

Concurrent Discourse Relations

Annotation, Computation and Theory

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Overview

- **Discourse relations** (DRels) are relations that hold between the sense or use of a clause or sentence (C/S) and the discourse context.
- The Penn Discourse TreeBank (PDTB) and other corpora similarly annotated for DRels assume that DRels can be signalled:
 - ① **Explicitly**, via conjunctions, discourse adverbials, “alternative lexicalizations”;
 - ② **Implicitly**, via adjacency, form/content of the Cs/Ss, S/H biases, world knowledge.
- A given C/S can contain one or more explicit signals of how it relates to the discourse context, as well as none at all.

What might multiple explicit signals imply?

If there is more than 1 explicit signal, what might this imply?

- Each may signal a **distinct** DRel between the given C/S and some **distinct** part of the context, **OR**
- Each may signal a **distinct** DRel between the given C/S and the **same** part of the context, **OR**
- Both may signal the **same** DRel between the given C/S and the **same** part of context, **OR**
- Both signal the **same** DRel between the given C/S and some **distinct** part of context.

What might multiple explicit signals imply?

- (1) The car was finally coming toward him. s_1
He finished his diagnostic tests, s_2
feeling relief. s_3

But then the car started to turn right. s_4 [Wiebe, 1993]

But conveys CONTRAST between s_4 and s_3 .

Then conveys SUCCESSION between s_4 and s_2 .

⇒ DRels to different parts of context

What might multiple explicit signals imply?

(2) I must wash the dishes s_1 because otherwise I can't go out. s_2

Because conveys EXPLANATION between s_2 and s_1 .

Otherwise conveys a NEG CONDITION DRel between s_2 and s_1 .

⇒ DRels to the same part of context

What might a single explicit signal imply?

If the single explicit signal is a **discourse adverbial** (DAdv), it might imply:

- There is only one DRel between the given C/S and context, and it's the one signalled by the "bare" DAdv, **OR**
- There are **concurrent DREls** between the given C/S and context:
 - one **explicitly** signalled by the DAdv,
 - another signalled **implicitly**, through adjacency, form/content, S/H biases, world knowledge.

What might a single explicit signal imply?

- (3) **Such problems will require considerable skill to resolve.** s_1
However, **neither Mr. Baum nor Mr. Harper has much international experience.** s_2 [wsj_0109]

However signals a CONTRAST between s_1 and s_2 .

⇒ Single DRel to context

What might a single explicit signal imply?

(4) I must wash the dishes s_1 . Otherwise I can't go out. s_2

Otherwise conveys a NEGATIVE CONDITION between s_2 and s_1 .

One also infers the same implicit EXPLANATION DRel between s_2 and s_1 as before.

⇒ Concurrent DREls to same part of context

Overview

The possibility of **concurrent DRels**, given only a single explicit DAdv, has implications for

- **Language Technology**: When can/should we extract multiple DRels at a given point?
- **Corpus annotation**: When and how should annotators be asked to annotate concurrent explicit and implicit DRels? Can it be done accurately by automated means?
- **Psycholinguistics**: What role do explicitly signalled DRels play in inferring implicit ones?

We don't know precisely what is going on, so:

- ① Can we get experimental evidence?
- ② Can we use that evidence to help automatically annotate concurrent relations?

Penn Discourse TreeBank 2.0 (PDTB 2.0)

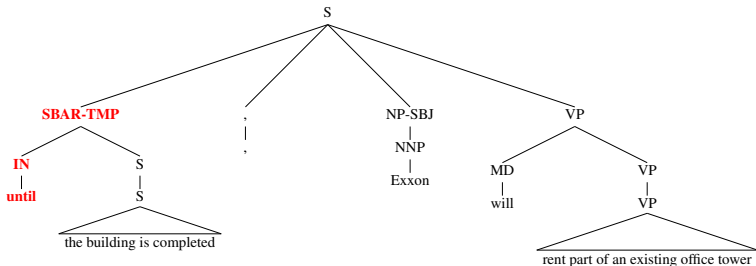
- The PDTB 2.0 was released in 2008 and remains the largest manually annotated corpus of DRels in English.
- It comprises annotation of the Penn WSJ corpus with
 - **DRels** between (the interpretation of) Cs/Ss that serve as its **arguments**;
 - **evidence** for such DRels (lexical grounding or adjacency);
 - **attribution**, as context which can change the polarity or modality of the relation.

Penn Discourse TreeBank 2.0 (PDTB 2.0)

- Unlike corpora annotated according to RST [Mann & Thompson, 1988] or SDRT [Asher & Lascarides, 2003], the PDTB does not commit to any higher structure or any relative prominence between the args.
- The same style of annotating DRels has been used in
 - Bio Discourse Relation Bank [Prasad et al, 2011],
 - **Arabic** Discourse TreeBank [Al-Saif & Markert, 2011]
 - **Chinese** Discourse TreeBank [Zhou & Xue, 2015]
 - **Hindi** Discourse Relation Bank [Kolachina et al, 2012]
 - **Turkish** Discourse Bank [Zeyrek et al, 2013].
- This style of annotation is **independent** of the set of DRels used.

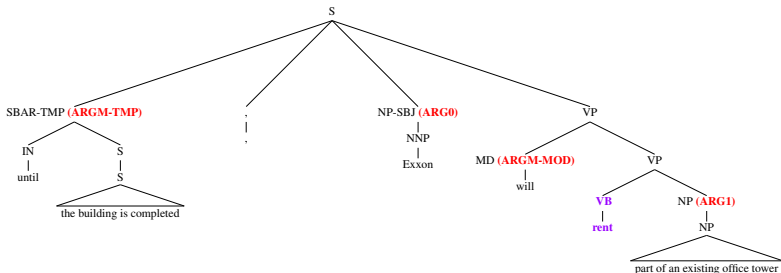
Comparison: Penn WSJ TreeBank Annotation

- (5) Until the building is completed, Exxon will rent part of an existing office tower. [wsj_0784]



Comparison: PropBank Annotation

Subord clauses and adjuncts fill specific or general MOD roles (e.g., ARGM-TMP, ARGM-PRP) vs. (ARGM-ADV). Their position with respect to the verb doesn't matter to PropBank annotation.



Comparison: PDTB 2.0 Annotation

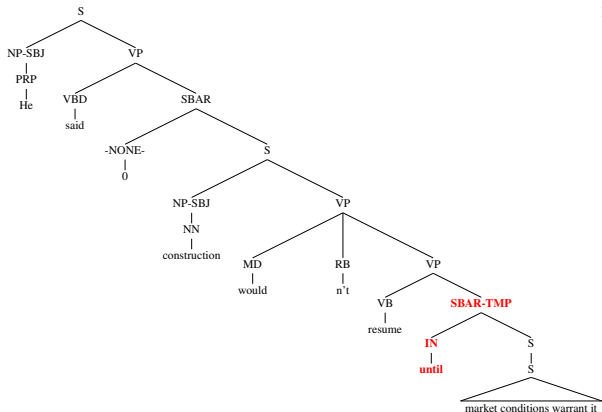
The PDTB 2.0 annotates **text spans** as:

- the span whose sense and/or use serves as **Arg1** of the DRel;
- the span whose sense and/or use serves as **Arg2** of the DRel;
- the span that provides explicit evidence for the DRel;
- the (optional) span that indicates *attribution* of the DRel or one of its args.

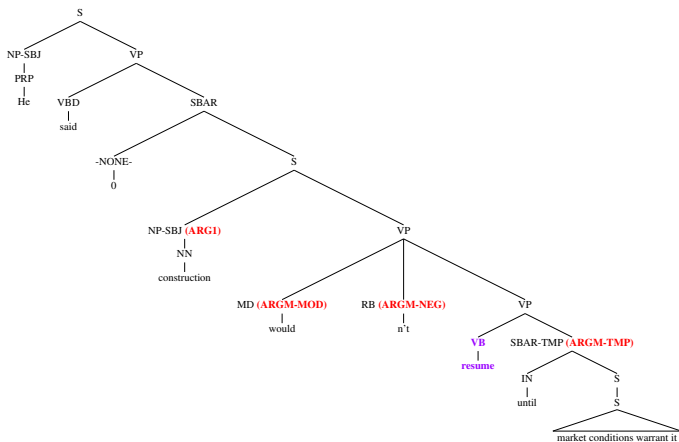
(6) Until (TEMPORAL.ASYNCHRONOUS.PRECEDENCE) **the building is completed, Exxon will rent part of an existing office tower.** [wsj_0784]

Comparison: Penn WSJ TreeBank Annotation

- (7) He said construction wouldn't resume until market conditions warrant it. [wsj_0610]



Comparison: PropBank Annotation



Comparison: PDTB 2.0 Annotation

- (8) *He said* **construction wouldn't resume** until
(TEMPORAL.ASYNCHRONOUS.PRECEDENCE) **market**
conditions warrant it. [wsj_0610]

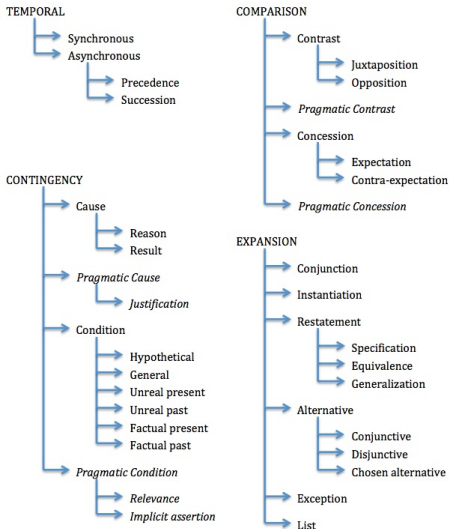
PDTB 2.0: Discourse connectives

Discourse connectives annotated as evidence for discourse relations in the PDTB 2.0 come from well-defined syntactic classes:

- **Subordinating conjunctions:** *because, though, when, if*, etc.
- **Coordinating conjunctions:** *and, but, so, nor, or* (and paired versions of the latter – *either..or, neither..nor*)
- **Discourse Adverbials:**
 - **PPs:** *as a result, on the one hand..on the other hand, insofar as, in comparison*, etc.
 - **Adverbs:** *then, however, instead, likewise, subsequently* etc.

The senses they are taken to signal are arranged in an **abstraction hierarchy**.

PDTB 2.0 Sense Hierarchy [Prasad et al, 2008]



Signalling DRels: Adjacency

DRels that hold by virtue of **adjacency** are annotated by inserting one or more **implicit connectives** between the spans and labelling them with sense relations.

- (9) **Mr. Lane's final purpose isn't to glamorize the Artist's vagabond existence.**

He has a point he wants to make, and he makes it, with a great deal of force. [wsj_0039]

Signalling DRels: Adjacency

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- (10) **Mr. Lane's final purpose isn't to glamorize the Artist's vagabond existence.**

(Implicit=rather EXP.ALT.CHOSEN_ALT)

He has a point he wants to make, and he makes it, with a great deal of force. [wsj_0039]

Adjacency and Concurrent DRels

- (11) **This cannot be solved by provoking a further downturn; reducing the supply of goods does not solve inflation.**

Our advice is this: Immediately return the government surpluses to the economy through incentive-maximizing tax cuts, and find some monetary policy target that balances both supply and demand for money (which neither aggregates nor interest rates can do). [wsj_0553]

Adjacency and Concurrent DREls

- (12) **This cannot be solved by provoking a further downturn; reducing the supply of goods does not solve inflation.**

(Implicit=so CONTINGENCY.CAUSE.RESULT, Implicit=instead EXP.ALT.CHOSEN_ALT)

Our advice is this: Immediately return the government surpluses to the economy through incentive-maximizing tax cuts, and find some monetary policy target that balances both supply and demand for money (which neither aggregates nor interest rates can do). [wsj_0553]

Preview: From PDTB 2.0 to PDTB 3.0

In 2014, NSF granted new funding to deliver an enriched resource to the community by 2017:

- Sense hierarchy has been extended and simplified;
- Additional DRels are being annotated **within** sentences (between conjoined VPs, between conjoined clauses, between free adjunct and matrix clause, etc.);
- Cross-paragraph relations are being annotated;
- **Concurrent DRels** will annotated.

Annotating Concurrent DREls

How can we annotate **concurrent DREls** both efficiently and consistently?

Only by first understanding:

- Which DAdvS can co-occur with explicit conjunctions to convey concurrent DREls: Not all may do so.
- Which conjunctions they co-occur with: Certain DAdvS may only co-occur with certain conjunctions.
- When a DAdv occurs alone, whether the inferred conjunction conveys a distinct DRel. Even if a DAdv can co-occur with different explicit conjunctions, when alone, the same one may always be inferred.

To get as much information on these questions as possible, we are crowd-sourcing data via *Amazon's Mechanical Turk (AMT)*.

Conjunctions as a proxy for sense relations

Rather than ask naive subjects what DRel they take to hold, they are asked what, if any, conjunction could be inserted to convey how the two Cs/Ss were related.

Justified in terms of their sense frequency in the PDTB 2.0.

Conjunction	No. tokens	Sense label	Overall %
and	3000	CONJUNCTION	91.0%
because	858	REASON	99.5%
before	326	PRECEDENCE	99.0%
but	3308	COMPARISON	90.7%
or	98	ALTERNATIVE	85.7%
so	263	RESULT	99.6%

Experimental Evidence for Concurrent DRelS

- Given an explicit DAdv, what DRel(s) do naive subjects take to be operative (based on their choice of conjunction)?
- Can these DRel(s) be predicted on the basis of the explicit DAdv alone?
- Can one get useful data on this via crowd-sourcing?

Priors: Google N-grams

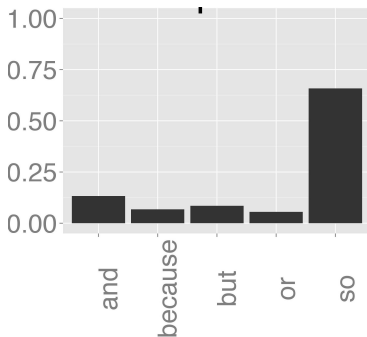


Figure: $\langle \text{CONJ} \rangle$ for example[,]

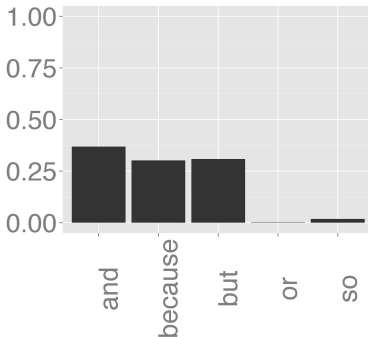


Figure: $\langle \text{CONJ} \rangle$ after all[,]

DAdvs show different patterns of occurrence vis-a-vis conjunctions.
 \Rightarrow Maybe we will see different patterns vis-a-vis what is inferred.

mTurk Experiments: Four sets of trials

- Phase 1:** 50 passages involving 4 DAdvs (11-12 passages per DAdv, plus 4 *catch trials*) were used to enrol mTurkers and get initial data using the method we developed.
- Phase 2:** Responses were gathered to ~1000 passages involving 20 DAdvs (~50 passages per DAdv) from 28 mTurkers identified in Phase 1.
- Phase 3:** Responses to ~1500 passages involving 30 DAdvs (~50 passages per DAdv) to be gathered from (ideally) the same mTurkers used in Phases 1 and 2.
- Phase 4:** Complementary set of trials targeting inferences about implicit DAdvs, rather than inferences about implicit conjunctions.

Phase 1: Explicit/implicit passages per adverbial

	explicit	implicit
<i>after all</i>	6	6
<i>in fact</i>	7	4
<i>in general</i>	7	5
<i>instead</i>	6	5
Total	26	20

Explicit: Conjunction used by the author (*and, because, but, or, so*) removed from the passage (26 passages).

Implicit: Author didn't use a conjunction (20 passages)

Catch Trials: Common phrase whose conjunction was removed (4 passages) – e.g., “Close _____ no cigar” (*and, because, but, or, so, Other, None*)

Phase 1: Participants

- Recruited 70 participants with U.S. addresses through *AMT*: Equal number of men and women.
- Each annotated 50 passages: 46 containing one of the four adverbials (*after all, in fact, in general, instead*), plus four catch trials.
- Removed only those participants who worked very quickly or frequently disagreed with choices made by 80% of participants.
- Analysis based on remaining 58 judgments/passage, so $58 \times 46 = 2668$ judgements.

Interface: Presenting Stimuli

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

Interface: Confirming Choices

ConnText

University of Edinburgh

Trial

Show Instructions

Their mother has lived in the United States longer than she lived in the Philippines. Her brother, who lives in Manila, scolds her: "We all thought you would become a **nun // but instead** you became an American!"

Conjunction:

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

Does 'but' sound okay?

- I could say it this way
- It sounds strange here

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

Submit

Phase 1: Judgments on Explicit Passages

<u>Author Conj</u> mTurker Conj	AND	BECAUSE	BUT	OR	SO
And	189	14	81	5	33
Because	60	105	60	2	9
But	68	48	497	7	9
Or	2	0	2	35	0
So	125	1	25	2	56
Other	3	1	8	2	0
None	17	4	23	5	9

⇒ Participants and authors often agree on conjunction, but not always: Differences are also of interest.

Phase 1: Judgments on Implicit Passages

<u>DAdv</u> mTurker Conj	after all	in fact	in general	instead
And	50	87	118	20
Because	245	35	86	38
But	16	83	50	103
Or	1	0	0	0
So	4	3	21	119
Other	5	3	2	0
None	26	20	13	10

⇒ With *after all*, mTurkers favor “Because”. With other adverbials, the responses are more varied.

Phase 1: Judgments on Explicit Passages (6) with *Instead*

<u>Author Conj</u> mTurker Conj	AND (2)	BUT (4)	Total
And	16	1	17
Because	0	1	1
But	6	210	216
Or	0	2	2
So	92	17	109
Other	0	0	0
None	2	1	3

Author-selected AND got “So” and “But” responses.

⇒ mTurkers asked to choose a conjunction that conveys the sense they infer seem to select one that is more specific than “And” [Knott & Mellish, 1996].

Phase 1: Judgments on Explicit Passages with *After all*

<u>Author Conj</u> mTurker Conj	AND (1)	BECAUSE (1)	BUT (4)	Total
And	18	6	30	54
Because	9	51	51	111
But	25	0	128	153
Or	0	0	0	0
So	0	0	3	3
Other	1	0	3	4
None	5	1	17	23

⇒ mTurkers frequently chose “Because” no matter what conjunction the author selected.

⇒ “Because” shares no senses with BUT or AND. What’s up?

Phase 1: Judgments on Explicit Passages with *After all*

(13) It has never worked before / _____ *after all*, nothing ever works until it works.

And Because But Or So [Other] None

(14) Yes, I suppose there's a certain element of danger in it that you can't get around / _____ *after all*, there's a certain amount of danger in living, whatever you do.

And Because But Or So [Other] None

Phase 1: Judgments on Explicit Passages with *After all*

(15) It has never worked before / _____ *after all*, nothing ever works until it works.

- Author: “But”
- mTurkers: 21/58 “Because”

(16) Yes, I suppose there’s a certain element of danger in it that you can’t get around / _____ *after all*, there’s a certain amount of danger in living, whatever you do.

- Author: “But”
- mTurkers: 22/58 “Because”

⇒ Maybe some EXPLANATIONS surprise one by CONTRAST with what one might expect.

Phase 1: Judgments on Explicit Passages with *in fact*

Author Conj mTurker Conj	AND (1)	BECAUSE (2)	BUT (2)	OR (1)	SO (1)
And	53	8	27	5	29
Because	1	54	4	2	1
But	1	48	74	7	6
Or	0	0	0	35	0
So	0	1	4	2	15
Other	0	1	5	2	0
None	3	3	2	5	7

⇒ Contrary to choosing “Because” for author BUT with *after all*, mTurkers sometimes chose “But” for author BECAUSE. Again, what’s up?

Phase 1: Judgments on Explicit Passages with *in fact*

(17) Americans' big-is-better mentality is a shame in the case of artichokes / _____ *in fact*, the small ones are much easier to clean, cook more quickly and can be purchased spontaneously because they don't take any more time than any other vegetables.

And Because But Or So [Other] None

- Author: "Because"
- mTurkers: 9/58 "But"

⇒ Those mTurkers may be **CONTRASTING** the second clause to American's *having* a big-is-better mentality about artichokes.

Conclusions

Our goal is to get experimental evidence for Concurrent DRels.
Analysis of Phase 1 data shows:

- Given an explicit DAdv, naive subjects do seem able to show what DRel they take to be operative, based on their choice of conjunction.
- For at least *after all*, the DRel does seem fairly predictable on the basis of the explicit DAdv alone, while for the other three adverbials, both context and current content seem relevant.
- One can certainly get useful data on concurrent DRels via crowd-sourcing.

Results of Phase 2 now being analysed, and passages prepared for Phase 3.

Conclusions

- Researchers have already observed that a sentence in Catalan & Spanish [Cuenca and Marin, 2009] and in Turkish [Zeyrek, 2014] may contain multiple explicit connectives, expressing multiple DRels.
- Clear that this also happens in German.
- I hope people will explore whether, when only one of these connectives is present, concurrent discourse relations are still being inferred.
- It would be surprising if this phenomena were limited to English.

References

[Al-Saif & Markert, 2011]

Al-Saif, A. and K. Markert. 2011. Modelling discourse relations for Arabic. *Proceedings, Conference on Empirical Methods in Natural Language Processing*, pp. 736747, Edinburgh.

[Asher & Lascarides, 2003]

Nicholas Asher and Alex Lascarides. 2003. *Logics of Conversation*. Cambridge University Press.

[Cuenca & Marin, 2009]

M.J. Cuenca and M.J. Marin. 2009. Co-occurrence of discourse markers in Catalan and Spanish oral narrative. *Journal of Pragmatics*, 41(5):899914.

[Jiang, 2013]

Xi Jiang. 2013. Predicting the use and interpretation of implicit and explicit discourse connectives. Masters thesis, Linguistics and English Language, University of Edinburgh.

References

[Knott & Mellish, 1996]

Alistair Knott and Chris Mellish, 1996. A Feature-based Account of the Relations Signalled by Sentence and Clause Connectives. *Language and Speech* 39(2-3):143-183.

[Kolachina et al, 2012]

Kolachina, S., R. Prasad, D. M. Sharma, and A. Joshi. 2012. Evaluation of discourse relation annotation in the Hindi Discourse Relation Bank. *Proceedings, Eighth International Conference on Language Resources and Evaluation*, pp. 823828, Istanbul.

[Mann & Thompson, 1988]

William Mann and Sandra Thompson, 1988. Rhetorical Structure Theory: Toward a Functional Theory of Text Organization, *Text* 8(3):243-281.

[Prasad et al, 2011]

Prasad, R., S. McRoy, N. Frid, A. Joshi, and H. Yu. 2011. The Biomedical Discourse Relation Bank. *BMC Bioinformatics*, 12(188):118.

References

[Zeyrek et al, 2013]

Zeyrek, D., I. Demirşahinn, A. Sevdik Çallı, and R. Çakıcı. 2013. Turkish Discourse Bank: Porting a discourse annotation style to a morphologically rich language. *Dialogue and Discourse*, 4(2):174184.

[Zeyrek, 2014]

Zeyrek, D. (2014). On the distribution of contrastive-concessive discourse connectives *ama* (but/yet) and *fakat* (but) in written Turkish. Suihkonen, P. & Whaley, L. (Eds.), *On Diversity and Complexity of Languages Spoken in Europe and North and Central Asia*.

[Zhou & Xue, 2015]

Zhou, Y. and N. Xue. (2015). The Chinese Discourse TreeBank: A Chinese corpus annotated with discourse relations. *Journal of Language Resources and Evaluation*. 49:397–431.