

Mentioning Atypical Properties of Objects is Communicatively Efficient

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Introduction

- **Problem of content selection:** which factors determine the information that speakers include in referring expressions?¹

1. (over)informativeness²

- say “blue banana” when only one banana

2. cost

- less likely to say long or infrequent property

3. typicality^{3,4,5}

- “blue banana” more likely than “yellow banana”

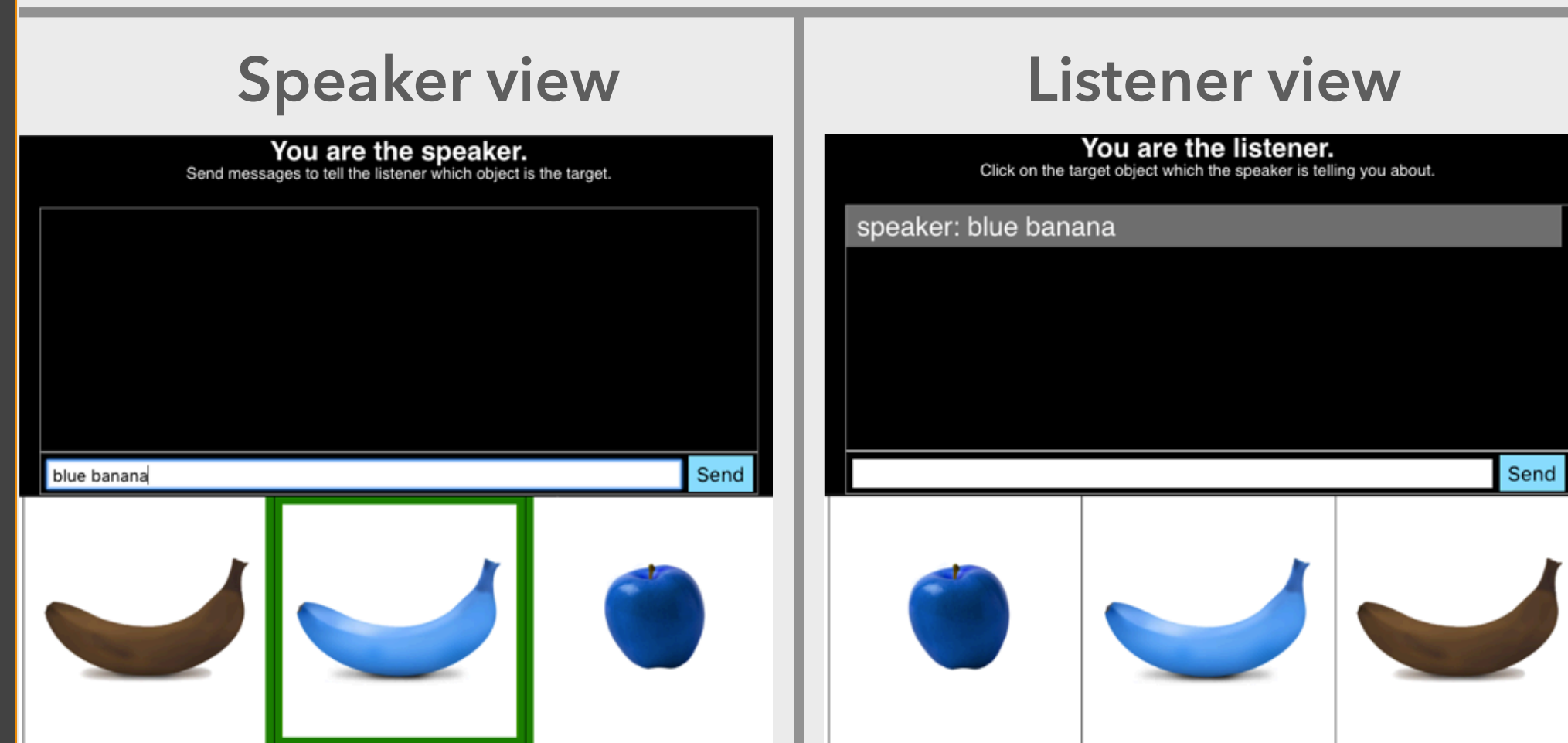
- Unified account of overinformative referring expressions lacking

- **Our approach:** when should a *rational* speaker mention an object’s color?

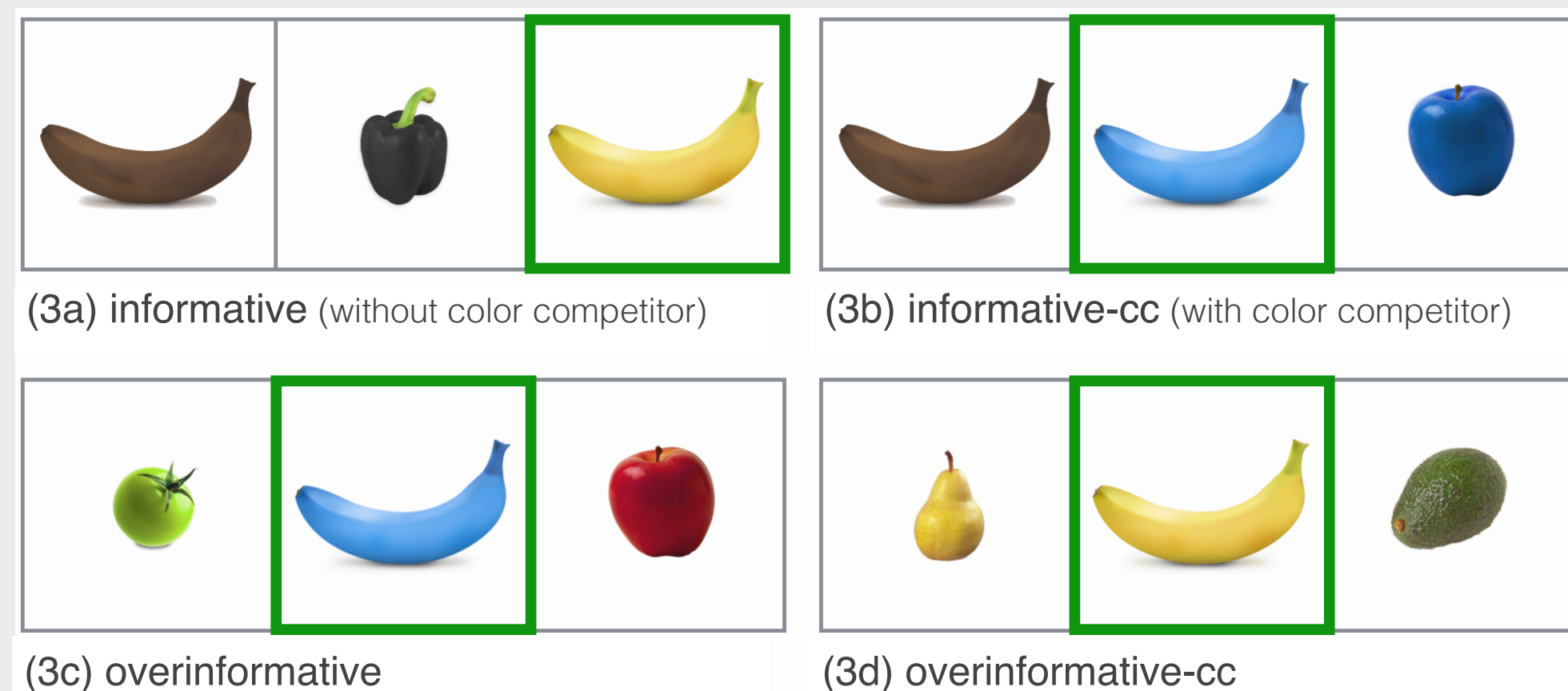
Production study

- Collect freely produced referring expressions through chatbox in two-player reference game
 - *Speaker* aim: Communicate target
 - *Listener* aim: Click on target

- Recruited 60 pairs on Amazon Mechanical Turk



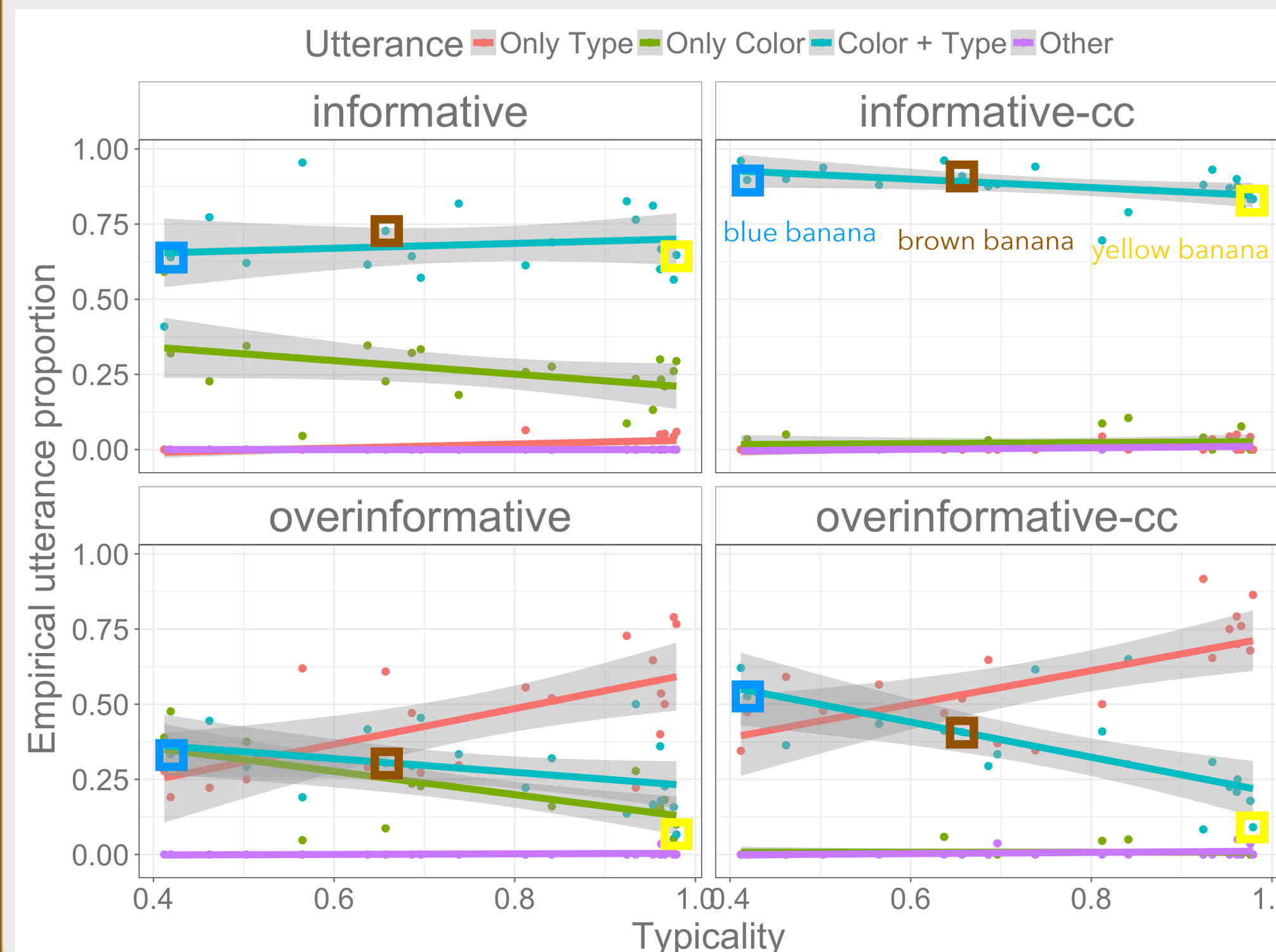
Conditions



Results

- Replicated typicality effect in overinformative conditions (more overinformative mentions of atypical colors)
- Also found typicality effect in informative conditions

Empirical Results (“COLOR banana” cases marked)



Computational model

- Formalize in Rational Speech Act (RSA) framework⁶
- Literal listener L_0 selects between contextual referents according to lexicon \mathcal{L} :

$$L_0(c|u, C) \propto \exp(\lambda_{typ} \mathcal{L}(u, c))$$

- Pragmatic speaker S_1 selects utterance to communicate an intended referent c_i by trading off *informativity* with *cost*:

$$S_1(u|c_i) \propto \exp(\alpha \log(L_0(c_i|u, C)) - \text{cost}(u))$$

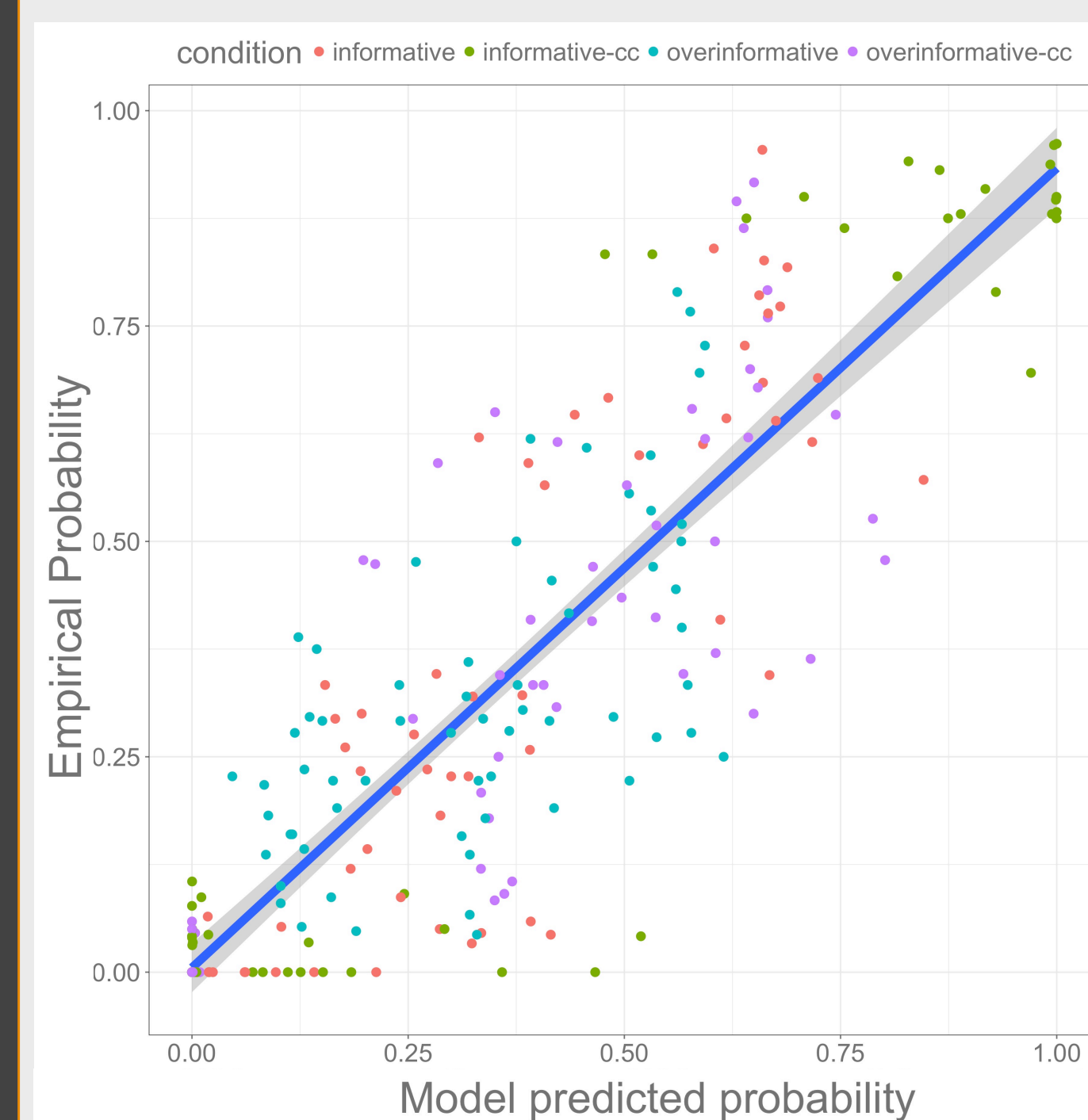
- Cost is defined as a function of an utterance’s length and its corpus frequency

$$\begin{aligned} \text{cost}(u) = & \beta_{freq} \hat{c}_f + (1 - \beta_{freq}) \hat{c}_l + \\ & \beta_{adj} \delta_{adj \in u} + \\ & \beta_{noun} \delta_{noun \in u} \end{aligned}$$

- Critically, we use a real-valued lexicon

Correlation Empirical vs Predicted

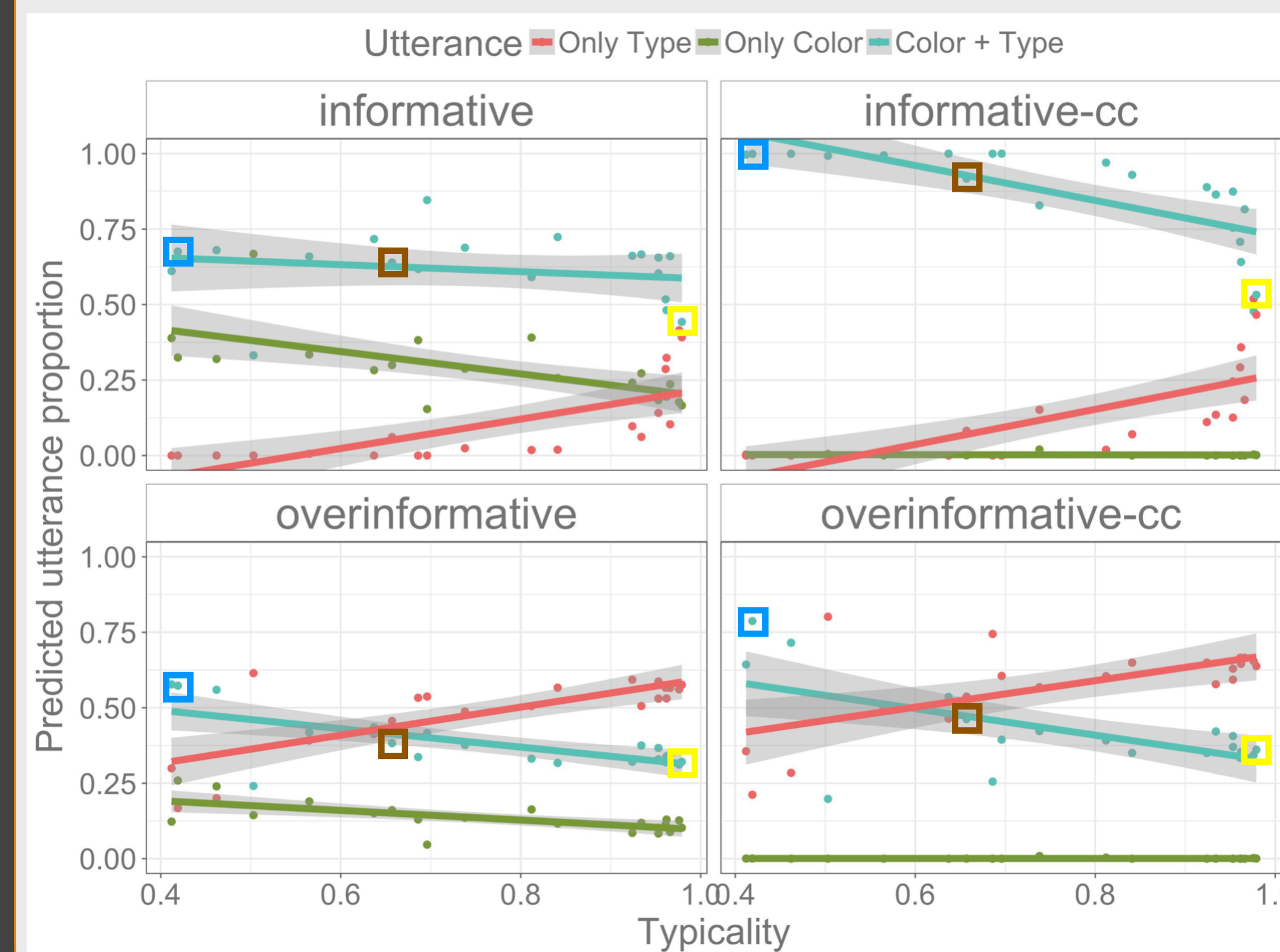
($R^2 = .75$; error bars are high but not displayed)



Parameter Values

Alpha: 10
Color-Cost: 0
Type-Cost: -1.5
LengthWeight: 0.5
TypicalityWeight: 6

Model Predictions (“COLOR banana” cases marked)

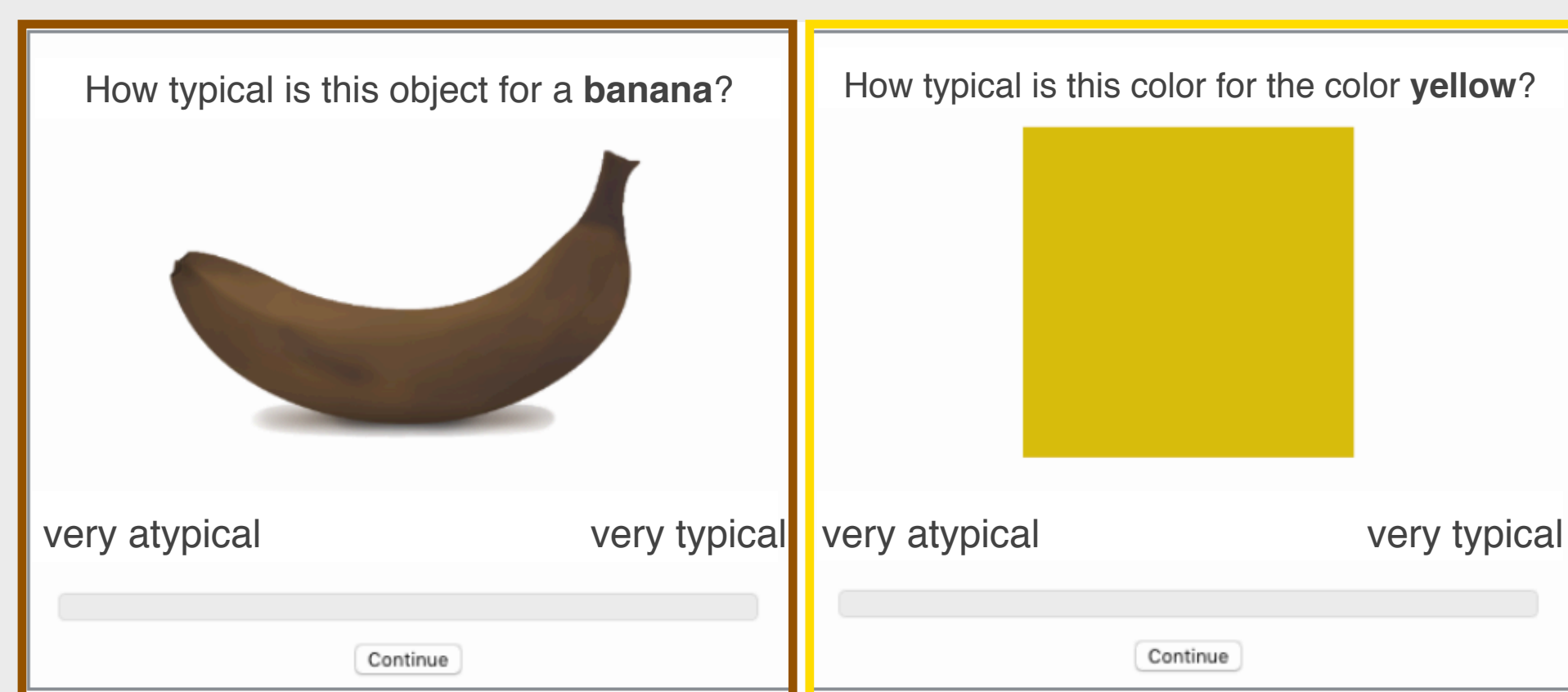


Typicality norming study

- Collect empirical typicality values for each utterance-object pair

- 3 separate studies

1. adjective + noun (“brown banana”)
2. noun (“banana”)
3. adjective (“yellow”)



Results

Example typicality values for the banana case; numbers shown in bold are “correct” pairings.

$\mathcal{L}(u, c)$	Banana items				Other
	Utterance	yellow	brown	blue	
	<i>banana</i>	.98	.66	.42	.05
	<i>yellow banana</i>	.98	.33	.17	.05
	<i>brown banana</i>	.28	.90	.18	.04
	<i>blue banana</i>	.20	.18	.91	.06

Conclusion

- Speakers redundantly mention color when confusability of intention is otherwise high
- RSA with continuous semantics captures this
- overinformative referring expressions

↑
rationally redundant

Try it yourself

Play around with our model!
Change parameters and see how the fit and the correlation with the empirical values changes.



<https://overinformativeness-model.shinyapps.io/OVERINF-MODEL/>

Discussion

- Informative and overinformative condition work against each other
 - In informative condition “Only Type” utterances are overpredicted,
 - In overinformative condition “Only Color” utterances are underpredicted

- Extension of the model
 - Incorporating that speaker thinks listener has uncertainty about what is in the context
 - Add noise to context by either exchanging or adding an object to context that is similar to the target (for “blue banana” add blue or banana objects)

Acknowledgments

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References

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