Today's question

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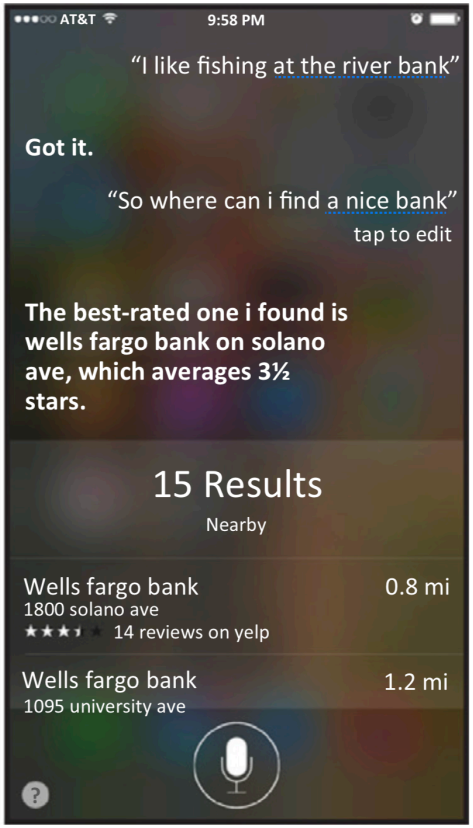
Human gestures perplex Asimo, Honda museum robot guide

Honda's popular robot Asimo faced problems with gesture recognition on its first day as a museum guide at the Miraikan science museum in Tokyo.

The machine struggled to differentiate between museum-goers raising their hands to ask a question and raising their hands to take photos, Associated Press reported.

It is "working" as a tour guide at the museum for the next four weeks as a trial.

Asimo is reported to have had problems identifying arm gestures



Why is this not an issue for us, humans?

Agent-based Modeling

Today's docket

1. Rational speech act

   Literal and pragmatic speakers and listeners, Bayesian inference

2. Interactive alignment

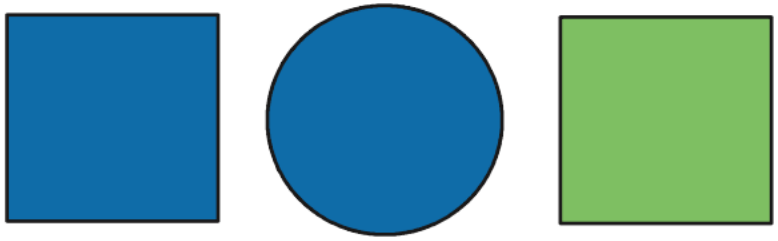
   Mutual priming, battle of the Alexas

3. Communicative obstacles

   Interpersonal asymmetry, signal ambiguity, typological inadequacy

Literal speaker, S0

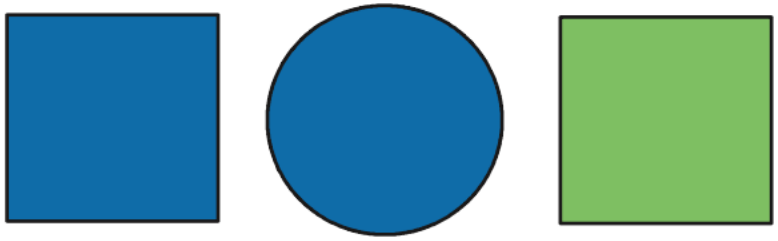
Speaker: Imagine you are talking to someone and you want to refer to the middle object. Which word would you use, "**blue**" or "**circle**"?



Blue	1/2	1/2	0
Green	0	0	1/2
Circle	0	1/2	0
Square	1/2	0	1/2
	2	2	2

Literal speaker, S0

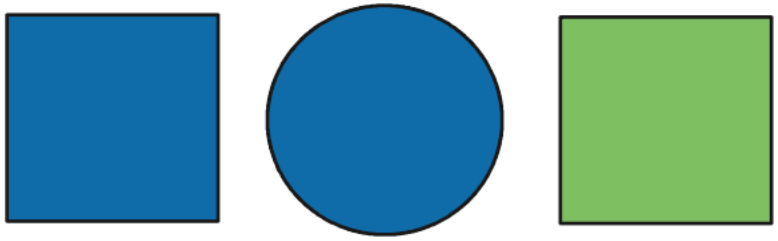
Speaker: Imagine you are talking to someone and you want to refer to the middle object. Which word would you use, "**blue**" or "**circle**"?



Blue	.5	.5	0
Green	0	0	.5
Circle	0	.5	0
Square	.5	0	.5

Literal listener, L0

Speaker: Imagine you are talking to someone and you want to refer to the middle object. Which word would you use, "**blue**" or "**circle**"?

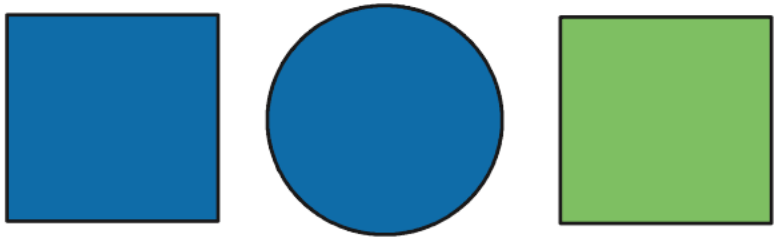


Blue	$1_{/2}$	$1_{/2}$	0	2
Green	0	0	$1_{/1}$	1
Circle	0	$1_{/1}$	0	1
Square	$1_{/2}$	0	$1_{/2}$	2

listener's perspective

Literal listener, L0

Speaker: Imagine you are talking to someone and you want to refer to the middle object. Which word would you use, "**blue**" or "**circle**"?

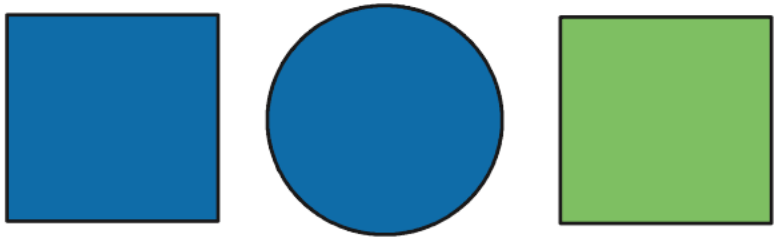


Blue	.5	.5	0
Green	0	0	1
Circle	0	1	0
Square	.5	0	.5

listener's perspective

Pragmatic speaker, S1

Speaker: Imagine you are talking to someone and you want to refer to the middle object. Which word would you use, "**blue**" or "**circle**"?

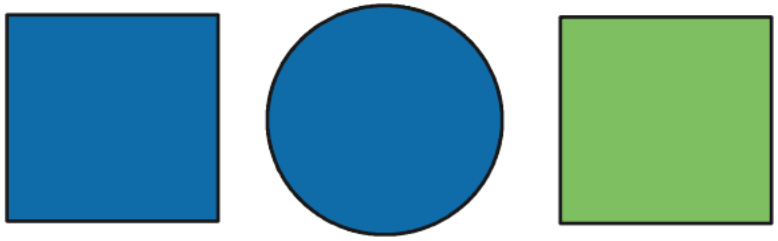


Blue	$.5_{/1}$	$.5_{/1.5}$	0
Green	0	0	$1_{/1.5}$
Circle	0	$1_{/1.5}$	0
Square	$.5_{/1}$	0	$.5_{/1.5}$
	1	1.5	1.5

listener's perspective

Pragmatic speaker, S1

Speaker: Imagine you are talking to someone and you want to refer to the middle object. Which word would you use, "**blue**" or "**circle**"?

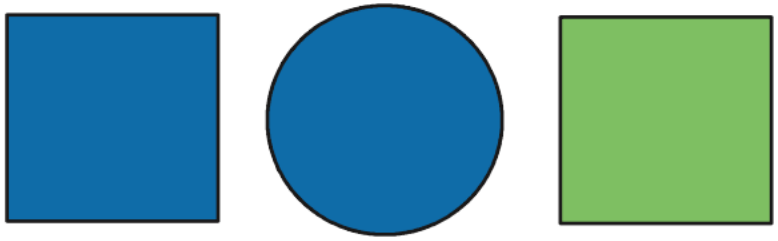


Blue	.5	.33	0
Green	0	0	.67
Circle	0	.67	0
Square	.5	0	.33

listener's perspective

Pragmatic listener, L1

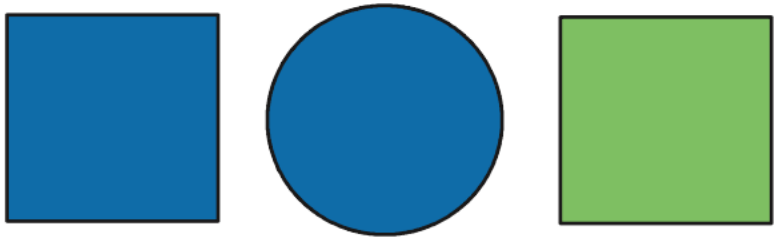
Listener/Salience: Imagine someone is talking to you and uses [the word "**blue**"/a word you don't know] to refer to one of these objects. Which object are they talking about?



Blue	.5/.83	.33/.83	0	.83
Green	0	0	.67/.67	.67
Circle	0	.67/.67	0	.67
Square	.5/.83	0	.33/.83	.83

Pragmatic listener, L1

Listener/Salience: Imagine someone is talking to you and uses [the word "**blue**"/a word you don't know] to refer to one of these objects. Which object are they talking about?



Blue	.6	.4	0
Green	0	0	1
Circle	0	1	0
Square	.6	0	.4

Bayesian inference

Likelihood speaker *s* would utter word *w* to refer to object *r*

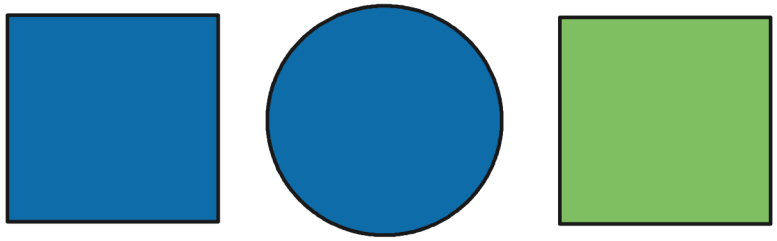
Prior probability that object *r* would be referred to

$$P(r_s|w,C) = \frac{P(w|r_s,C)P(r_s)}{\sum_{r' \in C} P(w|r',C)P(r')}$$

Likelihood that speaker *s* intended object *r* given uttered word *w* in context *C*

Normalizing constant, sum of the above computed for all referents in the context

Computer says no

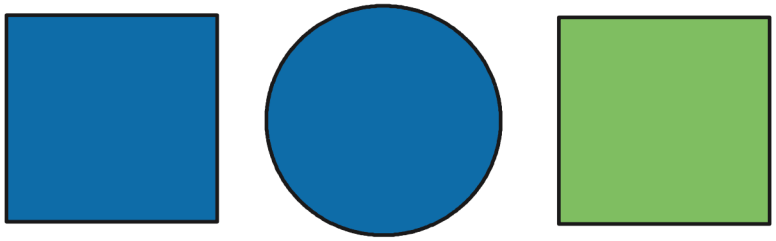


1/2	1/2	0	2
1/2	0	1/2	2

listener’s perspective

L0 correctly interprets the composite signal as referring to the blue square

Computer says no

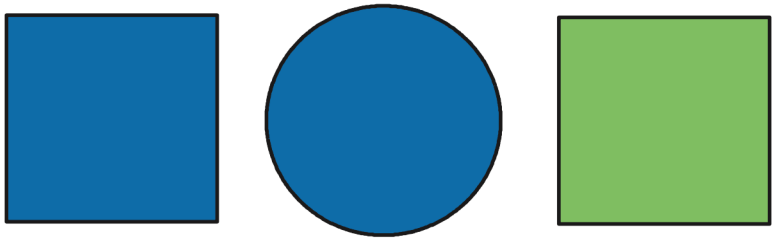


.5	.5	0
.5	0	.5
1	.5	.5

listener’s perspective

L0 correctly interprets the composite signal as referring to the blue square

Computer says no

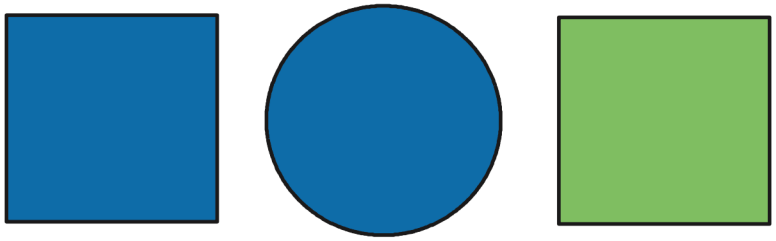


$.5_{/1}$	$.5_{/.5}$	0
$.5_{/1}$	0	$.5_{/.5}$
1	.5	.5

listener’s perspective

Perspective of pragmatic speaker, S1

Computer says no



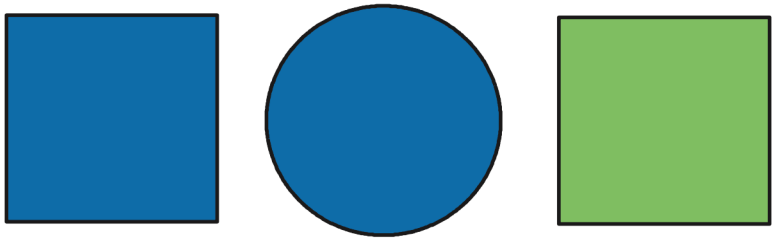
$.5_{/1.5}$ $1_{/1.5}$ 0 1.5

$.5_{/1.5}$ 0 $1_{/1.5}$ 1.5

listener’s perspective

Perspective of pragmatic speaker, S1

Computer says no



.33	.66	0
.33	0	.66
.66	.66	.66

listener’s perspective

L1 cannot reliably distinguish between the three referents

Computer says no

1.05 1.2 .75

L1 selects a non-intended referent

listener’s perspective

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   Mutual priming, battle of the Alexas

3. Communicative obstacles

   Interpersonal asymmetry, signal ambiguity, typological inadequacy

Interactive alignment

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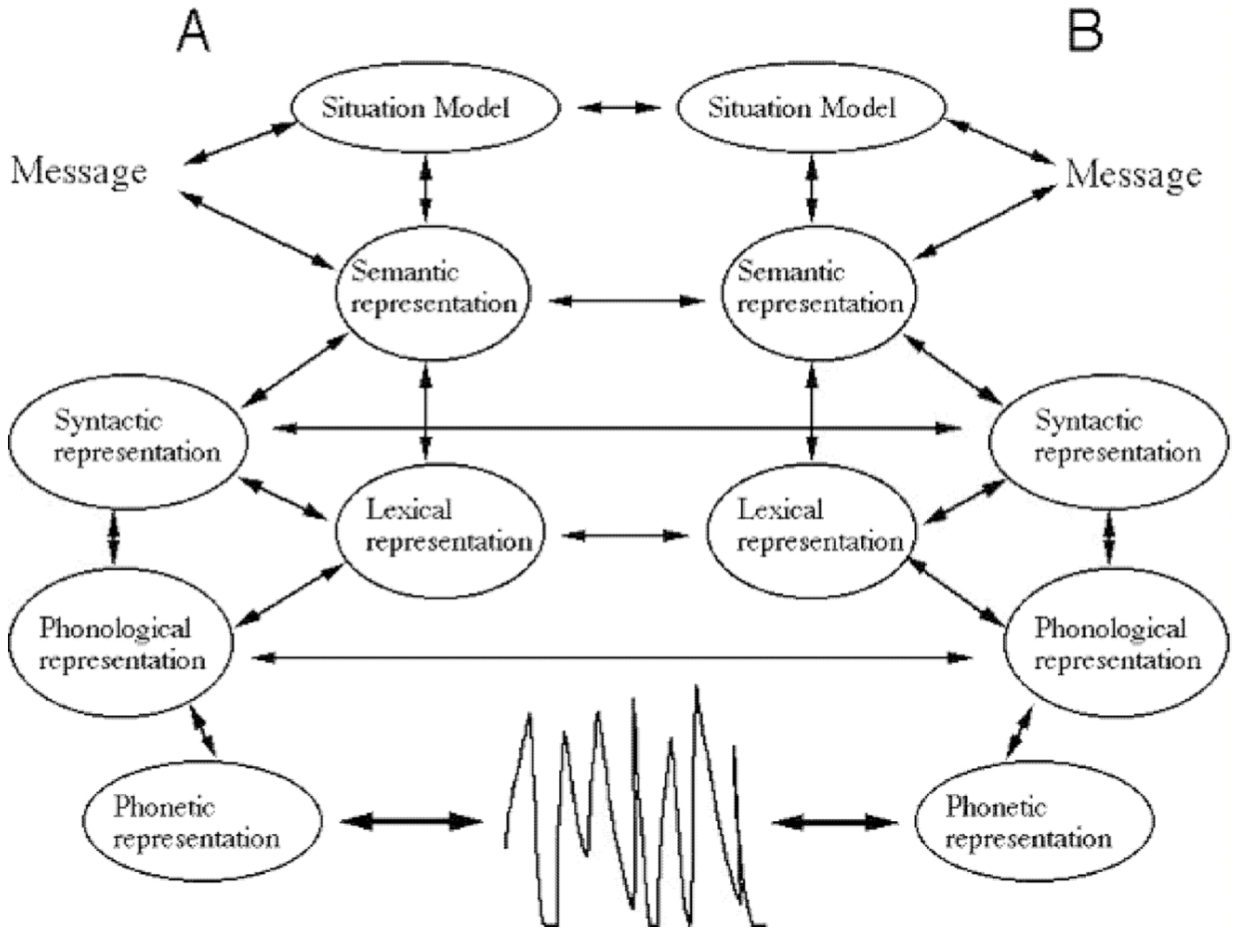
Mutual priming



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Toward a mechanistic psychology of dialogue

Priming would require perfect symmetry

Battle of the Alexas

Even perfect symmetry does not yield automatic understanding

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Interpersonal asymmetry

No two people have exactly the same experience and expertise

Signal ambiguity

- Inexactness, open to more than one interpretation
- For example, a reflexive vs. an embarrassed cough, “the bark was painful”, “it’s hard to give a good presentation”

There are multiple ambiguities in every utterance

Typological inadequacy

- Stereotyped dependencies between words and meanings can help communication but do not give the full meaning, e.g., "John dressed and had a bath"

- A communicator always needs to decide how to make an utterance that will be interpreted as intended in the current context

"There is not much dependence to be placed upon these Constructions that we put upon Signs and Words, which we understand but very little of, & at best can only give a probable Guess at their Meaning."

-- David Samwell, ship surgeon on James Cook's HMS Discovery, Hawaii, 1779

Signal types only give a probable guess at a signal's meaning

Take-home concepts

- Rational, probabilistic approaches can provide a measure of a word's uncertainty given the "context"(set of possible signals and referents)

- However, it is unclear how they could overcome fundamental communicative obstacles

Next up

- Dual 1: Big Brains