Discourse Coherence: Concurrent Explicit and Implicit Relations

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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.

→ Some relations can be left implicit; others can’t.
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. Instead let's take the bus.
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*)
  
  I sang. \( \wedge \) 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. **so instead** Let’s take the bus.

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

  It’s too far to walk. **so** Instead let’s take the bus.
Experimental Design: Conjunction-insertion

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

- 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.
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.

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.
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"
<table>
<thead>
<tr>
<th>Type</th>
<th>Passage</th>
<th>Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>parallel</td>
<td>There was no flight scheduled to Paris yesterday _______ instead there were several to Amsterdam.</td>
<td>BUT</td>
</tr>
<tr>
<td>non-parallel</td>
<td>There were too few flights scheduled to Paris yesterday _______ instead we went to Amsterdam.</td>
<td>SO</td>
</tr>
</tbody>
</table>
Proper placement of the testing device is an important issue otherwise the test results will be inaccurate.

→ Prediction confirmed: OR & BECAUSE
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
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. Instead let's take the bus.

> Better to take the bus or otherwise you'll have to walk.

- Informative disagreement
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!
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"
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.

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.
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