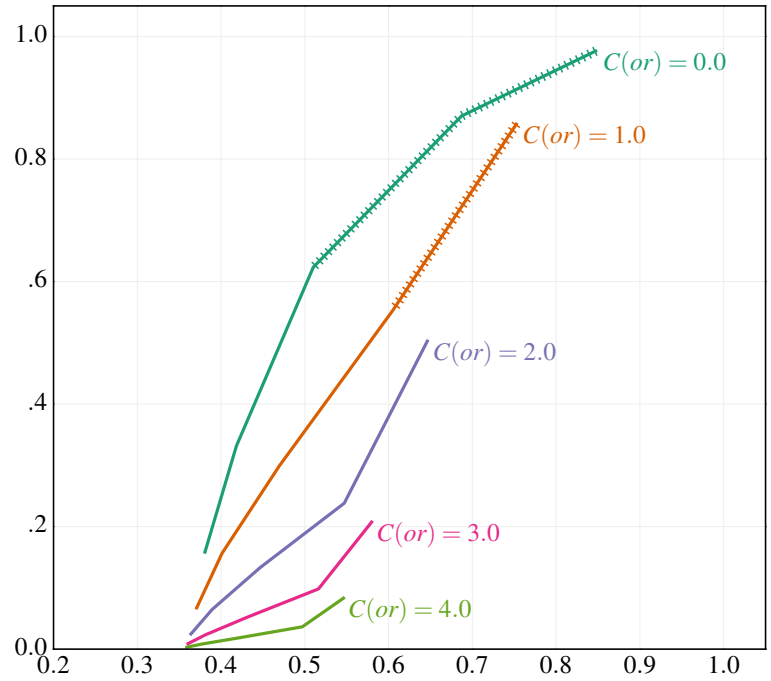
S_2 (Price $2.00 Price $1.00 Price $0.00 | *cheap or free*)



L_1 (Price $1.00 Price $2.00 | *cheap*)

Modeling I-implicature blocking

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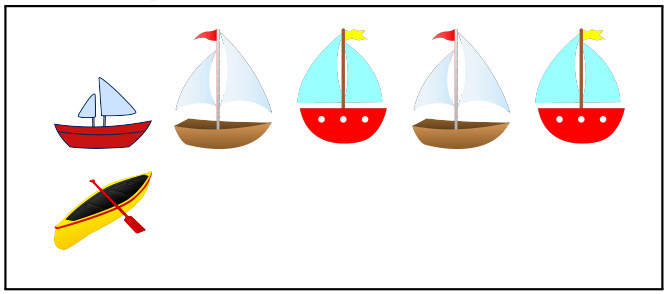
The speaker observes



Modeling I-implicature blocking

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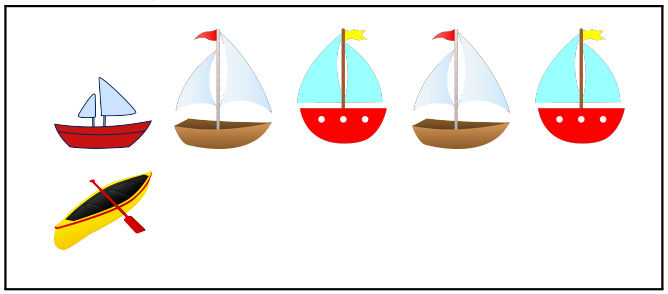

so *boat* holds,

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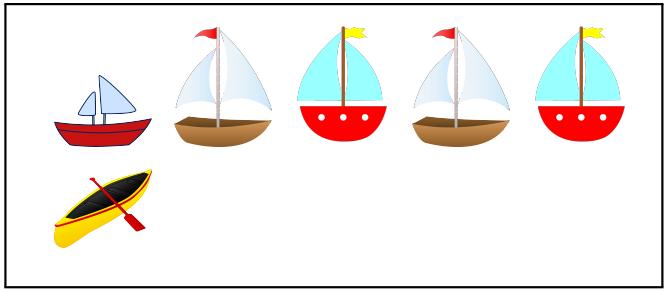

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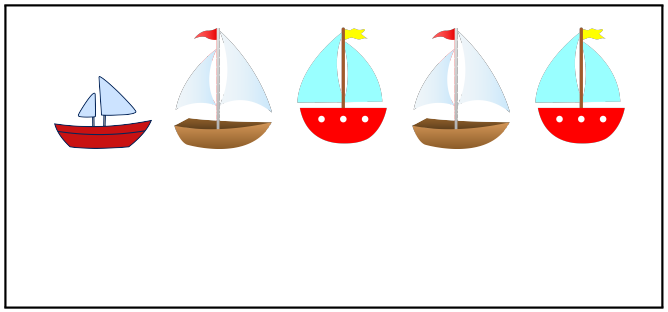
but the listener might infer



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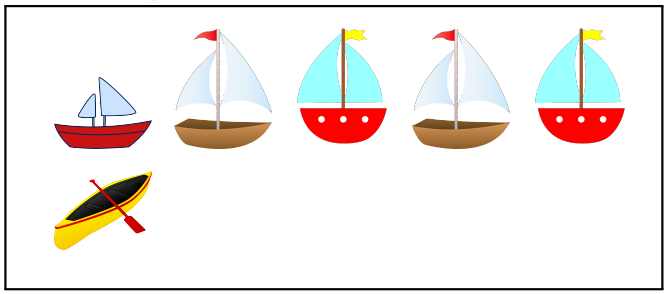

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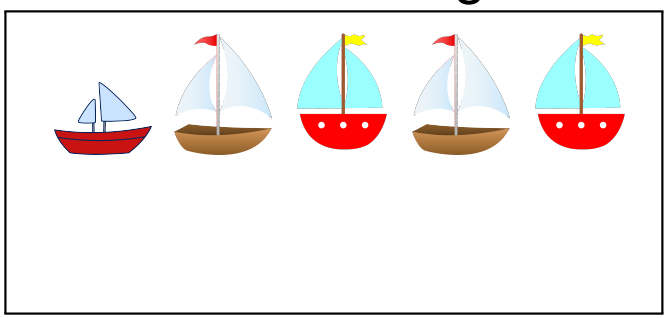

so hedge with *boat or canoe*.

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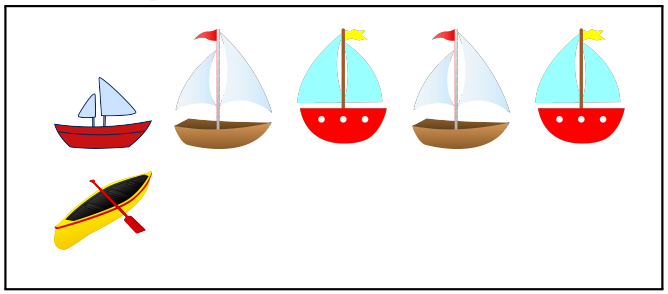

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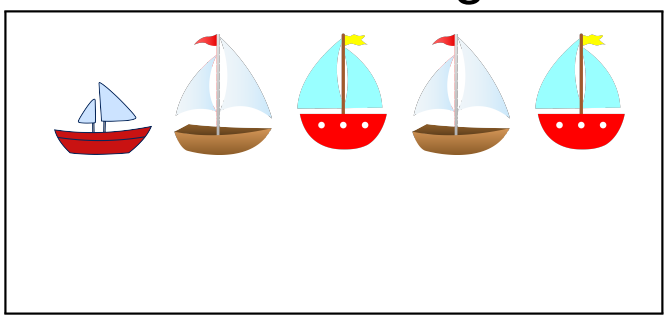

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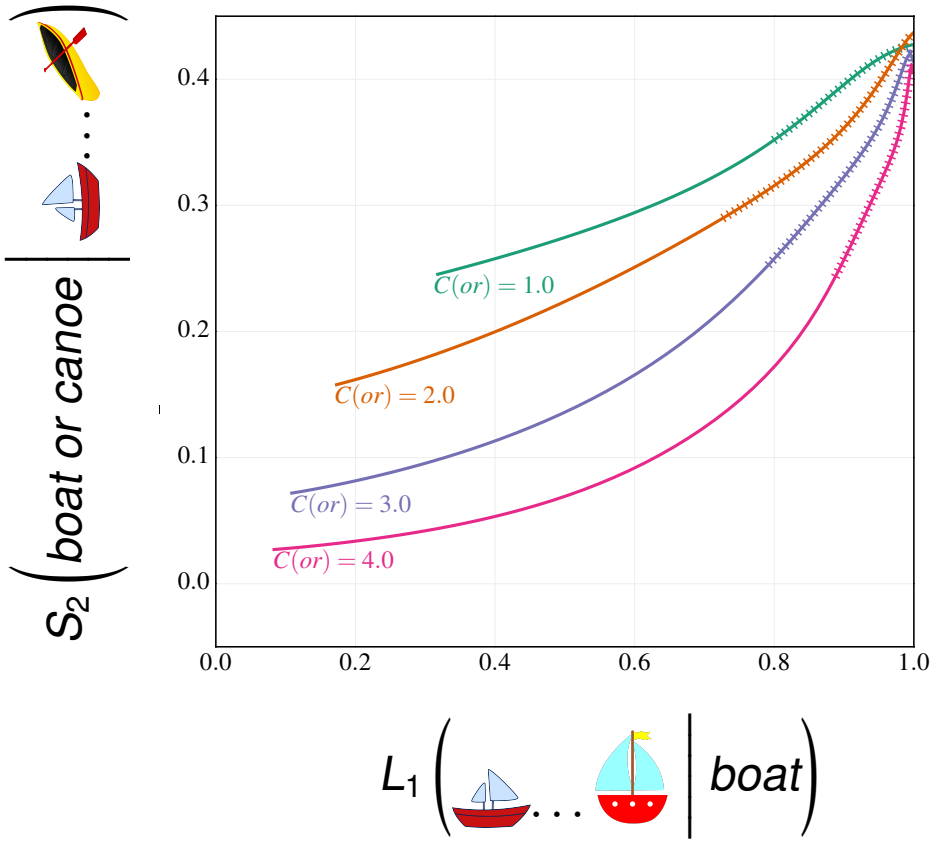

Conclusion

- Unified two seemingly conflicting inferences from disjunction
- Speakers who communicate in language about language
- Listeners who are attuned to such information
- New methods detecting and understanding the secondary messages encoded in speakers' utterances
- A partial characterization of implicature blocking by high-level pragmatic agents
- Code and data available to facilitate investigation: https://github.com/cgpotts/pypragmods

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Thanks!