'She has a tattoo where?': Cross-linguistic differences in scalar implicature calculation

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Outline

Introduction

Scalar Implicature: The use of a weaker form implicates the negation of a stronger alternative along the same scale.

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(1) She ate some of the grapes.
$\rightsquigarrow$ She did *not* eat *all* of the grapes.

Hearer thinks: If the speaker means 'all', they would say *all*, which is just as short (Manner), and more informative (Quantity).

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Frameworks for Scalar Implicature

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- Frank & Goodman (2012)
- And others...

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   Alternative: She ate *all* of the grapes.

To understand scalar implicature calculation, we need to understand what alternatives are available to listeners.

Constraining the set of alternatives

Different theories have imposed different constraints on the set of alternatives:

- Complexity-only constraints
  restrict alternatives based on word count.
  - Horn (2000)
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- Complexity-only constraints restrict alternatives based on word count.
  - Horn (2000)
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- Prevalence-based constraints restrict alternatives based on production probability.
  - Geurts (2011)
  - Frank & Goodman (2012), Goodman & Stuhlmüller (2013)

Digits in Scalar Implicature

To make these theories more concrete, let us consider a specific example: *finger*

It has been noted in the literature that an asymmetry exists between *finger* and *toe*.
(Horn, 1984, 2000; Geurts, 2011)

(2) She has a tattoo on her finger.
$\rightsquigarrow$ She does not have a tattoo on her thumb.

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It has been noted in the literature that an asymmetry exists between *finger* and *toe*.
(Horn, 1984, 2000; Geurts, 2011)

(2) She has a tattoo on her finger.
$\rightsquigarrow$ She does not have a tattoo on her thumb.

(3) She has a tattoo on her toe
$\not\rightsquigarrow$ She does not have a tattoo on her big toe.

Horn's conjecture

"We would predict that if the colloquial language replaced its *thumb* with the polymorphous *pollex* (the Latin and scientific English term for both 'thumb' and 'big toe'), the asymmetry [between *finger* and *toe*] would instantly vanish."

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"We would predict that if the colloquial language replaced its *thumb* with the polymorphous *pollex* (the Latin and scientific English term for both 'thumb' and 'big toe'), the asymmetry [between *finger* and *toe*] would instantly vanish."

Geurts (2011), *Quantity Implicatures*

"It is important to note, however, that the adjective 'colloquial' is doing real work in this statement: it is not enough for an alternative word to be in the language; it has to be sufficiently salient, as well: if the word 'thumb' was rarely used, then presumably the asymmetry between would vanish too."

The present study

Spanish: *pulgar* 'thumb' (equally as complex as *thumb*, less prevalent)

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Goal: To investigate, using cross-linguistic comparison, what determines the viability of alternatives when calculating a scalar implicature

Outline

Research Question

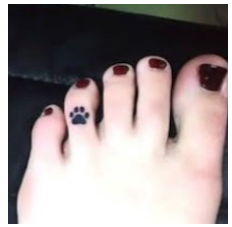
- When asked to choose between two digits as referents for a general term, do English and Spanish speakers prefer one digit over the other in accordance with the prevalence associated with the specific terms for that digit, or with the complexity associated with the specific terms for that digit?

Outline

Design/Procedure





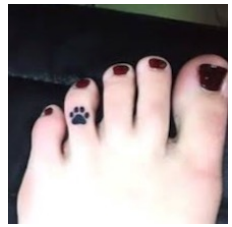



	Targets	Fillers
Norming: Production (fill in the blank)	6 digits	6 other body parts (arm, leg, back)

Design/Procedure





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Comprehension (forced choice)	6 digit-pairs	6 other pairs (mix of easy/hard)

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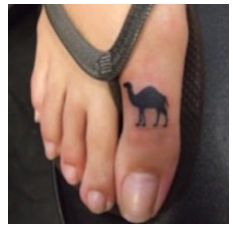
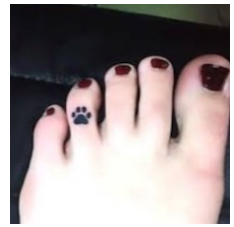


	Targets	Fillers
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Order, left-right presentation randomized.

Methodology

- Production Study: Asked participants to fill complete the sentence "She has a tattoo on her ___" given a specific image
- Comprehension Study: Asked participants to choose an image given the utterance "She has a tattoo on her finger" or "She has a tattoo on her toe"

Participants (via Prolific)

	English speakers	Spanish speakers
Production	24	23
Comprehension*	45	48

All different groups of participants.

*Only 1 English participant failed attention check

Tidying Production Data for analysis

Normalized production responses:

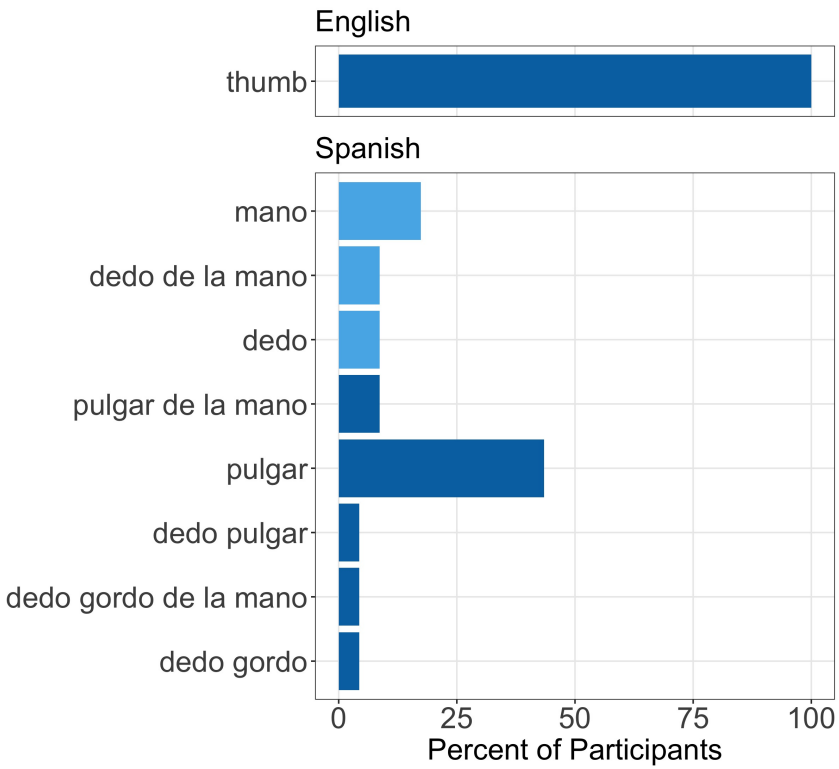
- Removed articles and directional terms (*left* or *right*)
  Ex: *the left pinky* → *pinky*

Coded for Specificity:

- Utterances that point to a single digit assigned a 1
  Ex: *pinky*
- Utterances that did not point to a single digit assigned a 0
  Ex: *finger*

Outline

Thumb vs. ring finger (Production)



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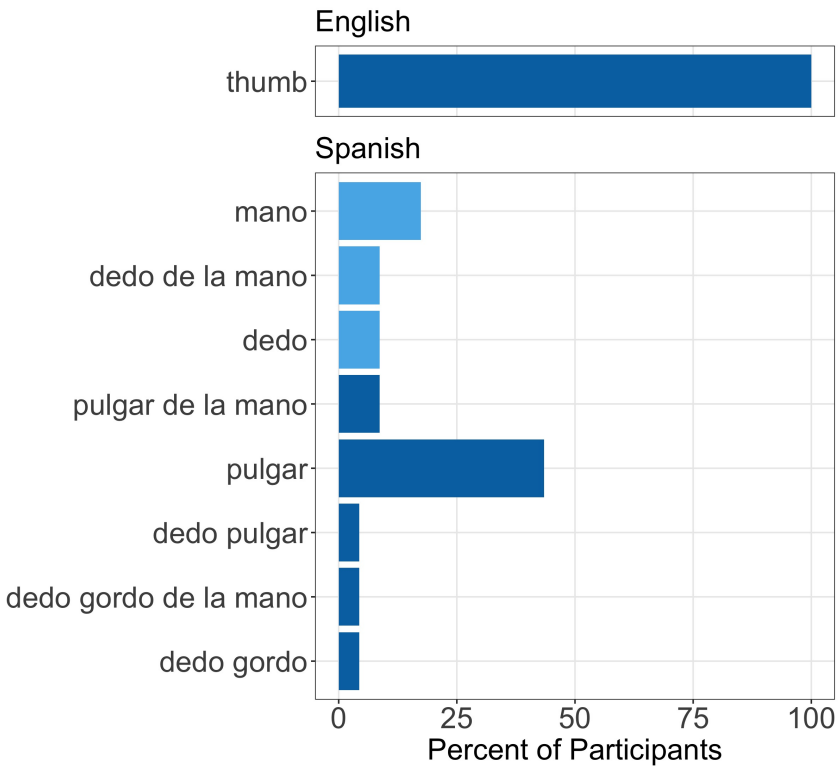
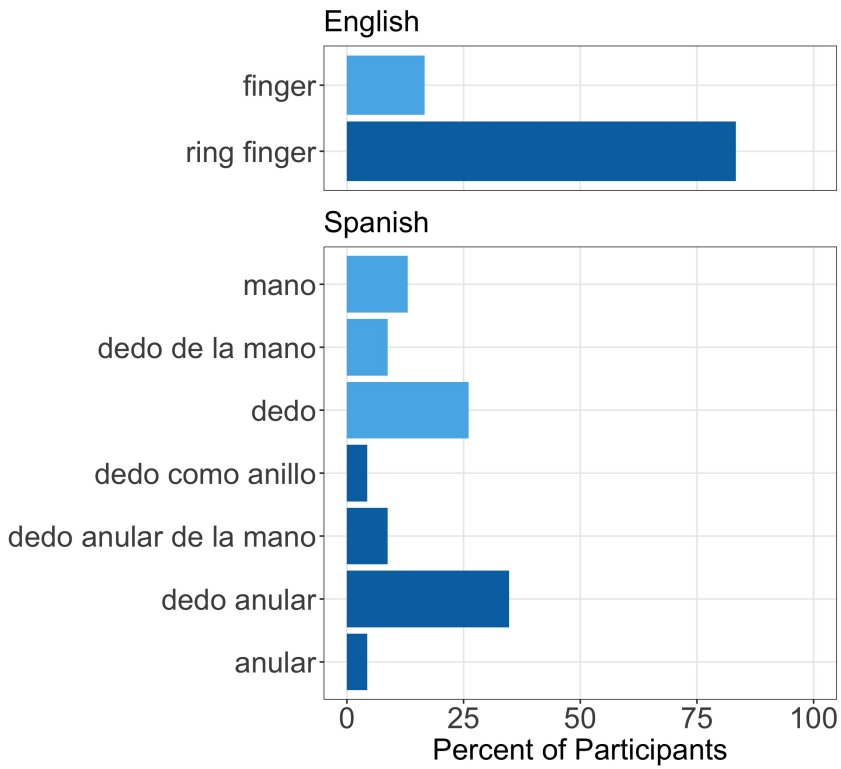
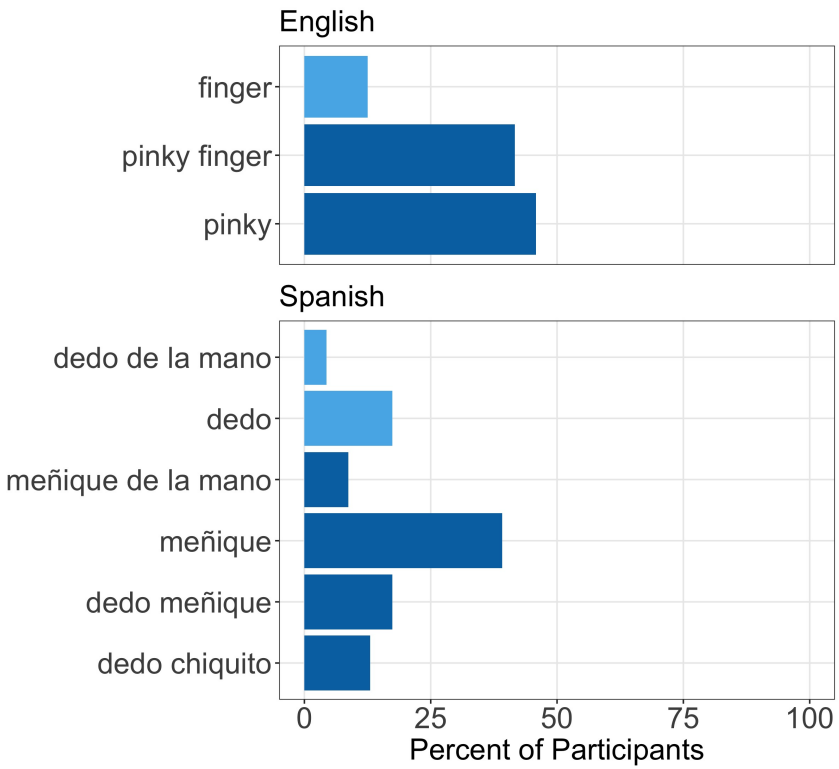
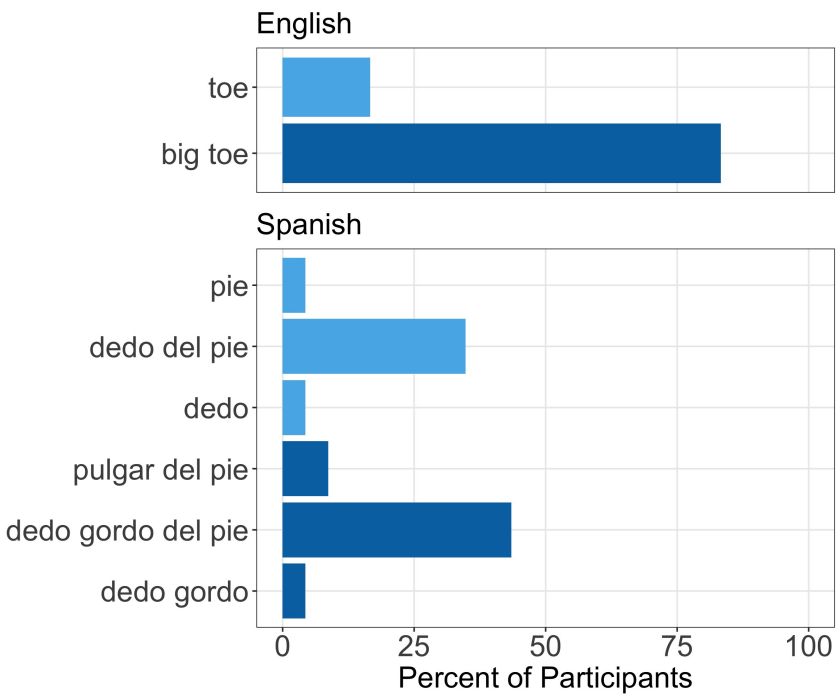




Pinky (Production)



Big toe vs. ring toe (Production)



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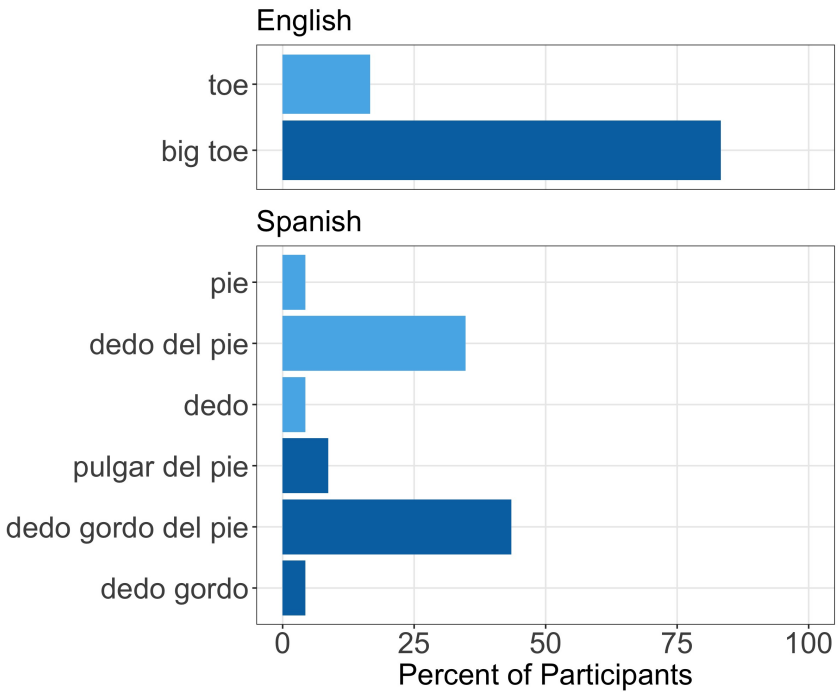
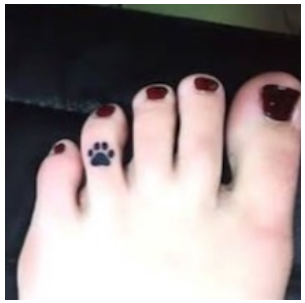
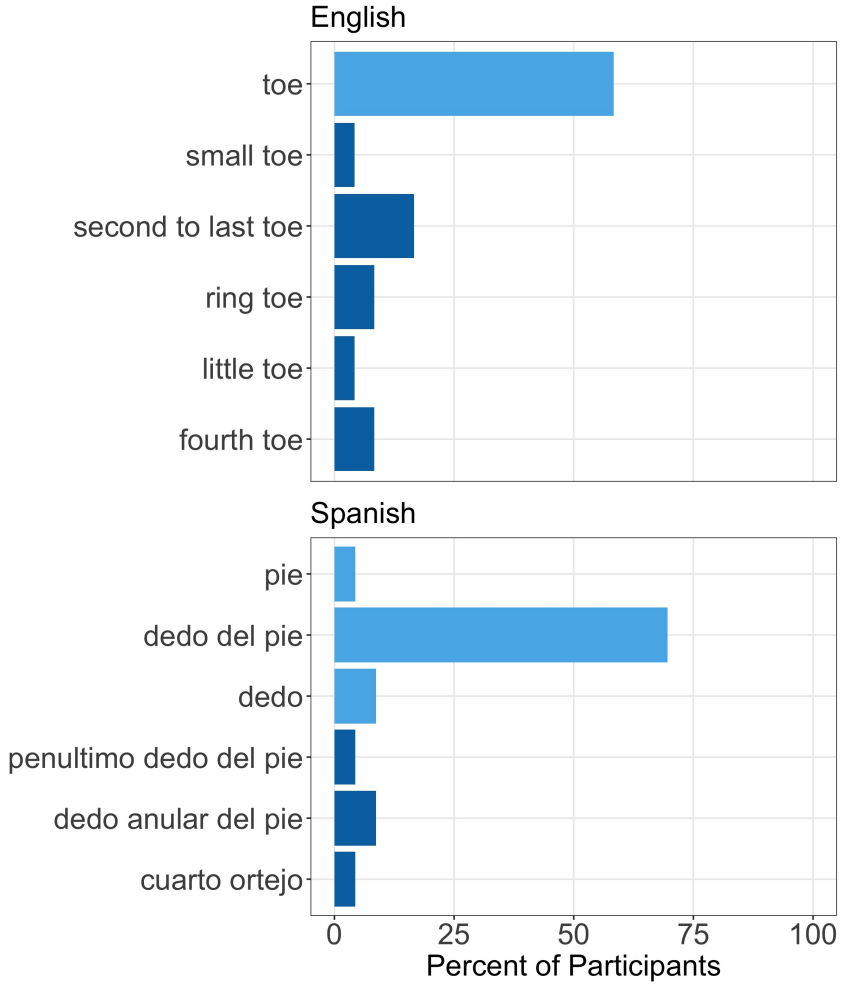
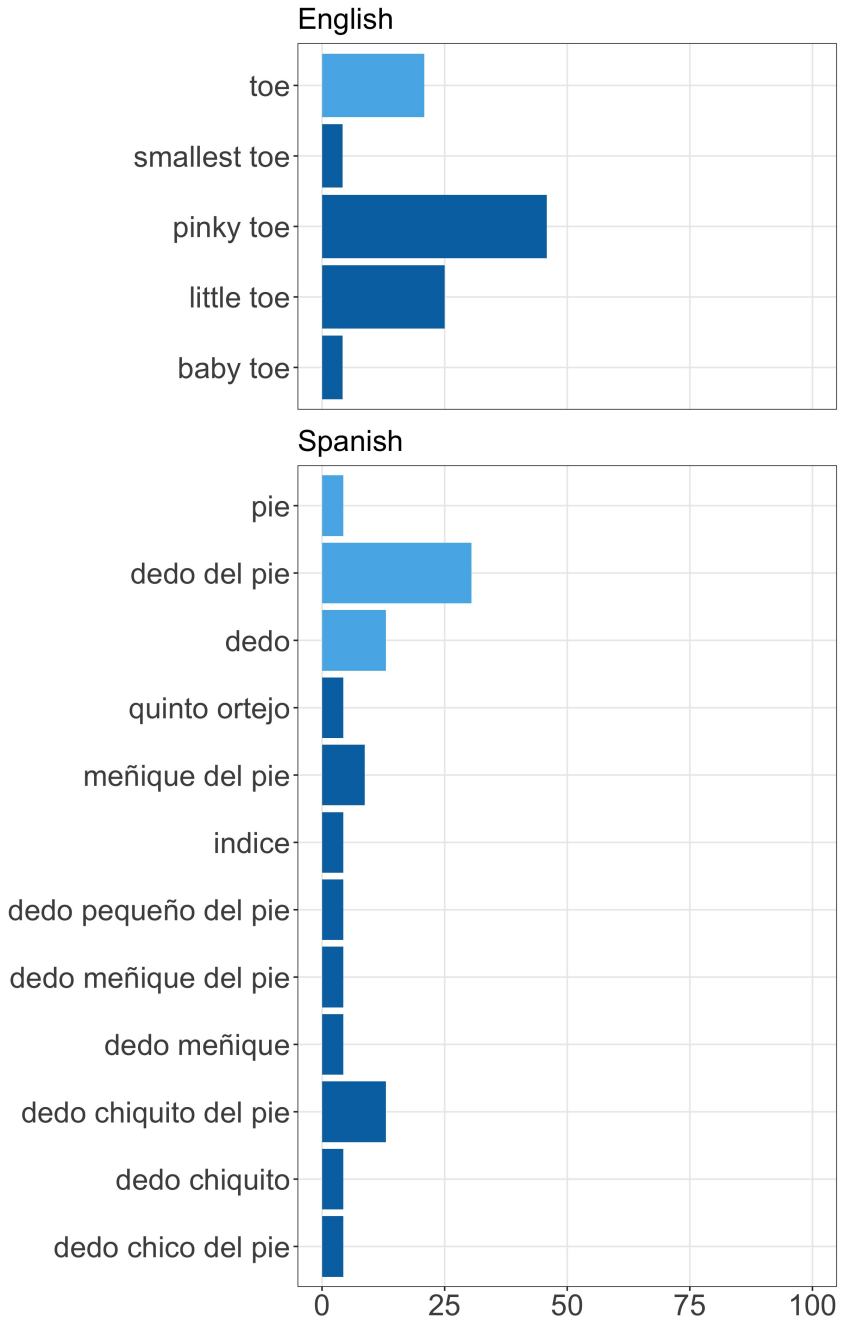






Pinky toe (Production)

Specificity
1
0



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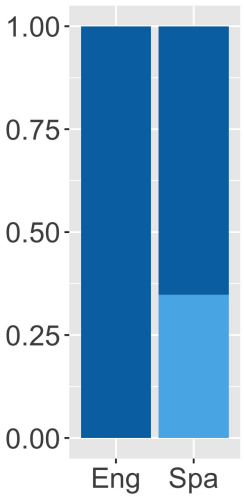

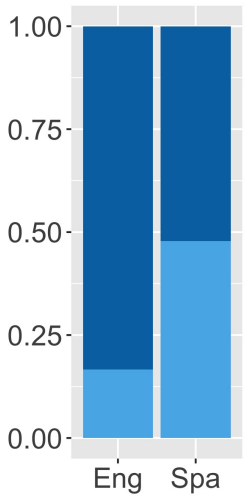

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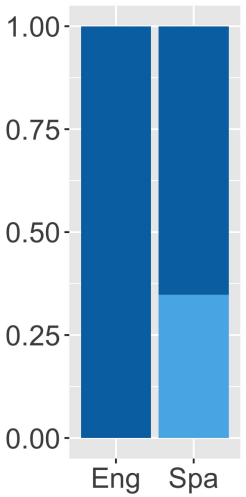
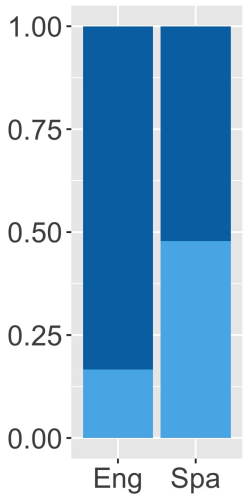
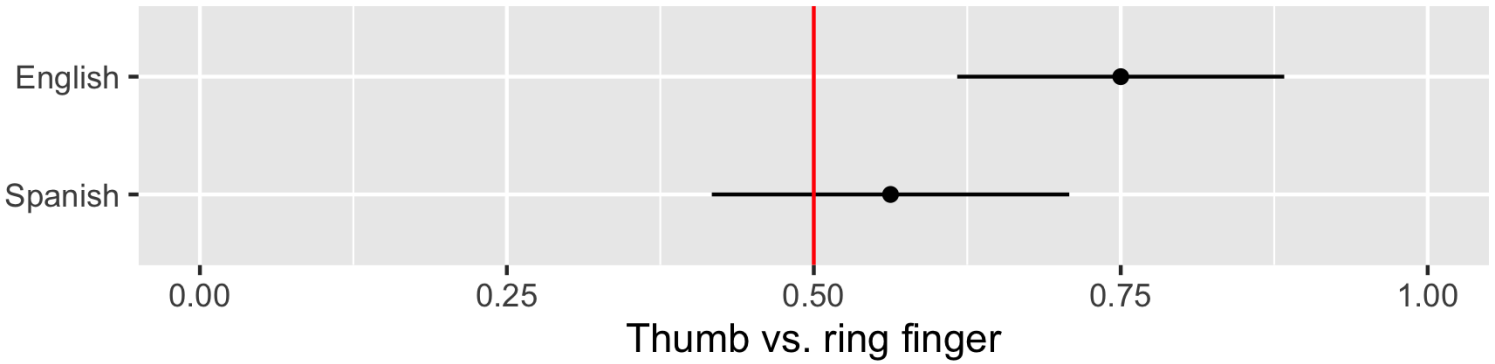


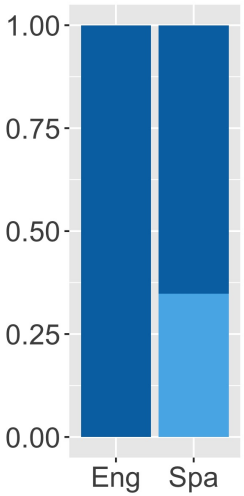


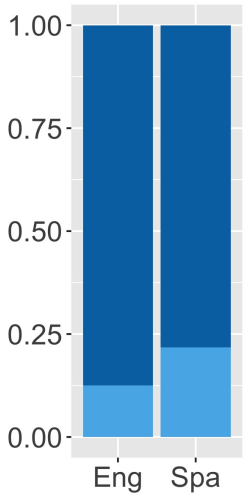


"She has a tattoo on her finger."

Observed rates plotted with 95% CI

Thumb vs. pinky finger (Comprehension)





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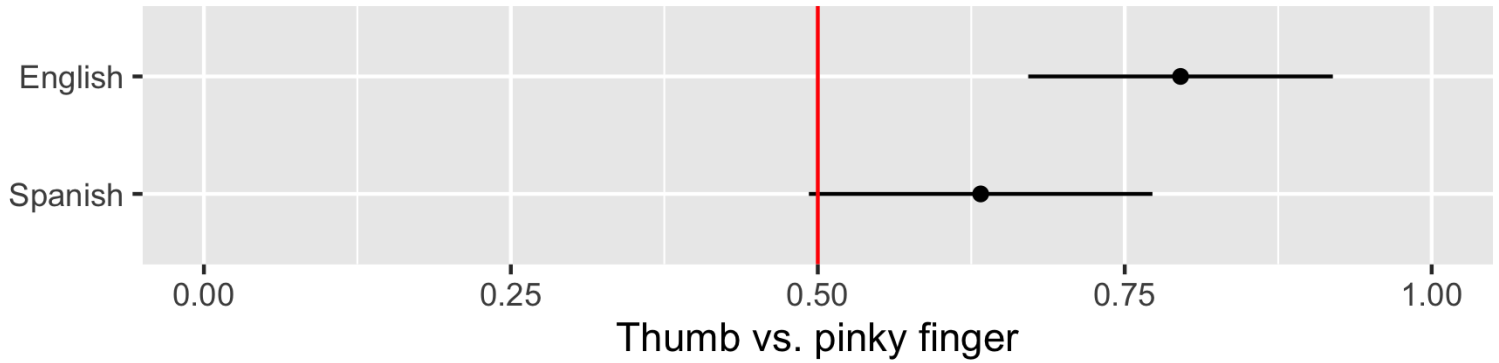

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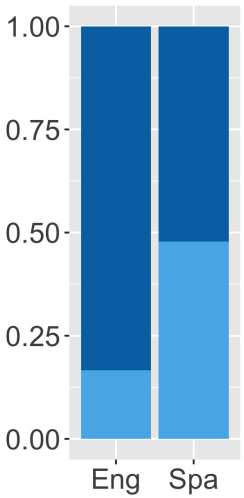

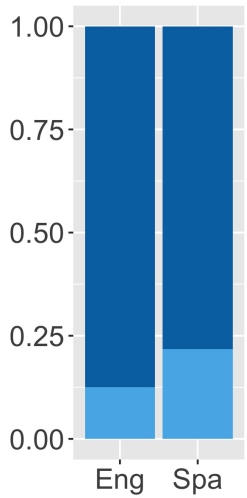

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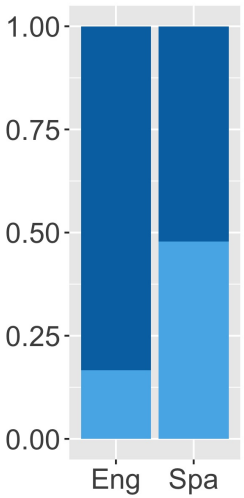
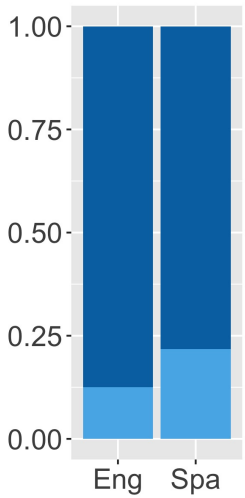
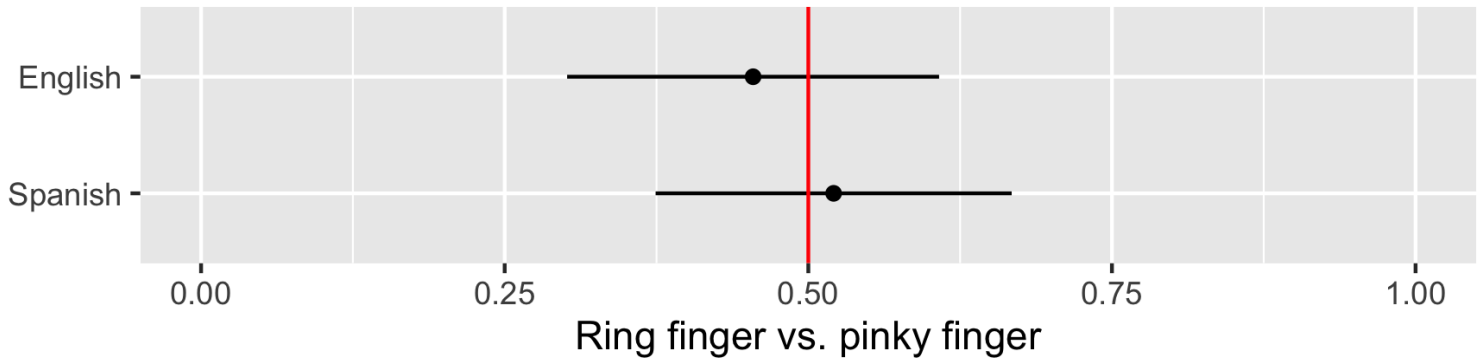
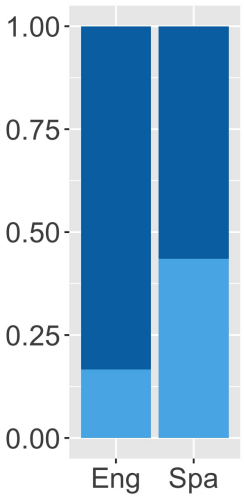


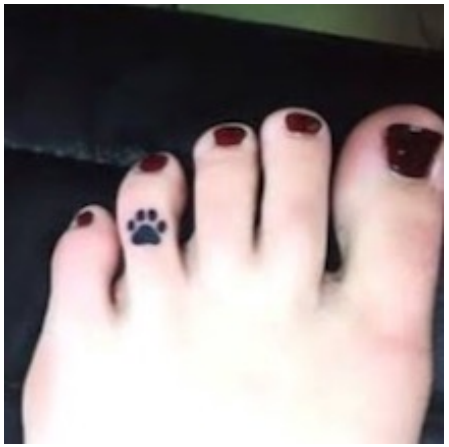


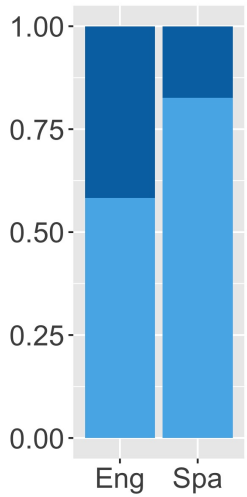


"She has a tattoo on her finger."

Big toe vs. ring toe (Comprehension)







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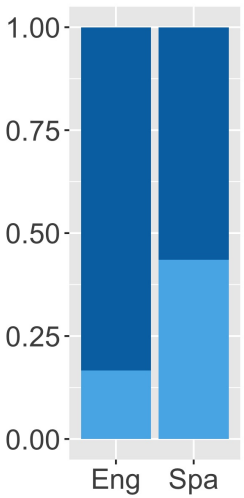
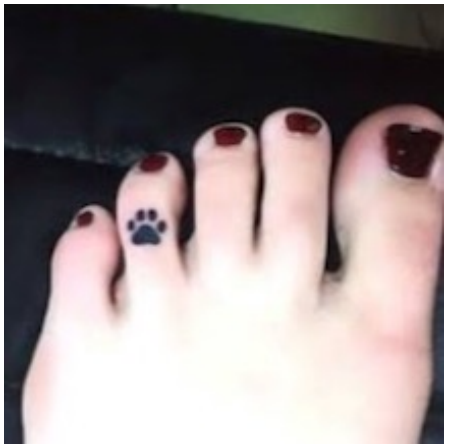
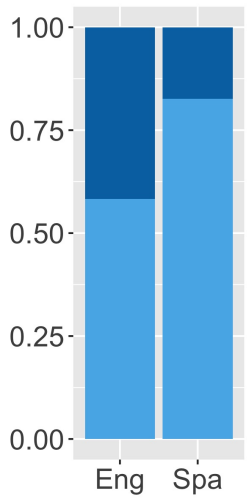
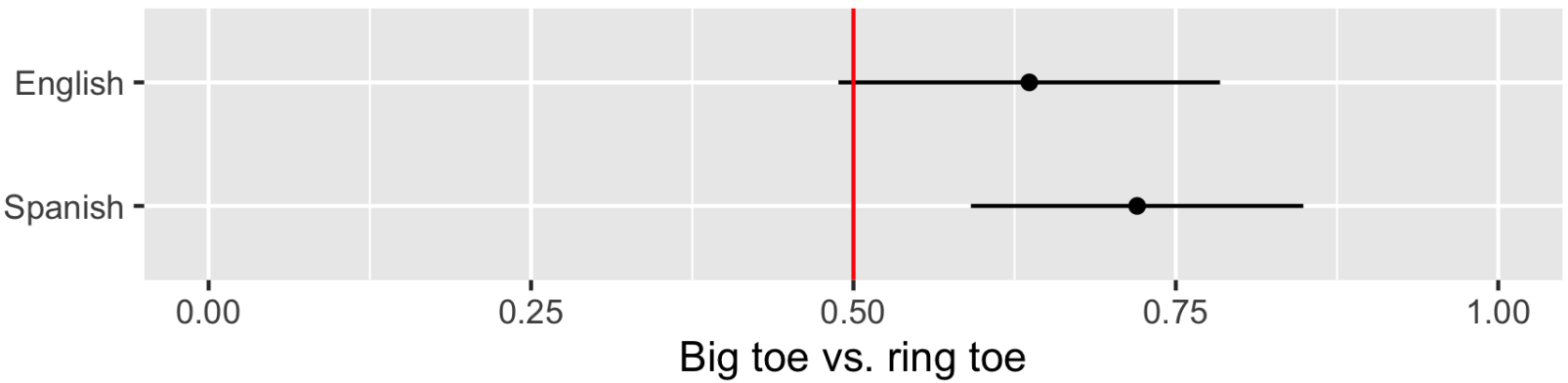


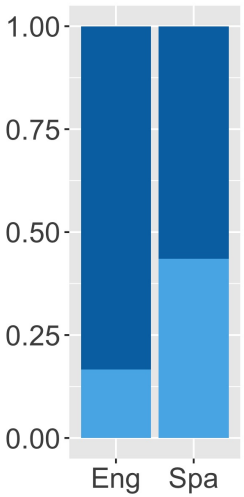


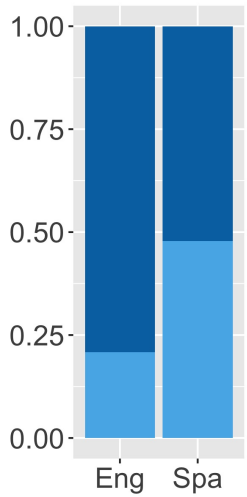




"She has a tattoo on her toe."

Big toe vs. pinky toe (Comprehension)





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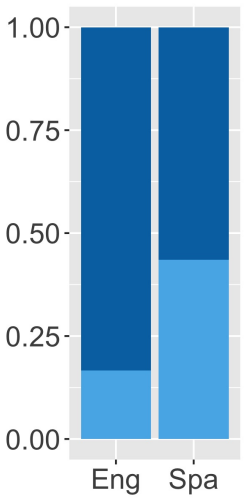

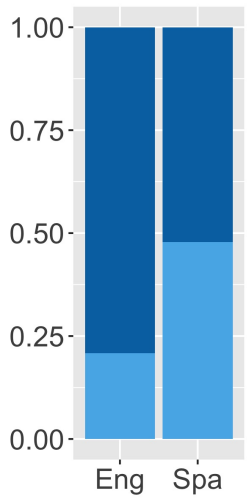

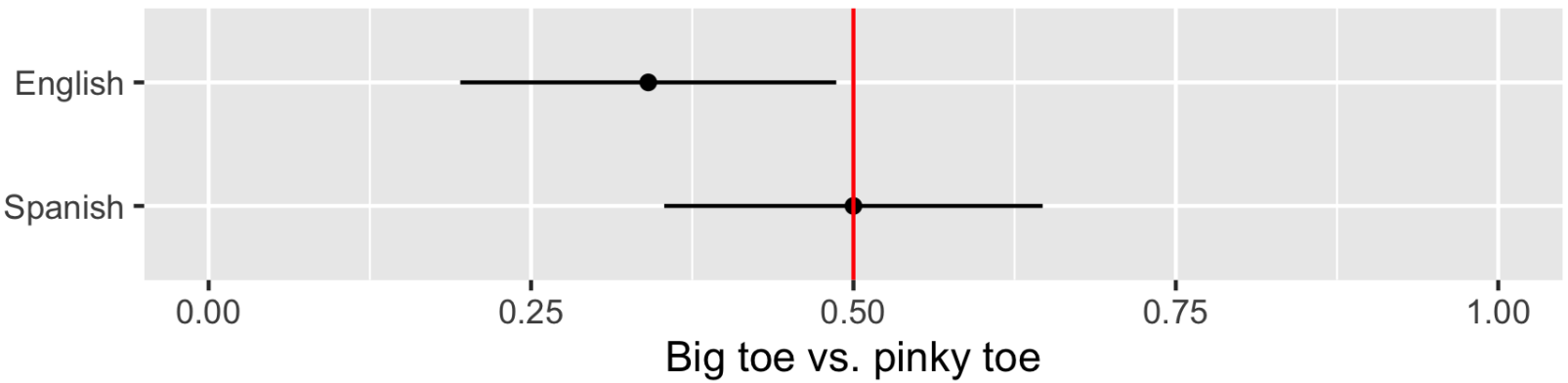

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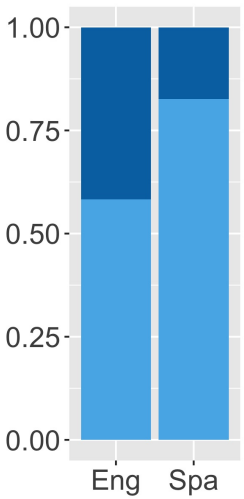
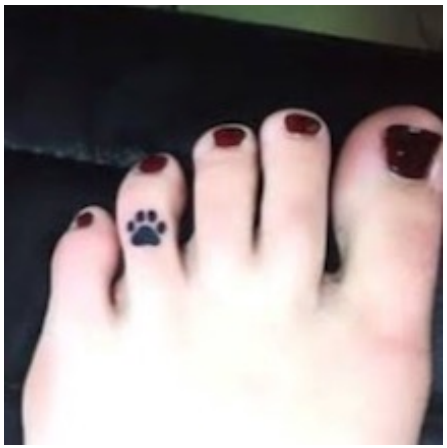
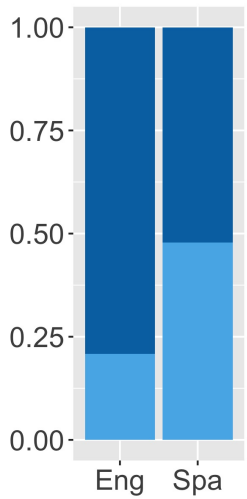
Ring toe vs. Pinky toe (Comprehension)







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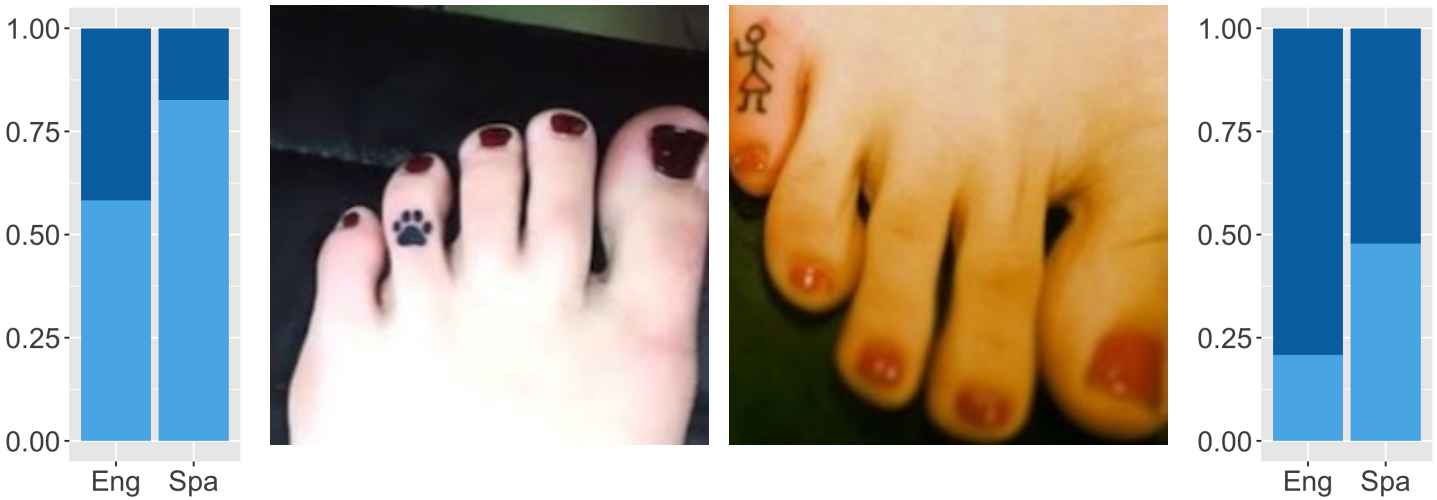

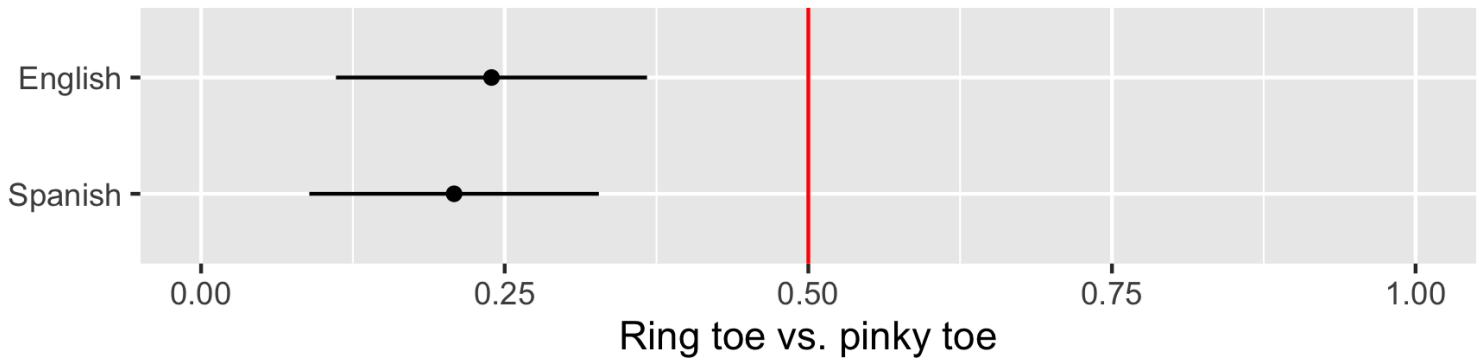

"She has a tattoo on her toe."

Comprehension Results: Summary

Results suggests participants are calculating scalar implicatures for the items in red.

	Condition	Language	Estimate	p-value	adj. p-value
1	Big toe vs. ring toe	Eng	0.64	0.097	0.145
2	Big toe vs. ring toe	Spa	0.72	0.002	0.007*
3	Big toe vs. pinky toe	Eng	0.34	0.05	0.10
4	Big toe vs. pinky toe	Spa	0.50	1.00	1.00
5	Ring toe vs. pinky toe	Eng	0.24	0.0006	0.002*
6	Ring toe vs. pinky toe	Spa	0.21	0.00009	0.0009*
7	Thumb vs. ring finger	Eng	0.75	0.002	0.004*
8	Thumb vs. ring finger	Spa	0.56	0.47	0.627
9	Thumb vs. pinky finger	Eng	0.80	0.0001	0.0009*
10	Thumb vs. pinky finger	Spa	0.63	0.086	0.145
11	Ring finger vs. pinky finger	Eng	0.45	0.651	0.781
12	Ring finger vs. pinky finger	Spa	0.52	0.885	0.965

Table 1: p-values and adjusted p-values for each language/condition pair.

Outline

The RSA Framework (e.g. Frank & Goodman 2012)

The RSA framework uses probabilistic reasoning to model the recursive nature of pragmatic reasoning.

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Let us consider two models of the speaker S:

- Complexity Model: penalizing longer utterances
- Production Model: perfect knowledge of speaker behavior (prevalence)

Complexity-based model: Summary

The **pragmatic listener** chooses an interpretation based on the speaker:

$$L(s \mid u) \propto S(u \mid s) \cdot P(s)$$

The **speaker** chooses an utterance based on accuracy and cost:

$$S(u \mid s) \propto \exp(\alpha \cdot L_0(s \mid u) - \beta \cdot \text{length}(u))$$

A **literal listener** chooses a true interpretation at random:

$$L_0(s \mid u) \propto [\![u]\!](s) \cdot P(s)$$

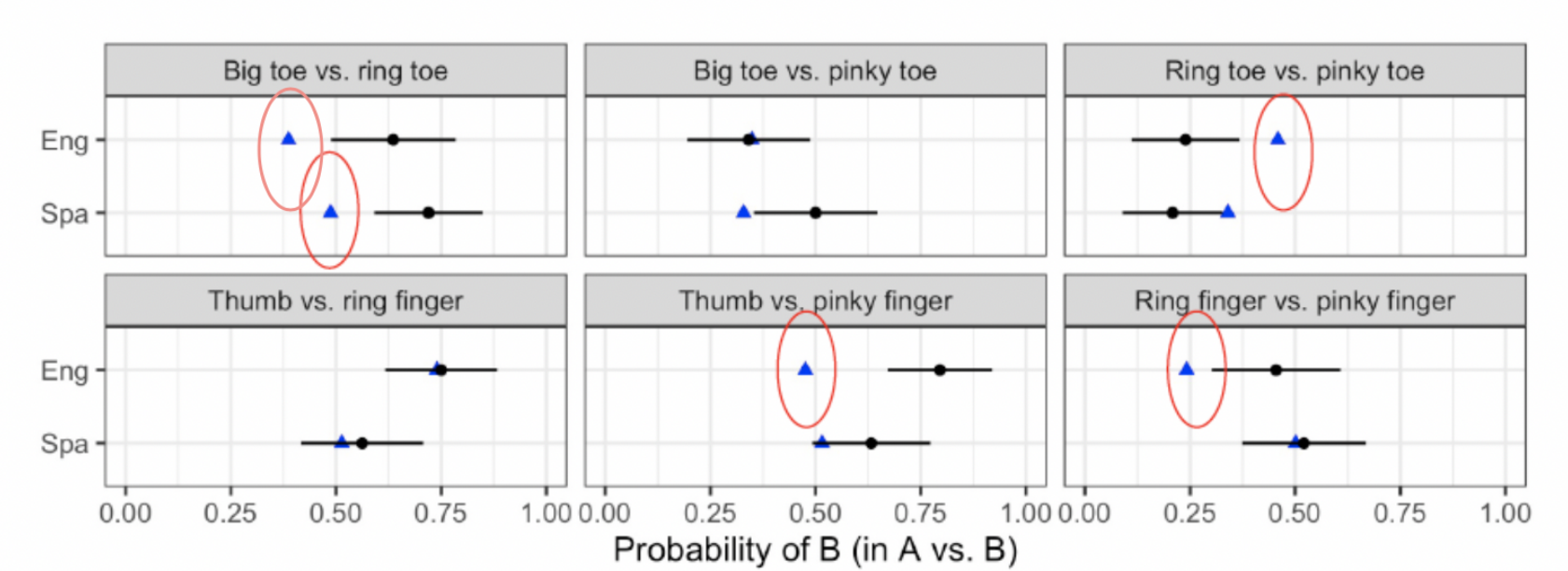
Production-based speaker model

The speaker chooses an utterance based on empirically observed frequencies in the production data:

$$S(u \mid s) \propto F(u \mid s)$$

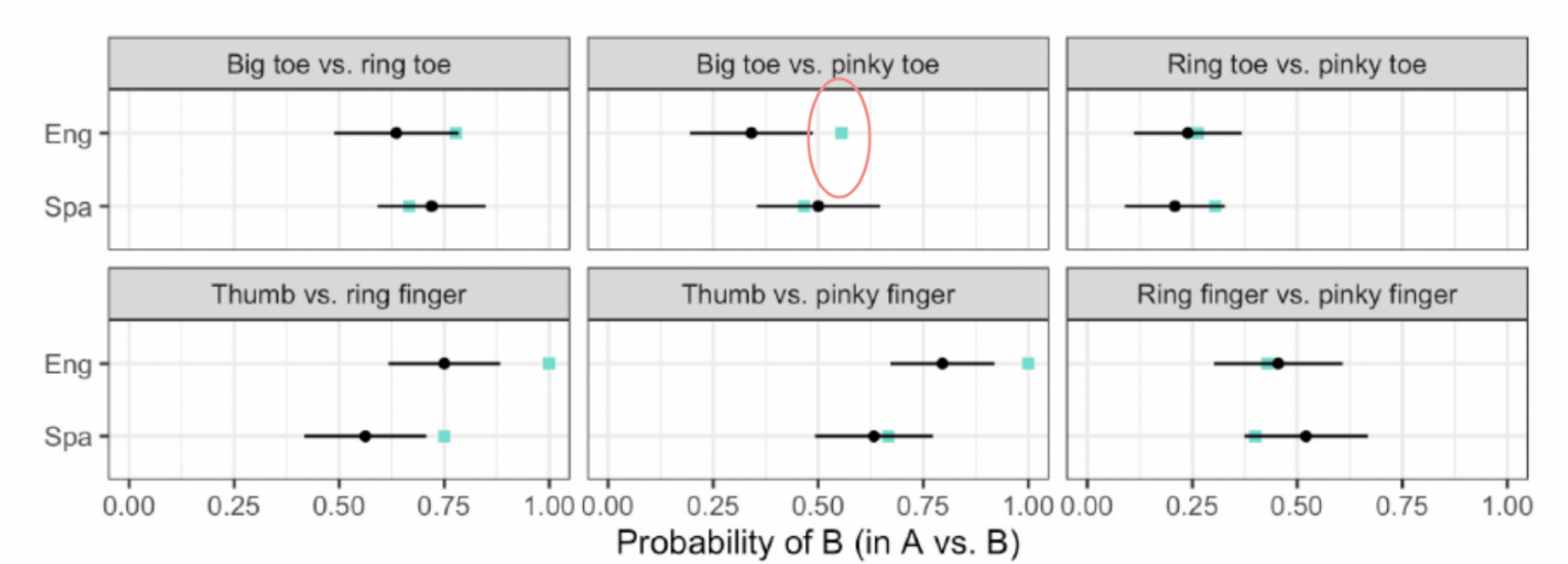
where $F(u \mid s)$ is the frequency with which utterance u was used in the production experiments to describe state s.

Complexity Model Results



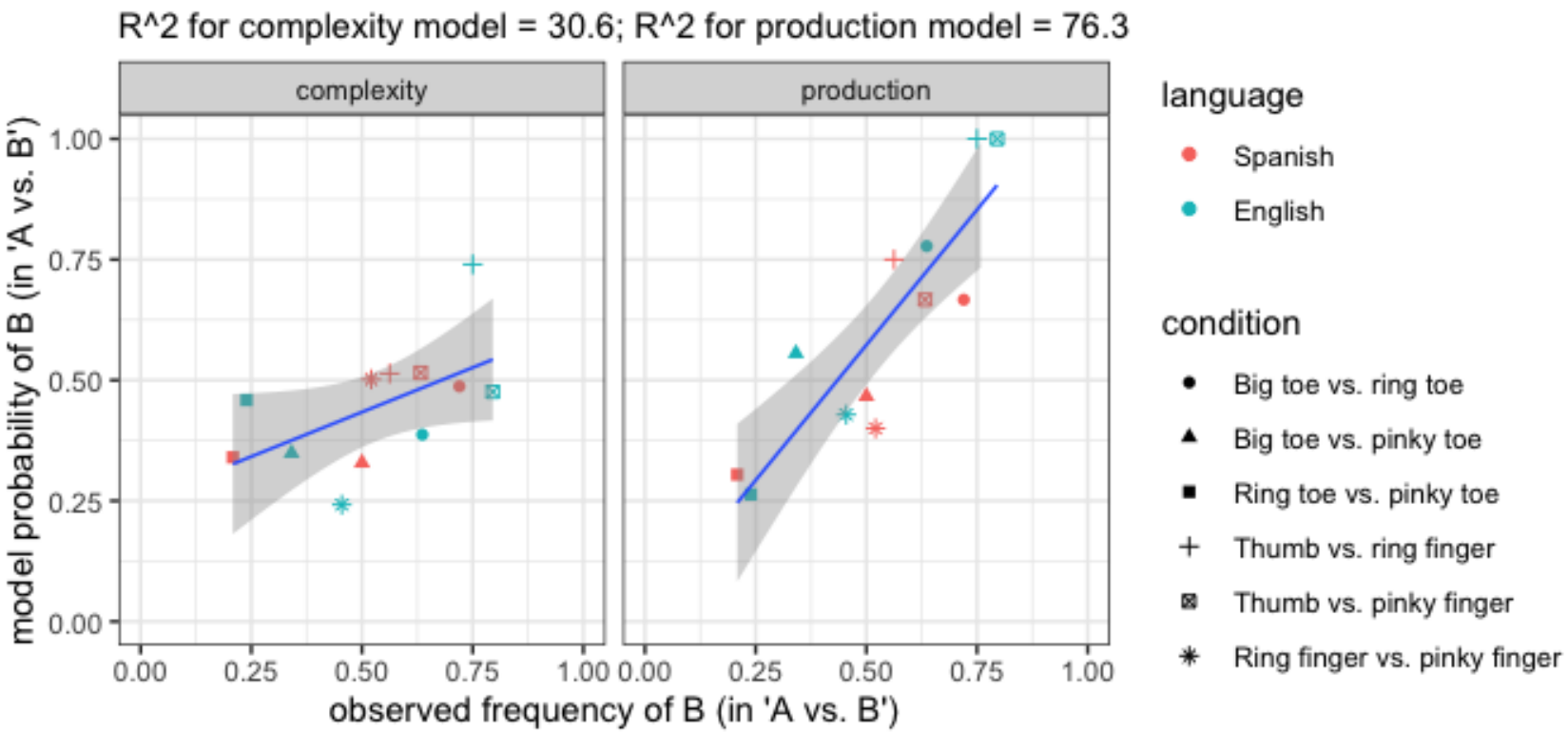
Complexity Model predictions (triangle) plotted against comprehension results; Inaccurate model predictions are circled in red

Production Model results



Production Model predictions (square) plotted against comprehension results; Inaccurate model predictions are circled in red

Model comparison



Comparison of Model Results

Outline

Discussion

Horn was right: If English had *pollex*, the asymmetry between *finger* and *toe* would disappear.

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Support: *pinky* doesn't act like *thumb* (in Spanish or English).
-Single-word alternatives available to speakers, but less prevalent.

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Troublesome for complexity-based accounts (Horn, 1984, 2000; Katzir, 2007)

Outline

Conclusions

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   - Languages differ in which alternatives are considered viable based on the prevalence of translational equivalents

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Conclusions

1. Viability of alternatives depends on how prevalent the alternatives are.
   - Languages differ in which alternatives are considered viable based on the prevalence of translational equivalents

2. Viability is tied to prevalence (production probability), and complexity is not all there is to it. Interlocutors are recursively probabilistic when communicating.

My findings provide evidence against a structural approach to calculating alternatives (Horn, 2000; Katzir, 2007), favoring theories that determine alternatives based on production probability (Geurts, 2011; Goodman & Stuhlmüller, 2013).

Questions to explore further

- Why are speakers calculating implicatures such as *toe* $\rightsquigarrow$ 'not pinky toe'?

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- Why do speakers do what they do?
- How should complexity be measured?
- What is the significance of dispersion?
- Where else might we find cross-linguistic pragmatic differences that arise due to prevalence of alternatives?

Thank you!

Gracias!

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