How to provide exactly one interpretation for every sentence, or what eye movements reveal about quantifier scope

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Quantifier scope

Theoretical considerations:

- What are the available readings?
- What are the relevant representations?
- How are these representations constructed?

Quantifier scope

Methodological considerations:

- Offline preferences: first interpretation or reinterpretation?
- Online results:
  - disambiguation often insufficient
  - disambiguation may distort preferences on ambiguous parts of the sentence

Quantifier scope

Bringing it all together...

Experiment

- written instructions: “Name an animal...”
- computer displays

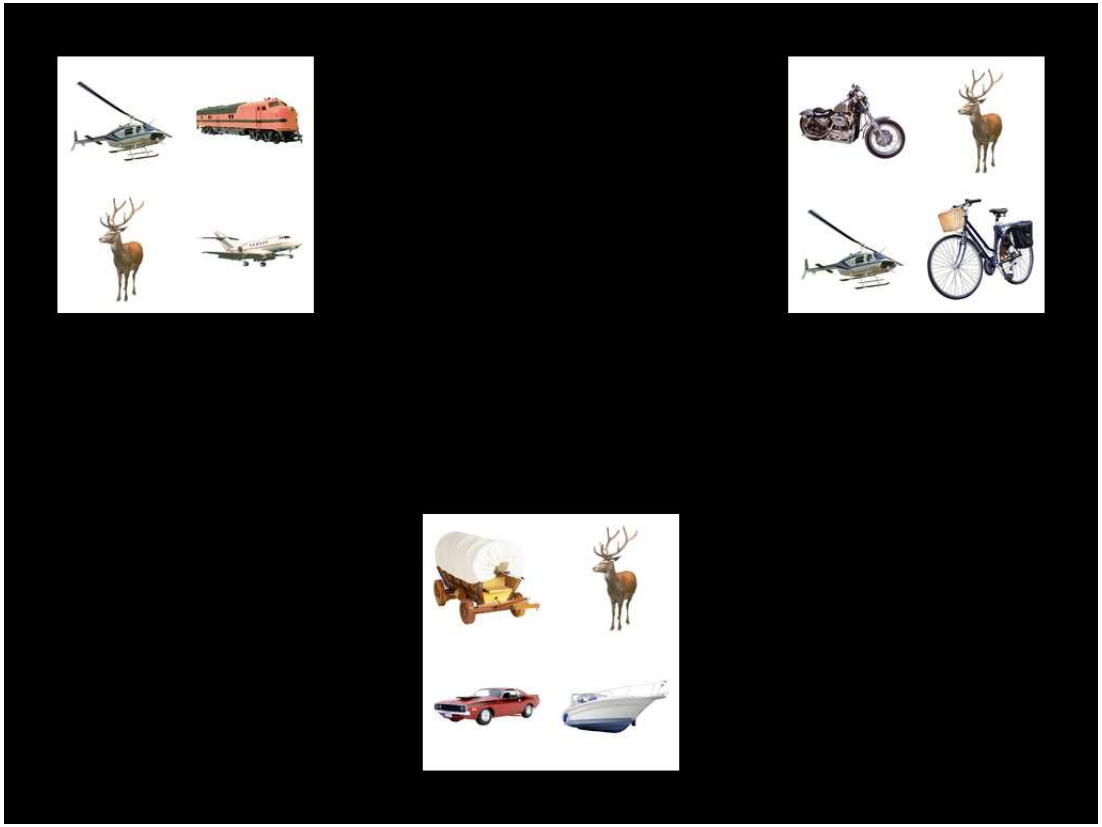
Materials: Control A

definite NP + ’each’/’all’

(c) Das Tier auf jedem Bild sollst du nennen!
“Name the animal in each field!”

(d) Das Tier auf allen Bildern sollst du nennen!
“Name the animal in all fields!”

Materials: Control A



Materials: Control A

- one picture appeared in all three fields
- all other pictures represented a different category

Materials: Items

Experimental items: inverse linking constructions

(a) Genau ein Tier auf jedem Bild sollst du nennen!
"Name exactly one animal in each field!"

(b) Genau ein Tier auf allen Bildern sollst du nennen!
"Name exactly one animal in all fields!"

- the inverse scope reading is favored
- 'each' demands wide scope more strongly than 'all'

Materials: Items

Experimental items: inverse linking constructions

(a) Genau ein Tier auf jedem Bild sollst du nennen!
"Name exactly one animal in each field!"

(b) Genau ein Tier auf allen Bildern sollst du nennen!
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- the inverse scope reading is favored
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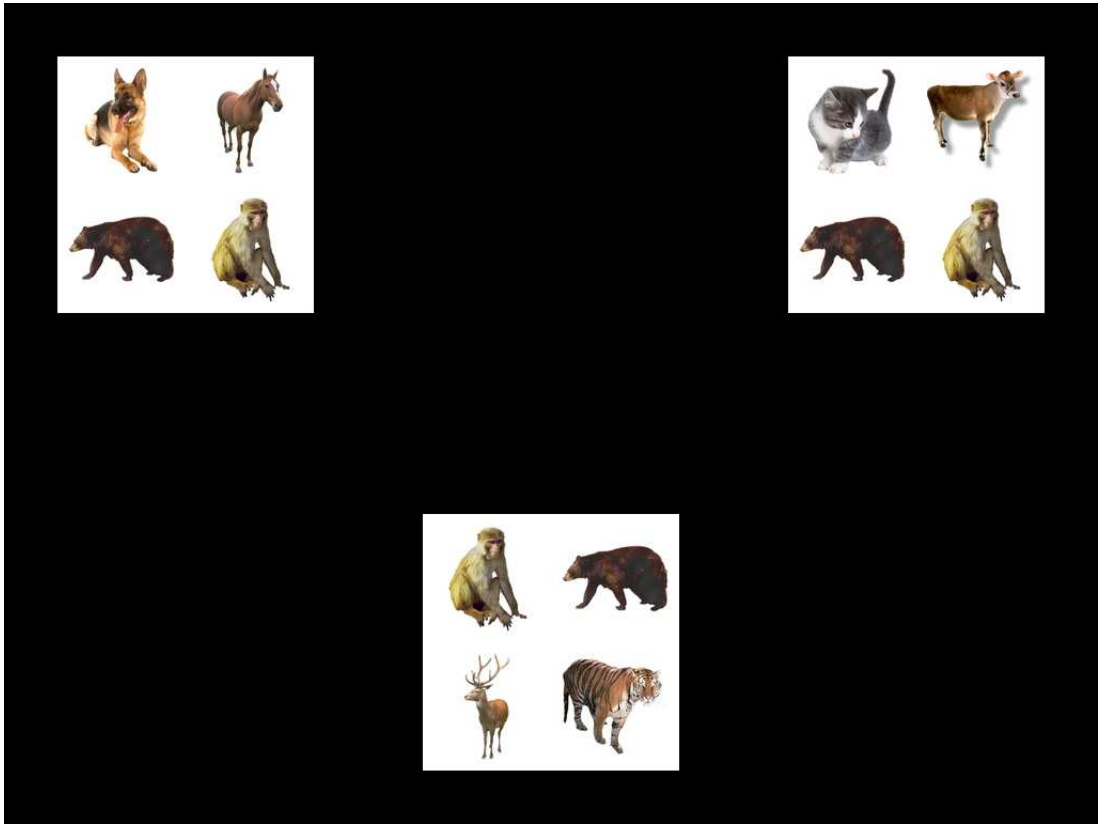
Materials: Items/Control B



Materials: Items/Control B

- all pictures belonged to the same category (e.g. animal)
- two pictures appeared in all three fields
- other pictures appeared only once in the display

Materials: Control B

two quantifiers, disambiguated

(e) Von jedem Bild sollst du irgendein Tier nennen!
"From each field, name some animal!" ∀∃ only

(f) Ein Tier, das sich auf allen Bildern befindet, sollst du nennen!
"Name an animal which can be found in all fields!" ∃∀ only

Sentence materials

Summary of conditions:

(a) two quantifiers, 'each', ambiguous

(b) two quantifiers, 'all', ambiguous

(c) definite NP, 'each'

(d) definite NP, 'all'

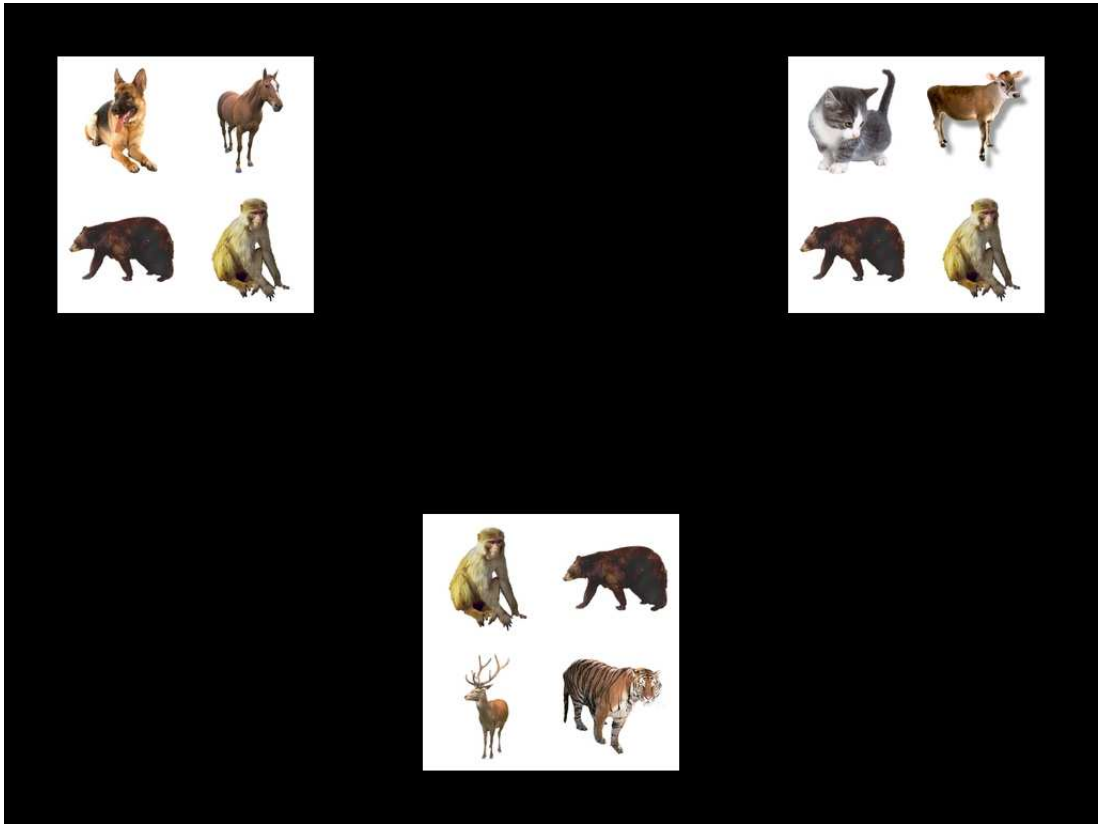
(e) two quantifiers, 'each', $\forall\exists$ only

(f) two quantifiers, 'all', $\exists\forall$ only

An experimental trial

Genau ein Tier auf jedem Bild/auf allen Bildern sollst du nennen!

An experimental trial



An experimental trial

“Monkey”

Method

Measures:

- eye movements during reading
- eye movements during inspecting displays
- responses

30 subjects, 72 items in 6 conditions, 70 fillers

Predictions

Cond. (a)
- inverse scope preferred, plus
- 'each' wants wide scope

$\longrightarrow$ second quantifier integrated easily

$\longrightarrow \forall\exists$ response

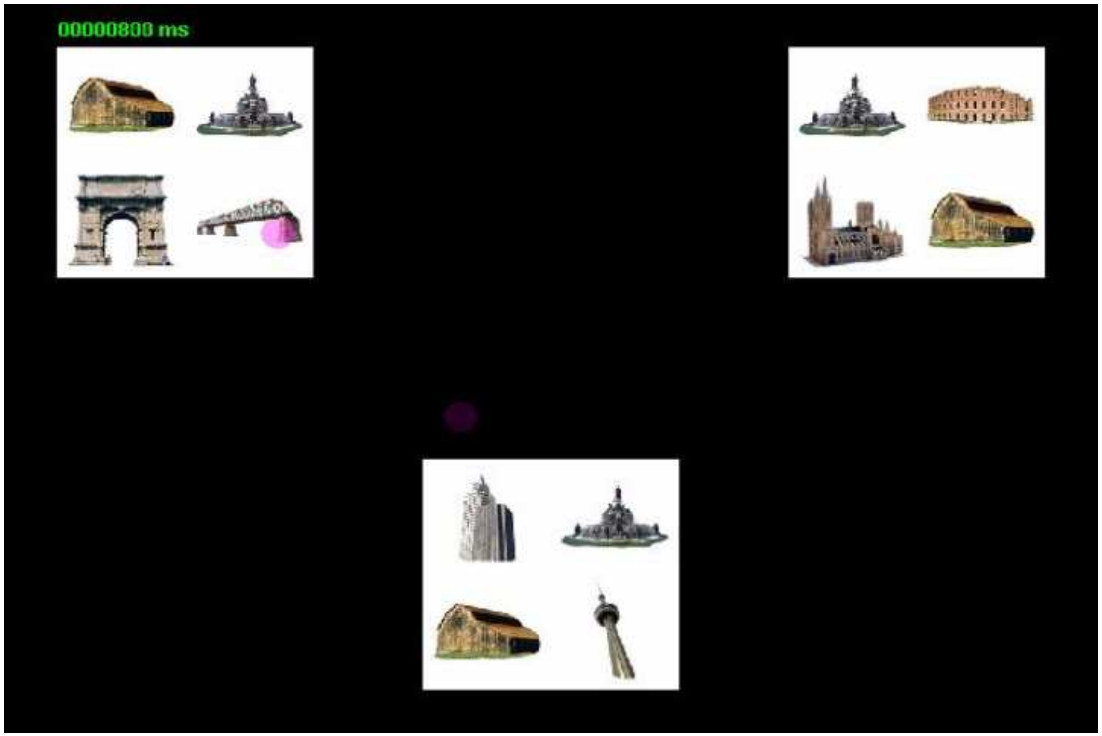
Cond. (b)
- inverse scope preferred, but
- 'all' does not want wide scope

$\longrightarrow$ difficulty integrating second quantifier

$\longrightarrow$ larger proportion of $\exists\forall$ responses

Do reading times differ depending on the answer?

Inspecting pictures



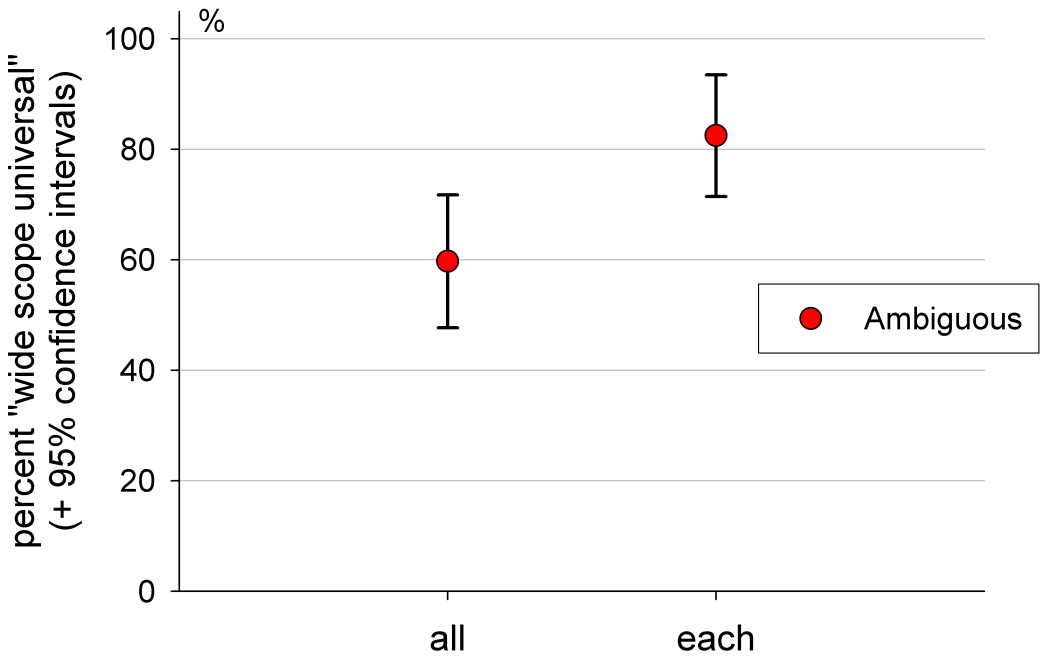
Responses

Coding the responses:

$\exists\forall$ reading: subject inspected all three fields, and provided a single answer

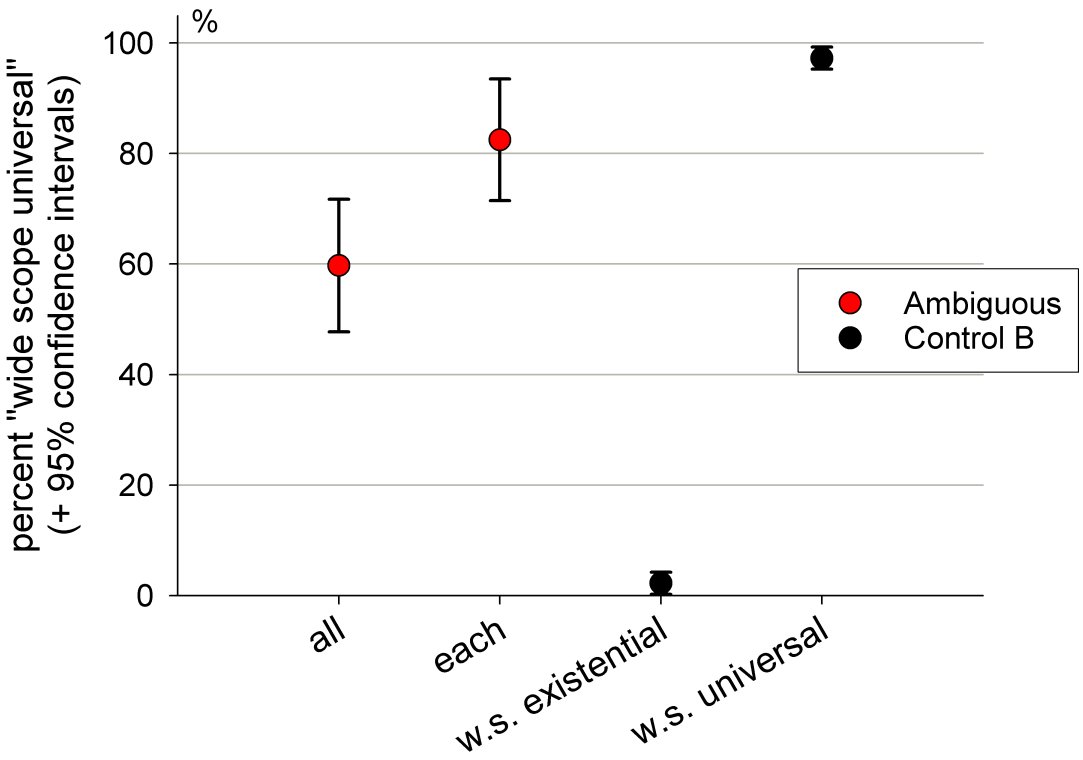
$\forall\exists$ reading: subject responded field-by-field

Results: Responses



- ’each’ received more ∀∃ responses than ’all’
- Cond. (b) (’all’) fully ambiguous (60% ∀∃ readings)

Results: Responses



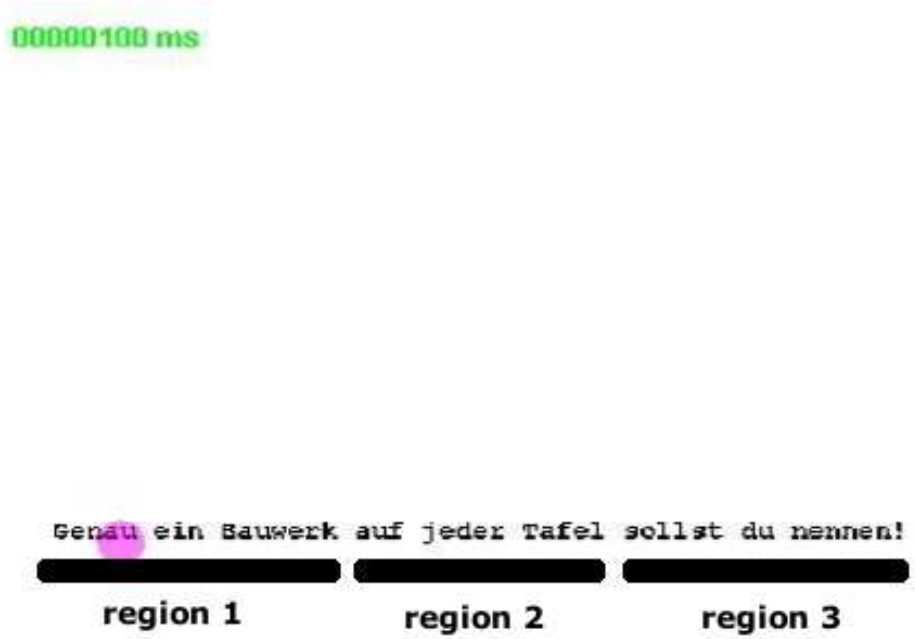
- control B (unambiguous): 99% expected answers

Reading instructions

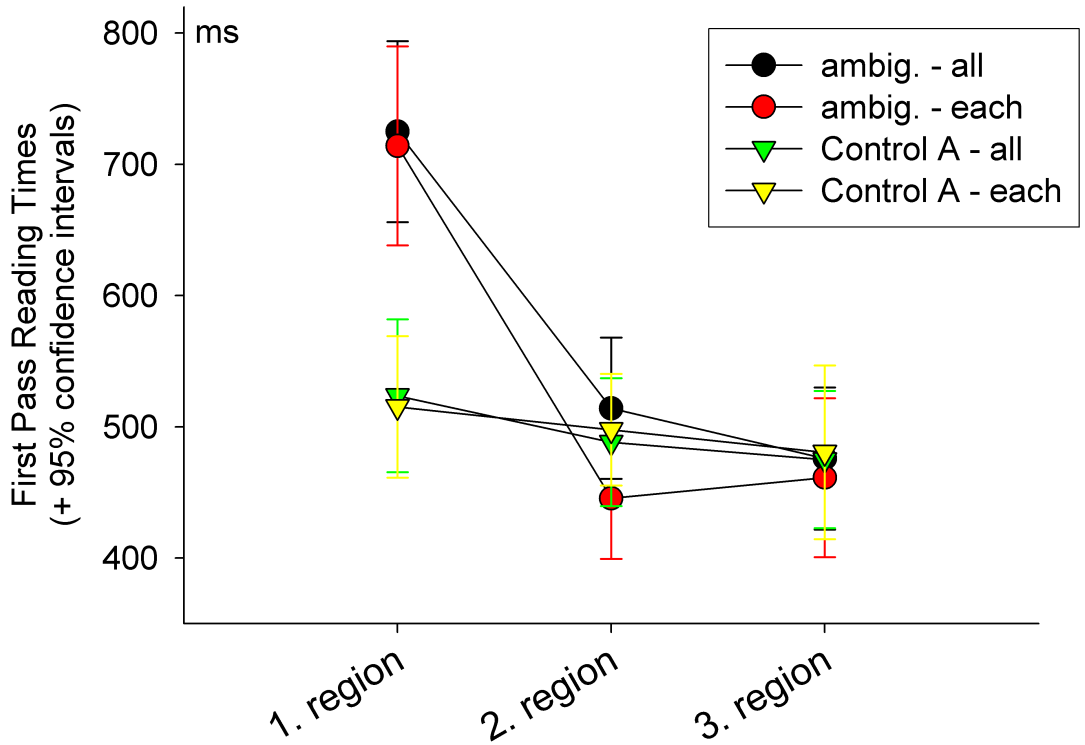
Genau ein Bauwerk auf jeder Tafel sollst Du nennen!

region 1 **region 2** **region 3**

Reading instructions



Results: Reading times



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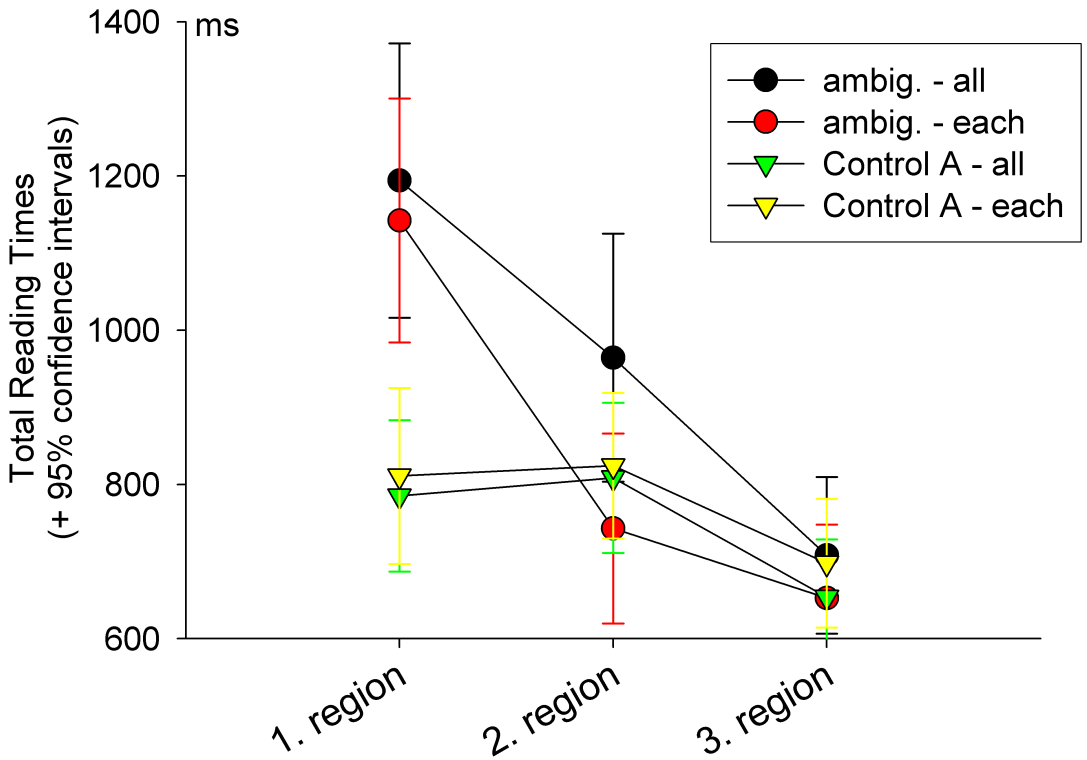
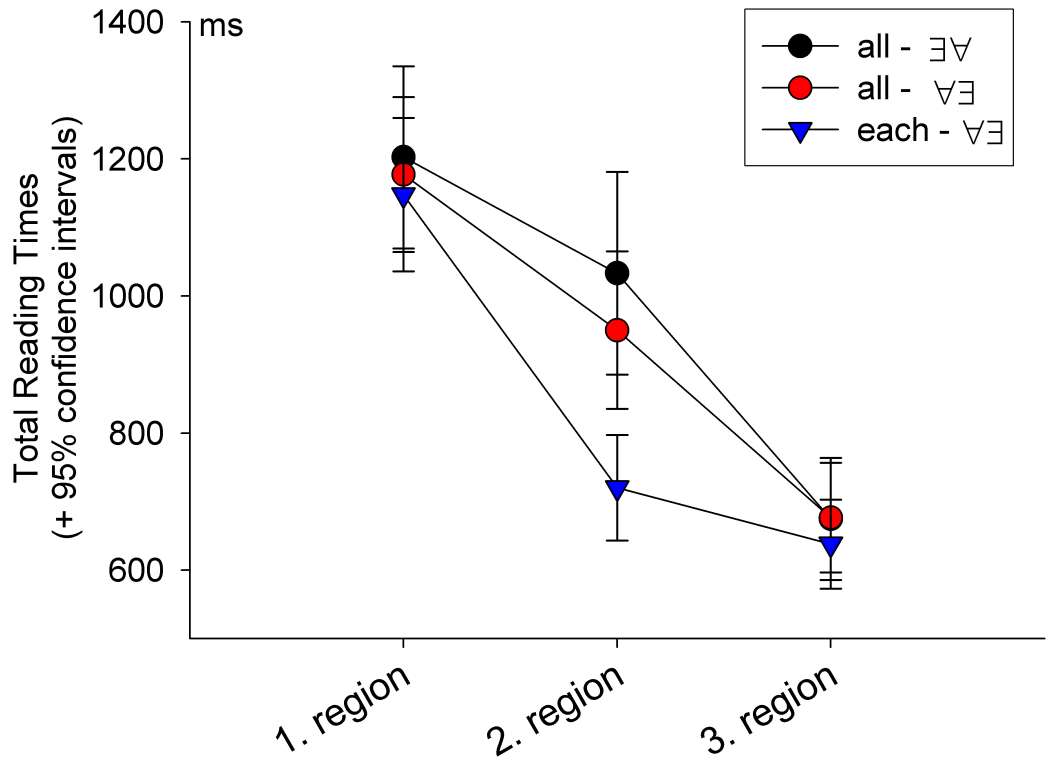


Results: Contingent reading times



Results: Summary

- overwhelming preference for inverse scope
- modulated by quantifier type
- scope relations computed immediately

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An additional contrast

Control A: definite NP + ’each’/’all’

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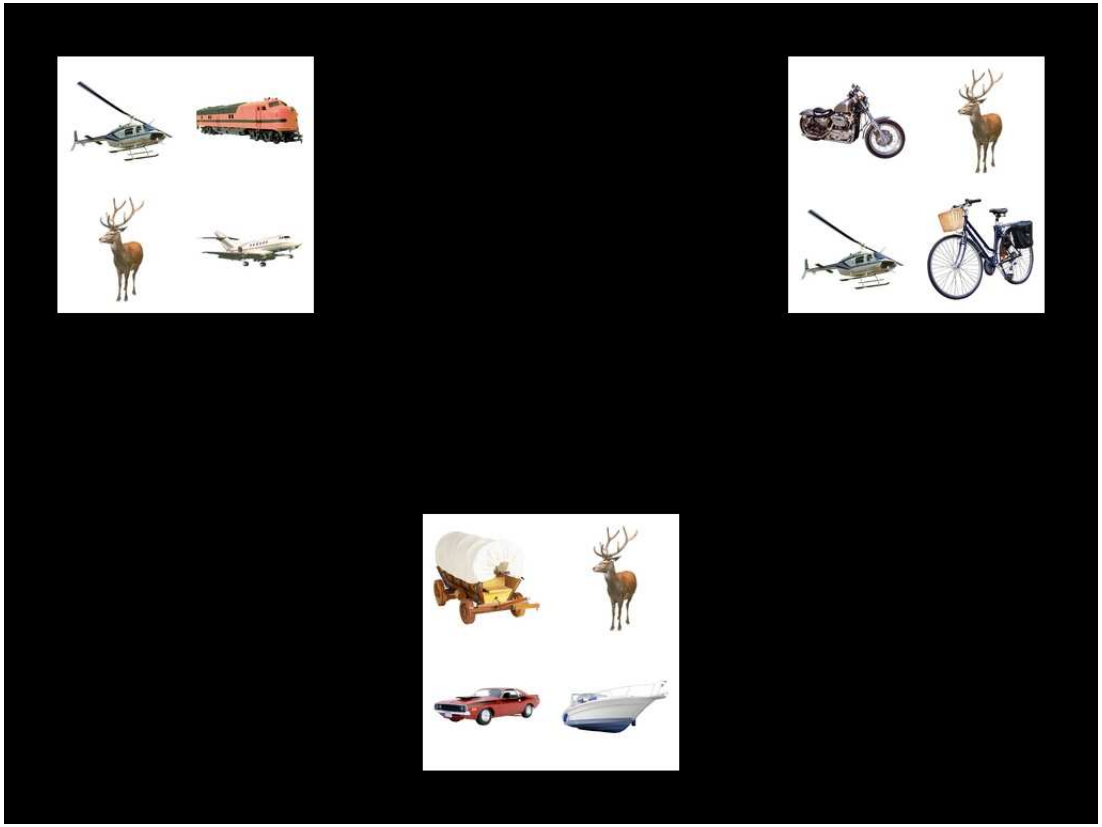

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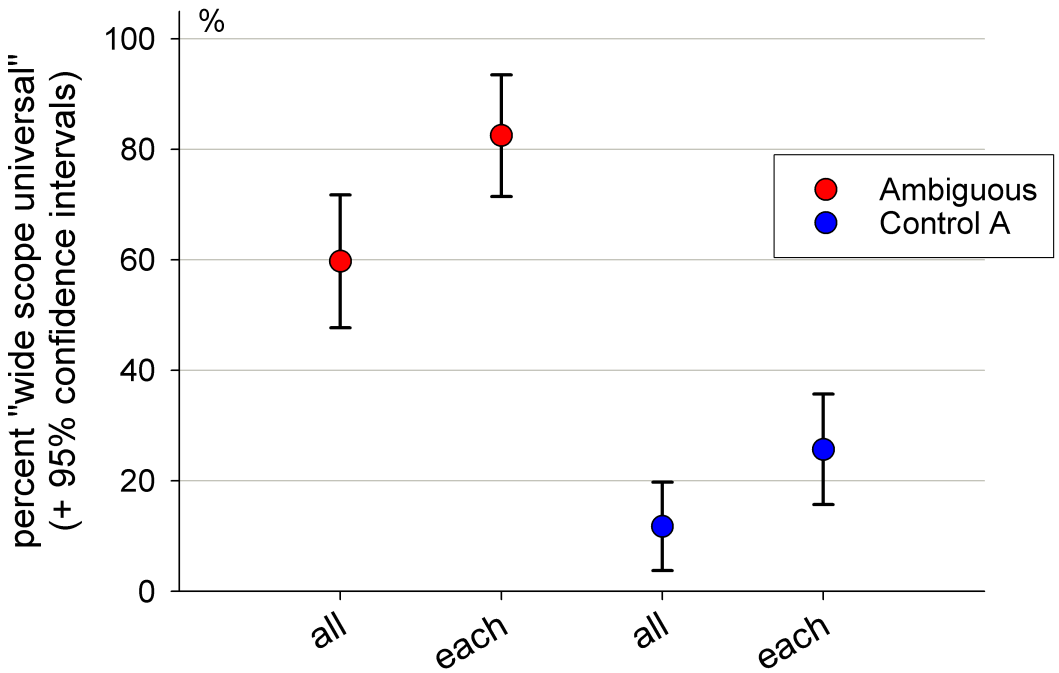

Conclusions

- What are the available readings?
  - depends on the quantifiers:
    distributivity influences scope preferences
- What are the relevant representations?
  - not always clear, cf. definite NPs
- How are these representations constructed?
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  - more balanced preferences → greater interpretation difficulty

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Acknowledgements

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