

# Discourse Coherence: Concurrent Explicit and Implicit 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.

# This paper: Recovering implicit relations

- ▶ The availability of implicit relations alongside explicit cues is a puzzle for existing models of coherence relations.
- ▶ Also a further challenge to discourse parsing.
- ▶ Evidence from 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. <sup>so?</sup> ~~N~~ **Instead** let's take the bus.**

# Back to the puzzle

- ▶ **Suppose that assumption is wrong:** It is not simply a choice of marking a coherence relations either explicitly or implicitly.
- ▶ **Question:** When should we posit an implicit relation alongside an explicit cue?
- ▶ **Why?** Establishing the possibility of **multiple concurrent relations** is a first step towards the related question of what leads people to see them.

# Multiple types of multiplicity

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

*while? whereas?*  
*because? so?*  
I sang. ^ John danced.

- ▶ Multiple connectives for same relation (Fraser 2013)

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; Prasad et al 2008, 2014)

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

# Multiple types of multiplicity

- ▶ Multiple connectives for distinct relations (Asher & Lascarides 2003; Cuenca & Marin 2009; Fraser 2013; Prasad et al 2014)

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. <sup>so instead</sup> **^** Let's take the bus.

- ▶ New result: Systematic inference of relations, distinct from ones explicitly cued.

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

# Experimental Design: Conjunction-insertion

ConnText University of Edinburgh

Trial [Show Instructions](#)

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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](#)

Judgments for 50 adverbials, each in 50+ passages, each passage judged by 28 people.  
70,000+ data points



# 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.**

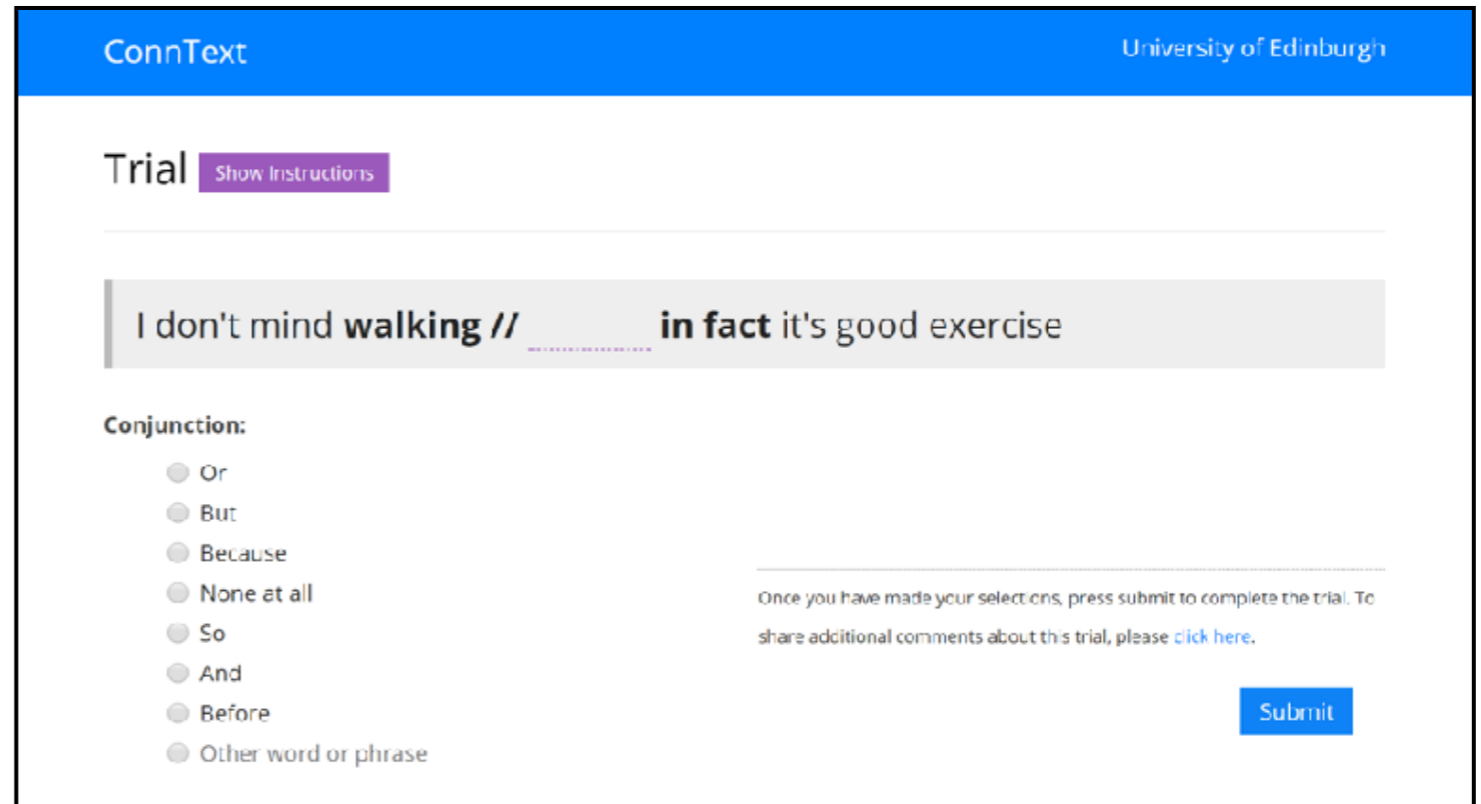
Author=NONE

**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, ...

# Experimental Design: Single Response

▶ Each passage viewed by 28 participants

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



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 button labeled 'Show Instructions'. A text span is shown in a light gray box: 'I don't mind walking // \_\_\_\_\_ in fact it's good exercise'. Below the text span, the word '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 blue 'Submit' button. At the bottom right, there is a small text box with the instruction: 'Once you have made your selections, press submit to complete the trial. To share additional comments about this trial, please [click here](#).'

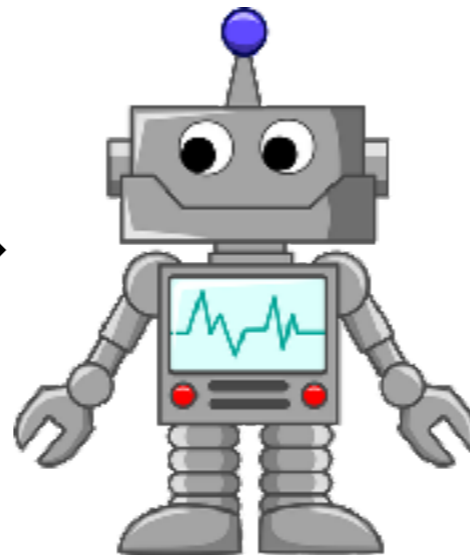
▶ Catch trials

**You can lead a horse to water // \_\_\_\_ you can't make it drink**

# Experimental Design: Single Response

- ▶ **Variability within adverbials:** Does the adverbial elicit the same conjunction for all passages?

- ▶ If deterministic →

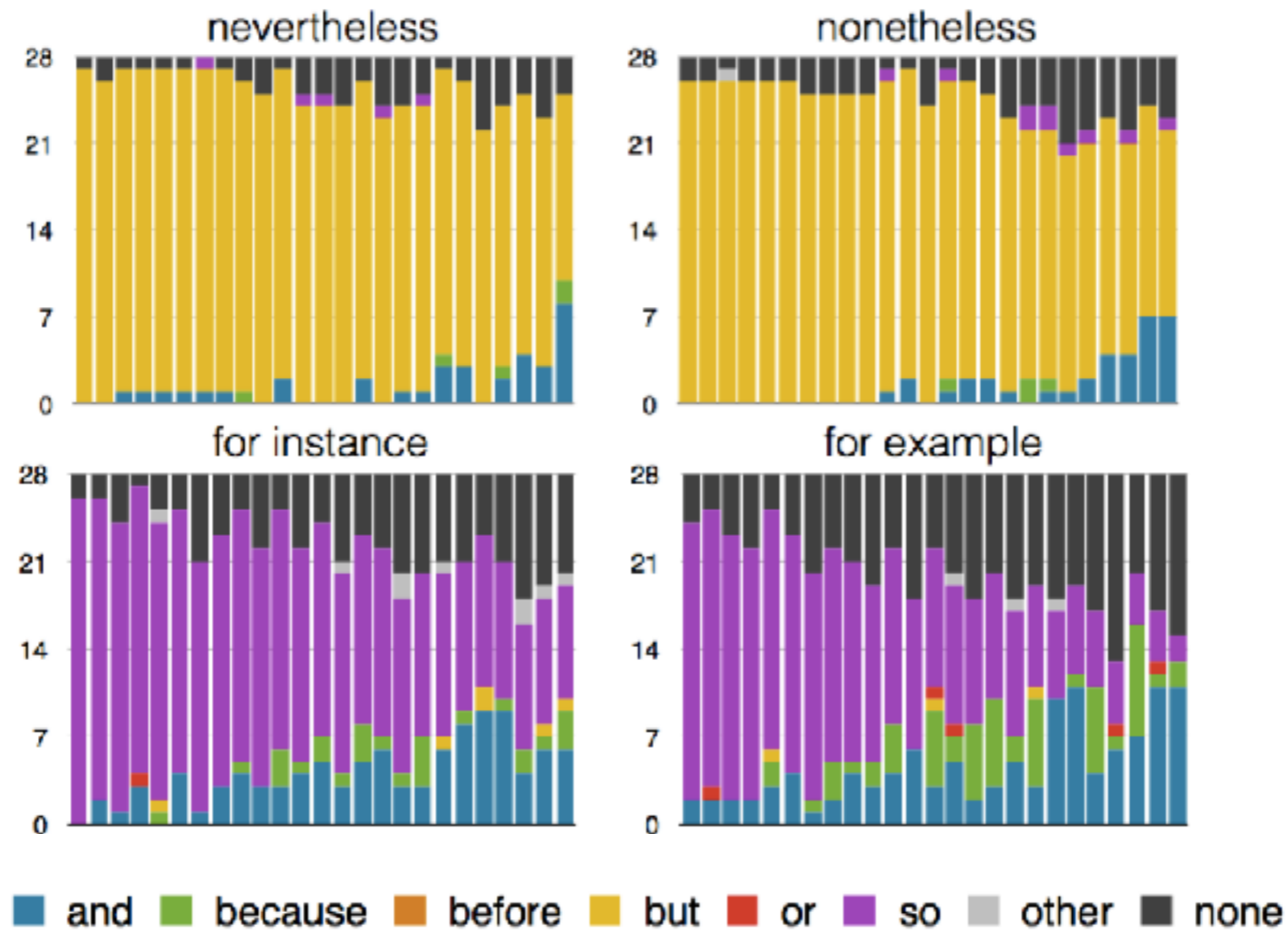


- ▶ If not →

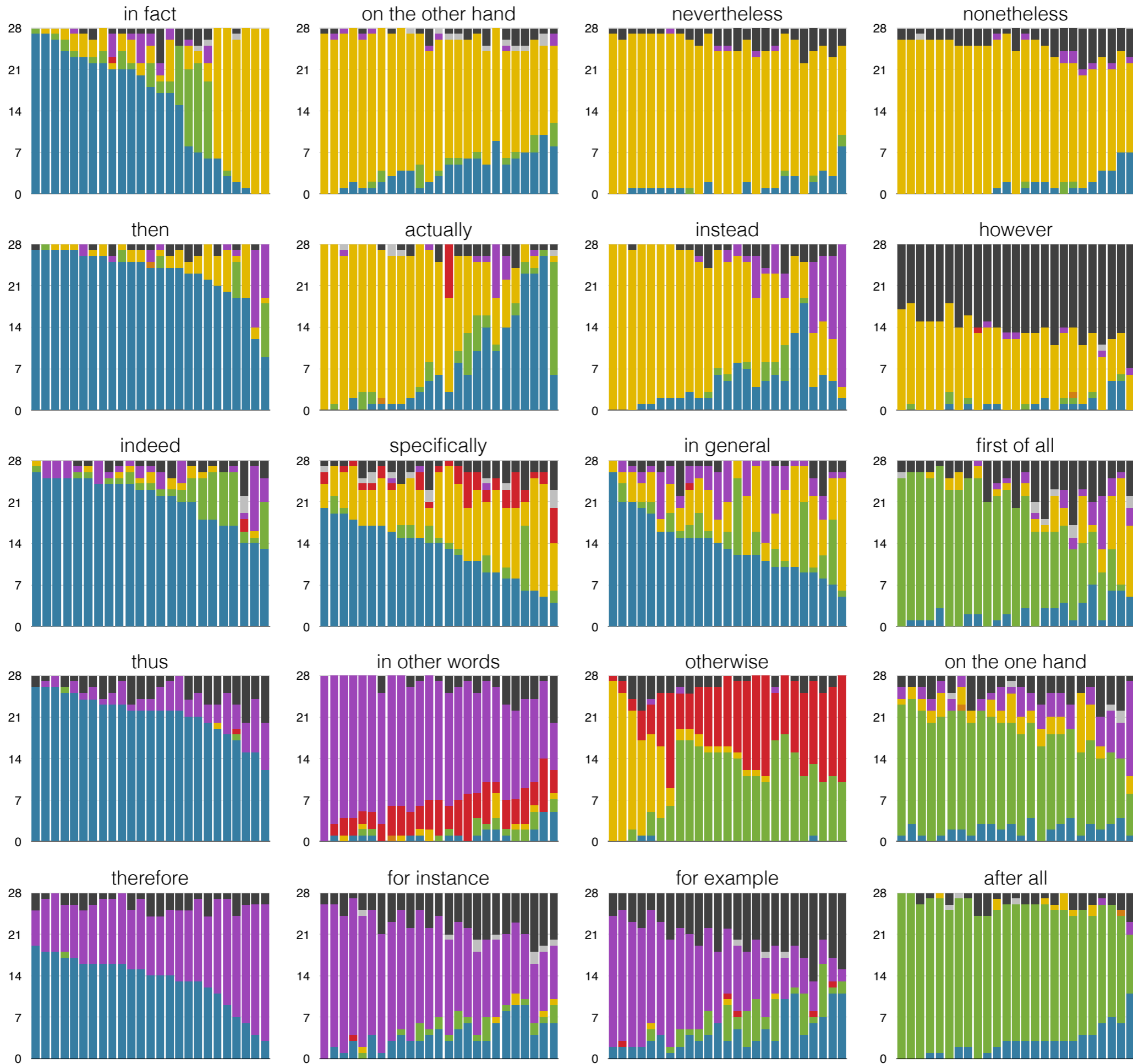


# Experimental Results: Implicit passages

- ▶ We saw some consistency in semantically related adverbial pairs, but also differences for a given adverbial.



and because before but or so other none



# Cases of disagreement

- ▶ Different conjunctions can reveal different attachments:

“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

We didn’t intend to have such examples.

# 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 and what they arise from.



# LexSem of Adverbials + Inference

- ▶ 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.**

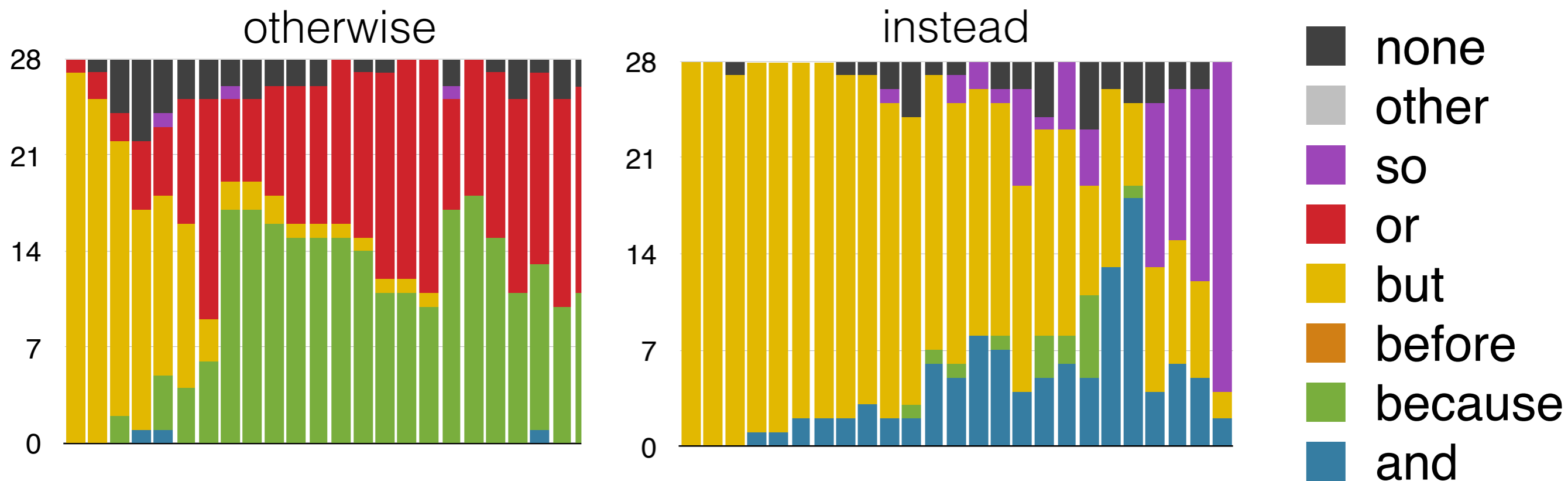
- *otherwise* encodes 'otherness' (OR)
- passage requires causal reasoning (BECAUSE)

**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)

# Lexical Semantics of Advs + Inference

- ▶ Adverbial meaning of 'otherness' from *otherwise* and *instead*
- ▶ Additional pragmatic inference from passage content
- ▶ Passages may elicit significantly different responses.



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

# Experimental Design: Multiple Responses

- ▶ **Materials:**

- ▶ 48 passages with *otherwise* (to assess perceived functional role of the *otherwise* clause)
- ▶ 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:** Identify best conjunction(s) for meaning of connection

- ▶ **Task 2 (for *otherwise*):** Identify a paraphrase of that meaning

# 'Otherwise': passages with different roles

**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)**

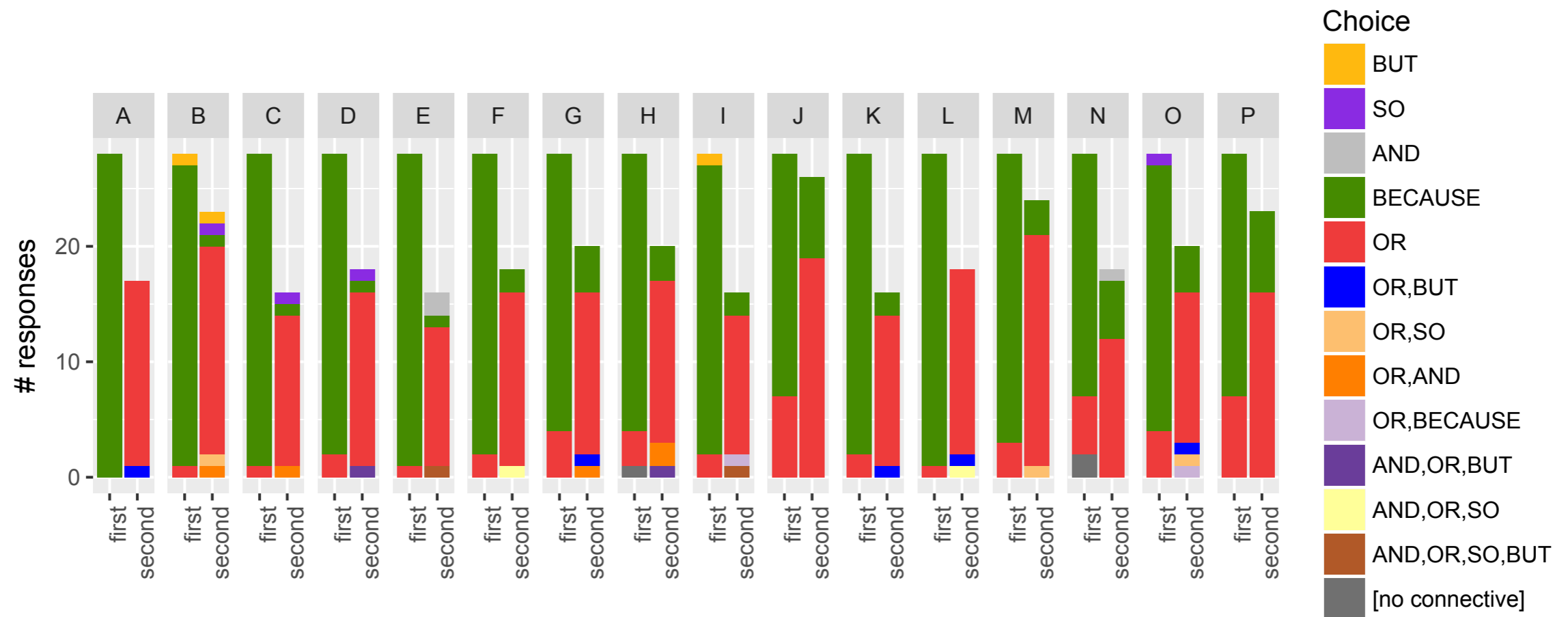
There were too few flights scheduled to Paris yesterday \_\_\_\_\_  
instead we went to Amsterdam.

→ Prediction: SO

# Results: *Otherwise*

**argumentation** Proper placement of the testing device is an important issue  
\_\_\_\_\_ otherwise the test results will be inaccurate.

→ Prediction confirmed: OR & BECAUSE

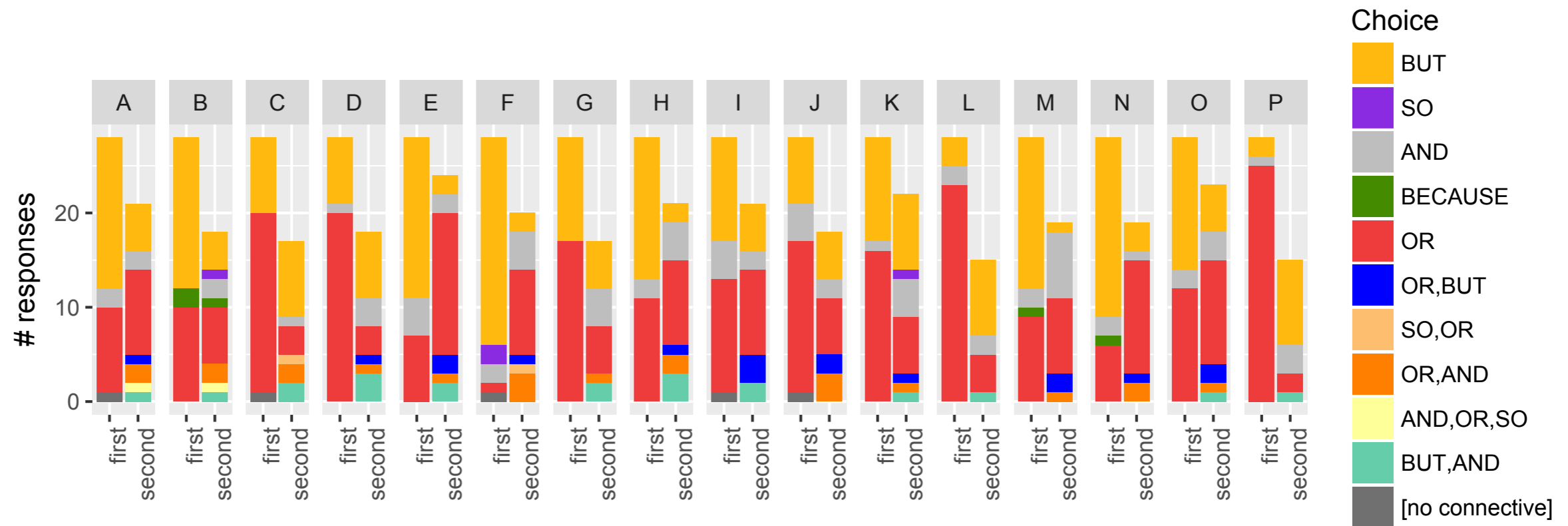


# Results: *Otherwise*

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

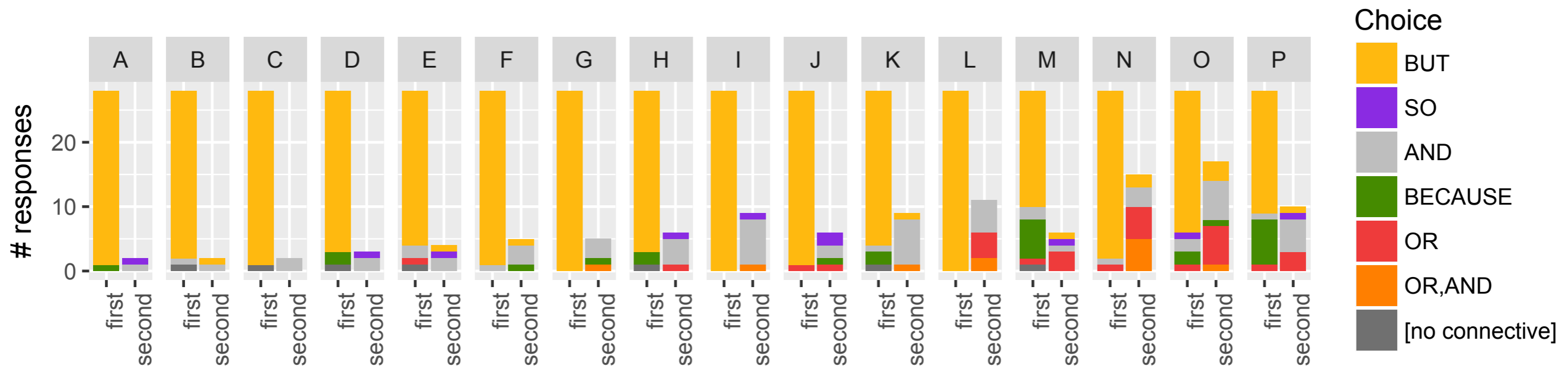


# Results: *Otherwise*

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*

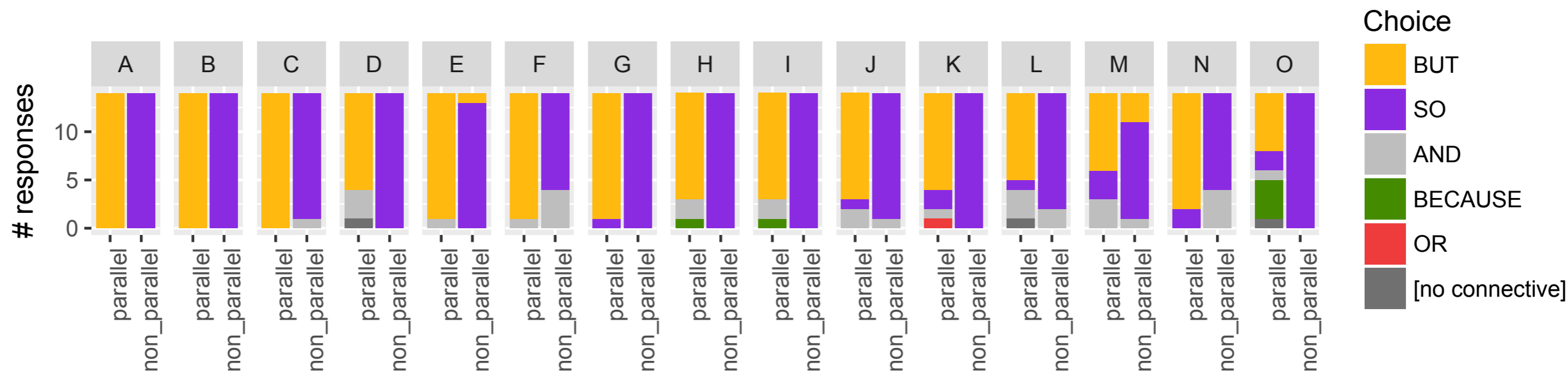
parallel

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. <sup>[result]</sup> Instead let's take the bus.

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

- ▶ Informative disagreement

# Conclusion & Future Work

- ▶ What participants chose can be explained in terms of the *lexical semantics* of discourse adverbials and properties of the passages that lead to particular *inferences*.
- ▶ With *'otherwise'*, inference aligns with the perceived function of the passage: argumentation, enumeration, exception.
- ▶ What leads to this functional inference?
- ▶ With *'instead'*, inference seems to align in part with what licenses the adverbial.
- ▶ We know what can license *'instead'* but we have yet to fully correlate these possibilities with what is inferred.

**Thanks!**



# Paraphrase results

| Researcher    | Participant   |             |             |          |
|---------------|---------------|-------------|-------------|----------|
|               | Argumentation | ENUMERATION | Exception   | Multiple |
| ARGUMENTATION | 401 (91.5%)   | 4           | 25          | 18       |
| ENUMERATION   | 23            | 364 (81.4%) | 46          | 14       |
| EXCEPTION     | 21            | 29          | 393 (87.7%) | 5        |

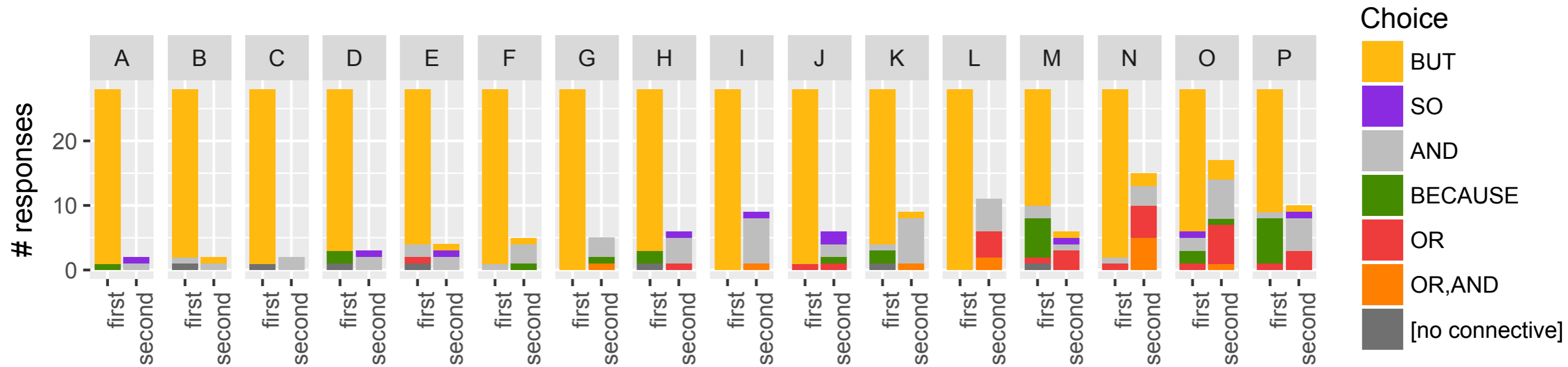
**Table 1:** Researcher labels assigned to *otherwise* passages vs. labels implied by participant paraphrases

**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"

"inaccurate test results are a special case; generally proper placement is important"

# Results



M

Democrats insist that the poor should be the priority, and that tax relief should be directed at them \_\_\_\_\_ otherwise they lack a cogent vision of the needs of a new economy.

P

He said that the proposed bill would give states more flexibility in deciding whether they wanted to use the Federal money for outright grants to municipalities or to set up loan programs \_\_\_\_\_ otherwise it left last fall's Congressional legislation unchanged.

# Results: “In other words”

Unfortunately, nearly 75,000 acres of tropical forest are converted or deforested every day \_\_\_\_\_ in other words an area the size of Central Park disappears every 16 minutes.

→ *in other words* encodes 'otherness' (OR)

→ reformulation conveys consequence (SO)

Unfortunately, nearly 75,000 acres of tropical forest are converted or deforested every day. *I don't know where I heard that* \_\_\_\_\_ in other words an area the size of Central Park disappears every 16 minutes.

→ intervening material blocks adjacency preferred for OR/SO, allowing more uses of BUT to emerge

