The Online Interpretation of Sentence Internal *Same* and Distributivity

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Adjectives of Comparison

- Languages have lexical means to compare two elements and express identity / difference / similarity between them
- English uses adjectives of comparison (AOCs) like *same*, *different* and *similar*

Sentence-external readings

- Comparing an element in the current sentence and an element mentioned previously

(1) a. Arnold saw '**Waltz with Bashir**'.

b. Heloise saw the **same** movie.

Sentence-internal readings

- A sentence-internal comparison, without referring to any previously introduced element, e.g.

(2) { Each student / The students / All the students } saw the **same** movie.

- Sentence-internal readings must be licensed by a semantic plural (Carlson, 1987)

(3) #Sue saw the same movie.

Our goal

Investigate how sentence-internal *same* is processed with:

- 3 of its licensors
  - EACH
  - ALL
  - THE
- 2 orders
  - Q+AOC: surface scope

(4) { Each student / The students / All the students } saw the **same** movie.

  - AOC+Q: inverse scope

(5) The **same** student saw { each movie / the movies / all the movies }

Previous theories and their predictions

Inverse scope interpretation harder to process than surface scope:

(6) A boy climbed every tree.

Tunstall, 1998, Anderson, 2004, Filik et al., 2004, Radó and Bott, to app.

Previous theories and their predictions

Explanation in terms of covert scope operations:

- Inverse scope requires an extra operation (Anderson, 2004)

(7) A boy climbed every tree.

- [every tree] [a boy climbed _]

Previous theories and their predictions

Explanation in terms of discourse model:

- Inverse scope requires revising discourse model structure (Fodor, 1982; Crain and Steedman, 1985)

(8) A boy climbed...

(9) A boy climbed every tree.

Previous theories and their predictions

The sentence-internal reading of *same* has to be scopally licensed:

(10) The same student saw every movie.

- *every movie* scopes and distributes over *same*

  (Carlson 1987, among many others)

But no revision necessary of the discourse model structure because of the meaning of *same*.

- Thus, **same** can help us distinguish between the two theories of inverse scope

Previous theories and their predictions

In addition, previous theories:

- postulated different meanings of *same*
- postulated different meanings for quantificational NPs

  (Heim 1985, Carlson 1987, Moltmann 1992, Beck 2000, Barker 2007, Dotlačil 2010, Brasoveanu 2011)

On-line interpretation of AOCs brings new data which can help decide between theories.

- Anderson 2004, Dwivedi et al. 2009

Plan

- Experimental study
- Results of the study
- Analysis of the results

Method

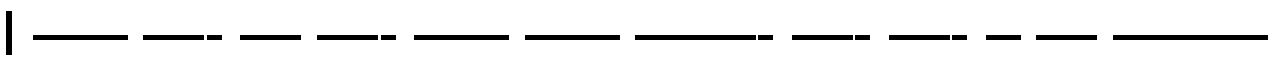
- A self-paced reading task testing how easy it is to process sentence-internal *same*
  - with 3 licensors: EACH, ALL and THE
  - in 2 orders: Q+SAME (quantifier precedes AOC) and SAME+Q (AOC precedes quantifier)
  - i.e., $3 \times 2 = 6$ conditions in total
- Each condition was tested 8 times
  - four times in sentences most likely judged as true relative to the background scenarios
  - four times in sentences most likely judged as false
  - for a total of 48 stimuli

Example

Sarah and Madeleine are two young women who live in a village that has only three shops, a fabric store, a bakery and a DVD store. Last Monday, Sarah went to the fabric store, then to the bakery and finally to the DVD store, while Madeleine was at home all day.

Example

Example



Example

- think —- — —- —— —— ——- —- —- – — ———

Example

- —— that — —- —— —— ———- —- —- – — ———

Example

- —— —- the —- —— —— ——- —- —- – — ——

Example

- —— —- — same —— —— ——- —- —- – — ———

Example

- —— —- — —- young —— ——- —- —- – — ———

Example

- —— —- — —- —— woman ——- —- —- – — ———

Example

- —— —- — —- —— —— visited —- —- – — ———

Example

- —— —- — —- —— —— ——- each —- – — ———

Example

Example

- —— —- — —- —— —— ——- —- —- in — ———

Example

- —— —- — —- —— —— ——- —- —- – the ——

Example

- —— —- — —- —— —— ——- —- —- – — village.

Example

Am I right to think that?

Scenarios

In general, scenarios consist of:

- 2 sets of entities (e.g., women and stores)
- a relation between them (e.g., ‘visit’)

Method

- 115 participants
- 2 groups
- each group: 12 items in surface scope, 12 items in inverse scope
- i.e., 24 test items plus 35 fillers $=$ 59 stimuli per participant
- the participants completed the experiment online
- order pseudo-randomized for each participant

Method

- the two data sets (75 and 40 participants) were initially analyzed separately
- no differences, hence final analysis based on merged data sets
- 22 participants excluded because 15% or more questions answered incorrectly
- Length of words and position in sentence factored out

Regions of interest

- Quantifier + 2 following words
- *Same* + 2 following words
- Reading times of full sentences

Quantifier and 2 following words

Surface scope:

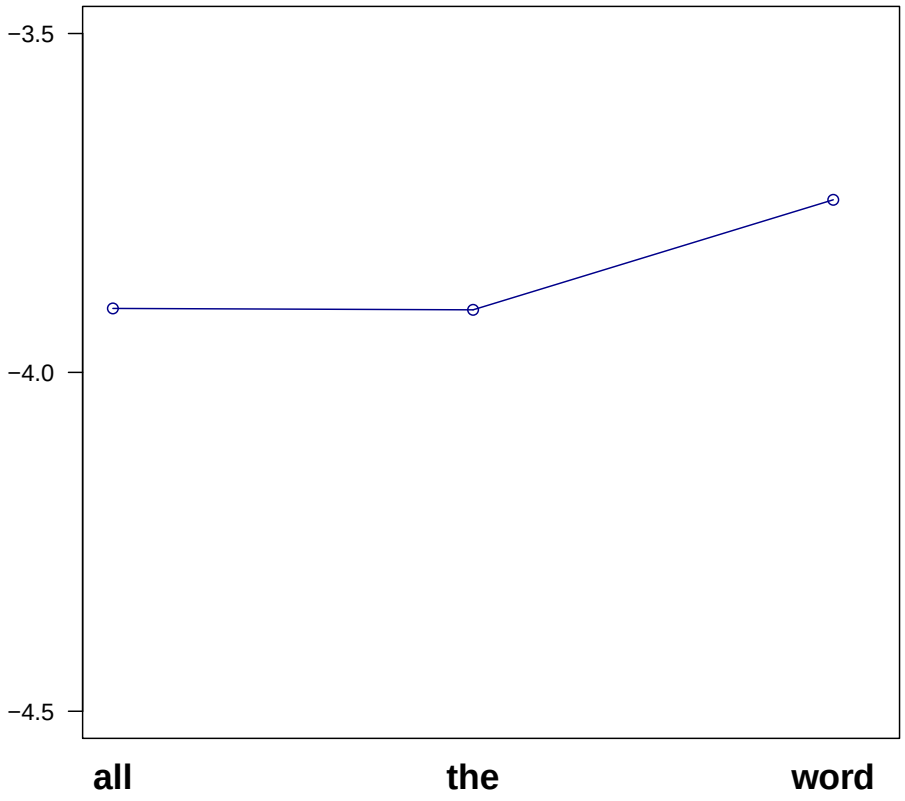
- I think that each young woman visited the same shop in the village.

Inverse scope:

- I think that the same young woman visited each shop in the village.

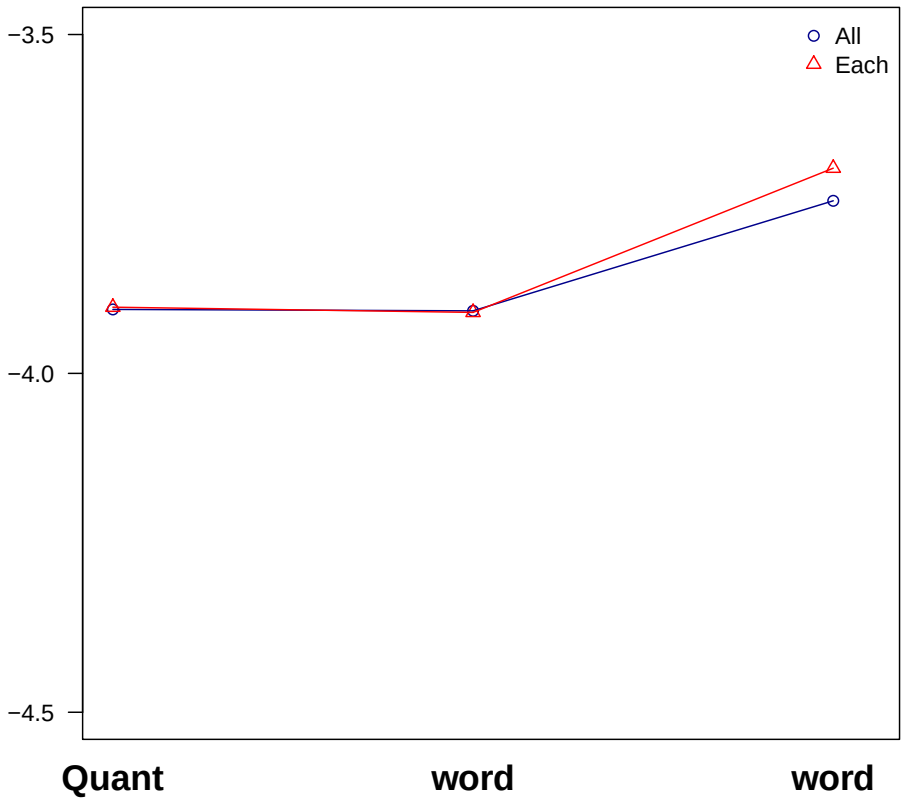
Quantifier and 2 following words

Surface scope



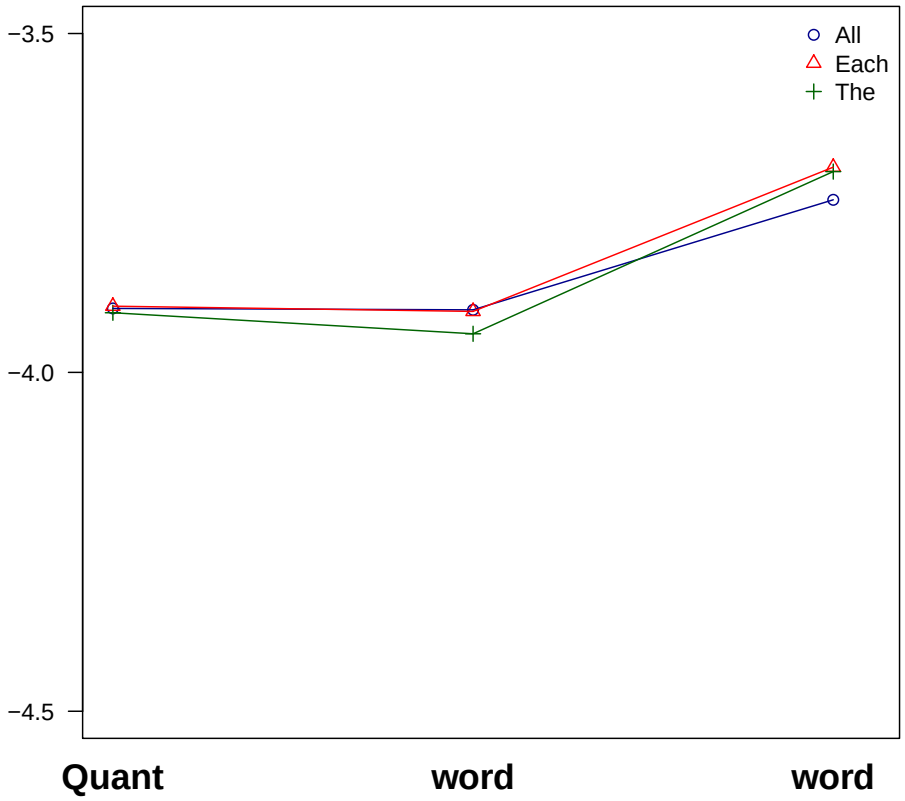
Quantifier and 2 following words

Surface scope



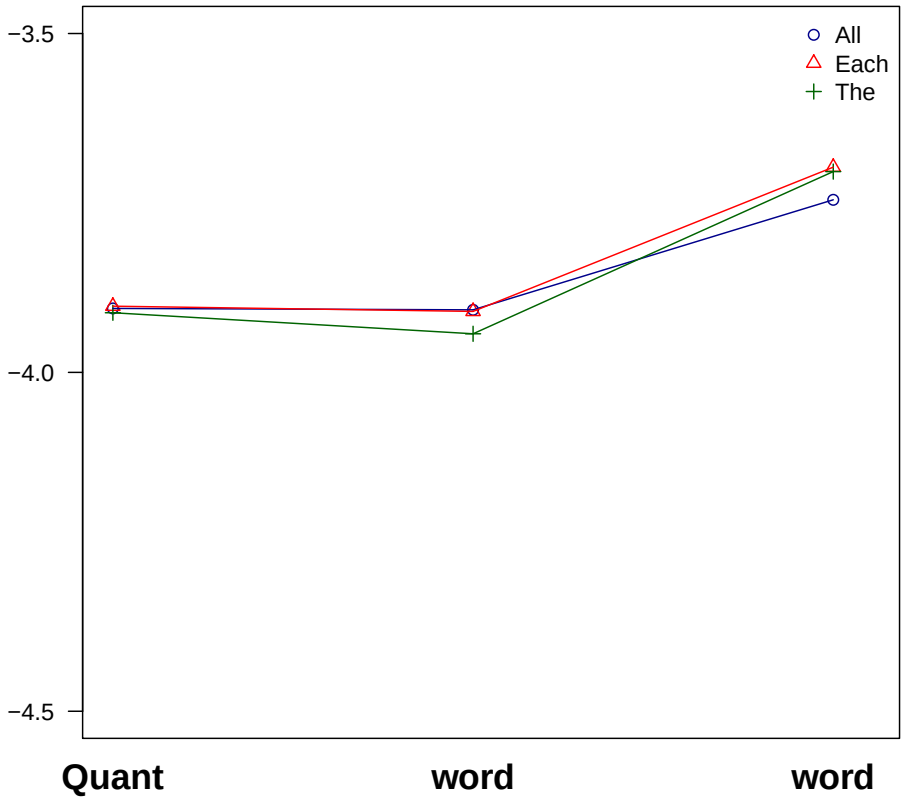
Quantifier and 2 following words

Surface scope

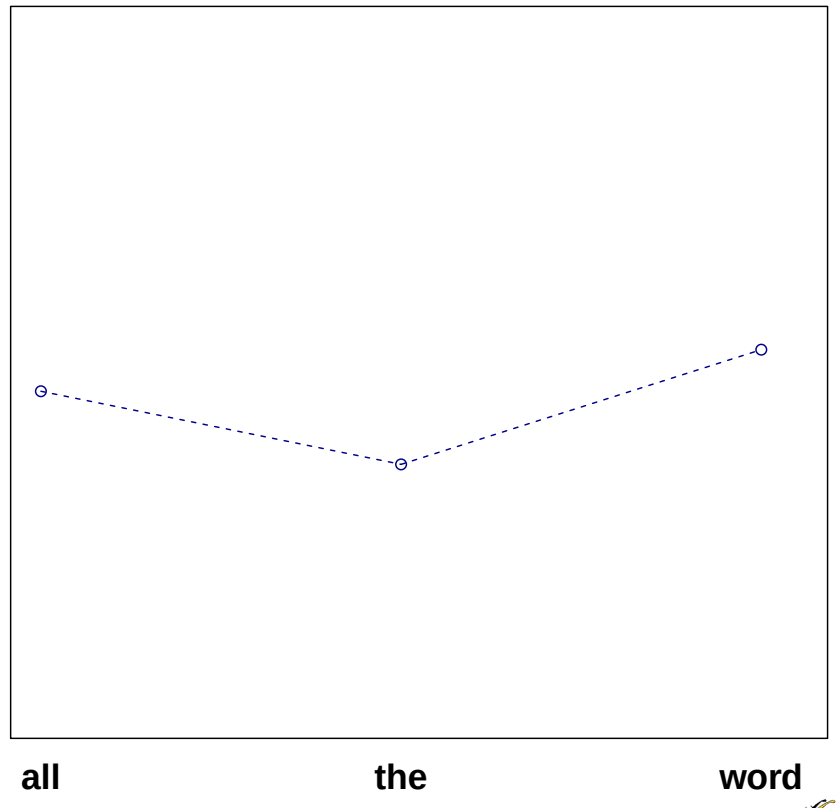


Quantifier and 2 following words

Surface scope

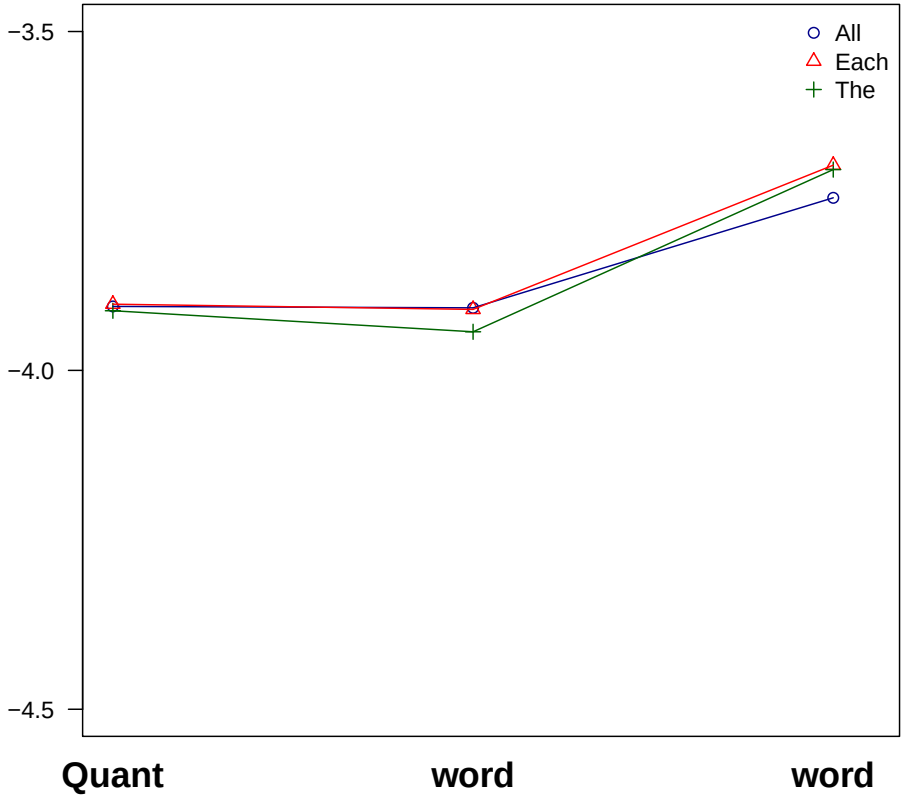


Inverse scope

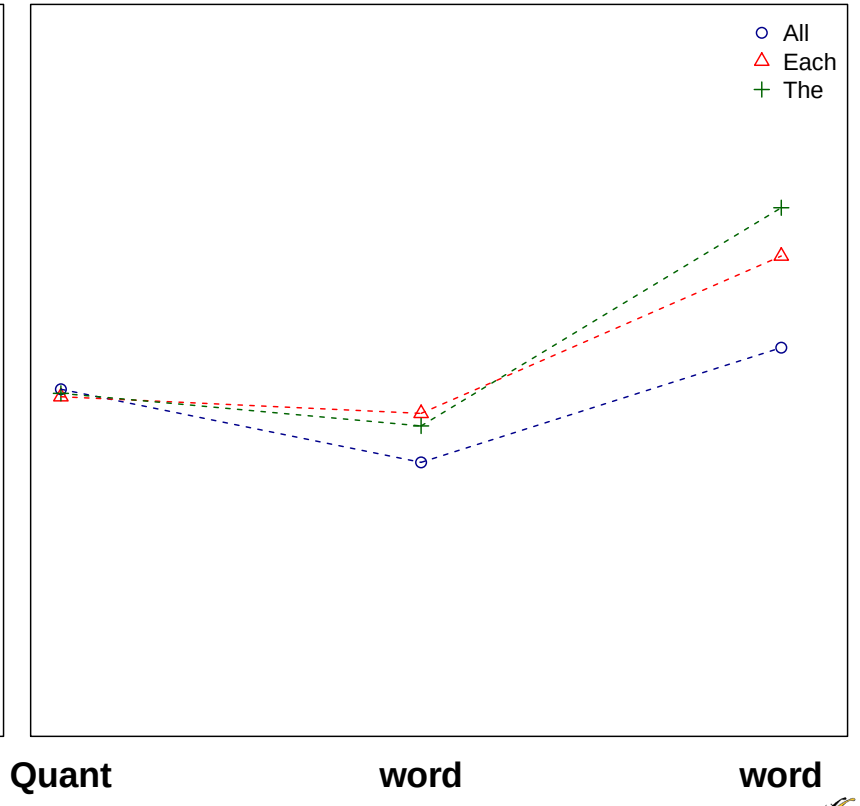


Quantifier and 2 following words

Surface scope



Inverse scope



Generalizations: Quant and 2 following words

- **Surface scope** $>$ **Inverse scope**

  (a$>$b means ‘a takes more time than b’)
  - But the two scopes are not directly comparable due to different positions of quantifiers (subject vs. object)
- In case of **Inverse scope**: **Each**, **The** $>$ **All**

Same and 2 following words

Surface scope:

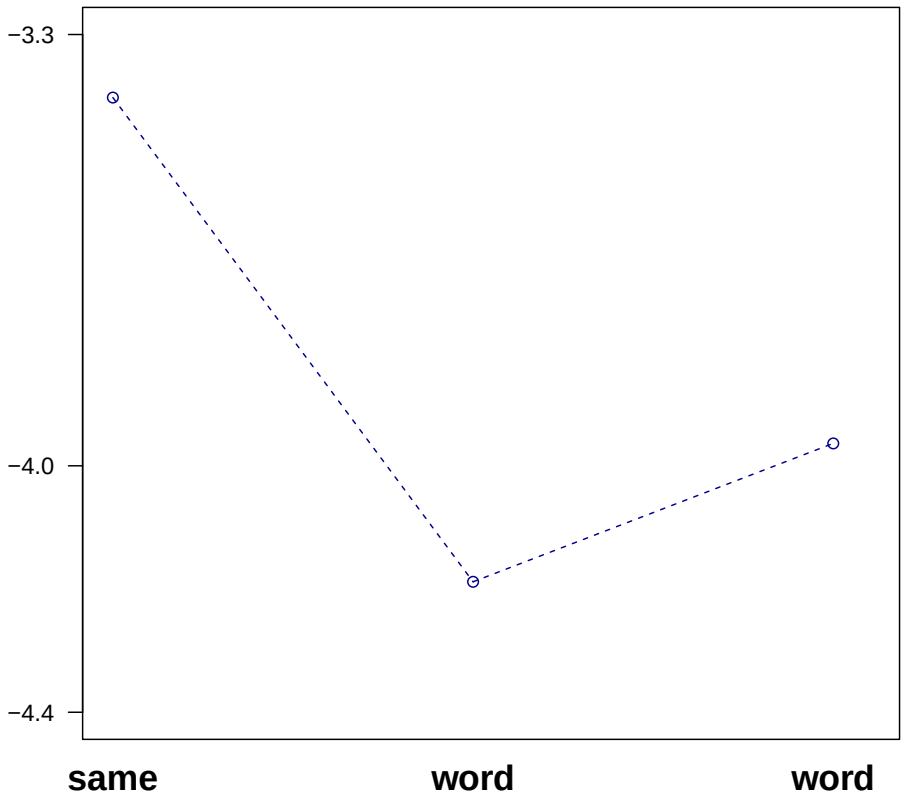
- I think that each young woman visited the same shop in the village.

Inverse scope:

- I think that the same young woman visited each shop in the village.

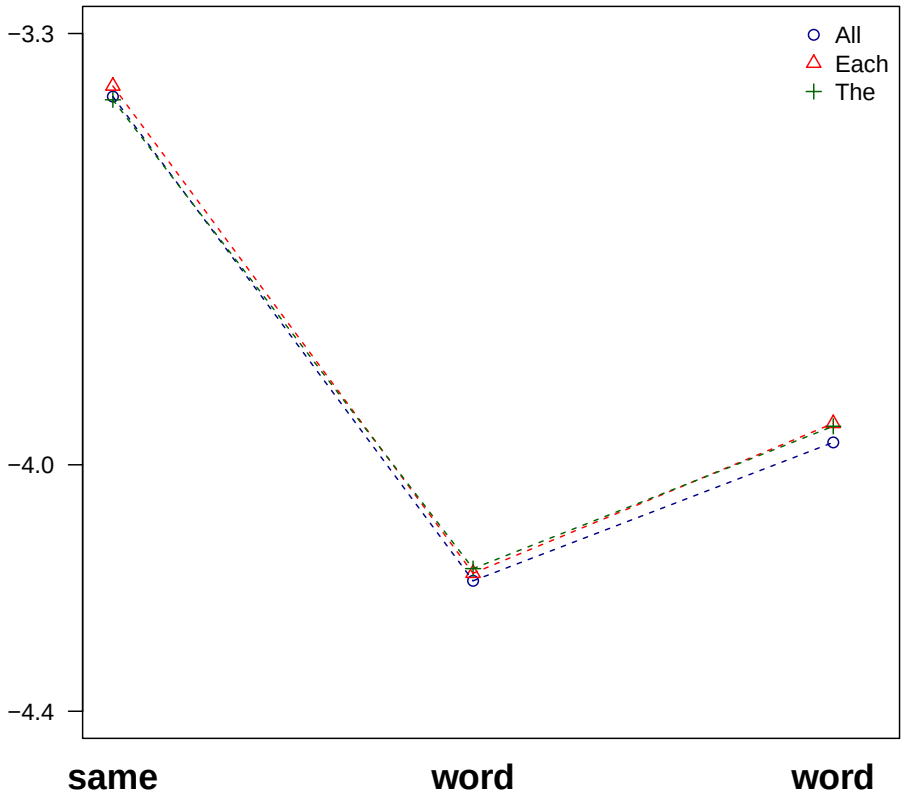
Same and 2 following words

Inverse scope



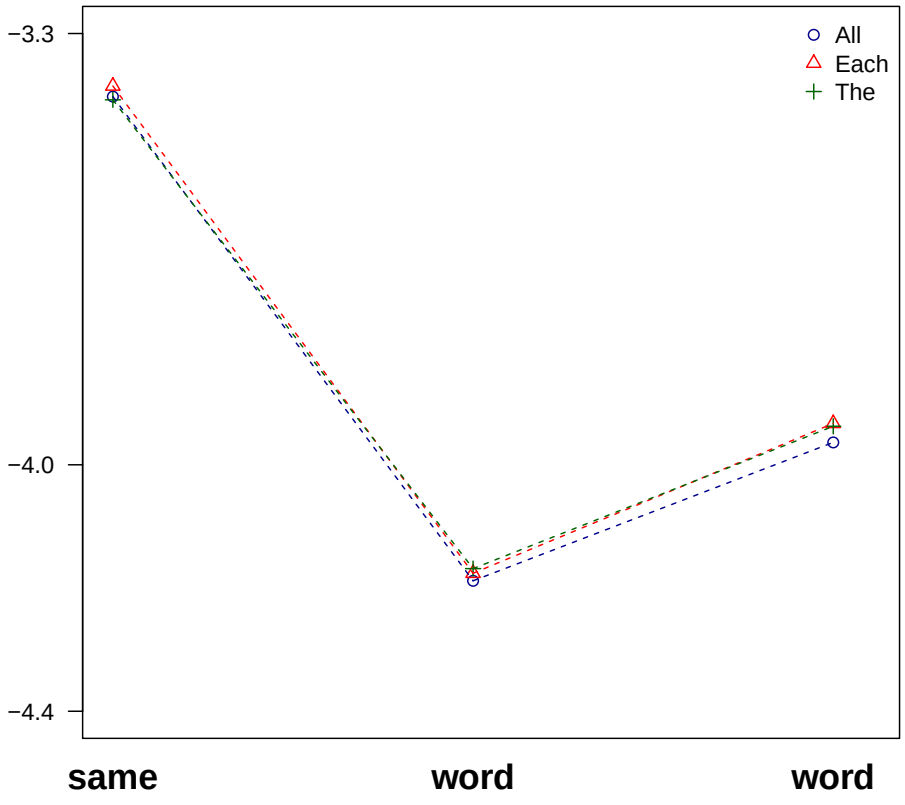
Same and 2 following words

Inverse scope

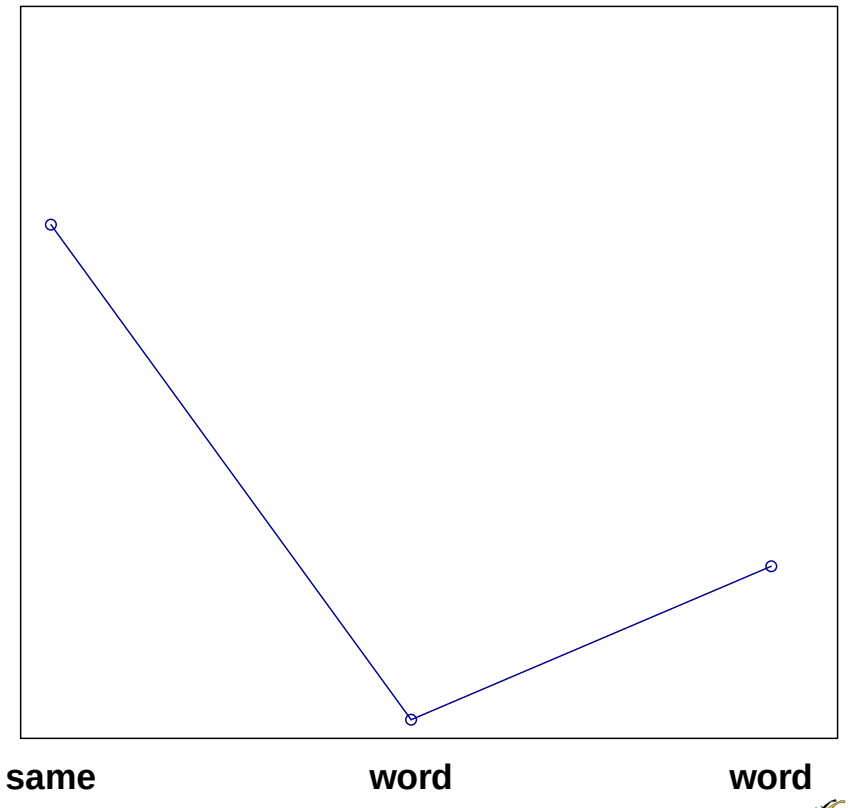


Same and 2 following words

Inverse scope

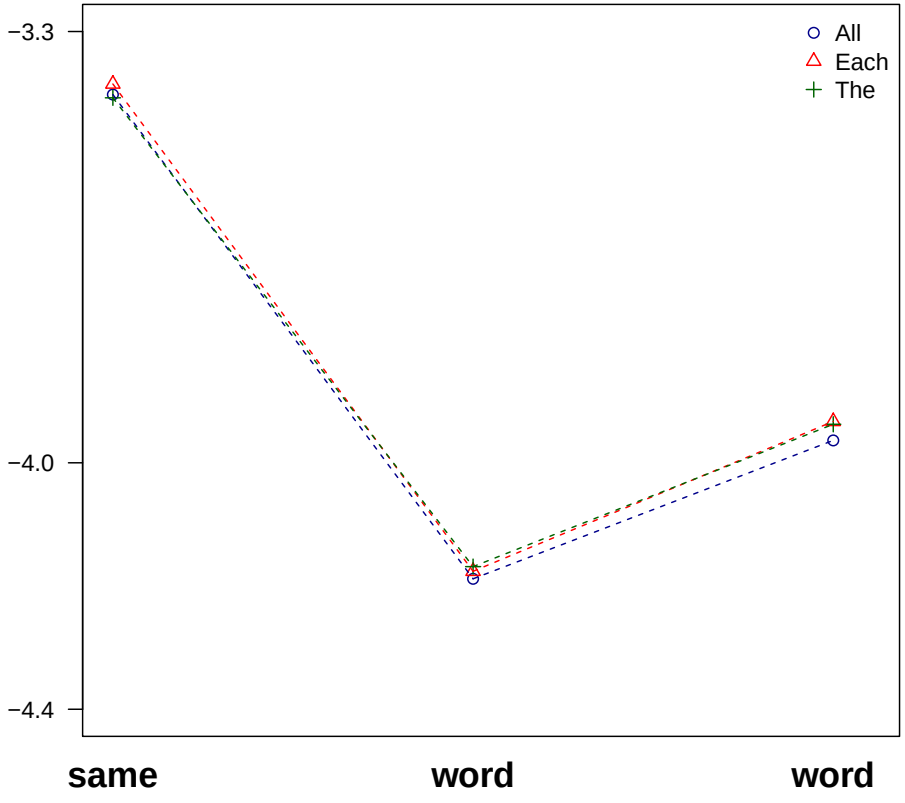


Surface scope

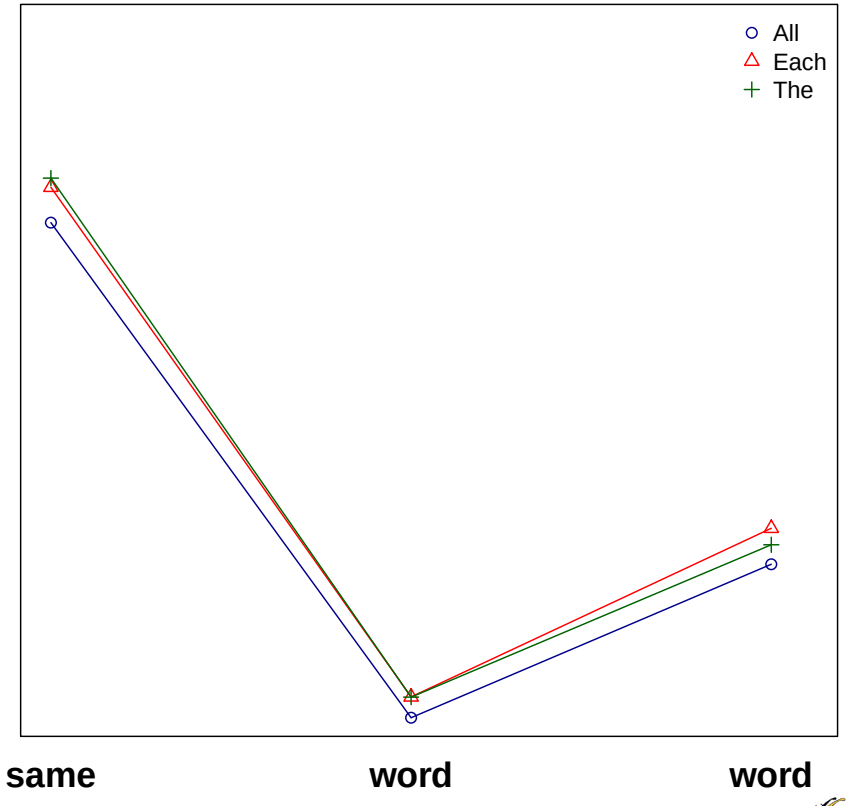


Same and 2 following words

Inverse scope



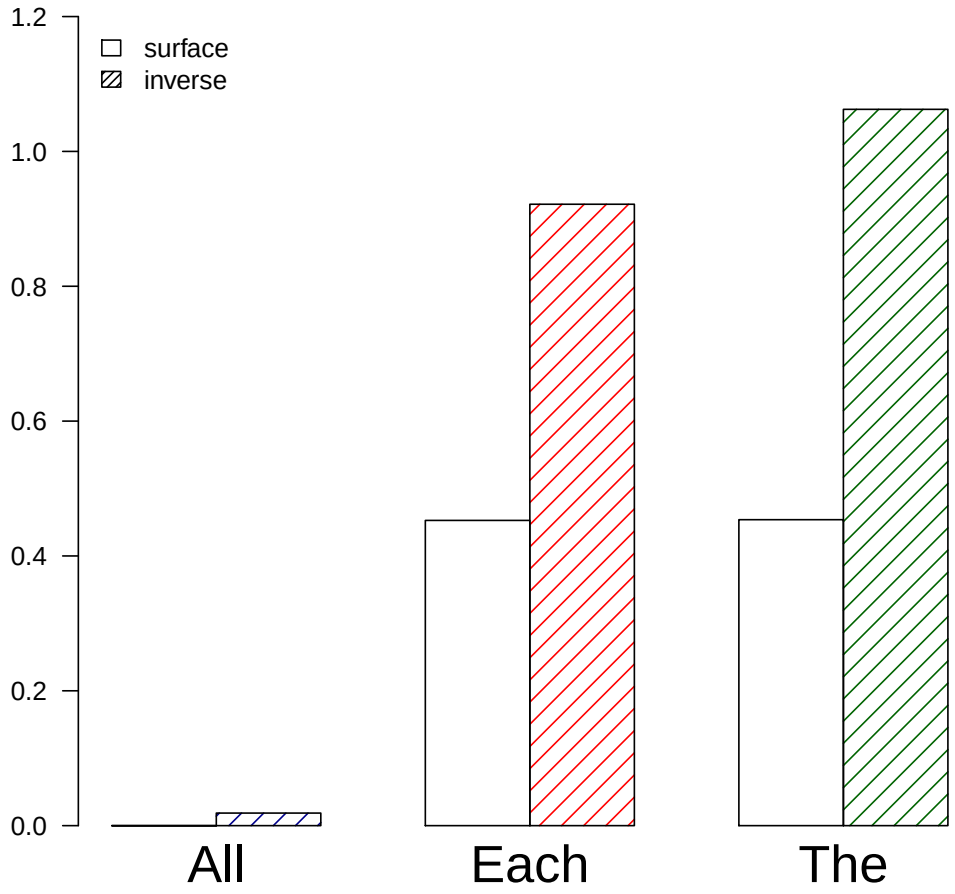
Surface scope



Generalizations: *Same* and 2 following words

- **Inverse scope** $>$ **Surface scope**
  - But the two scopes are not directly comparable due to different positions of *same* (subject vs. object)
- In case of **Surface scope**: **Each**, **The** $>$ **All**

Total times



Generalizations: Total times

- **All**:
  - Surface scope $\approx$ Inverse scope
- **Each**, **The** $>$ **All**
- **Each**, **The**:
  - Inverse scope $>$ Surface scope

Analysis

Three assumptions about the meanings of:

- *same* – ambiguous
- *each* – requires differentiation
- *the* – ordered interpretations

Assumption 1: *Same* is ambiguous

. . . like *different* in many languages (Beck, 2000; Dotlačil, 2010)

(11) { Iedere / ?Alle de / *De } jongen lezen een **ander** boek.

{ Every / ?All the / *The } boys read(s) a **different[1]** book.

(12) { #Iedere / Alle de / De } jongen lezen **verschillende** boeken.

{ #Every / All the / The } boys read(s) **different[2]** book.

Assumption 1: *Same* is ambiguous

Same[1]: identity between two entities

- Sentence-external:

(13) a. Arnold saw 'Waltz with Bashir'.
b. Heloise saw the same[1] movie.

The movie seen by Heloise $=$ 'Waltz with Bashir'

- Sentence-internal:

(14) $\left\{\begin{array}{c}\text{Each boy}\\ \text{All the boys}\end{array}\right\}$ saw the same[1] movie.

For any two boys b_1 and b_2, b_1's movie $=$ b_2's movie

Assumption 1: *Same* is ambiguous

- Sentence-internal:

(15) $\left\{\begin{array}{c}\text{Each boy}\\ \text{All the boys}\end{array}\right\}$ saw the same[1] movie.

- The distributive quantifier temporarily creates in its scope interpretation contexts of sentence-external form

$$\begin{array}{|c|}\hline \text{boy}_1 \\ \hline \text{boy}_2 \\ \hline \text{boy}_3 \\ \hline \end{array} \Rightarrow \left\{\begin{array}{l} \text{boy}_1\ \text{movie}_1\ \text{boy}_2\ \text{movie}_2 \quad \& \quad \text{movie}_1 = \text{movie}_2 \\ \text{boy}_1\ \text{movie}_1\ \text{boy}_3\ \text{movie}_3 \quad \& \quad \text{movie}_1 = \text{movie}_3 \\ \text{boy}_2\ \text{movie}_2\ \text{boy}_1\ \text{movie}_1 \quad \& \quad \text{movie}_2 = \text{movie}_1 \\ \qquad \text{etc.} \end{array}\right\}$$

Assumption 1: *Same* is ambiguous

Same[2]: relates parts of a plural individual to one entity by a binary relation R
Dowty, 1985, Barker, 2007

(16) $\left\{\begin{array}{c}\text{The boys}\\ \text{All the boys}\end{array}\right\}$ saw the same[2] movie.

- plural individual $=$ the boys
- $R =$ saw movie
- same[2]:

  'saw movie' relates any two boy atoms to the same entity

Assumption 1: *Same* is ambiguous

Sentence-internal reading with **same[1]**:

- all the work is done by the distributive quantifier (the licensor)

Sentence-internal reading with **same[2]**:

- all the work is done by *same*

Assumption 2: *Each* requires differentiation

Tunstall, 1998: *Each* needs "differentiated" events in its scope

(17) Jake photographed { #each student / every student / all the students } in the class, but not separately.

Assumption 3: Ordered readings for *The*

COLLECTIVE >> CUMULATIVE >> DISTRIBUTIVE

(18) a. The boys elected the representative.
b. The boys hugged the girls.
c. The boys had a sip of juice.

Brooks and Braine, 1996, Frazier, Pacht, and Rayner, 1999, Dotlačil and Brasoveanu, in prep.

Accounting for generalizations

The is interpreted collectively by default, so incompatible with *same*:

(19) # The boys elected the same president.

Reanalyzing towards non-collective takes extra time, hence:

- **The** $>$ **All** for reading times on *same* in surface scope

(20) The/all the young women visited the same shop in . . .

- and for full-sentence readings times in surface scope

(21) The/all the young women visited the same shop in. . .

Accounting for generalizations

Each requires differentiation:

(22) Each young woman visited a shop.

a very strong preference for distinct shops (Anderson 2004, Roeper et al. 2011)

. . . which makes it a dispreferred licensor of *same*:

(23) Each young woman visited the same shop.

Hence:

- **Each** $>$ **All** for reading times on *same* in surface scope

(24) Each/all the young women visited the same shop in . . .

- and for full-sentence readings times in surface scope

(25) Each/all the young women visited the same shop in. . .

Accounting for generalizations

No difference in full-sentence reading times between **Inverse scope** and **Surface scope** for **All**, hence:

- no evidence for processing costs of covert scoping operations

Accounting for generalizations

- **Inverse scope** $>$ **Surface scope** for **Each** and **The** for full-sentence reading times

(26) The same young woman visited each shop / the shops. . .

- **Each**, **The** $>$ **All** for reading times on QUANT in inverse scope

(27) The same young woman visited each shop / the shops . . .

Each and **The** (unlike **All**) force disambiguation of **same**:

- *same[1]* for **Each**
- *same[2]* for **The**

(28) The same young woman visited each shop / the shops.

Late disambiguation takes extra time
(Clifton and Staub, 2008)

Conclusion

- Inverse scope of quantifiers is costly because of model structure reanalysis, not because of covert scope operations
  - no inverse-scope slowdown when **All** licenses **same**
  - inverse-scope slowdown with **Each** and **The** due to **same** disambiguation
- Surface-scope slowdown on **Each** and **The**, as compared to **All**, because of lexical incompatibility with **same**

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