The value of corpus data in interpreting experimental results

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Experiments and Corpus data

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	Experiments	Naturalistic data
Advantages	Can target particular constructions/forms	Only way to capture what children hear
	Can pin down development	Possible breadth of coverage and contexts
Disadvantages	Can be very artificial	Difficulty of sampling dense enough data
		How naturalistic is it?

Obvious answer: Use one as a control on the other!

Complex sentences

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- here: main clause + adverbial clause
- express a specific relationship between two r (o more) situations

Our focus: *after, before*, *because* and *if*

Situation A		Relationship
After I put the kettle on	I ate a piece of toast	Temporal
Before she moved to Boston	she lived in LA	Temporal
Because she fell off her bike.	she grazed her knee	T + Causal
If you don't pay the money	I'll turn you in.	T + Conditional

Clause order

- Complex sentences can occur in two clause orders:
  - After I put the kettle on, I ate a piece of toast. [sub-main]
  - I ate a piece of toast after I put the kettle on. [main-sub]
  - Because she fell off the bike, she grazed her knee. [sub-main]
  - She grazed her knee because she fell off the bike. [main-sub]

Clause order

- The order can be iconic or non-iconic:

After I put the kettle on

I ate a piece of toast

Clause order reflects order of events in the real world.

I ate a piece of toast

after I put the kettle on

Clause **order is reversed** w.r.t. order of events in the real world.

Experiments on children's comprehension

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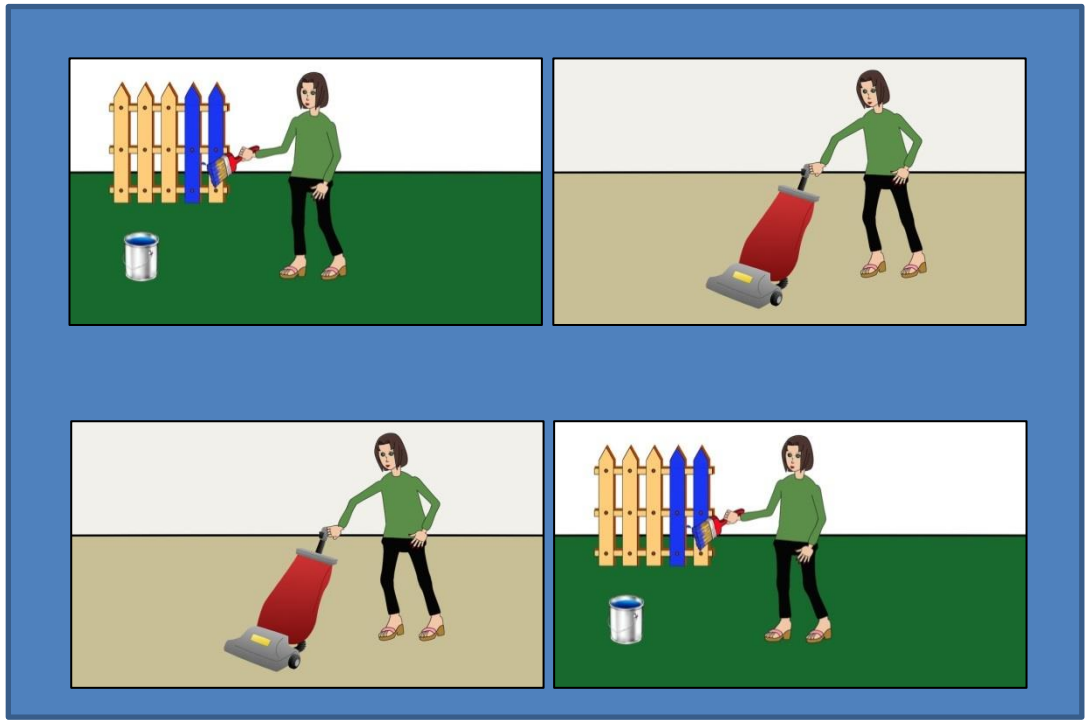
- Mixed picture:
  - Iconic orders are understood better than non-iconic orders
    (e.g., Blything et al., 2015; Corrigan, 1975; Emerson, 1979; Clark, 1971)
  - No difference between iconic and non-iconic orders
    (e.g., Amidon & Carey, 1972; Gorrell et al., 1989)
  - Information in the main clause is understood/processed better than information in the subordinate clause
    (e.g., Amidon & Carey, 1972; Gorrell et al., 1989; Johnson, 1975; Townsend & Ravelo, 1980)
  - *before* understood earlier than *after*
    (Blything et al., 2015; Clark, 1971; Feagans, 1980; Goodz, 1982)
  - *after* understood earlier than *before* (Carni & French, 1984)
  - No difference between *before* and *after*
    (e.g., Amidon & Carey, 1972; French & Brown, 1977; Gorrell, Crain, & Fodor, 1989)

See De Ruiter et al (2018) for these references

Design – De Ruiter et al 2018, *Cognition*

- Forced-choice picture selection task
  - Instruction: *Touch the matching story after the beep!*



Results

De Ruiter et al. 2018

- 4;0s barely above chance
- **Before** better than all other types
- **Iconic** orders better than non-iconic ones
- (Adults at ceiling)

Input

Correlations between input and language development have been found for other aspects of grammar such as morphology, but also syntax (e.g., relative clauses: **Kidd et al 2007; Brandt et al.2009)**

So, what do the complex sentences that children actually hear sound or look like?

Sampling

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Two important factors:

- Occurrence (frequency) of the linguistic feature
- Sample size and density of data collection:
  - Influences the probability of detecting a feature in the corpus
  - Influences the reliability of the estimates we make
  - Influences the estimated age of the first occurrence

Tomasello & Stahl, 2004
Rowland & Fletcher 2006

Types of corpora

***traditional** = 1 hour per 1-2 weeks, 26-52 hours per year = 1-2%*

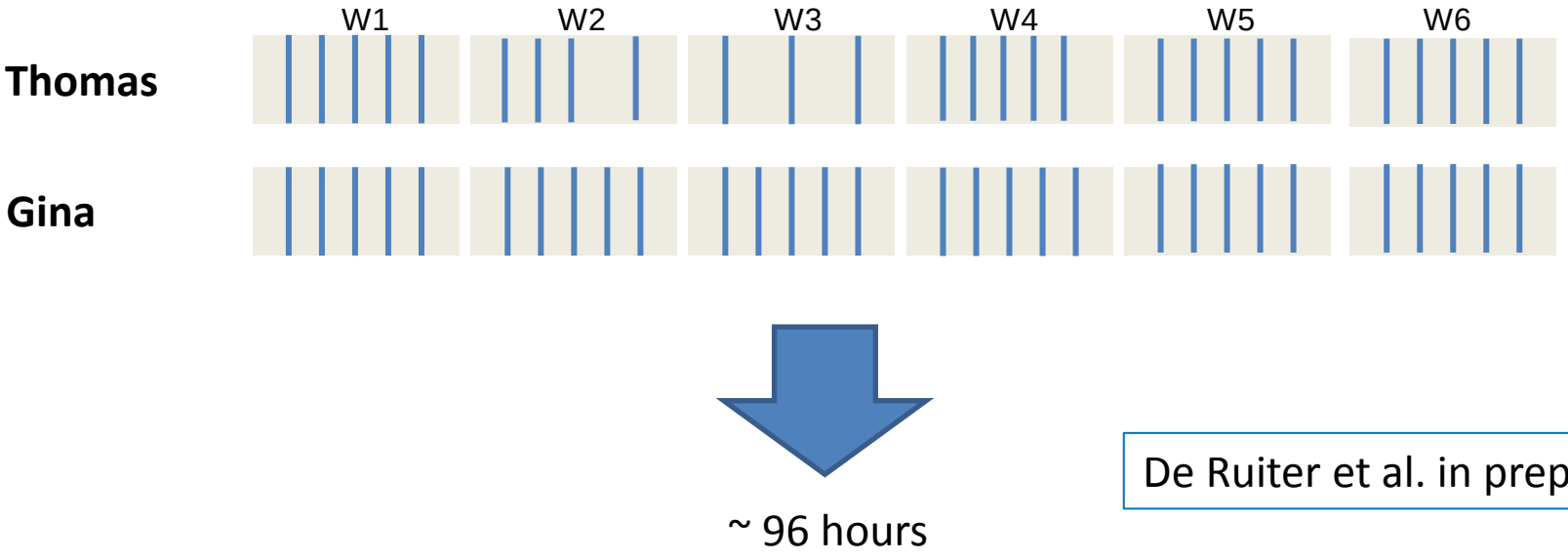
***high density** = 5 hours per week, 260 hours per year = 10%*
***double density** = 10 hours per week = 20%*

***diary** = Bowerman, Braunwald, Rowland,*

Lieven & Behrens 2012

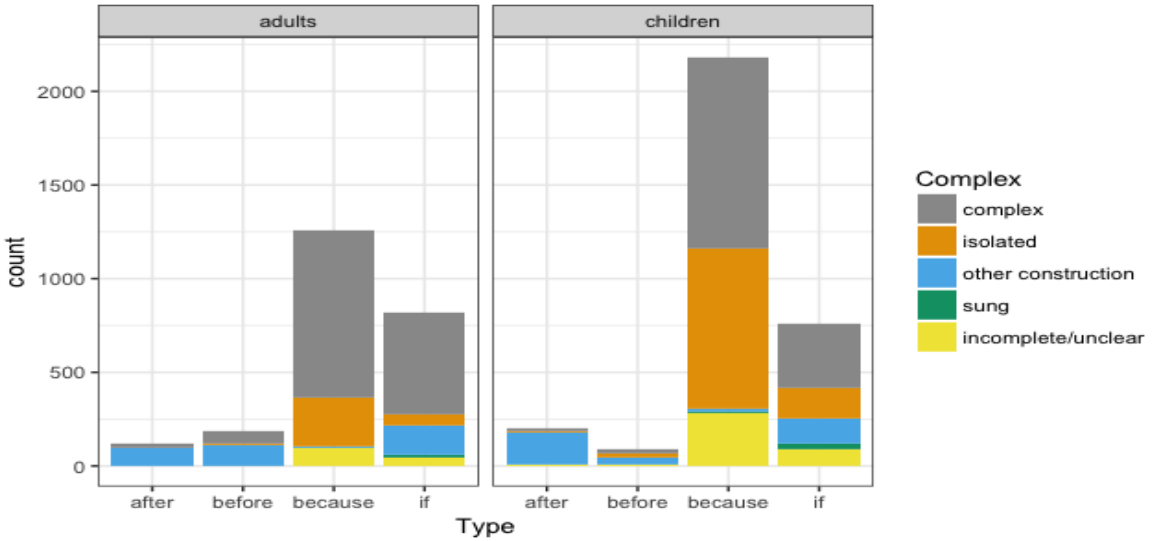
The data

- Child-directed speech (CDS) from two dense corpora of British English (Lieven, Salomo, & Tomasello, 2009)
- 6 weeks starting at the 3rd birthday, several recordings every week:



De Ruiter et al. in prep

Frequencies of adverbials and constructions



Vastly different overall frequencies for different adverbials

- ***after*** and ***before*** much less frequent than ***because*** and ***if***:
  both used more in other constructions but ***after*** almost exclusively

Relative frequencies similar for mothers and children

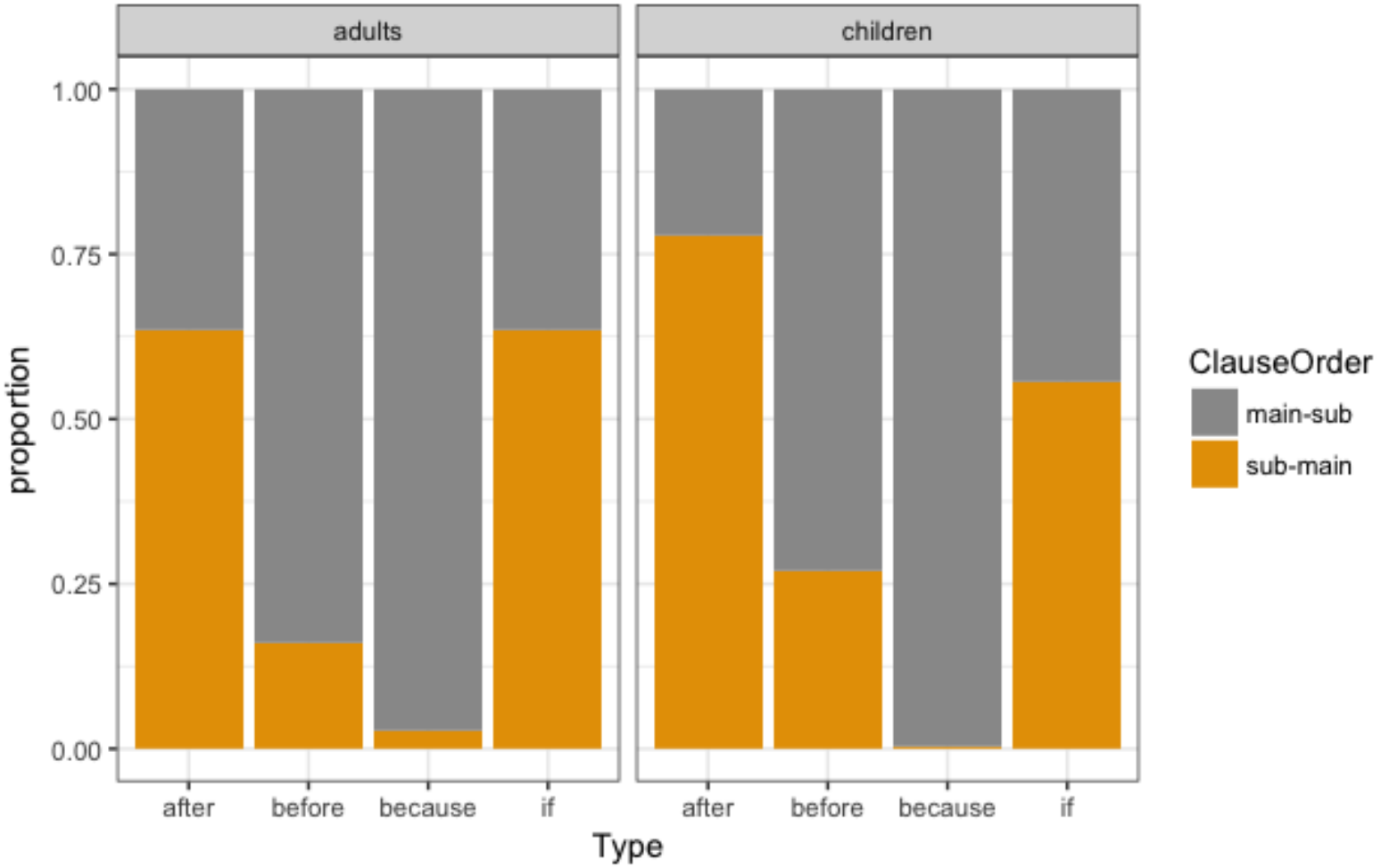
- ***because*** children >> adults (73.1% vs. 58.8%, $p < .0001$
  if children << adults (24.4% vs. 35.2%, $p < .0001$)
  before children << adults (1.9% vs. 4.5%, $p = .0003$)

Children used adverbial sentences in isolated utterances more than adults -
as replies in 20.4% of the cases, in contrast with only 8.4% for the mothers ($p < .0001$)

So even though children hear *before* much less than *because* and *if*, they are better with it in the experiment

De Ruiter et al. in prep

Clause order: adults and children

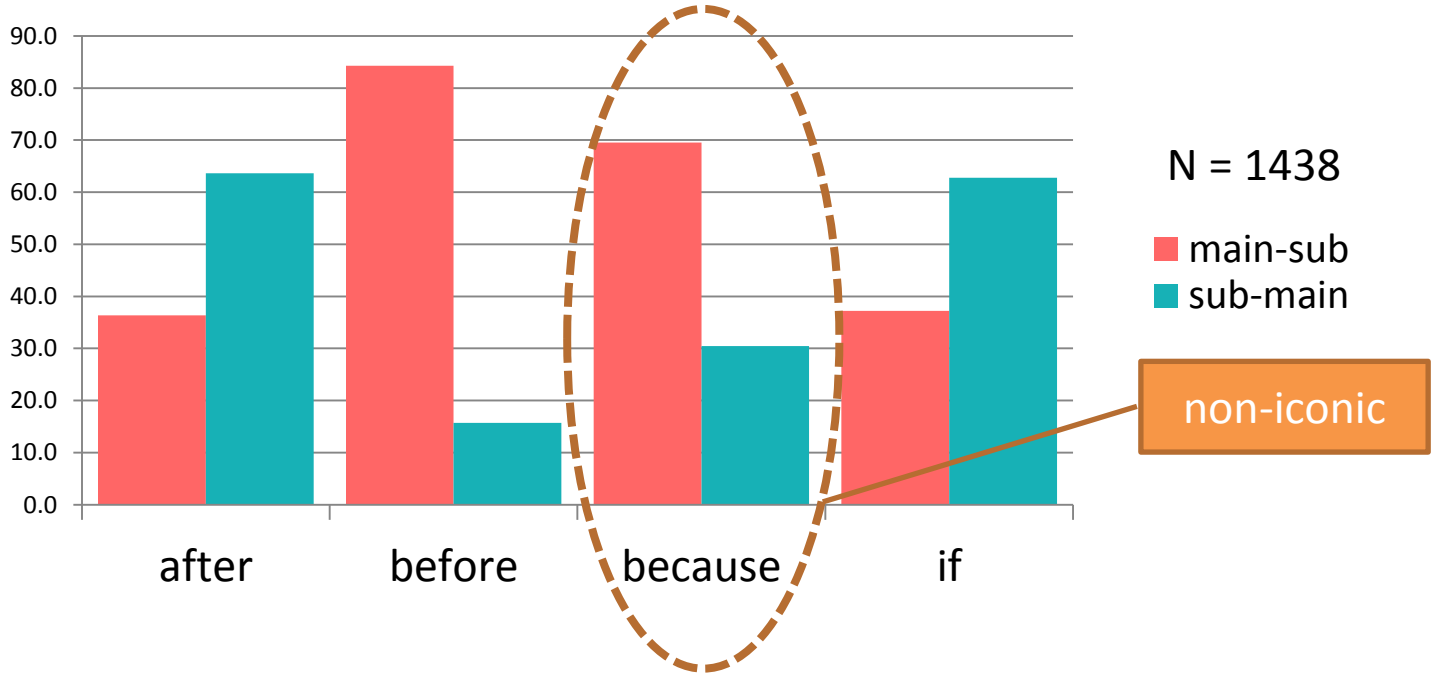


Relative frequencies very similar

Iconicity was the most important factor in the experiment.

➡ But not (entirely) predicted by input frequency.

Clause order by type in CDS corpus:



Because she fell off the bike, she grazed her knee.	[sub-main]	iconic
➢ She grazed her knee because she fell off the bike.	[main-sub]	non-iconic

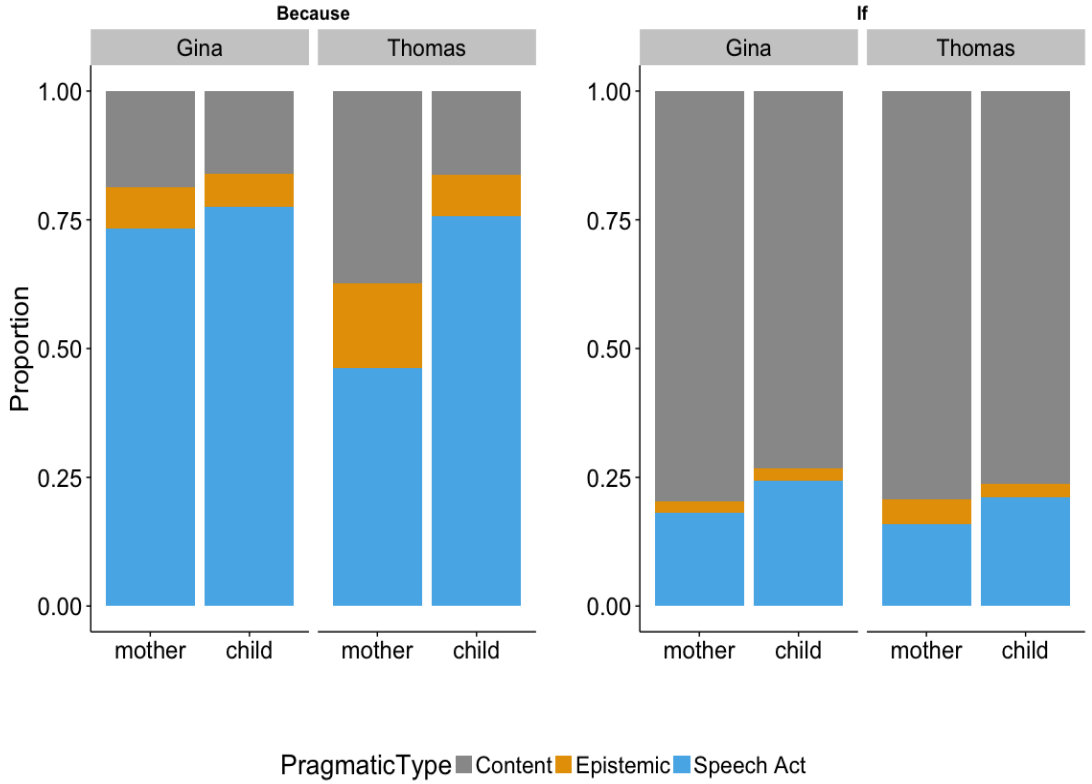
➡ So even though children hear the "[main clause….], ***because*** [sub clause…]" order much more often, they find the reverse, iconic order easier to understand in the experiment.

Other findings….

Subjects

- Nominal form mostly pronouns:
  - 92.4% of main clauses
  - 86.3% of subordinate clauses
- Definite/indefinite NPs or names relatively rare but these tend to be used in experiments (e.g. *the girl, the dog*)

Pragmatic type



De Ruiter, in prep.

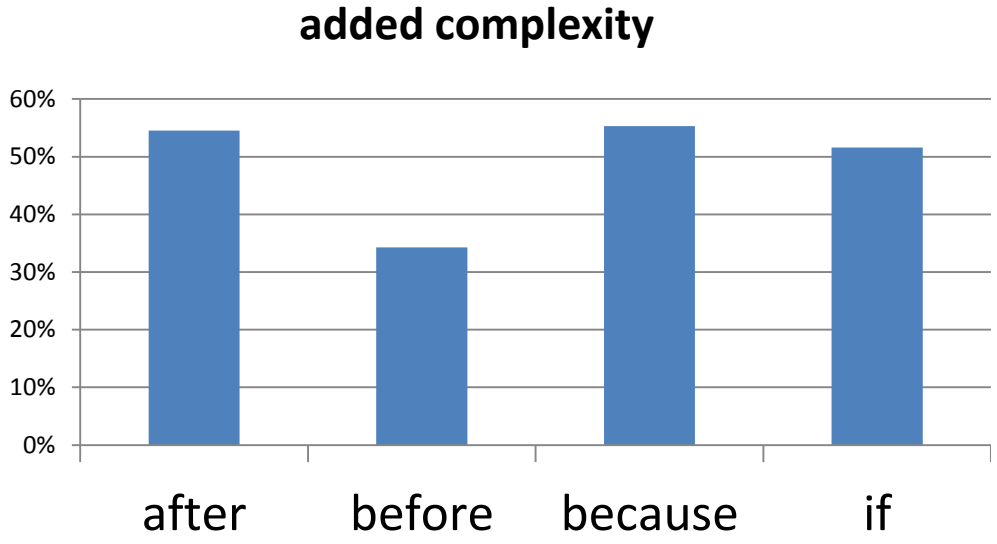
N = 2798.

- Patterns very similar for mothers and children
- ***because*** mainly used in speech act utterances
- ***if*** mainly used in content utterances

In experiments ***if*** and ***because*** are used in content utterances

Additional complexity

- About 50% of all complex sentences consisted of *more than* one main clause and one subordinated clause.



Additional Complexity (2)

- Reasons for additional complexity (ex.):
  - Complement clauses
    - *What number would we dial if we **wanted to talk** to Daddy at work?*
  - Compound complex sentences
    - *And she wanted Smudge **but** Smudge wouldn't go into her house because they used to have a dog.*
  - Multiple subordinators
    - ***If** you drop it on the floor there'll be trouble, Thomas , **because** you've been warned.*
    - *They make you very, very poorly **if** you take these **when** you don't need them.*
  - Constituent coordination
    - If **you're happy and you know** it stamp your feet.

Additional complexity (3)

- … And it can get very complex indeed:
  - *We haven't got a bird table so if I just throw the bread out on the grass and it goes soggy you eat it and that's not what you're supposed to do because when I throw the bread out it's stale.*
  - *Well either the train's very early or Mummy's very late, because if the train was going past Mummy's house before Mummy had left her house to go to the platform then either Mummy's running very, very late and she would've missed the train anyway, or the train's going past too early.*

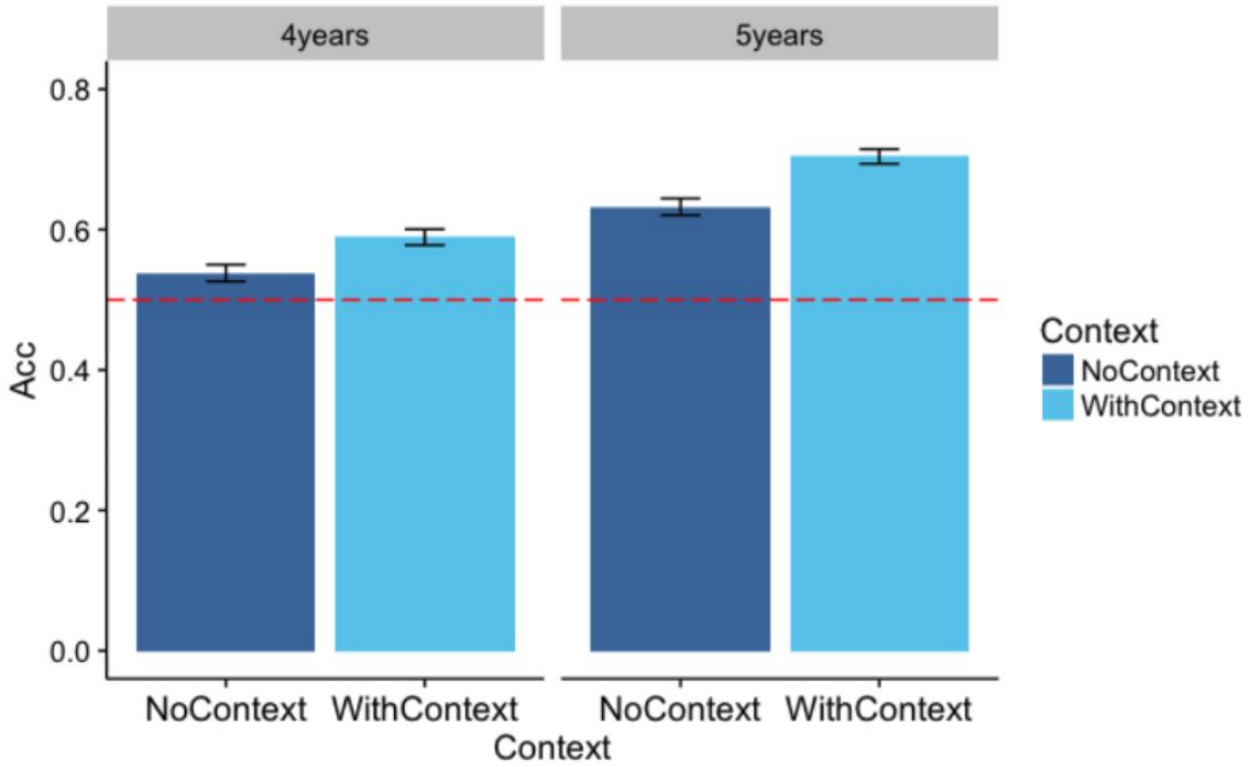
Summary of corpus findings

- Great variation in overall frequency of prepositions/ connectives, and relative frequency of use as subordinator:
  - *before/after* relatively rare, and mainly used in other constructions
- Type-specific preferences in clause order:
  - iconic clause order for *before, after* and *if*
  - non-iconic order (main-sub) for *because*
- Majority of clauses have pronominal subjects
- ***because*** mainly used for speech act sentences

  if mainly for simple content sentences, though mothers use significantly more hypotheticals
- Additional syntactic complexity common

Results from the experiment	Possible explanations
before better than ***after***	***after*** is used in more different constructions with other meanings?
before and ***after*** understood better than **because/if,** despite much lower frequency of use by both adults and children	-the cognitive challenge of causality and conditionality? ***-because*** used much more frequently in speech acts ***-if*** used in hypotheticals significantly more by adults than children
because understood better in iconic (sub-main) order despite being used in main-sub order by adults	Iconicity makes for easier processing at early stages? Children use ***because*** in isolated sentences in answer to adult questions?
4;0s at chance despite using these terms	No context -significantly above chance if context provided (de Ruiter et al., submitted)

Effects of context



Mean accuracy in De Ruiter et al.'s (2018) study with isolated sentences (NoContext) and the current study (Context) for the four-year-old and the five-year-old group. The red dashed line indicates chance level. The error bars indicate standard error

De Ruiter et al. submitted

Conclusions

- **Frequency mapping ubiquitous:**
  - Can explain why children can do things early and some things late
    - Possibility of schemas – "*He ,,, because ,,,,,*"
- **When frequency *can't* account for the results:**
  - frequent in the corpus and children learn it late
    - Cognitive complexity; Pragmatic usefulness
  - infrequent in the corpus and children learn it early
    - One-to-one form-function mapping; Pragmatic usefulness; Support from other constructions

[**Good**] corpus data is essential to understanding development
- It can clarify and explain experimental results
- It can generate new hypotheses for testing

The team …

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References

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The end

Thank you!