

Roles of meaning predictability in language **production and learning**

Chigusa Kurumada¹ & Scott Grimm²

¹Department of Brain and Cognitive Sciences,

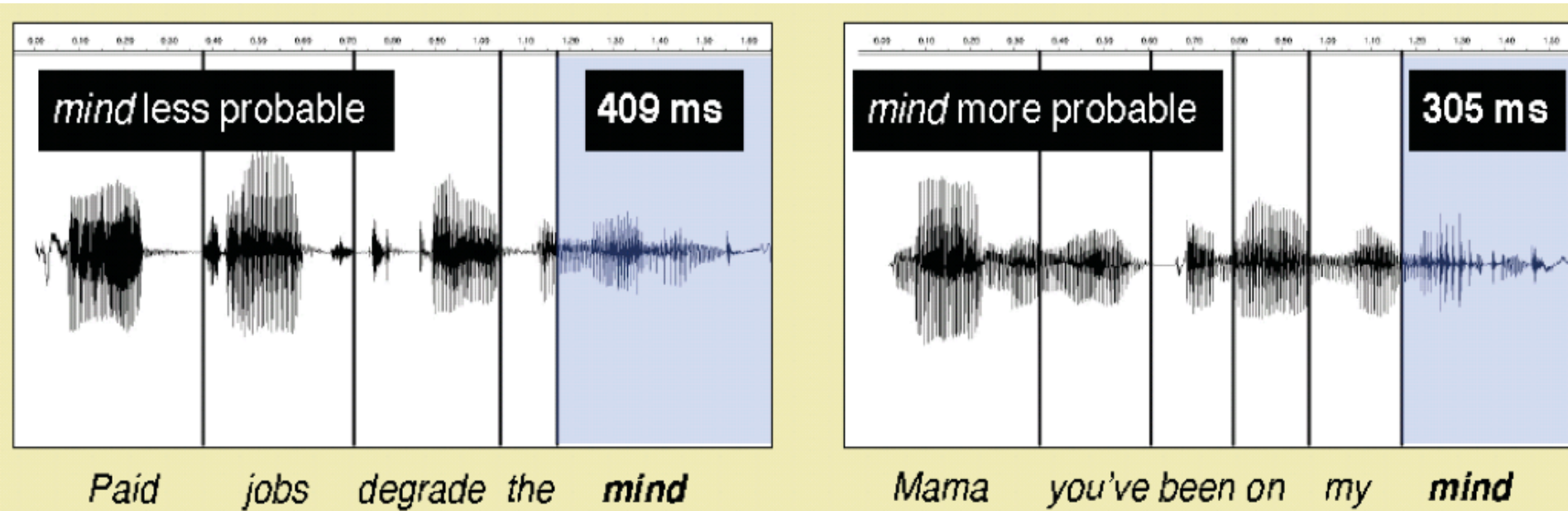
²Department of Linguistics

University of Rochester



Predictability and linguistic encoding

Frequent/predictable words are likely reduced or omitted
(e.g., Zipf, 1949; Jurafsky et al., 1996; Alyett & Turk, 2003; Bell et al., 2003)



Predictability of... what? Form? Meaning?

This talk: Plural marking morphology



English

pea

Basic form

pea-s

plurative form

Welsh

pys “peas”

Basic form

pys-en “pea”

singularitive form

This talk: Plural marking morphology



Dagaare

bíé “child”

Basic form

bíí-rí “children”

plurative form

bíè “seeds”

Basic form

bì-rí “seed”

singularitive form

Grimm (2012)

Optimizing efficiency?

- Capitalizing linguistic signal on a meaning that is otherwise less predictable (= less likely to be inferred)

Plural meaning more predictable



Overt **singular** marking

Plural meaning less predictable



Overt **plural** marking

Current study: Optional Plural Marking in production

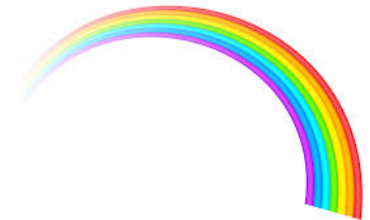
- Capitalizing linguistic signal on a meaning that is otherwise less predictable (= less likely to be inferred)

Plural meaning more predictable



Less overt plural marking

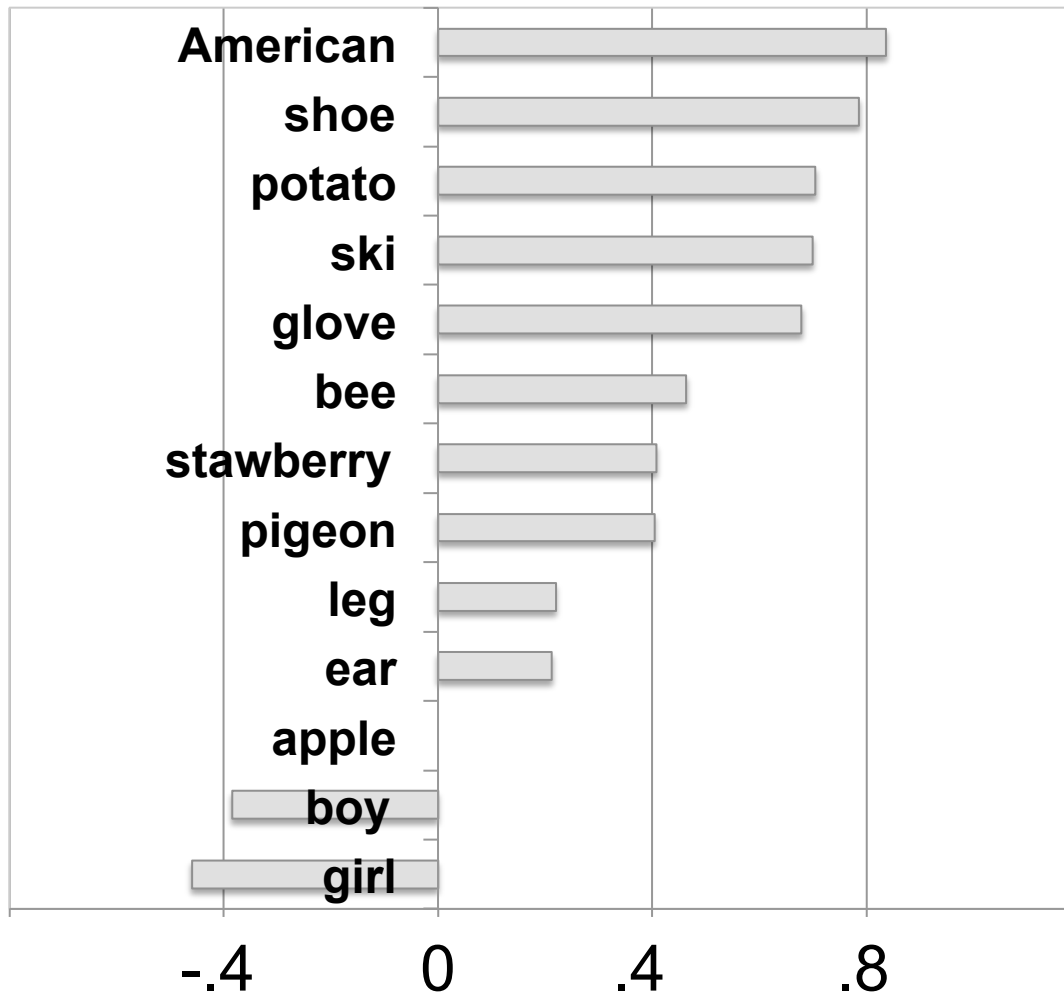
Plural meaning less predictable



More overt plural marking

How do we estimate the *meaning* predictability?

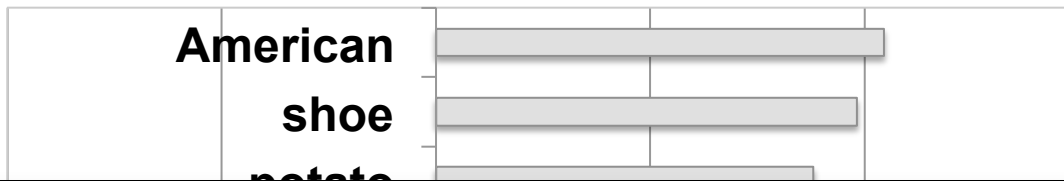
- Odds of Plural vs. Singular forms (e.g., “shoes” / “shoe”)



Based on Haspelmath & Karjus (2017)

How do we estimate the *meaning* predictability?

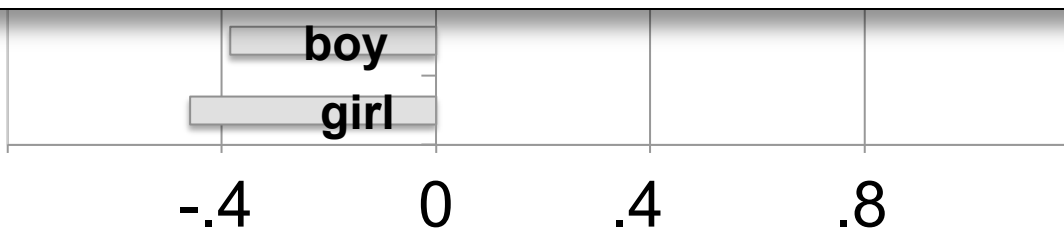
- Odds of Plural vs. Singular forms (e.g., “shoes” / “shoe”)



Phonetic duration of **-s** longer for words with lower plural predictability



Rose dissertation (2017) w/ Jen Hay



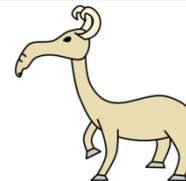
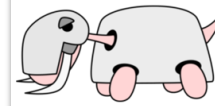
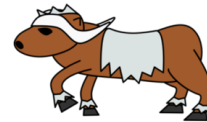
Based on Haspelmath & Karjus (2017)

Question 1

Is predictability of plural meaning a significant predictor of optional plural marker use?

Plural meaning
more predictable

Plural meaning
less predictable



Experiment 1: Artificial language learning study (e.g., Fedzechkina et al., 2012)

Subjects: 40 speakers of American English

Material: 12 novel nouns / 1 novel verb
Optional plural marker "-ka"

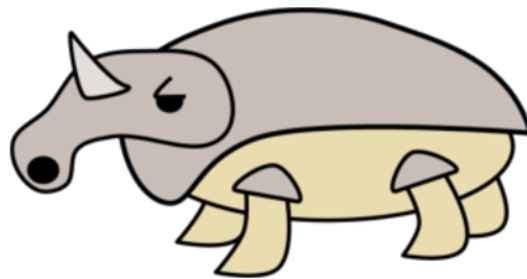
Learning: 4-alternative-forced choice
Sentence comprehension

Production: Prompted sentence production

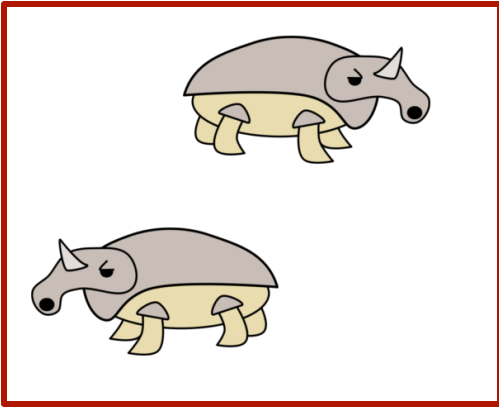
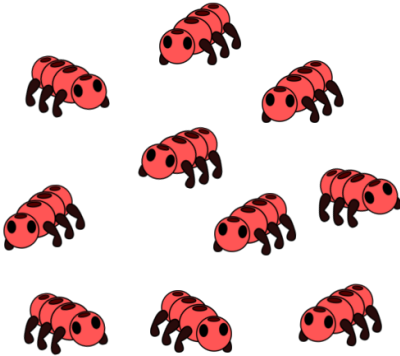
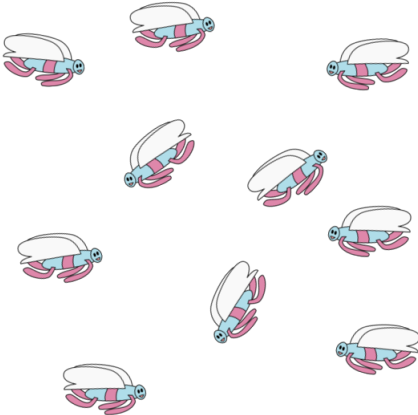
Word presentation: (12 * 2 = 24 trials)



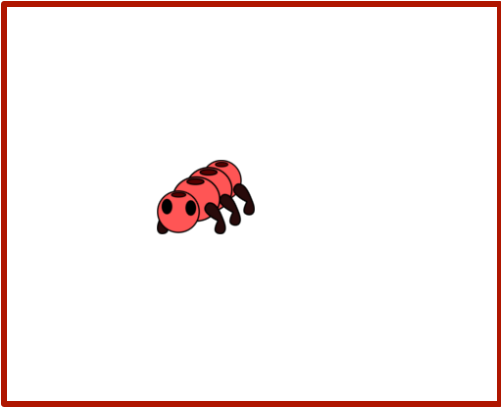
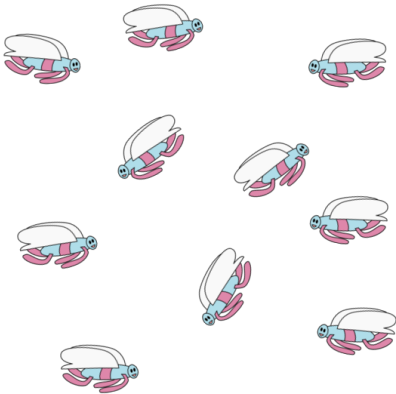
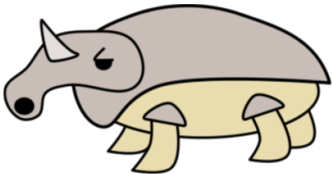
Word presentation: (12 * 2 = 24 trials)



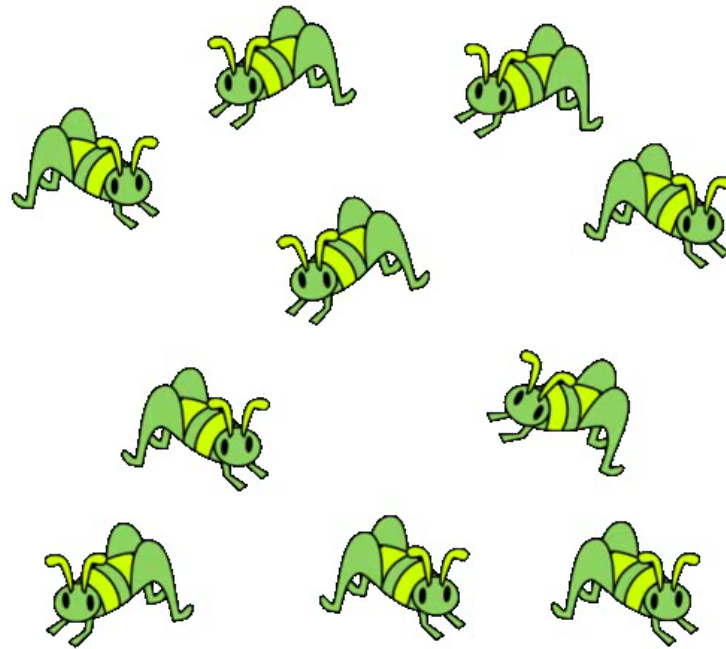
Word learning: 4 alternative forced choice (48 trials)



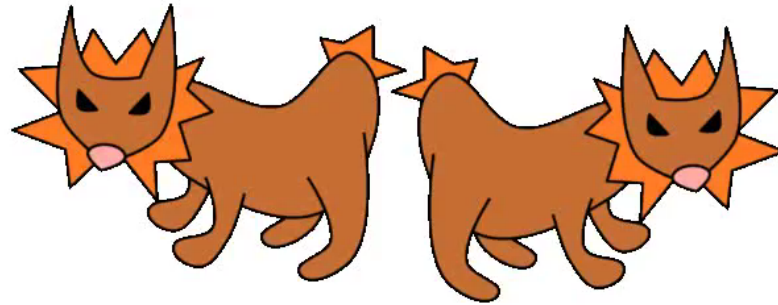
Word learning: 4 alternative forced choice (48 trials)



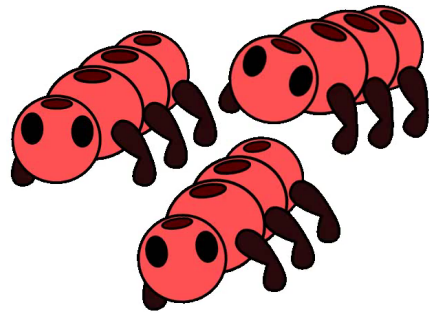
Sentence comprehension (12 items * 4 = 48 trials)



Sentence comprehension (12 items * 4 = 48 trials)

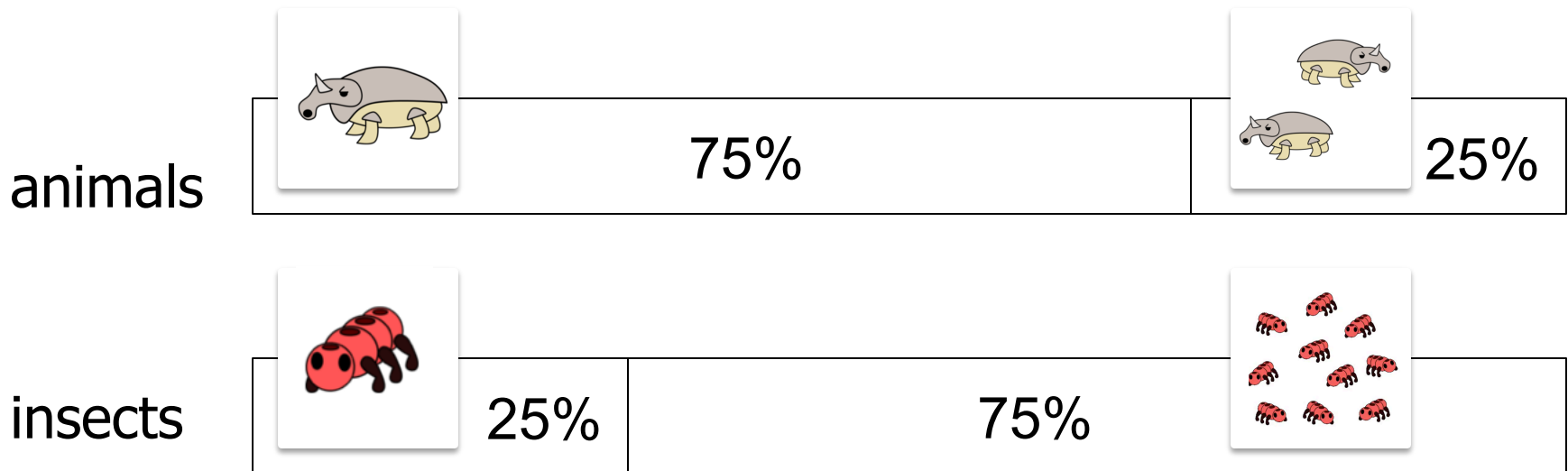


Sentence production (12 items * 2 = 24 trials)



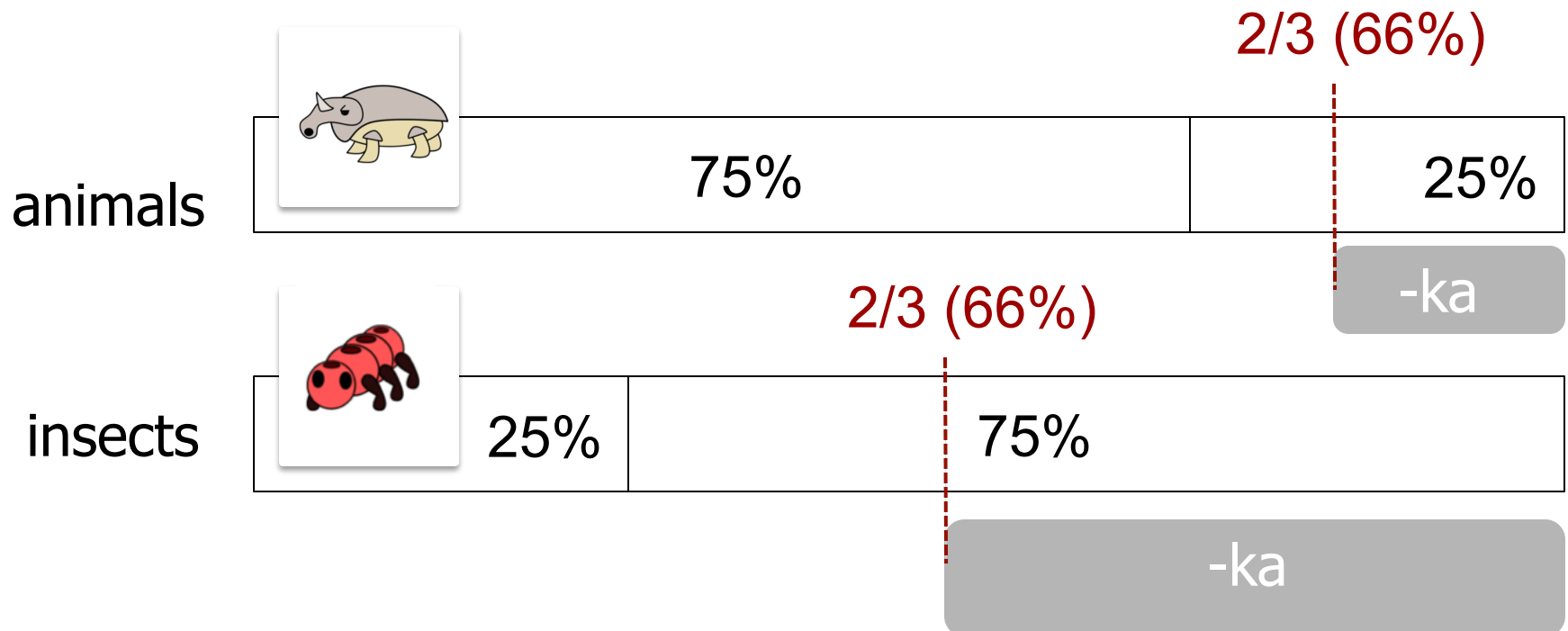
Meaning predictability manipulation

- They are learning:
 - Words
 - Plural predictability (including fillers in 4AFC trials)

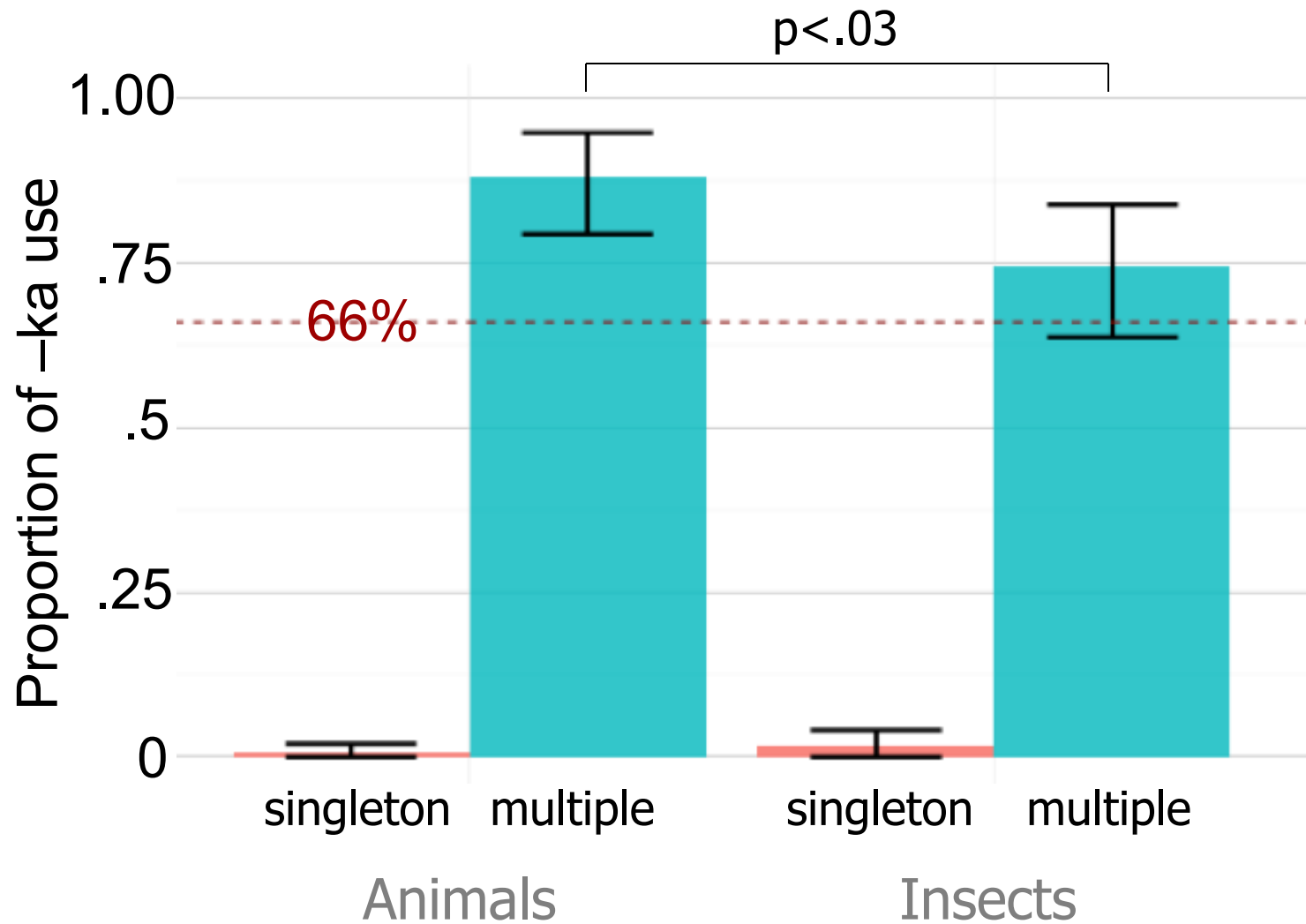


Meaning predictability manipulation

- Prediction: Less overt *-ka* use for [] when presented as multiples

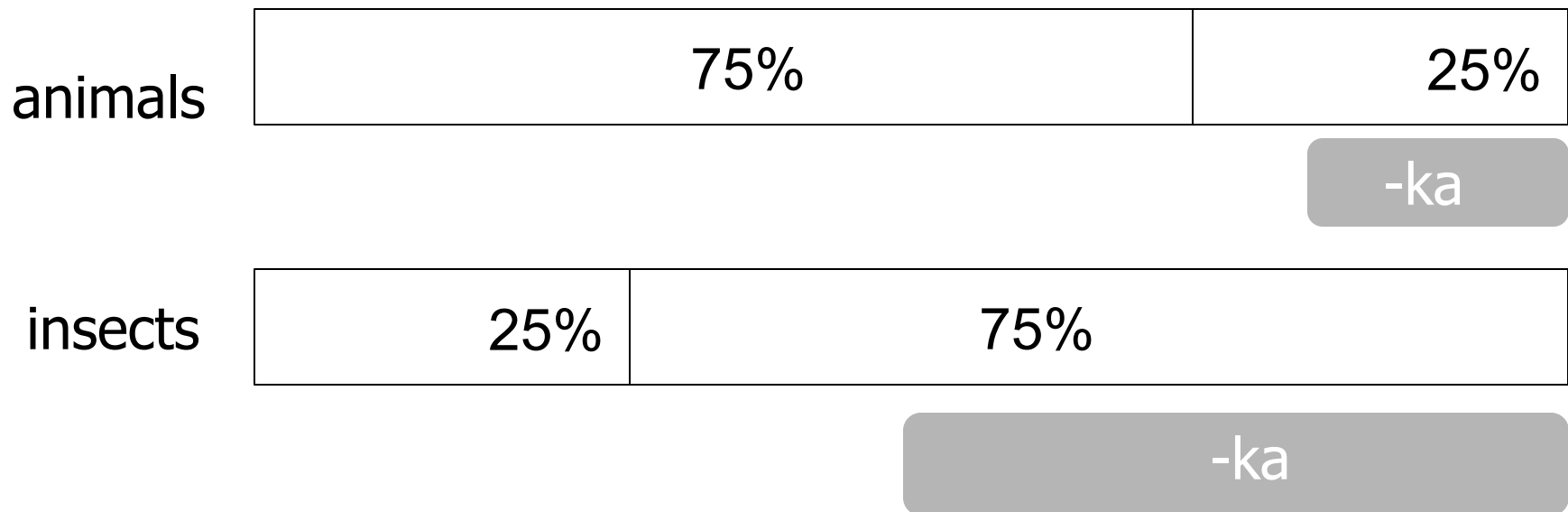


Results1: Proportions of plural marker use



Summary 1: Animals vs. Insects

1. Optional plural marking more likely when the plural meaning is less predictable
2. Restructuring of the marking patterns (The animal vs. insect asymmetry not present in the input)



Summary 1: Animals vs. Insects

- Plural meaning predictability higher for insects
- Where does this knowledge come from?

$$p(\text{plural} \mid \text{🐛}) > p(\text{plural} \mid \text{🐢})$$

World knowledge



Exposure input

25%

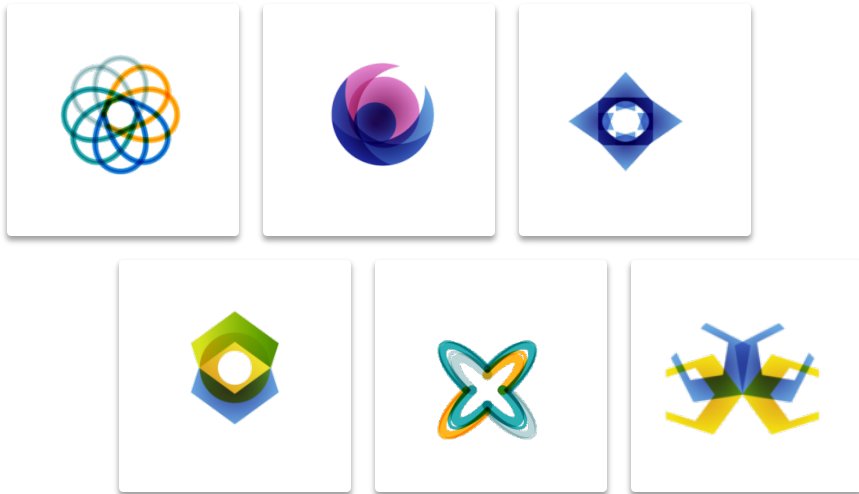
75%

-ka

Question 2

Is predictability of plural meaning learnable based on the input statistics?

Plural meaning more predictable



Plural meaning less predictable



Experiment 2: Replicating Exp.1 w/ new referents

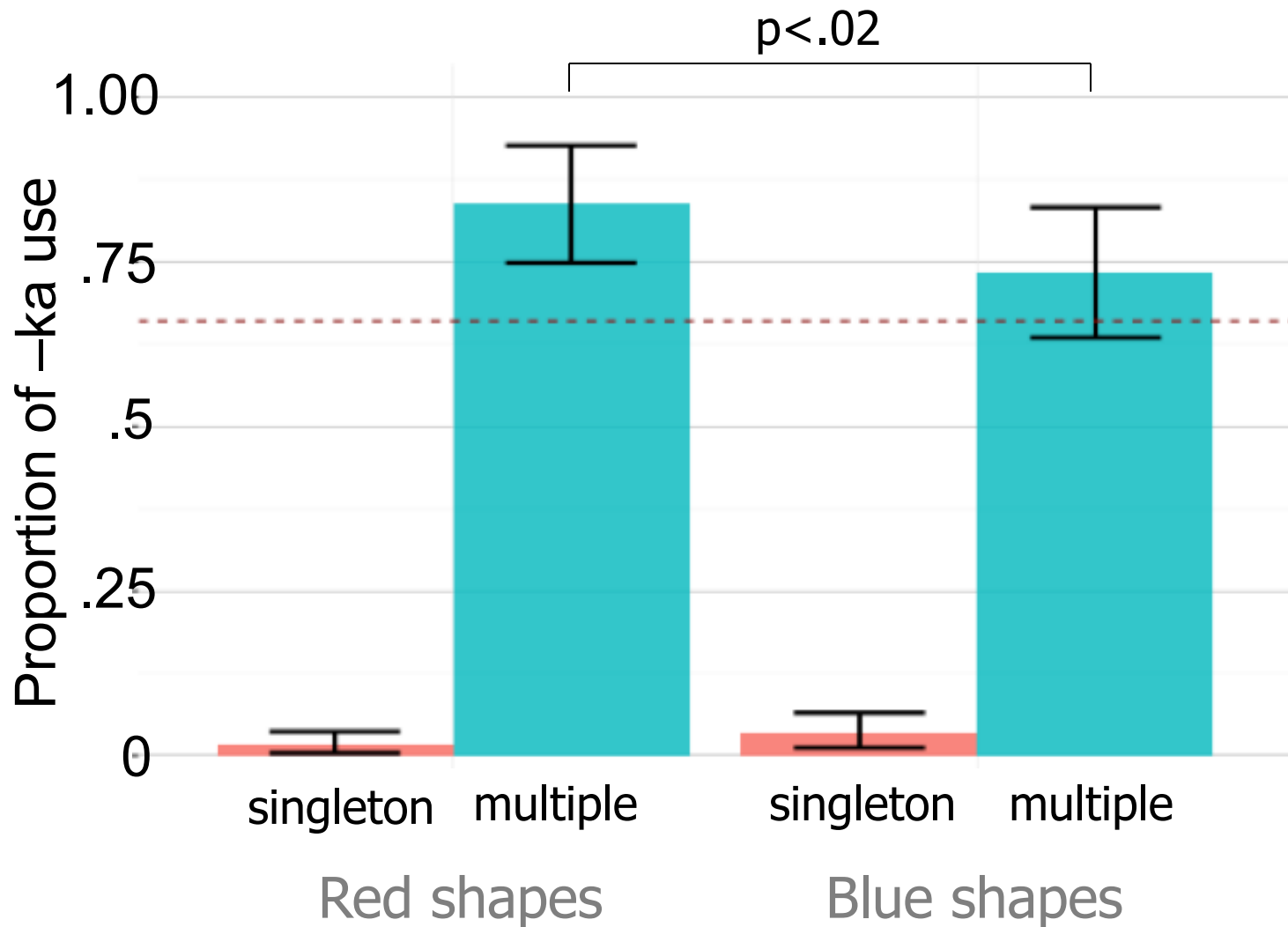
Subjects: 40 speakers of American English

Material: 12 novel nouns / 1 novel verb
Optional plural marker "-ka"

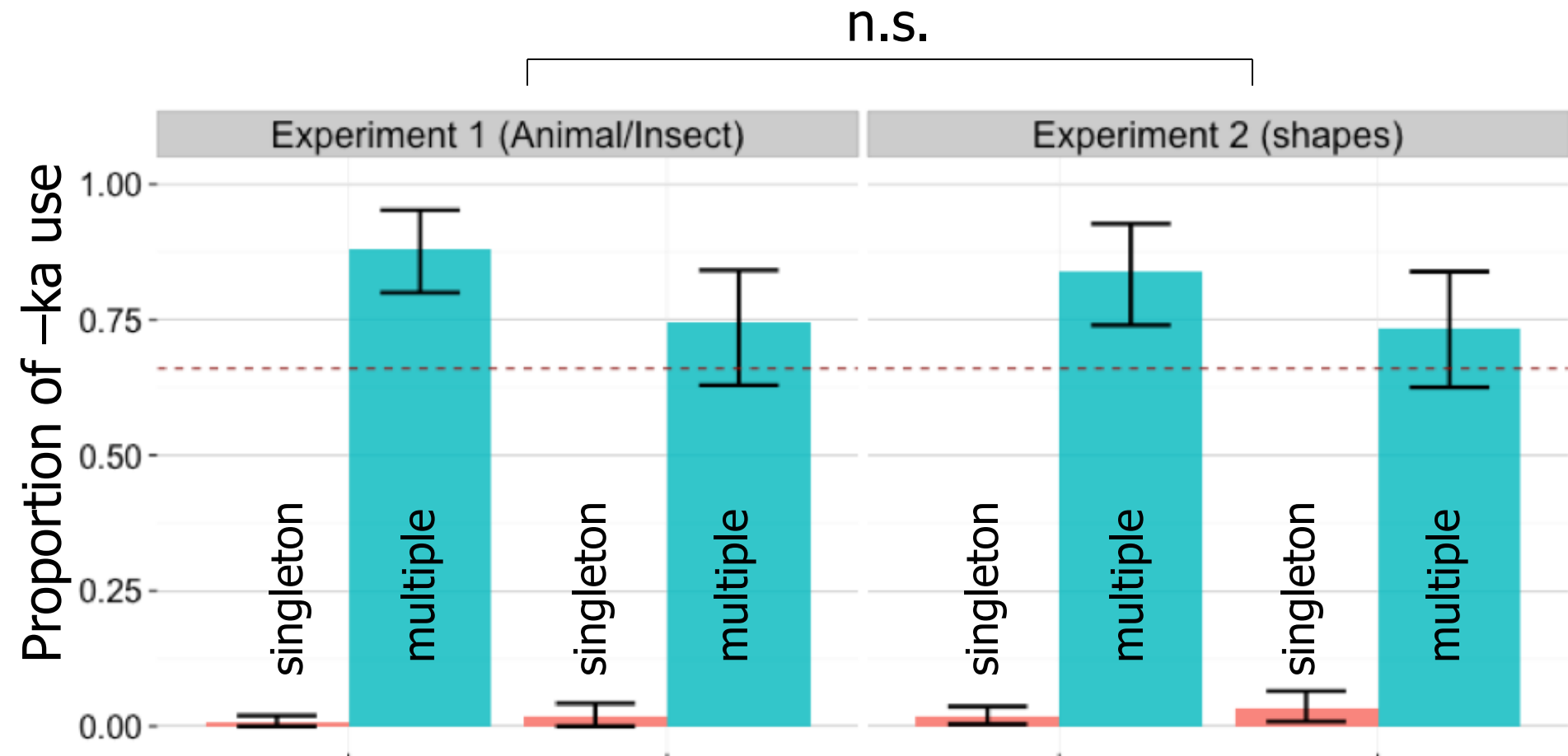
Learning: 4-alternative-forced choice
Sentence comprehension

Production: Prompted sentence production

Results 2: Predictability based on the input?



Results 2: Predictability based on the input?



Predictability of plural meaning is learnable based on the input statistics.

Conclusion: Form vs. Meaning predictability?

Bias towards explicitly encoding meaning that is otherwise less predictable.

Can we count meaning (independent of frequencies of word/linguistic forms)?

| | |
|--|--|
| | |
|--|--|



| | |
|--|--|
| | |
|--|--|



Thank you!

Thanks to:

Masha Fedzechkina (University of Arizona)

T. Florian Jaeger (University of Rochester)

Experimental Semantics and Pragmatics group

RAs:

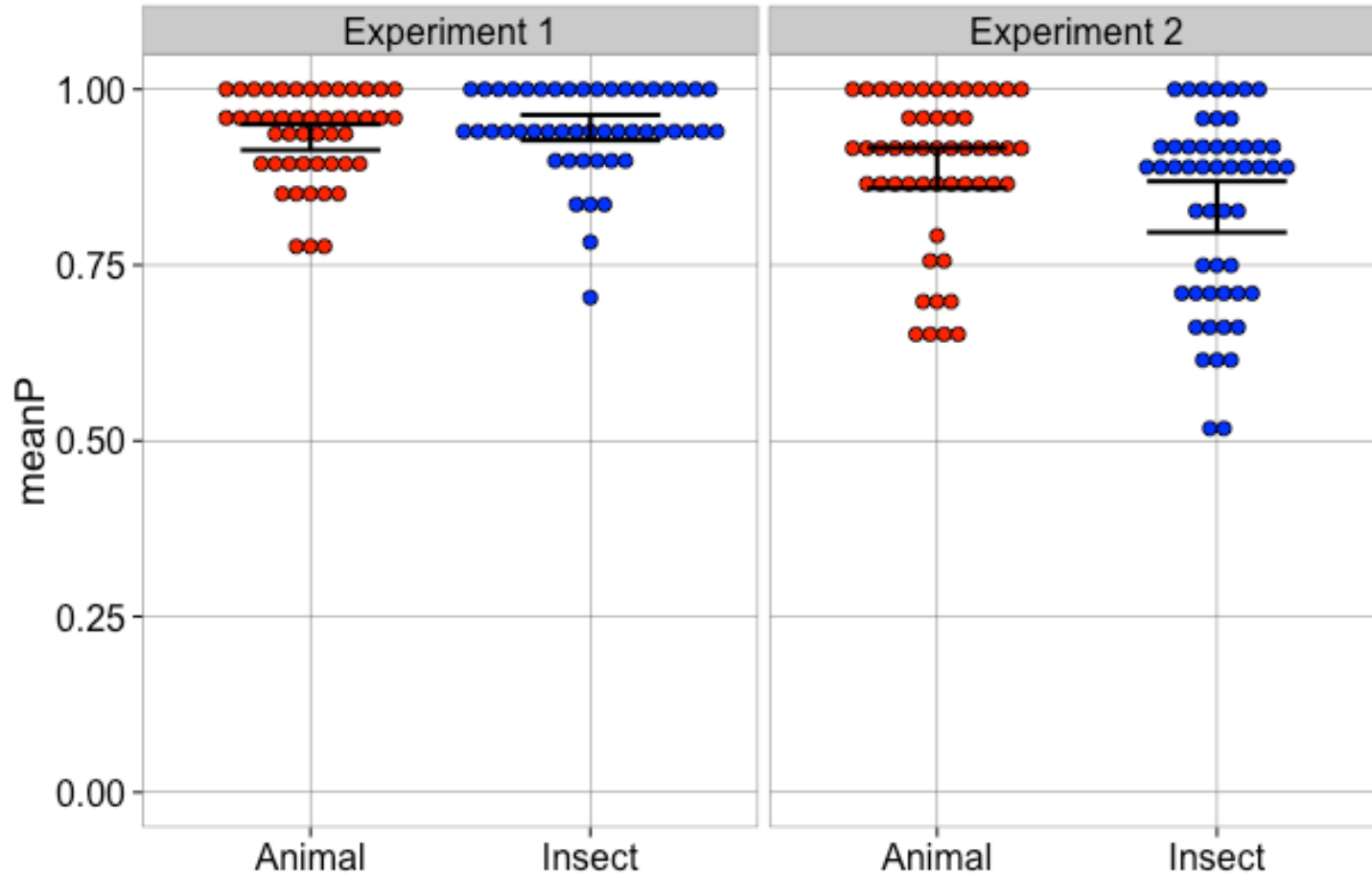
Wesley Orth (Northwestern University)

Joseph Plvan-Franke (University of Rochester)

Rachel Myers (University of Rochester)

summary: language learners can **learn differential predictabilities of the plural meaning** for noun classes and make efficient use of optional plural marking morphology.

Results 2: Inferability beyond animacy



Efficiency-based account: 3 key assumptions

1. Linguistic communication as a inference problem over noisy input given world/linguistic/context knowledge



2. Speaker balance between 1) speed / ease / effort and 2) robust (successful) information transfer
3. Provide more linguistic signal for message (parts) otherwise less predictable