

Filling in the Blanks in
Understanding Discourse Adverbials:
Consistency, Conflict,
and Context-Dependence in a Crowdsourced
Elicitation Task

Hannah Rohde, Anna Dickinson, Nathan Schneider,
Christopher N. L. Clark, Annie Louis, & Bonnie Webber

Discourse relations

- ▶ Bridge between sentence- and discourse-level semantics
- ▶ Can be signalled explicitly with (multiple) connectives

I planned to make lasagna, **but instead** I made hamburgers.

I didn't know how to make lasagna, **so instead** I decided to make hamburgers.

Surprisingly, they ignored the lasagna, **and instead** they just ate the salad.

- ▶ ~~and?~~ Or implicitly conveyed via inference

I didn't know how to make lasagna. **Instead** I decided to make hamburgers.

This study: conjunction completions

I don't know how to make lasagna _____ **instead** I decided to make hamburgers.

1. Do inferable discourse relations hold when a discourse adverbial is already present?
 - Yes, adverbials license inferred conjunctions
2. How can discourse adverbials best be characterized with respect to inferred relations?
 - Not predictable from adverbial or semantic class
 - More than one valid connection in some cases

Contributions

- ▶ Multiple judgments can inform our understanding, not just correct for noise/bias.
- ▶ Current resources annotated with discourse relations assume explicit connectives preclude inferred relations.
- ▶ First step for informing theories of adverbials, conjunctions, and coherence

Our recent work

- ▶ Preliminary crowd-sourced conjunction completion task
- ▶ 4 adverbials (Rohde et al. 2015)

ConnText University of Edinburgh

Trial [Show Instructions](#)

I don't mind **walking** // **in fact** it's good exercise

Conjunction:

- Or
- But
- Because
- None at all
- So
- And
- Before
- Other word or phrase

Once you have made your selections, press submit to complete the trial. To share additional comments about this trial, please [click here](#).

Preliminary findings from our recent work

- ▶ People can do this task.
 - ▶ Passage matters: e.g., for INSTEAD, some passages favored 'so', others 'but', others 'because'
 - ▶ Adverbial-specific bias: e.g., for AFTER ALL, bias overall for 'because' (more so than IN FACT, IN GENERAL, INSTEAD)
- Current study offers extension to more adverbials & analysis of inter-annotator **disagreement**

Current study: conjunction completion

- ▶ Materials: for each adverbial, 50 passages (mostly) from NYTimes Annotated Corpus (Sandhaus, 2008)

- ▶ Half originally explicit

“Nervous? No, my leg’s not shaking,” said Griffey, who caused everyone to laugh // _____ indeed his right foot was shaking.

Author=‘because’

- ▶ Half originally implicit

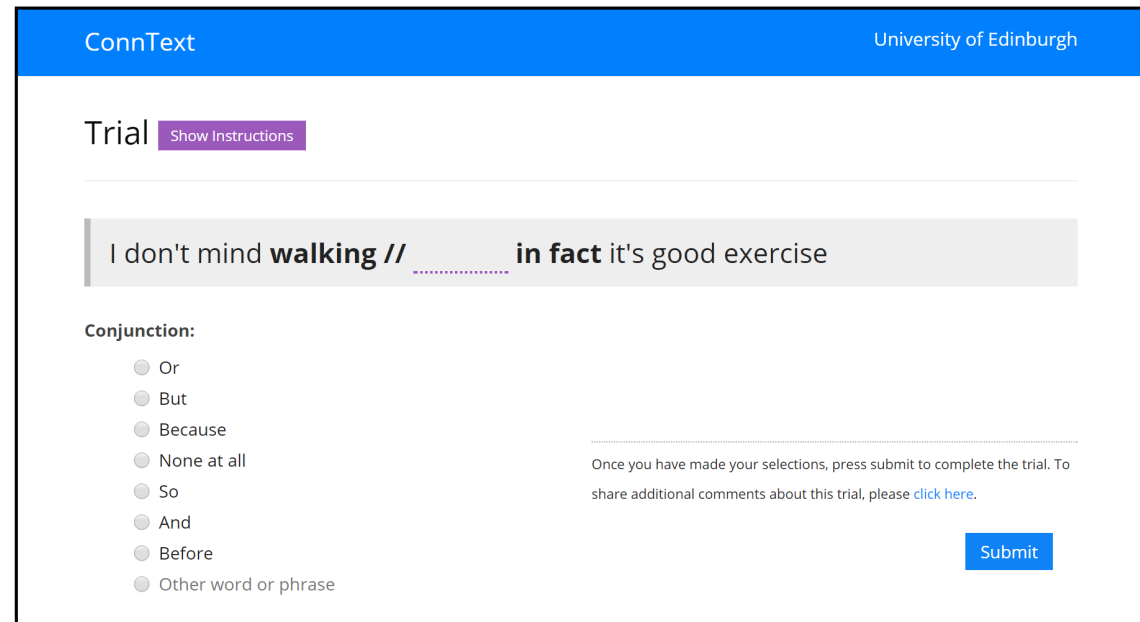
Sellers are usually happy, too // _____ after all they are the ones leaving with money.

Author=NONE

Adverbials: ACTUALLY, AFTER ALL, FIRST OF ALL, FOR EXAMPLE, FOR INSTANCE, HOWEVER, IN FACT, IN GENERAL, IN OTHER WORDS, INDEED, INSTEAD, NEVERTHELESS, NONETHELESS, ON THE ONE HAND, ON THE OTHER HAND, OTHERWISE, SPECIFICALLY, THEN, THEREFORE, & THUS

Current study: conjunction completion

- ▶ 28 participants from Amazon Mechanical Turk
- ▶ Procedure: one passage at a time
- ▶ Find conjunction to 'best reflect meaning of connection' between text spans
- ▶ Catch trials



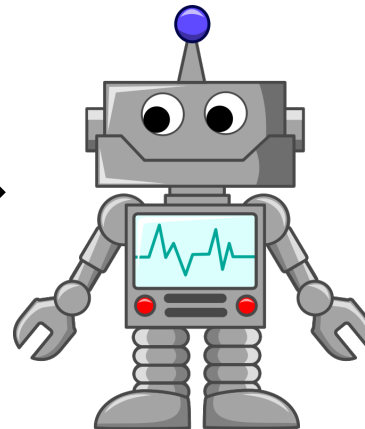
The screenshot shows a web interface for a trial. At the top, there is a blue header with "ConnText" on the left and "University of Edinburgh" on the right. Below the header, the word "Trial" is displayed next to a purple "Show Instructions" button. A text box contains the sentence: "I don't mind walking // in fact it's good exercise". Below this, the label "Conjunction:" is followed by a list of radio button options: "Or", "But", "Because", "None at all", "So", "And", "Before", and "Other word or phrase". To the right of the options, there is a note: "Once you have made your selections, press submit to complete the trial. To share additional comments about this trial, please [click here](#)." At the bottom right, there is a blue "Submit" button.

You can lead a horse to water // ____ you can't make it drink

Hypotheses

- ▶ **Variability across adverbials:** Do adverbials pattern uniformly or vary (by semantic type)?
- ▶ **Variability within adverbials:** Does the adverbial predict the same conjunction for all passages?

- ▶ If deterministic →



- ▶ If not →

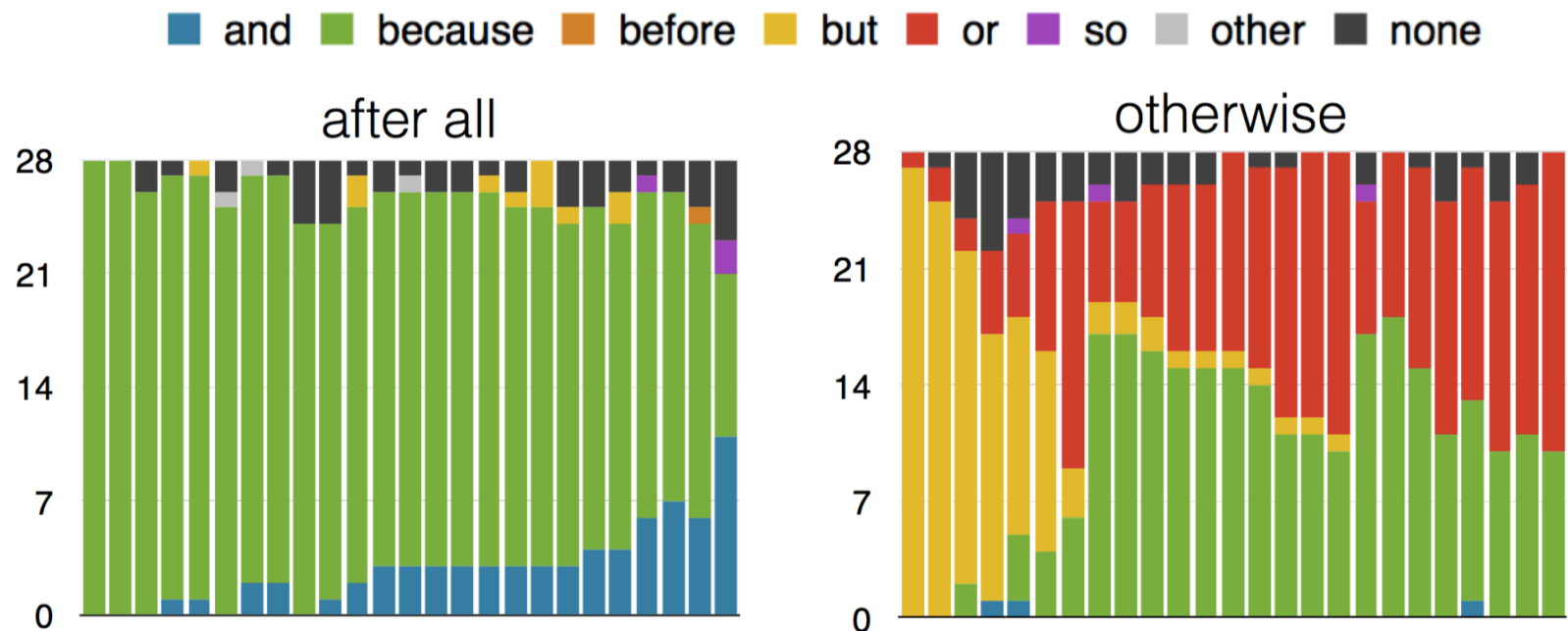


Results: Explicit passages

- ▶ Dataset: 12,216 data points
- ▶ Recover same conjunction author used: 57%
- ▶ If 'so'/'but' considered compatible with 'and' (Knott 1996), calculated match with author: 70%

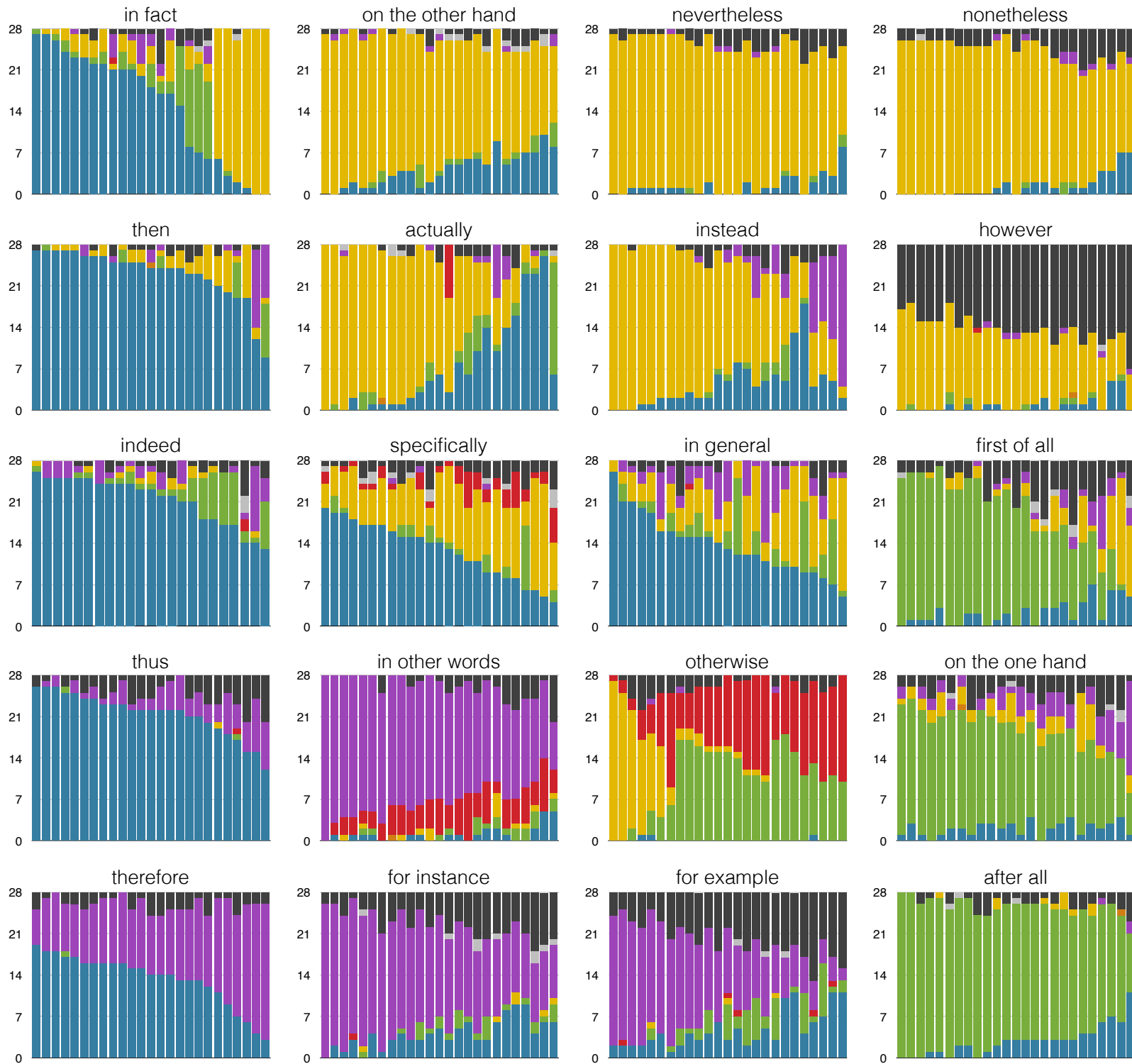
Results: Implicit passages

- ▶ Dataset: 13,916 data points
- ▶ For each adverbial, visualize completions for all passages



- AFTER ALL's bias to 'because' replicates Rohde et al. (2015)
- Pattern of OTHERWISE shows importance of passage context

and because before but or so other none



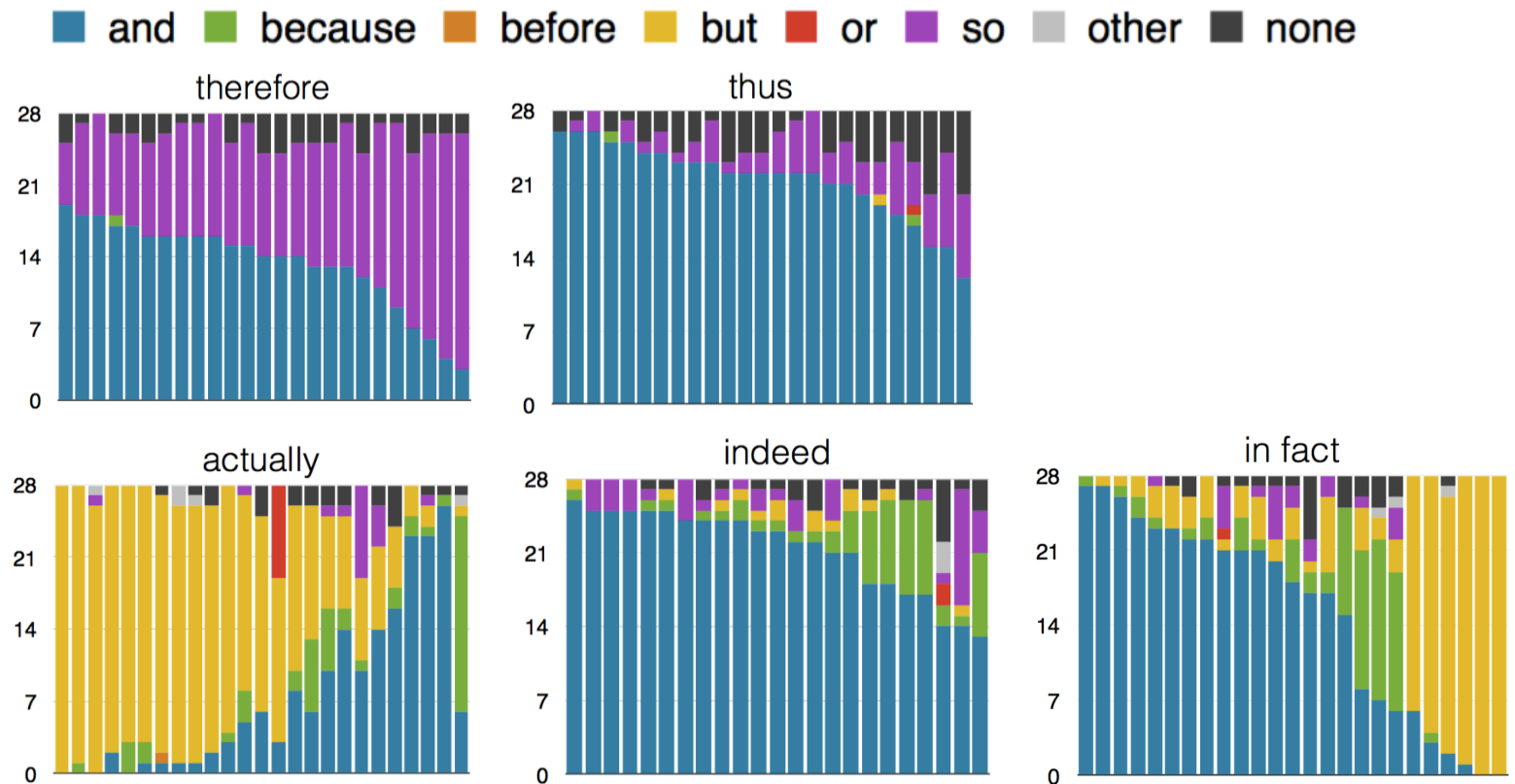
Results: Implicit passages

- ▶ Adverbials do not uniformly favor one conjunction.
- ▶ How to characterize adverbials?
- ▶ On one hand, we see some consistency in semantically related adverbial pairs.



Results: Implicit passages

- ▶ But also divergence for near synonyms or for adverbials that are all used to convey modal stance



- ▶ Adverbial itself matters, as does passage content.

Informative disagreement

- ▶ Conjunction can disambiguate the attachment point

“Nervous? No, my leg’s not shaking,” said Griffey, who caused everyone to laugh // _____ indeed his right foot was shaking.

‘because’

‘but’

Author=‘because’

13 Participants=‘because’

11 Participants=‘but’

- ▶ Conjunction can signal alternative reasoning

There was a testy moment driving over the George Washington Bridge when the toll-taker charged him \$24 for his truck and trailer // _____ after all it was New York.

Author=‘but’

11 Participants=‘but’

15 Participants=‘because’

Informative disagreement

- ▶ Adverbial-specific patterns arise: e.g., Author~Participant divergence with OTHERWISE

“The Ravitch camp has had about 25 fund-raisers and has scheduled 20 more. Thirty others are in various stages of planning,” Ms. Marcus said. “It has to be highly organized // _____ otherwise it’s total chaos,” she added.

Author='or'

17 Participants='or'

11 Participants='because'

- ▶ Not noise
- ▶ Not evidence of ambiguity
- ▶ Rather, different context-sensitive ways of conveying same sense with different conjunctions

Characterization of adverbials

- ▶ Previously undocumented conjunction+adverbial combinations
- ▶ Unpredictability of conjunction from adverbial alone
- ▶ Contributions from conjunction and adverbial:
 - ▶ same sense (e.g., 'so thus')
 - ▶ separate sense (e.g., 'so in other words')
 - ▶ parasitic (e.g., 'so for example')

Implications for annotation efforts

- ▶ Disagreements are not errors, contra prior work on:
 - ▶ Corrections for biased/inattentive participants (Hovy et al. 2013, Passonneau & Carpenter 2014)
 - ▶ Importance of many annotators for reducing bias (Artstein & Poesio, 2005, 2008)
 - ▶ Use of naive annotators to infer discourse relations (Scholman et al., 2016)
- ▶ All with same assumption of a single correct answer

Take-home points

- ▶ **Multiple connectives:** Establish necessity of entertaining implicit relations when adverbial is present
- ▶ **Context sensitivity:** Adverbial alone does not completely predict discourse relation



- ▶ **Informative disagreement:** Demonstrate possibility of divergent valid annotations
- ▶ The study is pre-theoretical but stands to inform annotation efforts and theory development.

Corpus to be released via the Linguistic Data Consortium

Thanks!

Results: Explicit passages

- ▶ Dataset: 12,216 data points

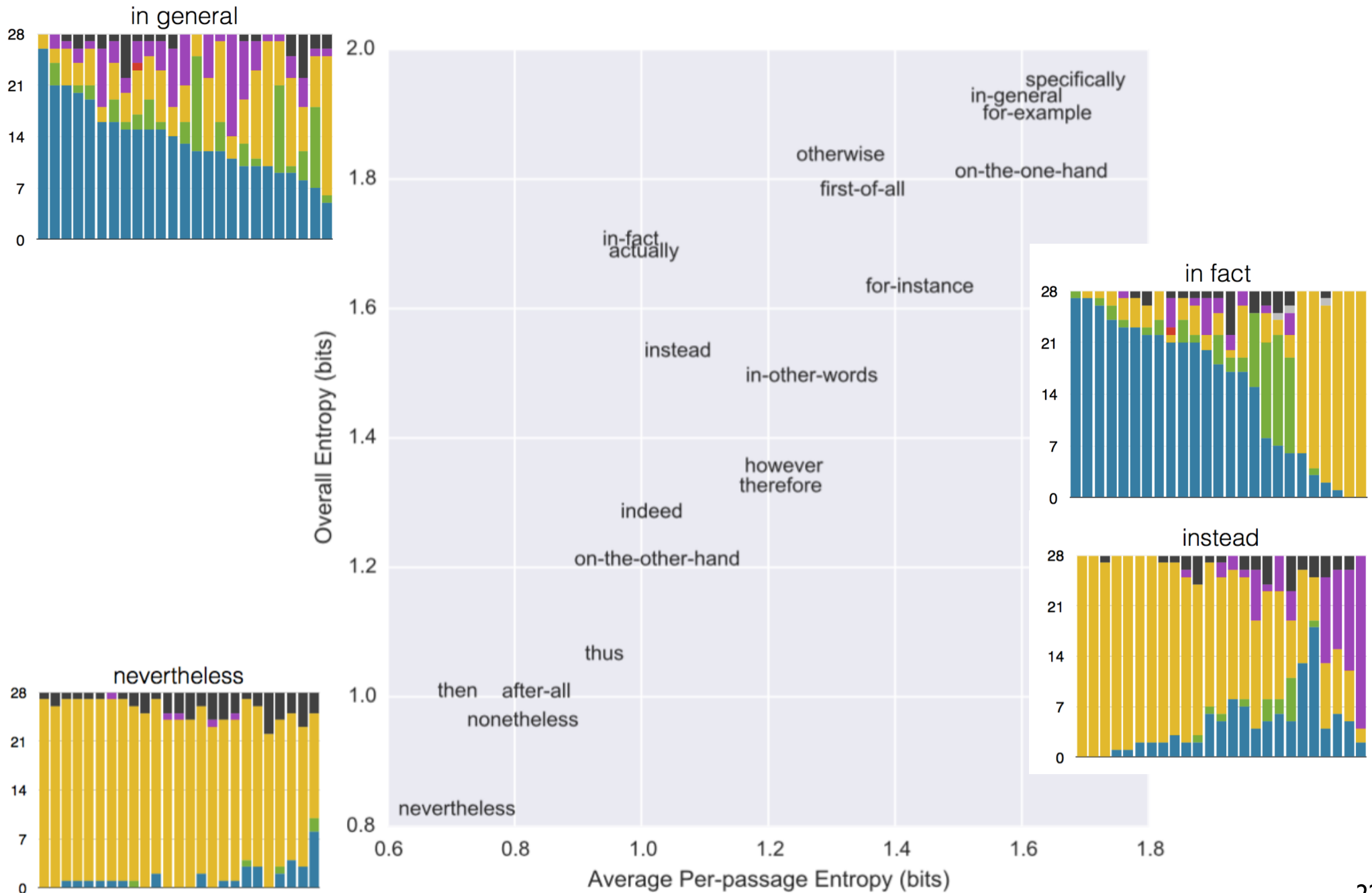
Original author

Participant selection

	and because	but	or	so	
and	2686	149	325	159	344
because	280	786	176	156	156
but	1000	174	2798	179	180
or	68	41	15	355	28
so	550	127	129	298	1215
before	4	2	1	0	1
NONE	248	105	158	108	167
other	8	16	10	5	9

- ▶ Recover same conjunction author used: 57%
- ▶ If 'so'/'but' considered compatible with 'and' (Knott 1996), calculated match with author: 70%

Source of (in)consistency: adverbials? passages?



New work

- ▶ New data on 35 more adverbials
- ▶ How many senses: given best sense, are other senses available?
- ▶ Inference of adverbial: do similar response profiles signal interchangeable adverbials?
- ▶ Underspecification of conjunctions: 'and' in context