Multiple concurrent discourse relations

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Discourse coherence

Recipe for whipped cream frosting:
Put cream cheese and whipping cream into a bowl.
(then)
Add sugar and vanilla.
(then)
Beat the mixture until the cream can hold a stiff peak.
(then)
Cover cakes with this frosting that won't melt at room temperature.
because? Otherwise you'll be left with soggy cupcakes.

→ Some relations can be left implicit; others can't.

(Asher & Lascarides 2003; Hobbs 1979; Kehler 2002; Mann & Thompson 1988; Prasad et al,2014; Roberts 1996; Sanders et al. 1992)

This talk: Where to posit implicit relations

▶ A puzzle for existing models of coherence relations

▶ Applications of coherence inferences

▶ Conjunction-insertion experiments

→ Results show role for inference alongside explicit cues

A puzzle

▸ Deduction of implicit information from juxtaposed sentences

It's too far to walk. Let's take the bus.

Infer alternatives: walk/bus as means of transport
Infer causal relation: too far, therefore bus
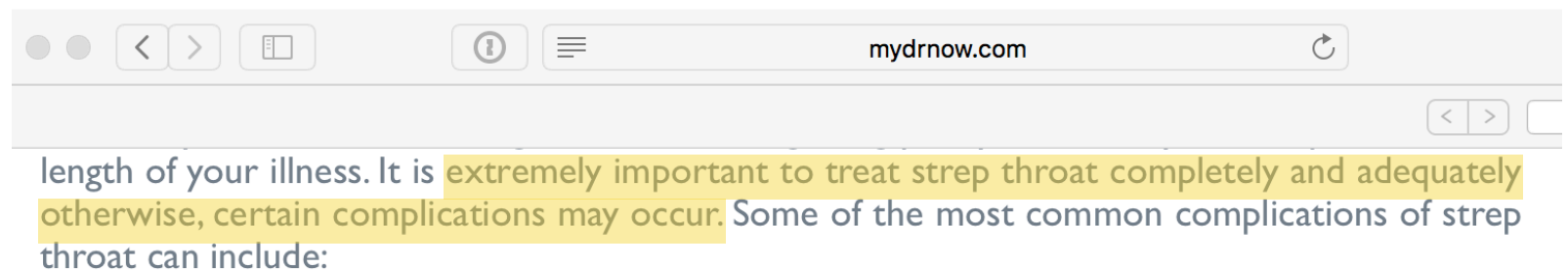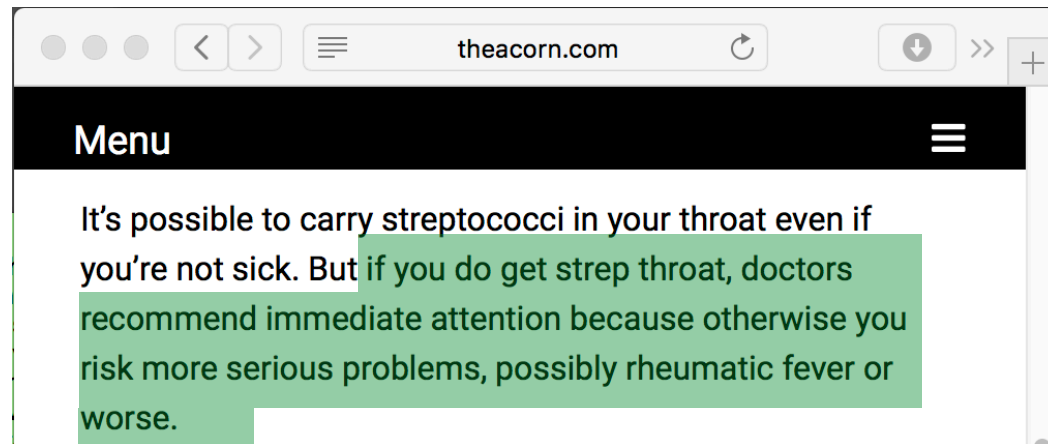
It's too far to walk so let's take the bus.

▸ **Assumption:** A passage marks its coherence relation either explicitly or implicitly — i.e., if explicit connective is present, no need for further inference about additional relations.

It's too far to walk. Instead let's take the bus.
so?

Coherence relations in NLP

▶ Question-answering

Query: "why treat strep throat?"

It's possible to carry streptococci in your throat even if you're not sick. But if you do get strep throat, doctors recommend immediate attention because otherwise you risk more serious problems, possibly rheumatic fever or worse.

length of your illness. It is extremely important to treat strep throat completely and adequately otherwise, certain complications may occur. Some of the most common complications of strep throat can include:

Coherence relations in NLP

▶ Question-answering

→ Extraction of best answer may depend on linked clauses

→ Links may not always be explicit

Coherence relations in text

▸ Question-answering

▸ Text generation, automatic summarisation:
  Systems must decide what to make explicit to sound natural

▸ Coreference resolution:
  Best antecedent may vary across coherence relations

▸ Given this utility, development of large-scale annotated resources

Back to the puzzle

▶ **Assumption:** A passage marks its coherence relation either explicitly or implicitly

▶ **Question:** When should we posit an implicit relation alongside an explicit cue?

▶ **Why?** Establishing the possibility of **concurrent relations** is a 1st step for the related question (for this workshop) of <u>when/ how</u> such relations are marked

Multiple types of multiplicity

▸ Multiple alternative analyses (Mann & Thompson 1988; *inter alia)*

I sang. **∧** **John danced.**

while? whereas? because? so?

▸ Multiple connectives for same relation

**John made a fool of himself at the restaurant,
so as a result, we avoid going there.**

▸ Multiple relations from same connective (Miltsakaki et al. 2005)

We avoid that restaurant since John made a fool of himself there.

Multiple types of multiplicity

▶ Multiple indicators for different relations (Asher & Lascarides 2003; Cuenca & Marin 2009; Fraser 2013)

> **I bought the apartment but then I rented it out.**

▶ Multiple inferred relations (Prasad et al. 2008, 2014; Dunietz et al. 2017)

> **It's too far to walk.** **so instead** **Let's take the bus.**

▶ Today: Possibility of inference in the presence of explicit cue(s)

> **It's too far to walk.** **so** **Instead let's take the bus.**

Psycholinguistic studies

1. **Do inferable discourse relations hold when a discourse adverbial is already present?**
   → Yes, adverbials license co-occurring conjunctions
2. **How to characterise discourse adverbials with respect to inferred relations?**
   → Not predictable from adverbial or semantic class
   → More than one valid connection in some cases
3. **How to account for unexpected combinations?**
   → Multiple simultaneous sources of coherence

Study 1: Conjunction-insertion

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.
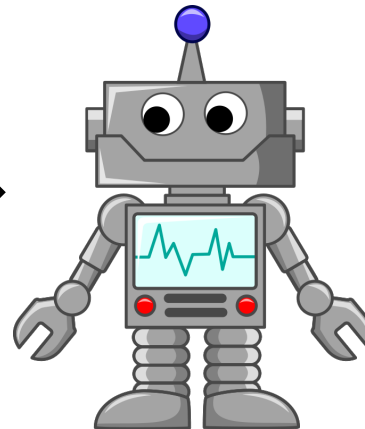
Submit

→ Current dataset of judgments for 50 adverbials, each in 50+ passages, each passage judged by 28 people... 70,000+ data points

(Rohde et al. 2016, 2017; see also Scholman et al. 2016)

Passages in dataset

▶ 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 include: ACTUALLY, AFTER ALL, FIRST OF ALL, FOR EXAMPLE, FOR INSTANCE, IN FACT, IN OTHER WORDS, INDEED, INSTEAD, NEVERTHELESS, NONETHELESS, ON THE ONE HAND, ON THE OTHER HAND, OTHERWISE, SPECIFICALLY, THEN, THEREFORE, THUS, …

Judgments from naive annotators

▶ Each passage viewed by 28 participants

▶ Instructions:
Find conjunction
to 'best reflect
meaning of
connection'
between text spans

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.

Submit

▶ Catch trials

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

Hypotheses for implicit passages

▶ **Variability across adverbials:** Do implicit passages pattern uniformly or vary across adverbials (by semantic type)?

▶ **Variability within adverbials:** Does the adverbial predict the same conjunction for all passages?
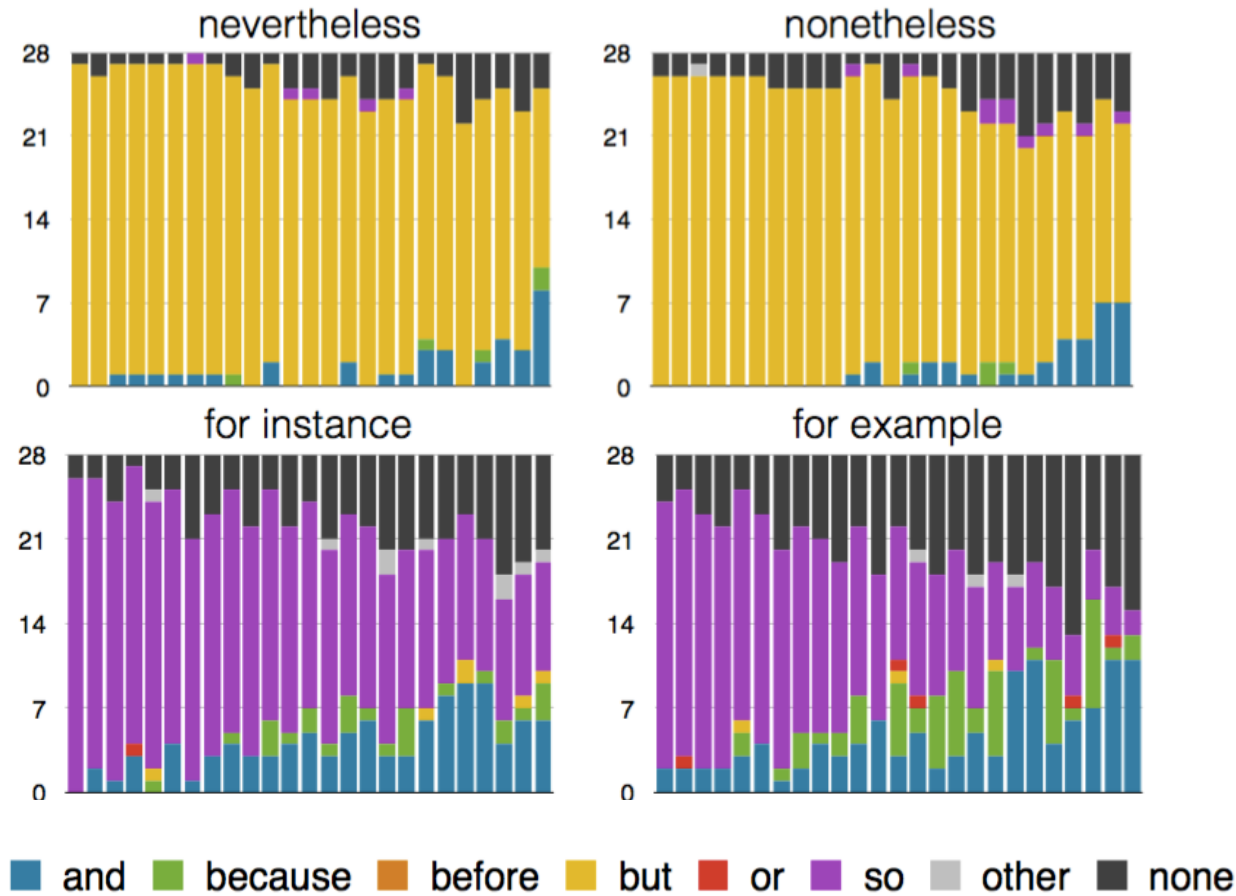
▶ If deterministic →

▶ If not →

Results: Explicit passages

▶ Recover same conjunction author used: 57%

▶ If SO/BUT considered compatible with AND
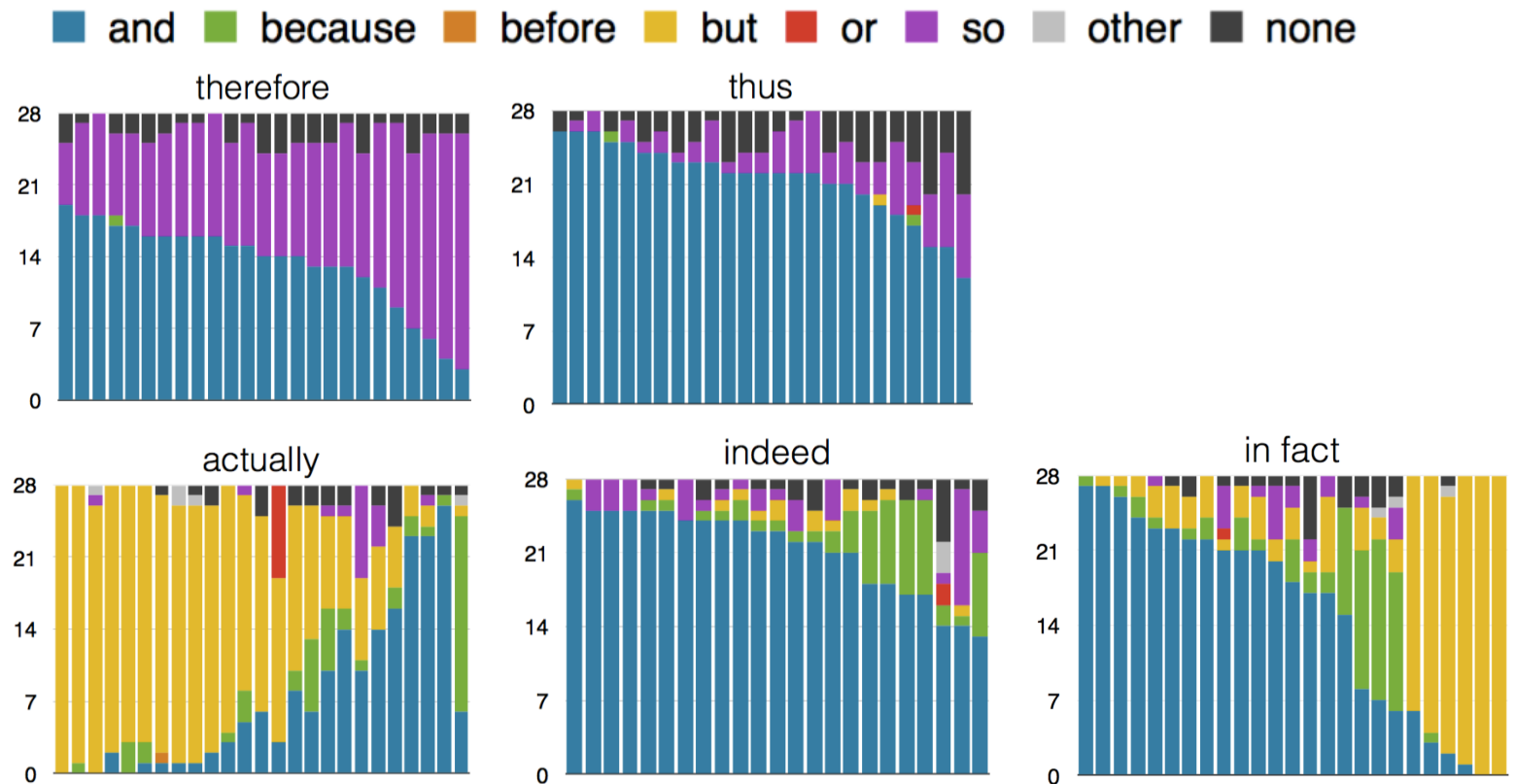(Knott 1996), calculated match with author: 70%

Results: Implicit passages

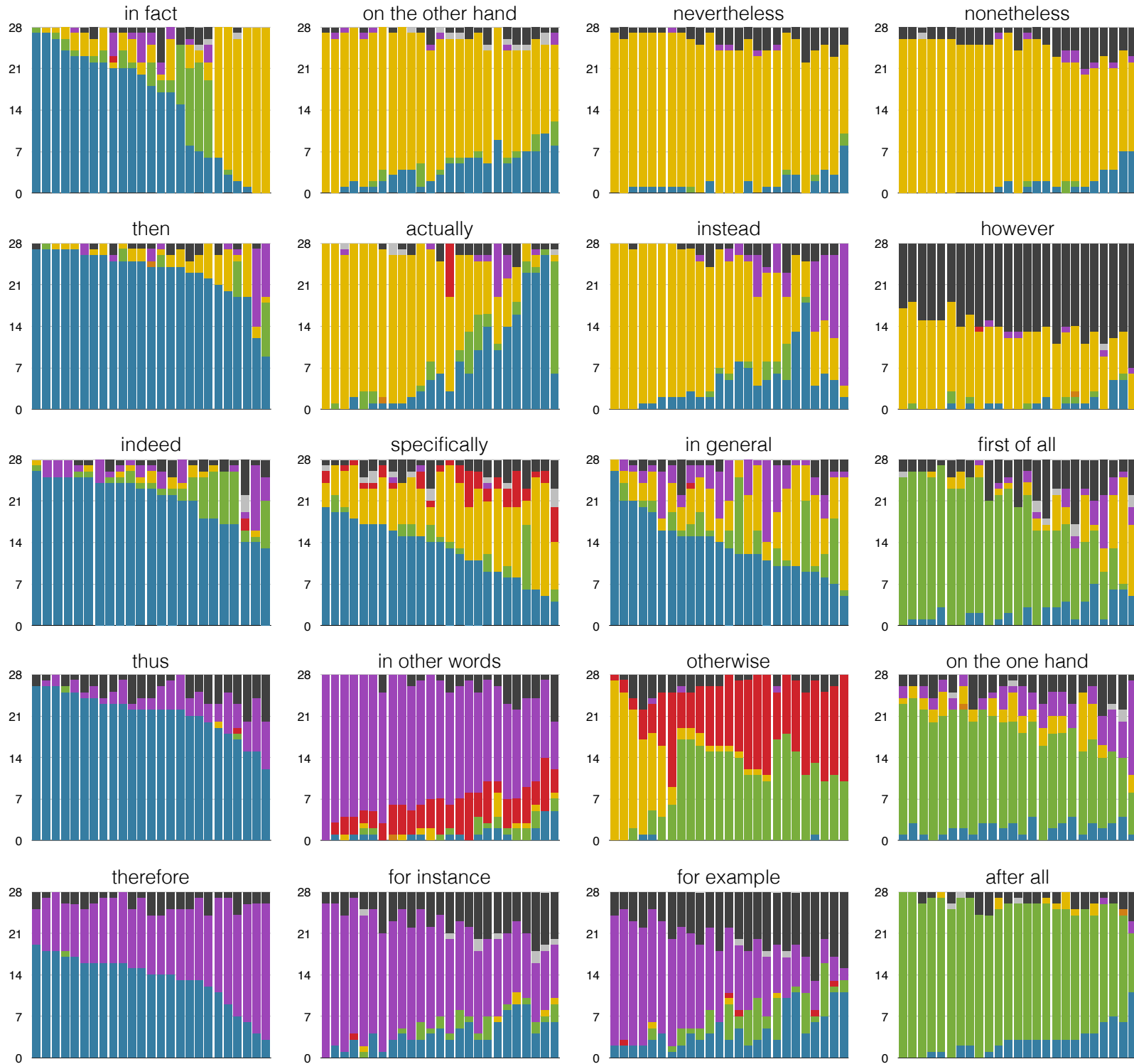▶ On one hand, we saw some consistency in semantically related adverbial pairs.

Results: Implicit passages

▶ But also divergence for near synonyms or for adverbials of a similar type (e.g., modal stance)

▶ Adverbial itself matters, as does passage content.

Cases of 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

Cases of 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

▸ Improbable combinations, but perfectly fine

Summary so far

▶ **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

Study 2: Adverbials about 'alternatives'

▶ Lexical semantics of adverbial licenses one conjunction

▶ Inference from passage content licenses another

> **Gouges are deep scratches that must be filled as well as colored _____ otherwise they will collect dirt and become permanently discolored.**

➔ *otherwise* encodes 'otherness' (OR)
➔ passage requires causal reasoning (BECAUSE)

> **For the plane to Paris, there are only a few tickets left ____ instead you could go via Amsterdam.**
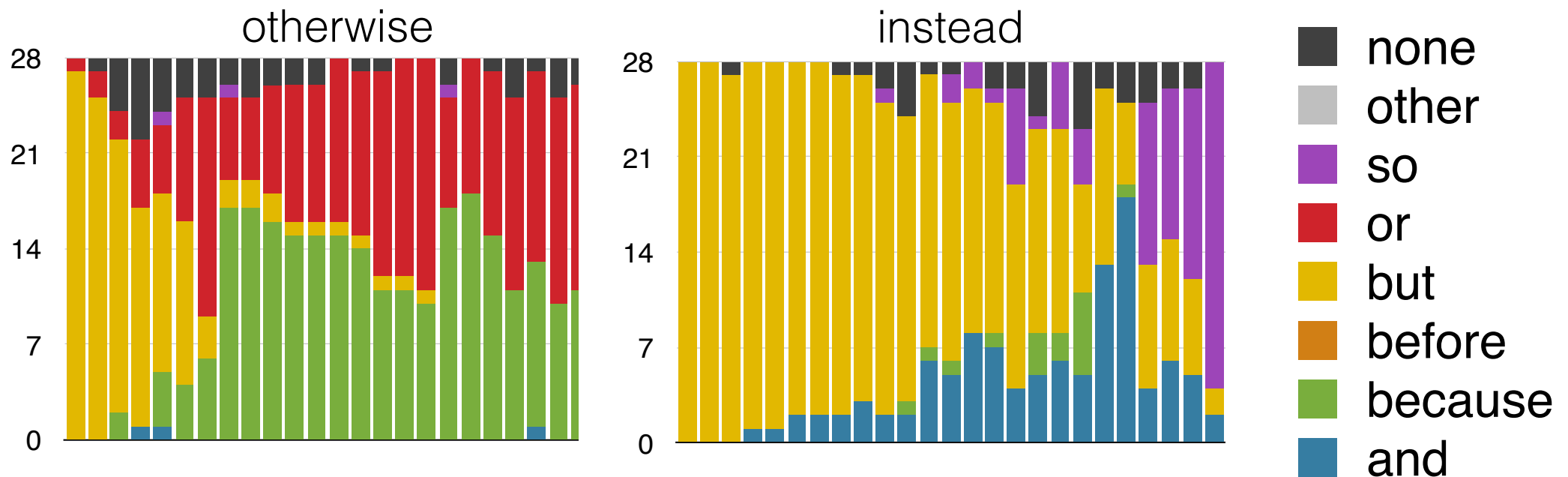
➔ *instead* encodes substitution (OR)
➔ passage may permit emphasis on contrast (BUT)
➔ passage may permit causal reasoning (SO)

▶ Adverbial meaning of 'otherness' from *otherwise* and *instead*

▶ Additional pragmatic inference from passage content

▶ From Study 1, these adverbials showed disagreements…

▶ Was this evidence of different analyses across annotators or would same annotator endorse more than one conjunction?

Study 2: Insert conjunction(s)

▸ **Materials:**

  ▸ 48 passages with *otherwise* (16 argumentation, 16 exception, 16 enumeration)

  ▸ 16 passages with *instead* (minimal pairs to test parallel/ non-parallel readings)

  ▸ + passages for *in other words* and *after all*

▸ **Participants:** 28 participants

▸ **Task 1:** Find best conjunction(s) for meaning of connection

▸ **Task 2:** Find paraphrase of that meaning

'Otherwise': passages with different logic

argumentation

Proper placement of the testing device is an important issue _____ otherwise the test results will be inaccurate.

"a reason to place the test properly is to avoid inaccuracy"

enumeration

A baked potato, plonked on a side plate with sour cream flecked with chives, is the perfect accompaniment _____ otherwise you could serve a green salad and some good country bread.

"there are two choices for a side: potato or salad"

#"a reason to have a potato is to avoid a salad"

exception

Mr. Lurie and Mr. Jarmusch actually catch a shark, a thrashing 10-footer _____ otherwise the action is light.

"shark catching is a special case; generally action is light"

#"there are two choices for the film: sharks or light action"

'Instead': passages w/different emphasis

parallel

> There was no flight scheduled to Paris yesterday _____
> instead there were several to Amsterdam.
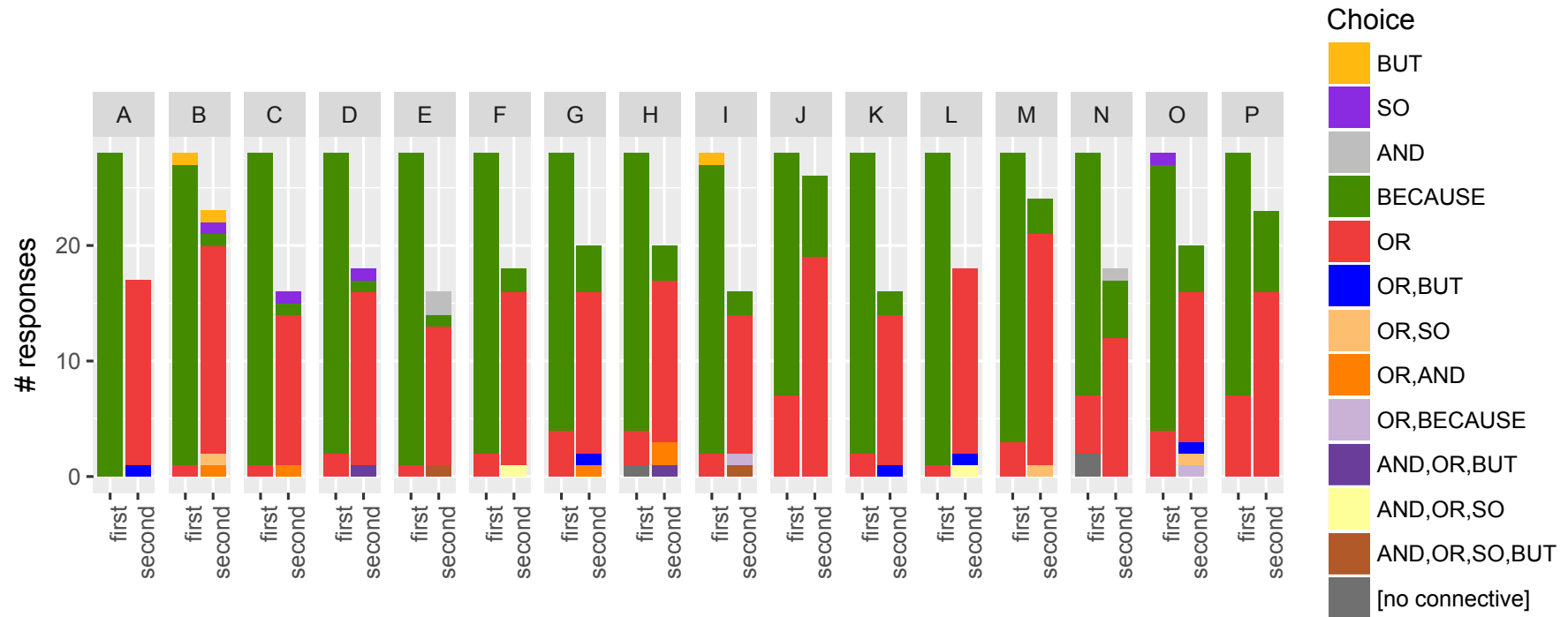
→ Prediction: BUT

**non-parallel
(causal)**

> There were too few flights scheduled to Paris yesterday _____
> instead we went to Amsterdam.

→ Prediction: SO

argumentation Proper placement of the testing device is an important issue _____ otherwise the test results will be inaccurate.
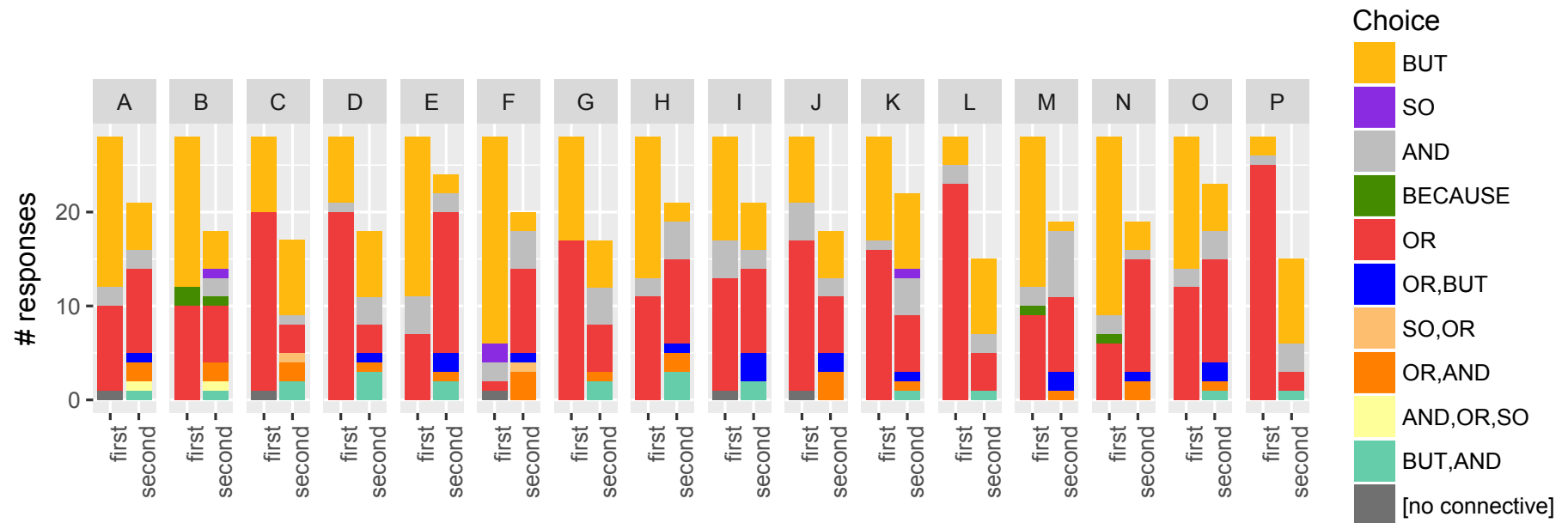
→ Prediction confirmed: OR & BECAUSE

enumeration

> A baked potato, plonked on a side plate with sour cream flecked with chives, is the perfect accompaniment ____ otherwise you could serve a green salad and some good country bread.
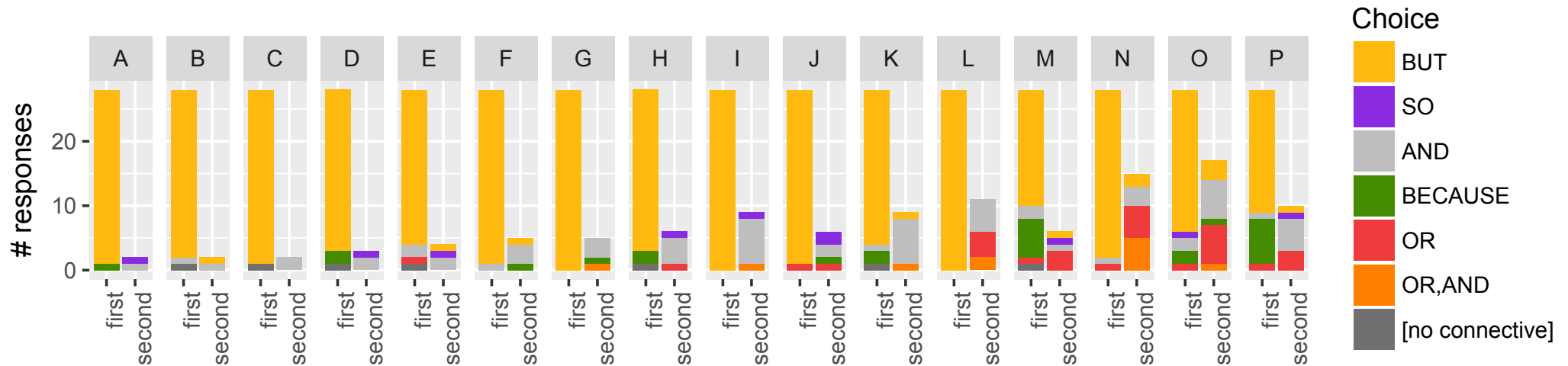
→ Prediction confirmed: OR & BUT

Results: *Otherwise*

exception

Mr. Lurie and Mr. Jarmusch actually catch a shark, a thrashing 10-footer _____ otherwise the action is light.

→ Prediction confirmed: BUT only

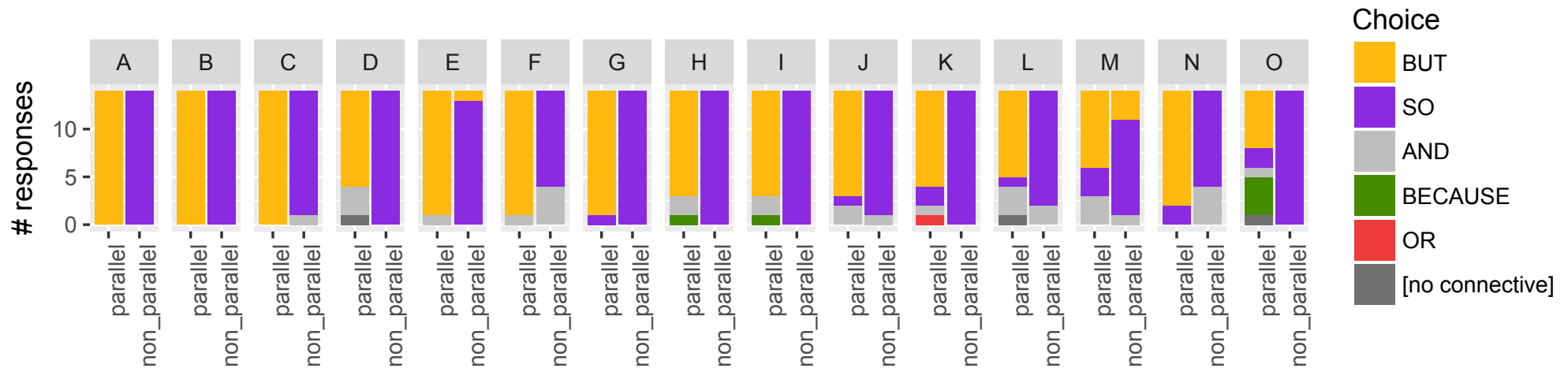→ Main effect of 3-way underlying category on BUT (p<0.001)

Results: *Instead*

parallel	**There was no flight scheduled to Paris yesterday _____ instead there were several to Amsterdam.**
non-parallel	**There were too few flights scheduled to Paris yesterday _____ instead we went to Amsterdam.**

→ Prediction confirmed: main effect of condition on use of BUT/SO (p<0.001)

Summary: Choosing among alternatives

▶ Multiple co-occurring relations

> **It's too far to walk. Let's take the bus.**

▶ Inference even with explicit cues

> **It's too far to walk. [result] Instead let's take the bus.**

> **Better to take the bus [reason] or otherwise you'll have to walk.**

▶ Informative disagreement

Thanks!