Today's question

What's the best way to say this?

Agent-based Modeling

Today's docket

1. Rational speech act

   Literal and pragmatic speakers/listeners, Bayesian inference

2. MATLAB

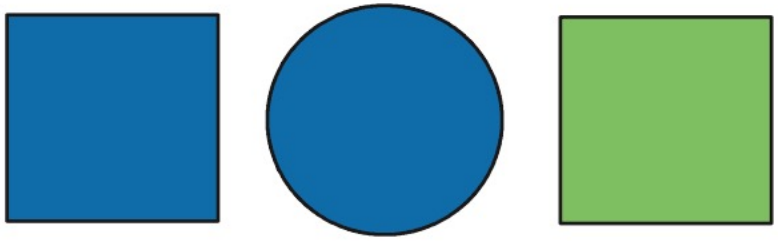
   A primer

3. Breakout session

   Building a pragmatic agent

Literal speaker, S0

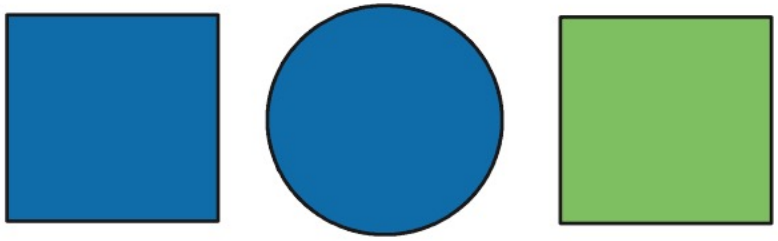
Speaker: Imagine you are talking to someone and you want to refer to the middle object. Which word would you use, "**blue**" or "**circle**"?



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

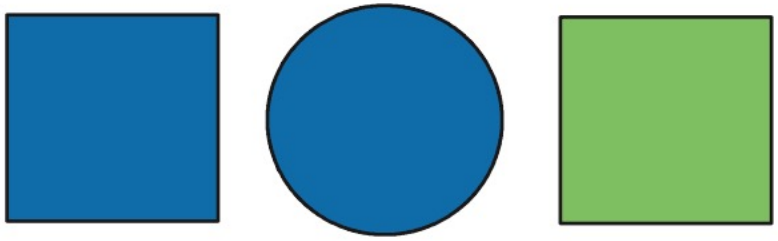
Speaker: Imagine you are talking to someone and you want to refer to the middle object. Which word would you use, "**blue**" or "**circle**"?



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**"?

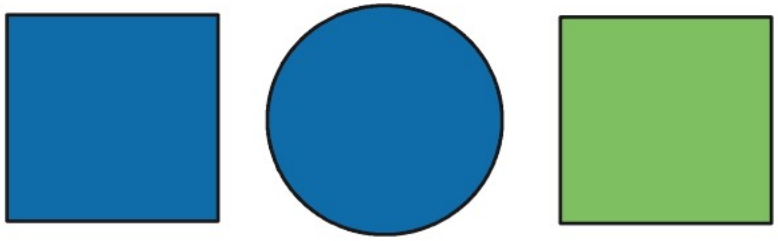


Blue	$1_{/2}$	$1_{/2}$	0	2
Green	0	0	$1_{/1}$	1
Circle	0	$1_{/1}$	0	1
Square	$1_{/2}$	0	$1_{/2}$	2

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**"?

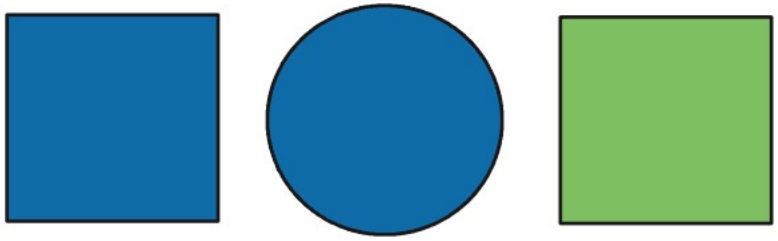


Blue	.5	.5	0
Green	0	0	1
Circle	0	1	0
Square	.5	0	.5

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**"?

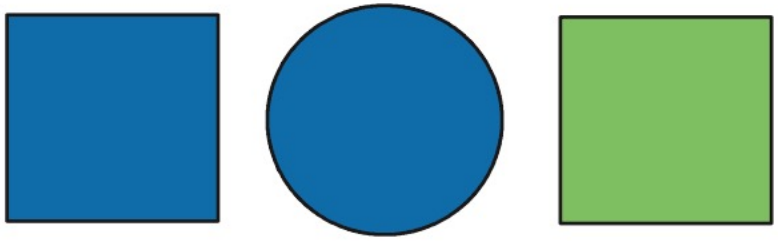


Blue	$.5_{/1}$	$.5_{/1.5}$	0
Green	0	0	$1_{/1.5}$
Circle	0	$1_{/1.5}$	0
Square	$.5_{/1}$	0	$.5_{/1.5}$
	1	1.5	1.5

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**"?

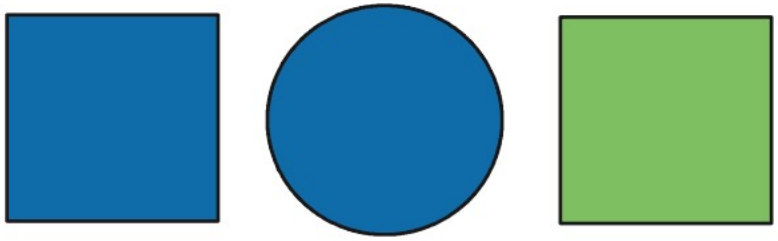


Blue	.5	.33	0
Green	0	0	.67
Circle	0	.67	0
Square	.5	0	.33

listener's perspective

Pragmatic listener, L1

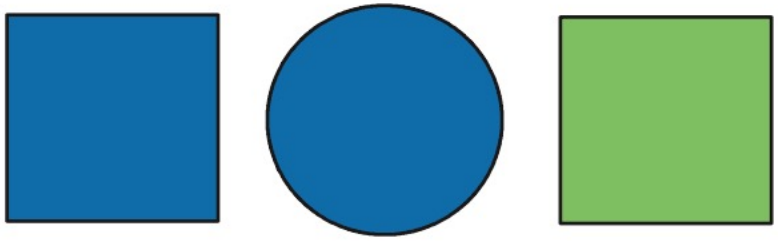
Listener/Salience: Imagine someone is talking to you and uses [the word "**blue**"/a word you don't know] to refer to one of these objects. Which object are they talking about?



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

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Array Creation

To create an array with four elements in a single row, separate the elements with either a comma (`,`) or a space.

```
a = [1 2 3 4]
```

```
a = 1×4

     1     2     3     4
```

This type of array is a *row vector*.

To create a matrix that has multiple rows, separate the rows with semicolons.

```
a = [1 2 3; 4 5 6; 7 8 10]
```

```
a = 3×3

     1     2     3
     4     5     6
     7     8    10
```

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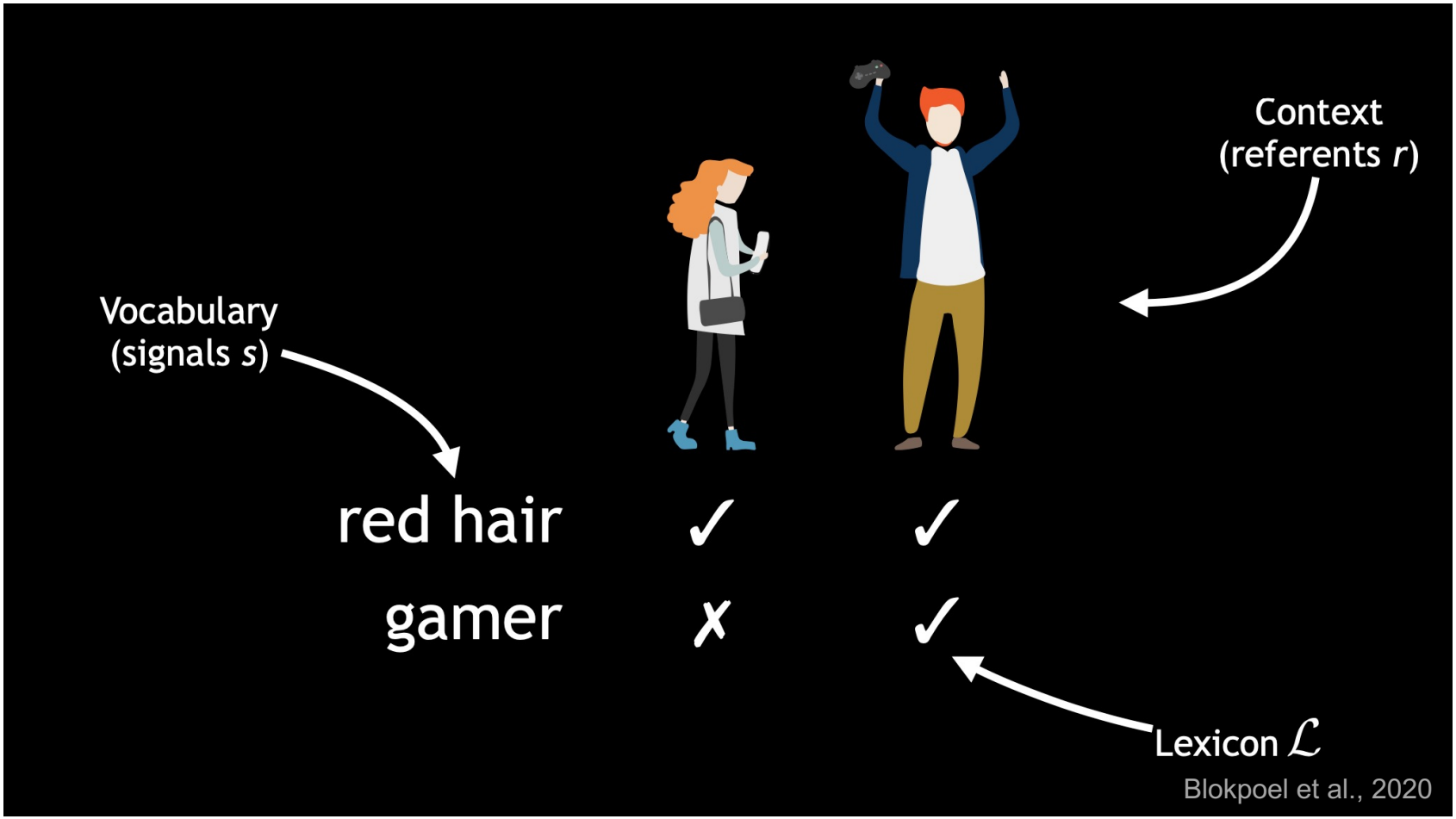
Breakout session



Whom is referred to with “red hair”?

Breakout session

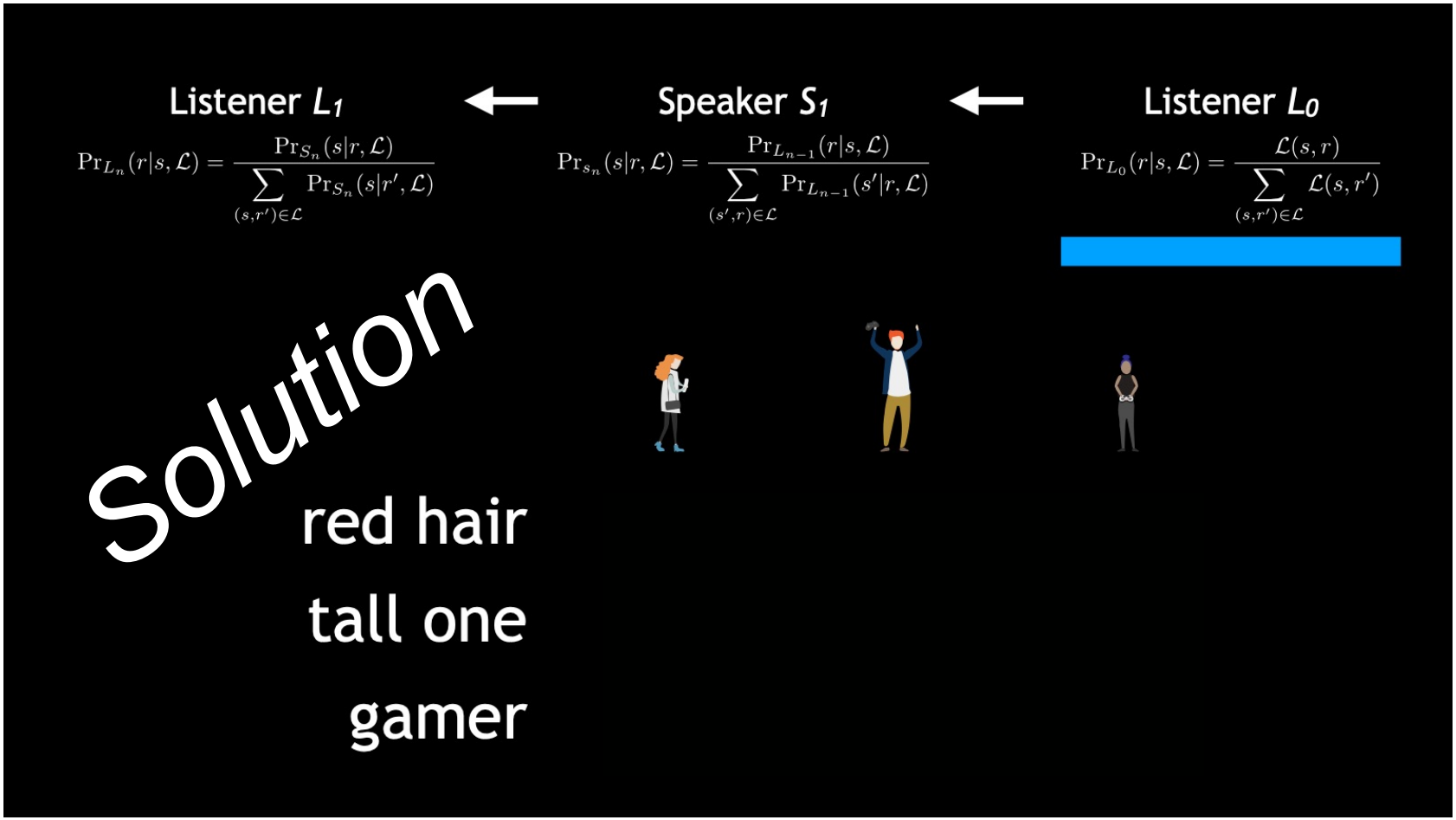
open Lab2.m or .ipynb

Problem

red hair	✓	✓	✗
tall one	✗	✓	✗
gamer	✗	✓	✓

Whom is referred to with “red hair”, from the perspective of a literal and of a pragmatic listener?

Breakout session



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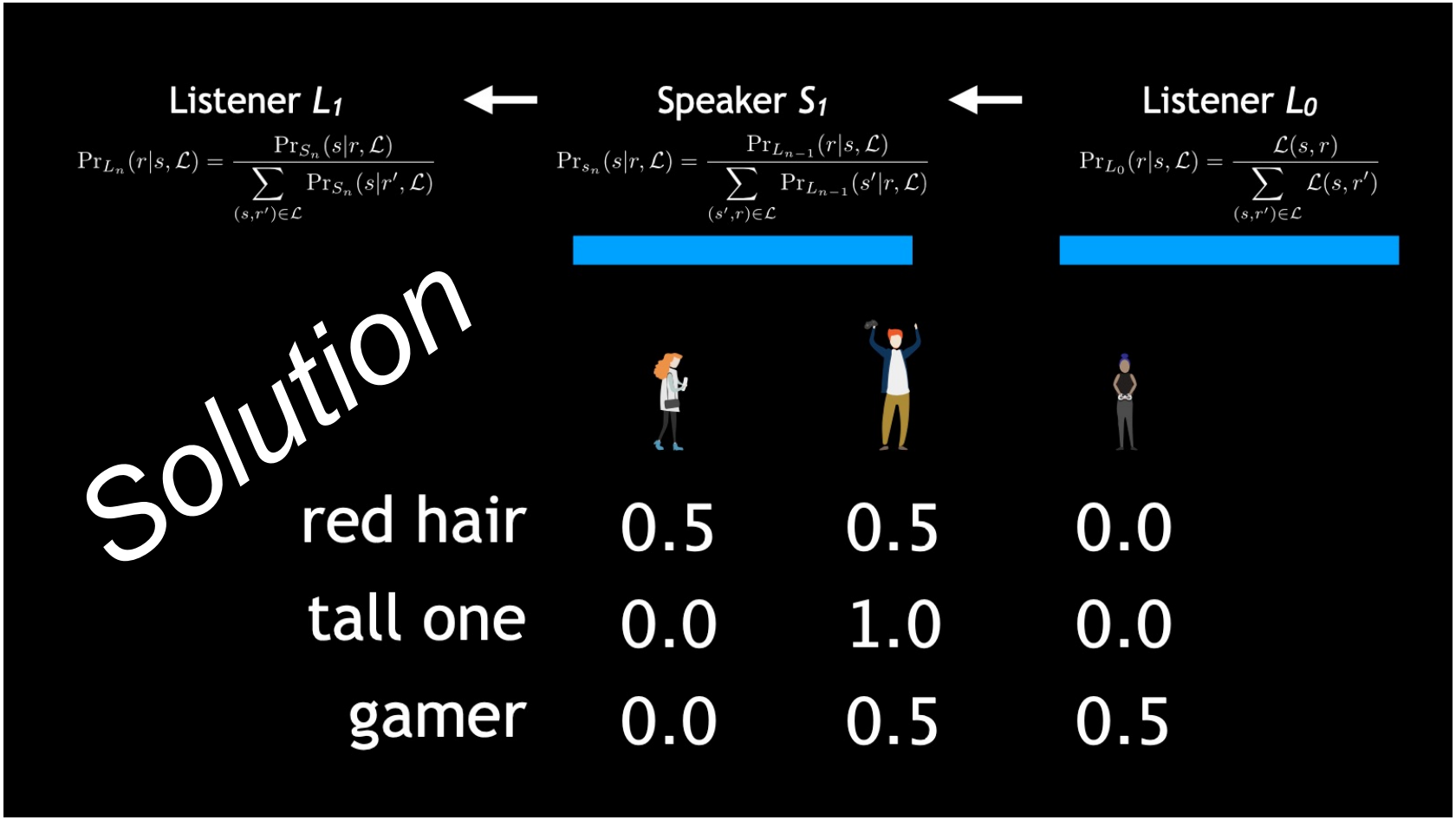
Breakout session



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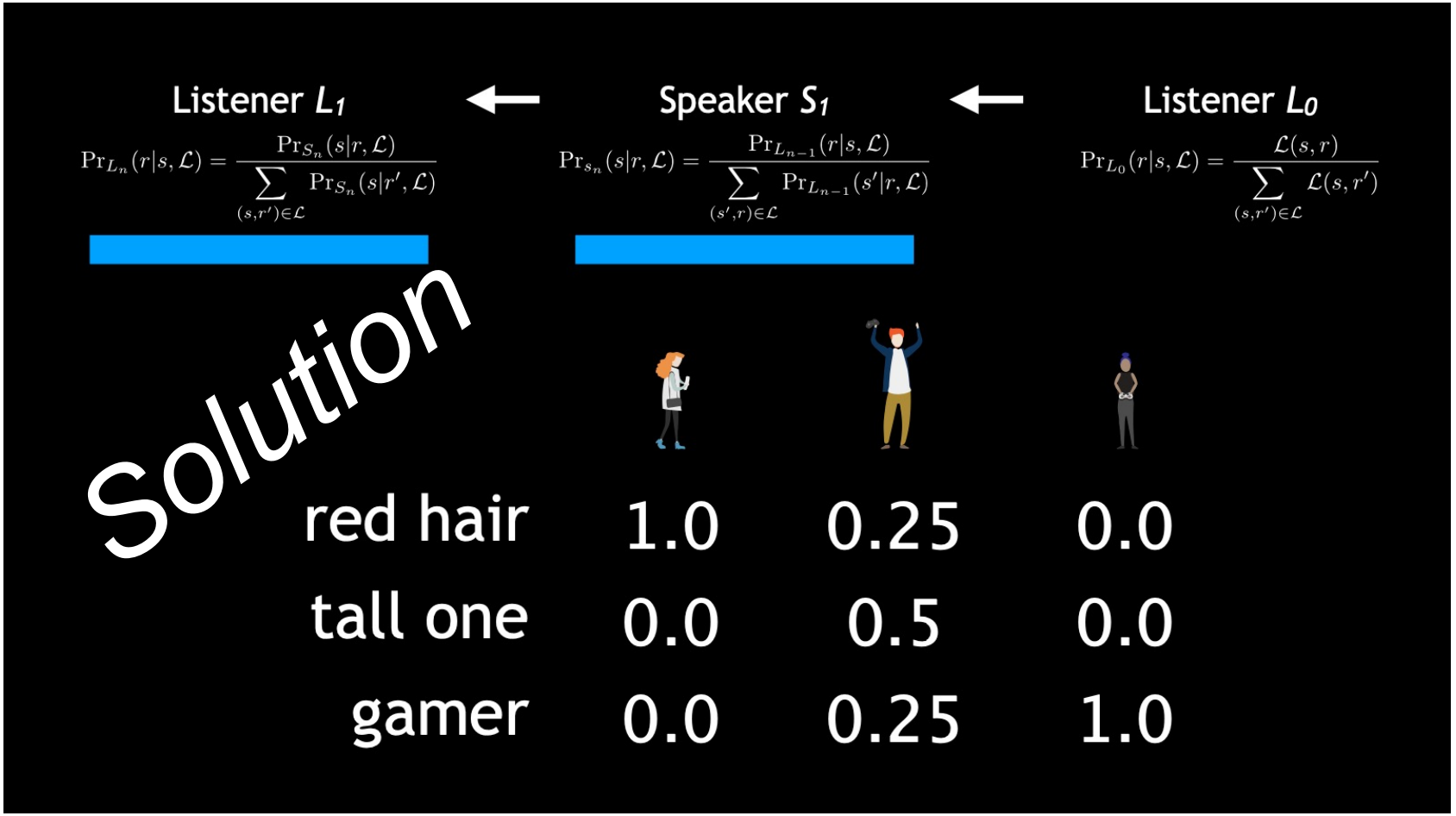

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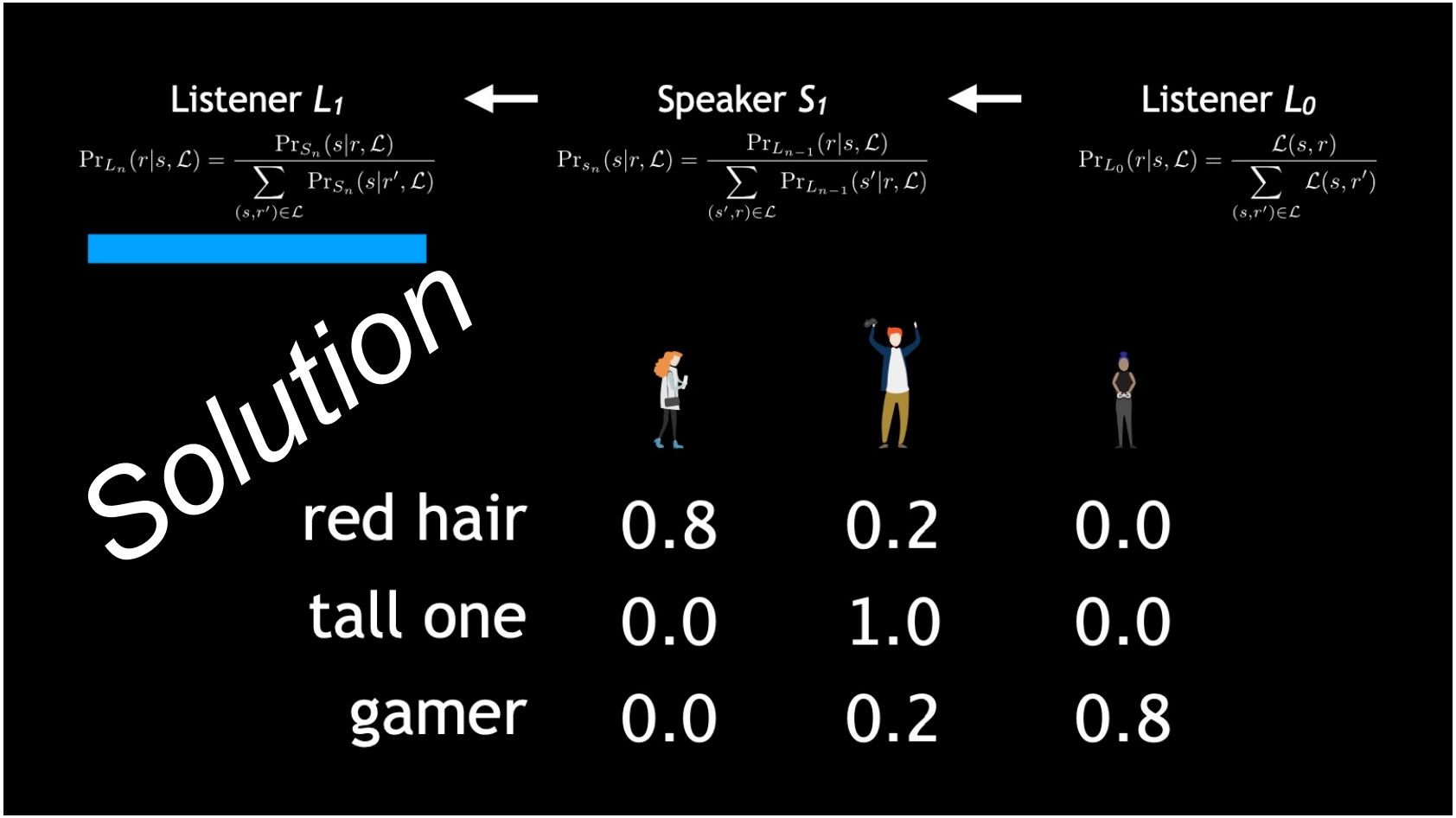
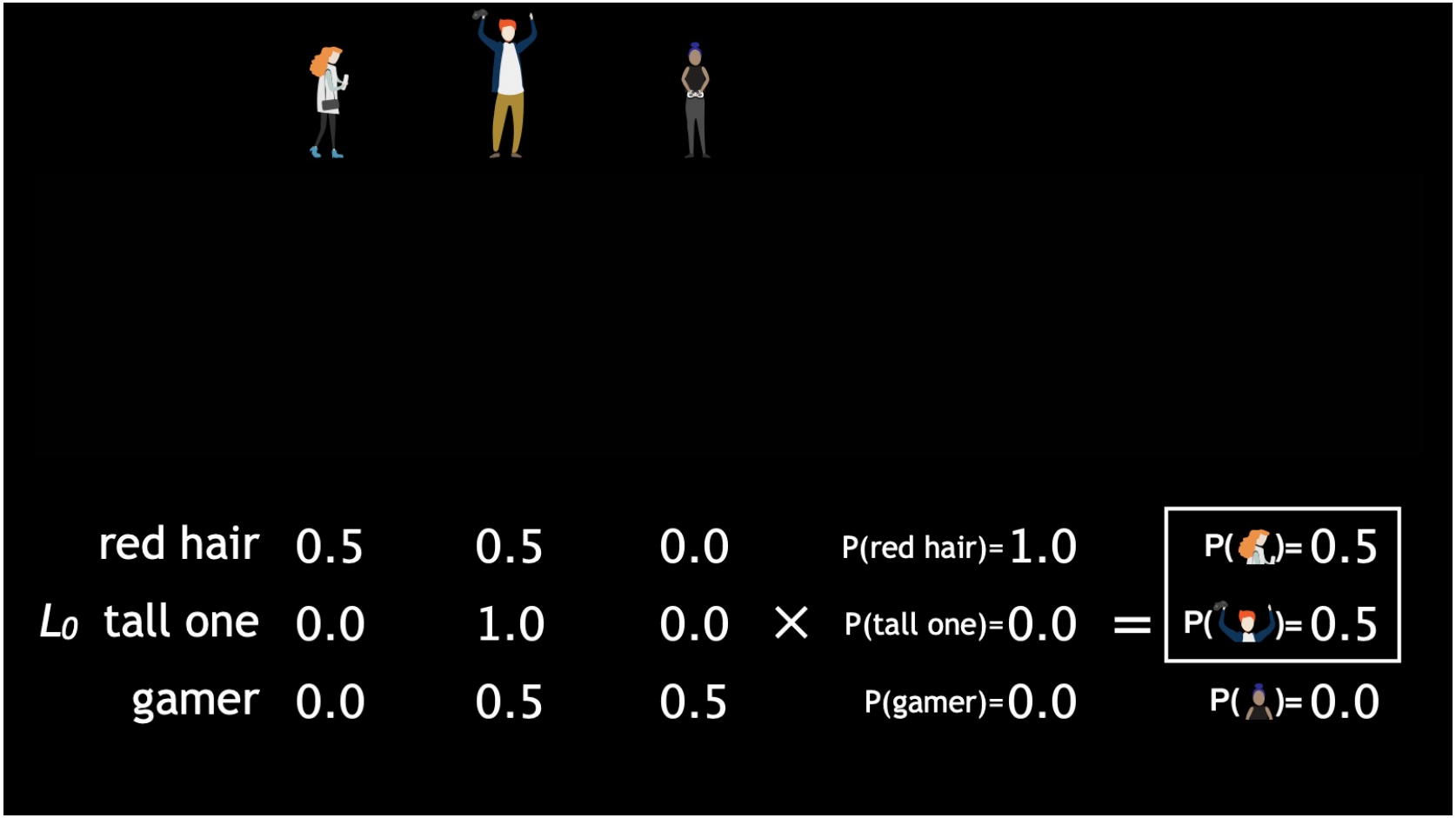
Breakout session



Whom is referred to with “red hair”, from the perspective of a literal and of a pragmatic listener?

Breakout session



Whom is referred to with “red hair”, from the perspective of a literal and of a pragmatic listener?

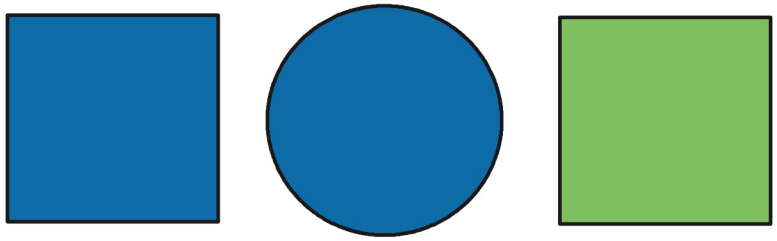
Breakout session

- Measure of a word's uncertainty given "context" (set of possible signals and referents)
- Scalability in terms of multi-order reasoning
- But, assumes humans are rational thinkers
- Requires exhaustive definition of the "context"
- Questionable if it scales to the real world or maps onto human cognition

Next up

- Audience Design

Bonus: Computer says no

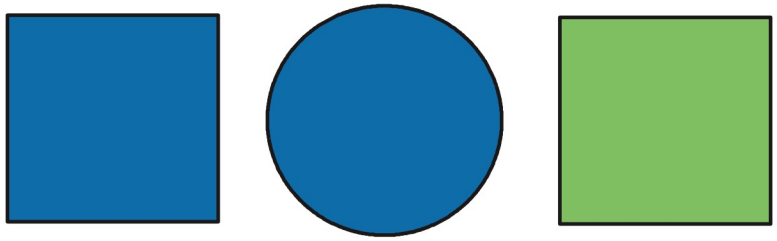


$1_{/2}$	$1_{/2}$	0	2
$1_{/2}$	0	$1_{/2}$	2

listener’s perspective

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

Bonus: Computer says no

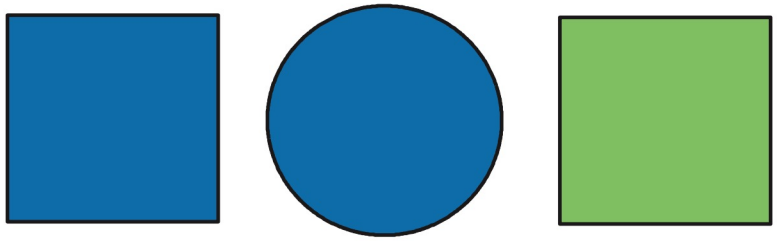


.5	.5	0
.5	0	.5
1	.5	.5

listener’s perspective

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

Bonus: Computer says no

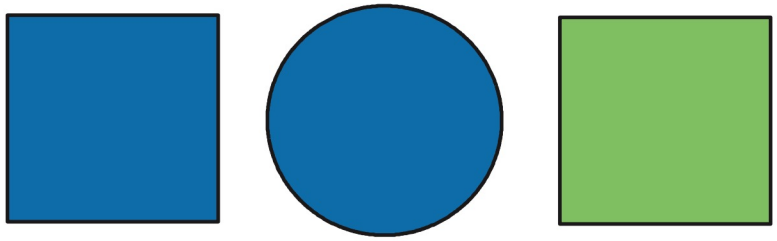


$.5_{/1}$	$.5_{/.5}$	0
$.5_{/1}$	0	$.5_{/.5}$
1	.5	.5

listener’s perspective

Perspective of pragmatic speaker, S1

Bonus: Computer says no

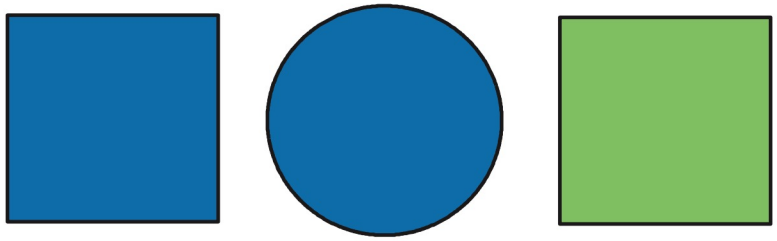


$.5_{/1.5}$	$1_{/1.5}$	0	1.5
$.5_{/1.5}$	0	$1_{/1.5}$	1.5

listener’s perspective

Perspective of pragmatic speaker, S1

Bonus: Computer says no



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

listener’s perspective

L1 cannot reliably distinguish between the three referents

Bonus: Computer says no

1.05 1.2 .75

L1 selects a non-intended referent

listener’s perspective