

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”

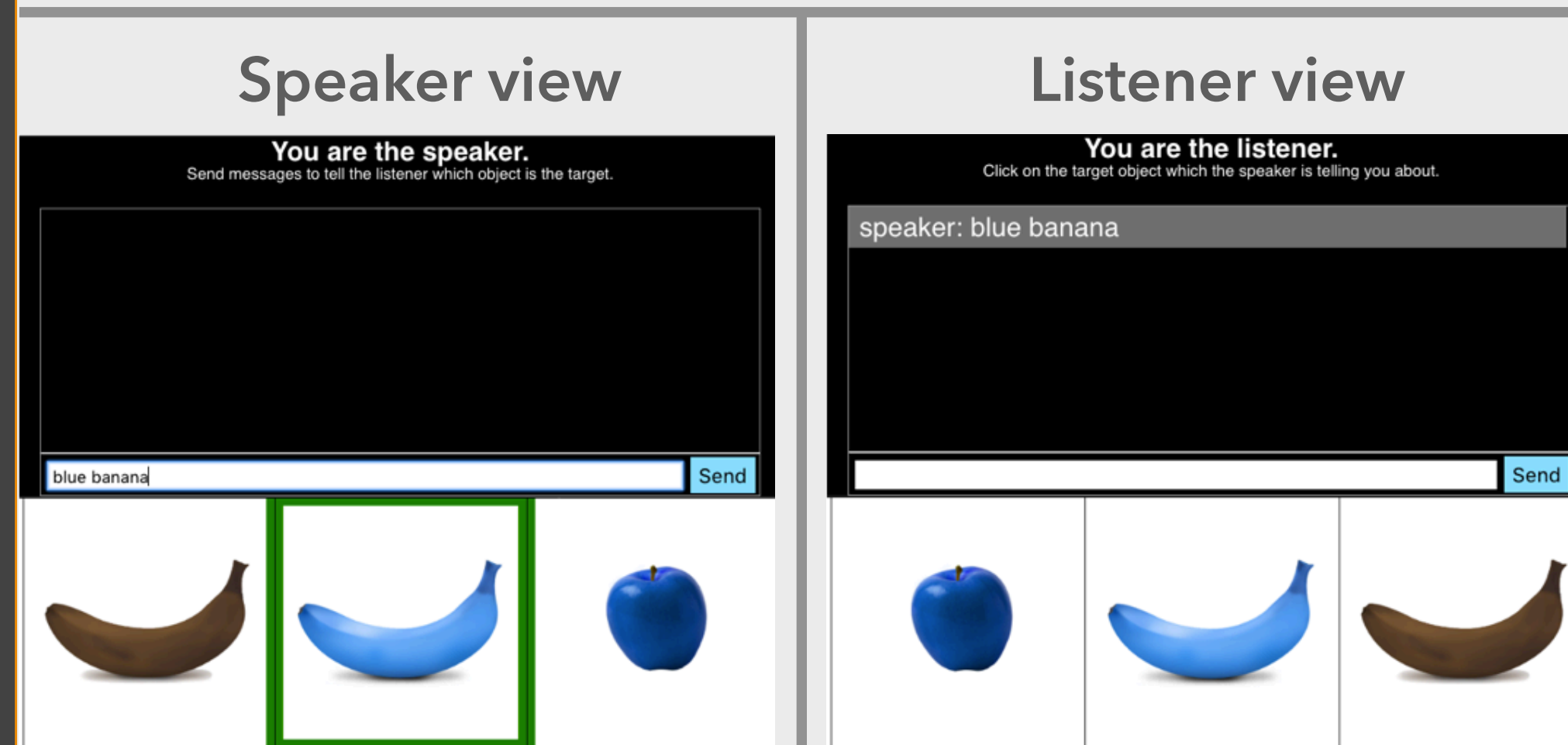
- Unified account of overinformative referring expressions lacking

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

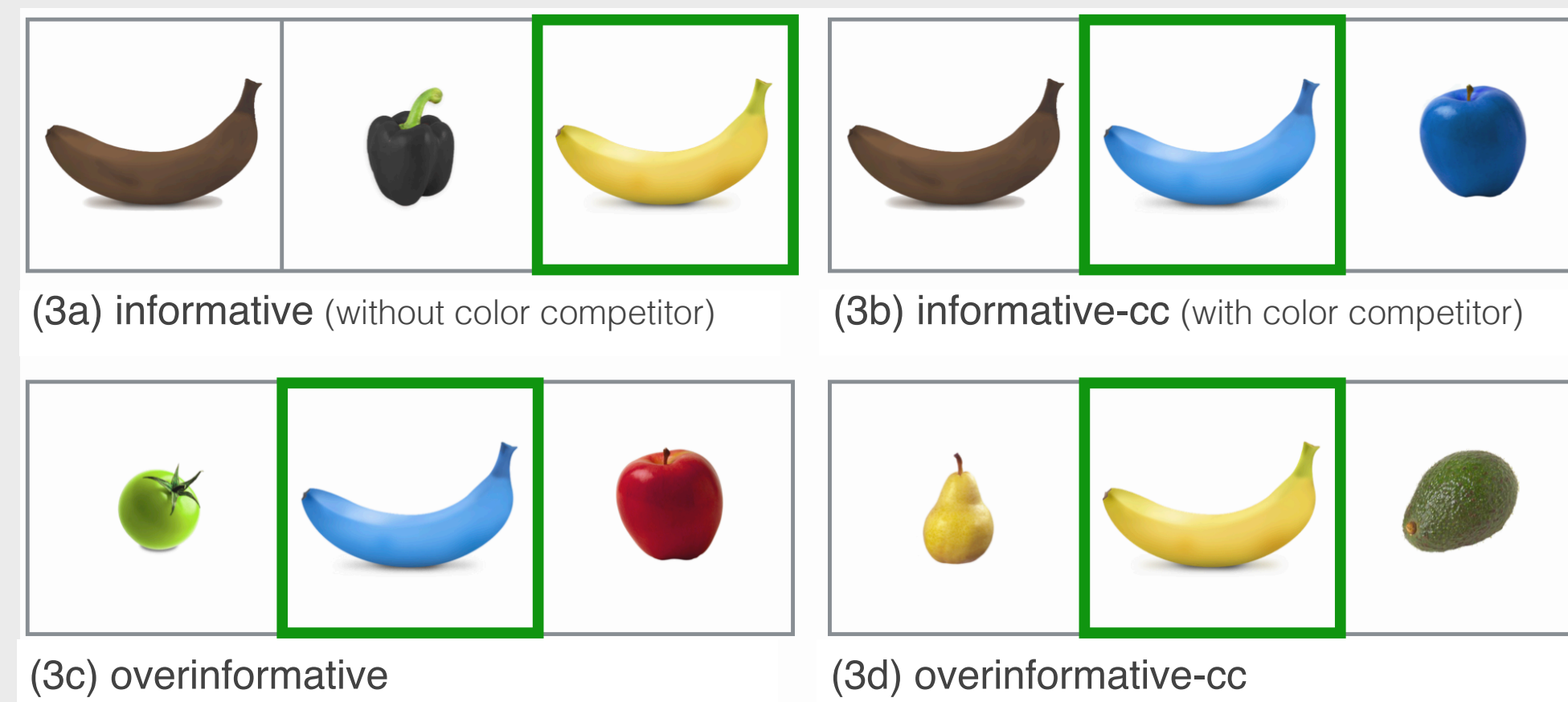
Production study

- 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



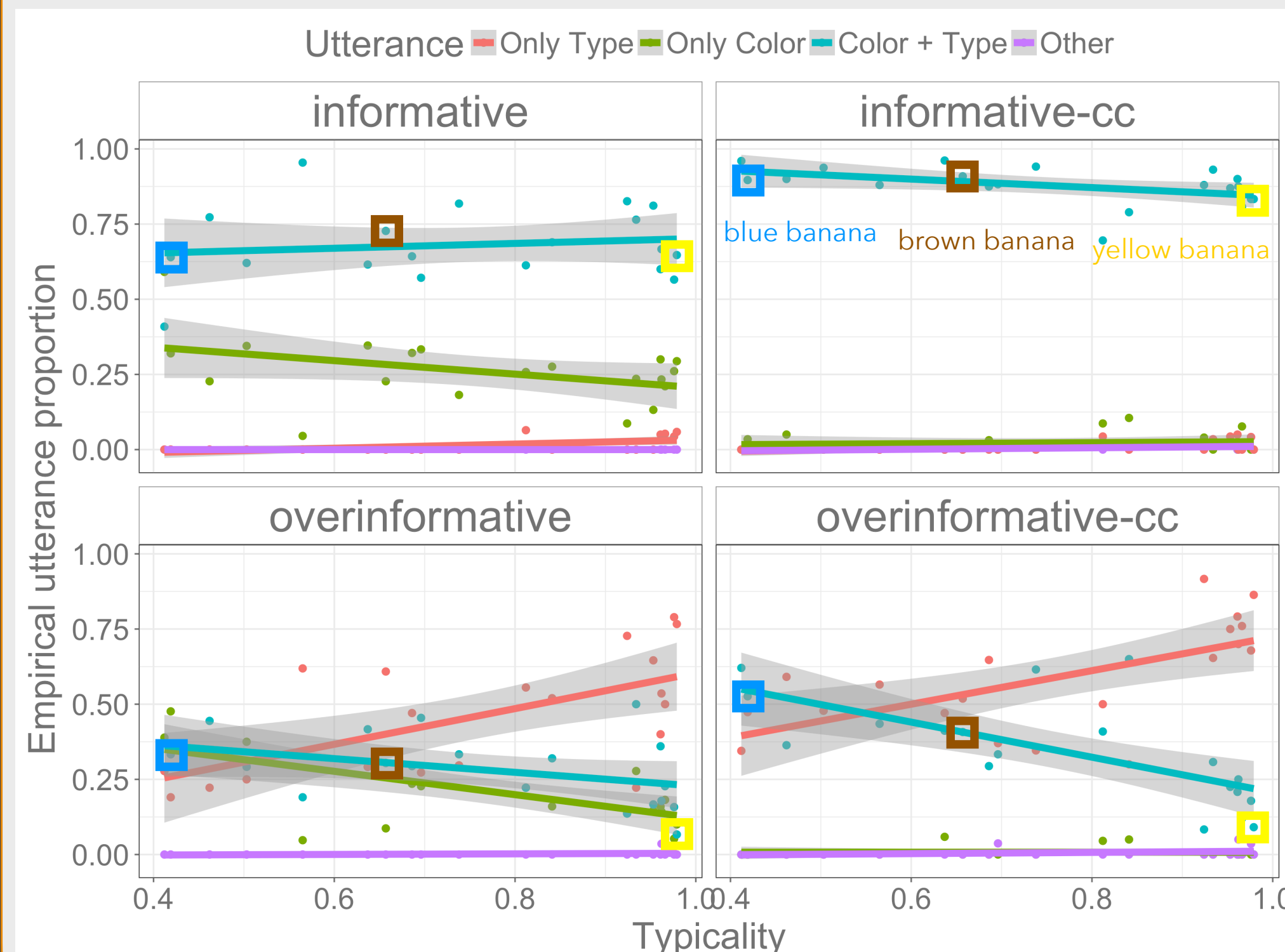
Conditions



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

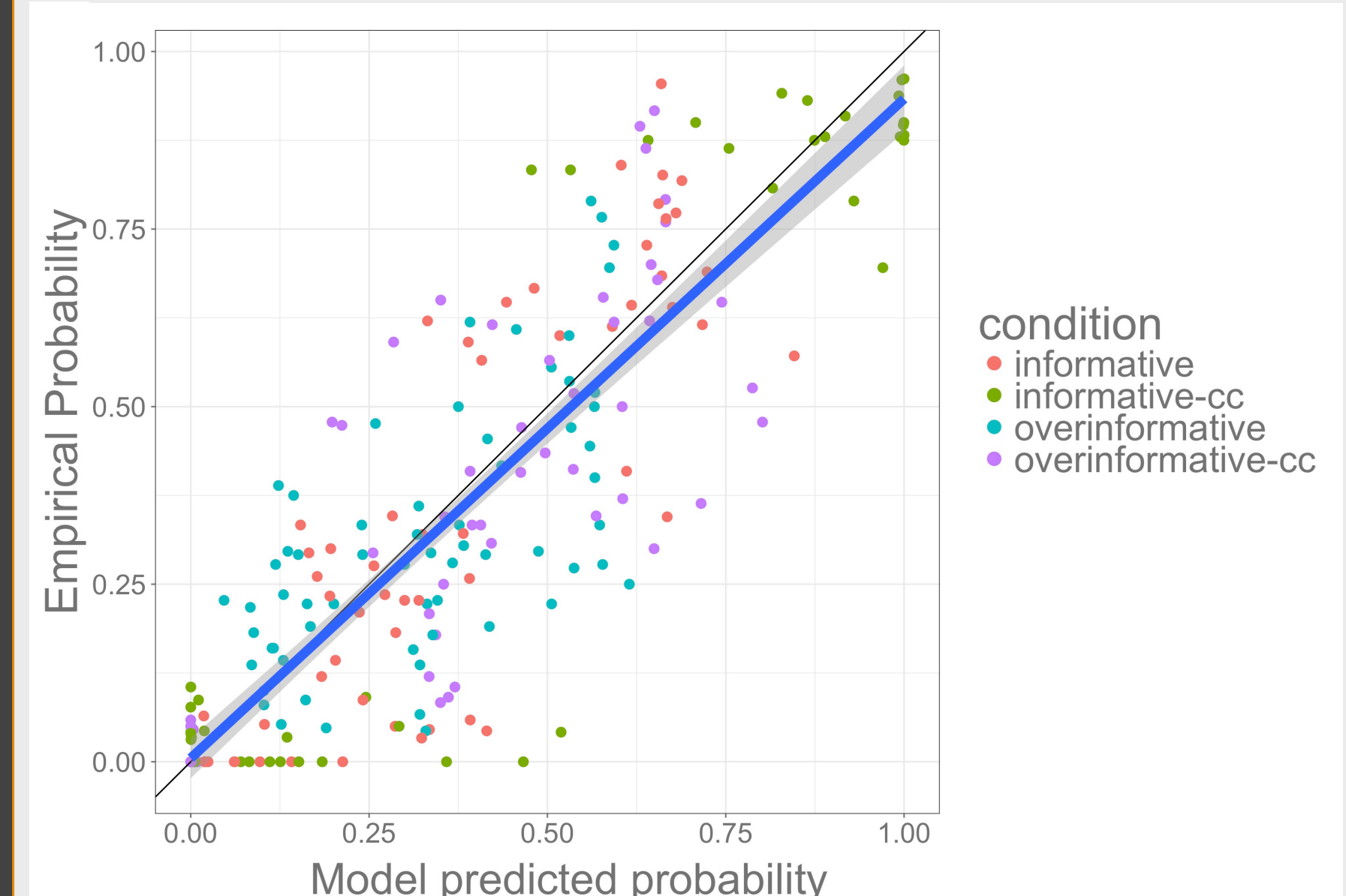
$$\text{cost}(u) = \beta_{freq} \hat{c}_f + (1 - \beta_{freq}) \hat{c}_l + \beta_{adj} \delta_{adj \in u} + \beta_{noun} \delta_{noun \in u}$$

table with parameter values (range), mark used one

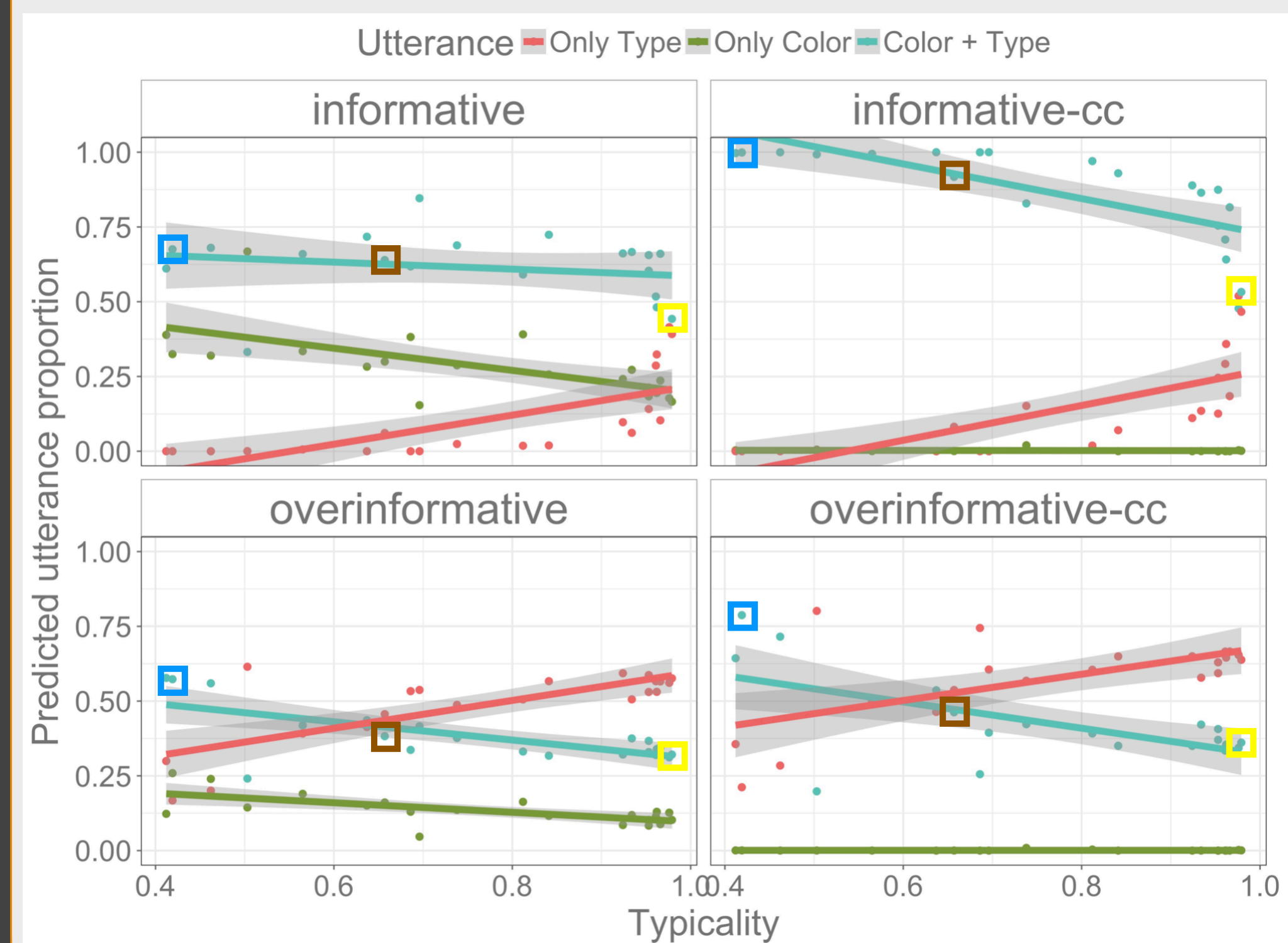
- Critically, we use a real-valued lexicon

Correlation Empirical vs Predicted

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



Model Predictions (“COLOR banana” cases marked)

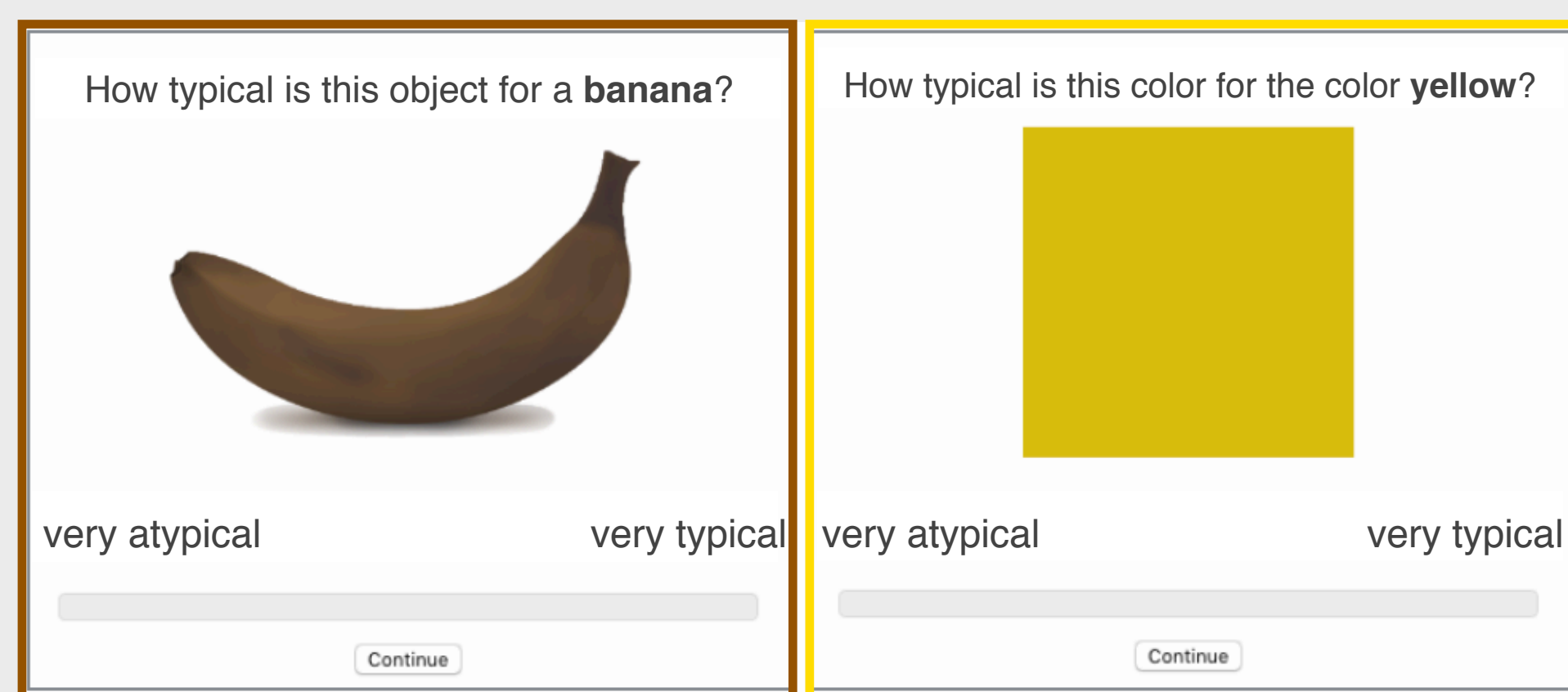


Typicality norming study

- 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

References

- ¹ Grice, H. P. (1975). Logic and Conversation. *Syntax and Semantics*, 3, 41–58.
- ² Pechmann, T. (1989). Incremental speech production and referential overspecification. *Linguistics*, 27(1), 89–110.
- ³ Rubio-Fernandez, P. (2016). How redundant are redundant color adjectives? An efficiency-based analysis of color overspecification. *Frontiers in Psychology*, 7 (153).
- ⁴ Sedivy, J. C. (2003). Pragmatic versus form-based accounts of referential contrast: evidence for effects of informativity expectations. *Journal of psycholinguistic research*, 32(1), 3–23.
- ⁵ Westerbeek, H., Koolen, R., & Maes, A. (2015). Stored object knowledge and the production of referring expressions: the case of color typicality. *Frontiers in Psychology*, 6(July), 1– 12.
- ⁶ Goodman, N.D. & Frank, M.C. (2016). Pragmatic language interpretation as pragmatic inference. *Trends in Cognitive Sciences*. 20(11), 818-829.

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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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/>



Parameter	Range	Value used for plots
Alpha	0,2,4,...,18	
Cost for mentioning color		-3
Cost for mentioning type		
LengthWeight		
TypicalityWeight		