Concurrent Discourse Relations

Bonnie Webber

School of Informatics
University of Edinburgh
bonnie@inf.ed.ac.uk

Dialogue (Moscow) — June 1, 2016

Prologue

A discourse is more than its individual sentences.

Instead, each clause in a sentence relates to the context established by the previous discourse – in terms of a subject's awareness of

- the structure of the text
- its topic
- the entities it refers to
- its semantic & rhetorical relations (**discourse relations**) to elements of **context**.

Prologue

Evidence for **discourse relations** can come from **discourse connectives**:

(1) He suspected he shouldn't interrupt the speaker with a question.

- <u>Nevertheless</u> he did.
  - ⇒ what he did **contrast**s with what he should have done
- <u>Instead</u> he should wait until the end of the talk.
  - ⇒ waiting is a preferred **alternative** to interrupting

Prologue

While some situations may need an explicit connective to supply
evidence for a discourse relation:

(2) He suspected he shouldn't interrupt the speaker with a
question. Φ He did.

$\not\Rightarrow$ **contrast**

(3) He suspected he shouldn't interrupt the speaker with a
question.
<u>Nevertheless</u> he did.

$\Rightarrow$ **contrast**

Prologue

While some situations may need an explicit connective to supply evidence for a discourse relation:

(4) He suspected he shouldn't interrupt the speaker with a question. Φ He did.
$\not\Rightarrow$ **contrast**

other situations don't:

(5) He suspected he shouldn't interrupt the speaker with a question. Φ He should wait until the end of the talk.
$\Rightarrow$ waiting is a preferred **alternative** to interrupting

Prologue

The Penn Discourse TreeBank (PDTB) and similar corpora assume
that evidence for discourse relations can come:

- **Explicitly**, via discourse connectives, adverbials, marked
  syntactic forms, or other explicit signals;
- **Implicitly**, via inference based on adjacency, speaker/hearer
  biases, and/or world knowledge.

A clause can contain ≥ 1 piece of explicit evidence for how it
relates to the discourse context, or none at all.

Multiple Pieces of Explicit Evidence

Why might a clause contain >1 explicit pieces of evidence?

- Each may signal a **different** relation to a **different** part of the context;
- Each may signal a **different** relation to the **same** part of the context;
- They may redundantly signal the **same** relation to the **same** part of context;
- They may signal the **same** relation to a **different** part of context.

Multiple Pieces of Explicit Evidence

(6) The car was finally coming toward him. $_{s1}$
    He finished his diagnostic tests, $_{s2}$
    feeling relief. $_{s3}$
    <u>But</u> <u>then</u> the car started to turn right. $_{s4}$ [Wiebe, 1993]

Conjunction <u>but</u> signals CONTRAST between $s4$ and $s3$.
Adverbial <u>then</u> signals SUCCESSION between $s4$ and $s2$.

$\Rightarrow$ **Different** relations to **different** parts of context

Multiple Pieces of Explicit Evidence

(7) I must wash the dishes $_{s1}$ <u>because</u> <u>otherwise</u> I can't go out. $_{s2}$

Conjunction <u>because</u> signals that $s2$ serves as an EXPLANATION for $s1$.

Adverbial <u>otherwise</u> signals that $s1$ serves as a NEGATIVE CONDITION for $s2$.

$\Rightarrow$ **Different** relations to the **same** part of context

Multiple Pieces of Explicit Evidence

(8) Is it plausible for a beginner to learn Ruby $_{s1}$ <u>while</u> <u>at the same time</u> learning HTML and CSS $_{s2}$?

Conjunction <u>while</u> signals that $s2$ is SYNCHRONOUS with $s1$ (i.e., happening at the same time)
Adverbial <u>at the same time</u> also signals that $s2$ is SYNCHRONOUS with $s1$.

⇒ **Same** relation to the **same** part of context (Redundant)

Single Piece of Explicit Evidence

What might a single explicit piece of evidence imply?

- There is only one relation between the clause and its context
  — the relation explicitly signalled by the evidence;

- There are **concurrent discourse relations** between the clause
  and its context:
  $\Rightarrow$ one relation signalled by the explicit evidence;
  $\Rightarrow$ other inferrable relations.

Single Piece of Explicit Evidence

(9) **Such problems will require considerable skill to resolve**. $s1$
<u>However</u>, **neither Mr. Baum nor Mr. Harper has much international experience**. $s2$ [wsj_0109]

Adverbial <u>however</u> signals a CONTRAST between $s1$ and $s2$.

$\Rightarrow$ One relation to context

Single Piece of Explicit Evidence

(10) I must wash the dishes $_{s1}$. <u>Otherwise</u> I can't go out. $_{s2}$

Adverbial <u>otherwise</u> conveys a conditional relation between the negation of $s1$ and $s2$ (NEGATIVE CONDITION).

But we still infer an EXPLANATION relation holding between $s2$ and $s1$.

$\Rightarrow$ I must wash the dishes because I want to go out.

$\Rightarrow$ Concurrent Discourse Relations to same part of context

No Explicit Evidence

If there are adjacent clauses or sentences with no explicit signal of how they relate, it might imply:

- they aren't related;
- they are related by a single inferrable (implicit) discourse relation;
- they are related by concurrent discourse relations (all implicit and inferrable).

No Explicit Evidence: Concurrent Discourse Relations

(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
... [wsj_0553]

No Explicit Evidence: Concurrent Discourse Relations

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

   (Implicit=<u>so</u> CONTINGENCY.CAUSE.RESULT,
   Implicit=<u>instead</u> 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
. . . [wsj_0553]

Importance of Concurrent Discourse Relations

The possibility of **concurrent discourse relations** has implications for

- **Language Technology**: When is it worth trying to extract multiple relations from text?
- Corpus annotation
- Psycholinguistics

Importance of Concurrent Discourse Relations

The possibility of **concurrent discourse relations** has implications for

- Language Technology
- **Corpus annotation**: When should annotators be asked to annotate concurrent relations manually **vs.** when can automated methods make accurate decisions?
- Psycholinguistics

Importance of Concurrent Discourse Relations

The possibility of **concurrent discourse relations** has implications
for

- Language Technology
- Corpus annotation
- **Psycholinguistics**: What role, if any, do explicitly signals play
  in allowing hearers to infer other implicit relations?

Importance of Concurrent Discourse Relations

The problem is that we don't fully understand concurrent discourse relations, so:

1. Can we get evidence from corpora?
2. Can we get evidence from experiments?
3. Can we use such evidence to help automatically annotate concurrent relations and improve the ability of systems to extract information from text.

Prologue: Discourse Relations   **PDTB 2.0**
Corpus Evidence   PDTB 3.0
Experimental Evidence   Google N-grams

Penn Discourse TreeBank 2.0 (PDTB 2.0)

- The Penn Discourse TreeBank 2.0 was released in 2008 and remains the largest manually annotated corpus of Discourse Relations in English.
- It comprises annotation of the Penn WSJ corpus with
  - **Discourse Relations** between clauses whose sense or use serve as **arguments** to the relation;
  - **Lexical/Phrasal Evidence** for such relations.
- The PDTB does not annotate higher–level structure (RST [Mann & Thompson, 1988], SDRT [Asher & Lascarides, 2003]) or relative prominence between arguments (RST).

Penn Discourse TreeBank 2.0 (PDTB 2.0)

Other corpora annotated in the style of the PDTB:

- 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].

Recently started corpora in Polish (Maciej Ogrodniczuk, IPIPan) and in Portuguese (Amalia Mendes, University of Lisbon).

Three forms of annotation: Penn TreeBank

(13) Until the building is completed, Exxon will rent part of an existing office tower. [wsj_0784]
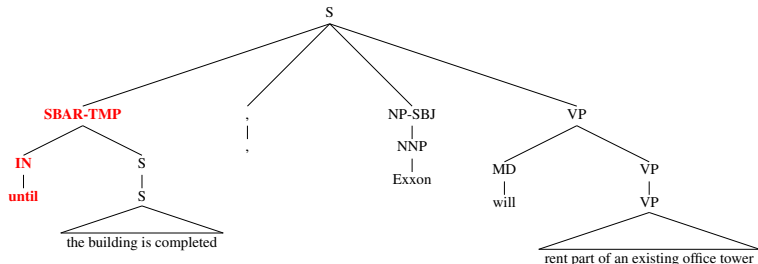
Three forms of annotation: PropBank

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.

Prologue: Discourse Relations
Corpus Evidence
Experimental Evidence

PDTB 2.0
PDTB 3.0
Google N-grams
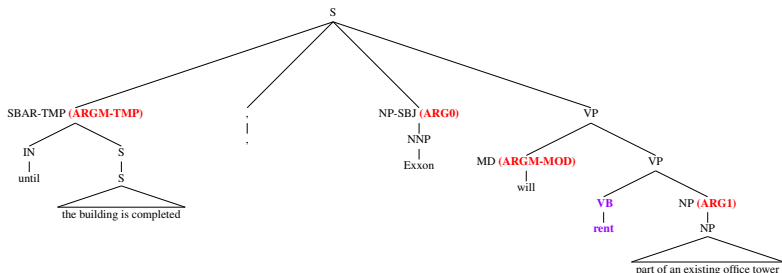
Three forms of annotation: PDTB 2.0

The PDTB 2.0 annotates discourse relations by labelling **text spans** involved in a relation:

- the text span whose sense and/or use serves as **Arg1** of the relation;

- the text span whose sense and/or use serves as **Arg2**;

- the (optional) text span that serves as <u>evidence</u> for the relation;

- the ≥ 1 senses that hold between the arguments.

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

Senses such as TEMPORAL.ASYNCHRONOUS.PRECEDENCE are arranged in an **abstraction hierarchy**.

Prologue: Discourse Relations
Corpus Evidence
Experimental Evidence

PDTB 2.0
PDTB 3.0
Google N-grams

PDTB 2.0 Sense Hierarchy [Prasad et al, 2008]
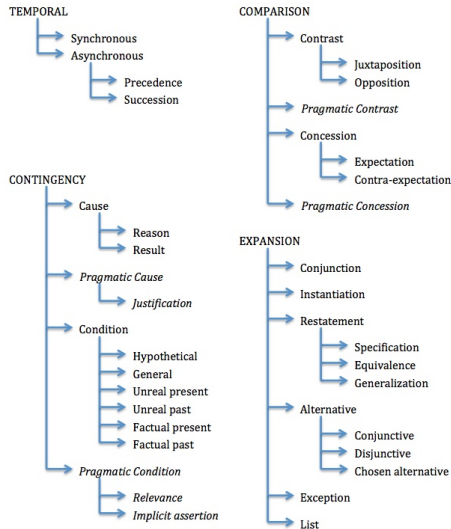
PDTB 2.0: Explicit and Implicit Relations

Discourse connectives annotated as evidence for explicit discourse relations come from well-defined syntactic classes:

- **Subordinating conjunctions**: *because, though, when, if*, etc.
- **Coordinating conjunctions**:
    - Ordinary conjunctions: *and, but, so, nor, or,*
    - Discontinuous conjunctions: *either..or, neither..nor, not only..but also*)
- **Discourse Adverbials**:
    - PPs: *as a result, insofar as, in comparison*, etc.
    - Adverbs: *then, however, instead, likewise, subsequently*, etc.

Implicit relations inferred between **adjacent** sentences are annotated by inserting ≥ 1 **implicit connectives** between the spans and labelling them with the sense(s) that have been inferred.

Annotating Implicit Relations with Implicit Connectives

(15) **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]

Prologue: Discourse Relations   **PDTB 2.0**
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Annotating Implicit Relations with Implicit Connectives

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

(Implicit=<u>rather</u> EXP.ALT.CHOSEN_ALT)

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

Concurrent relations annotated in the PDTB 2.0

Concurrent relations can hold between arguments in the PDTB 2.0 because senses are only disjoint if:

- they are defined as inverses:
  REASON vs. RESULT: A REASON for B ⇔ B RESULT of A
  PRECEDENCE vs. SUCCESSION: A PRECEDE B ⇔ B SUCCEED A
  EXPECTATION vs. CONTRA-EXPECTATION

- or their definitions are incompatible:
  REASON (**Arg2** ≤ **Arg1**) vs. PRECEDENCE (**Arg1** < **Arg2**)
  FACTUAL PRESENT vs. FACTUAL PAST
  FACTUAL PRESENT vs. UNREAL PRESENT

But most senses are compatible.

Prologue: Discourse Relations
Corpus Evidence
Experimental Evidence

PDTB 2.0
PDTB 3.0
Google N-grams

Concurrent relations annotated in the PDTB 2.0

PDTB annotators were allowed to assign up to **two** compatible senses as holding between arguments to an explicit connective.

999/18459 explicit connectives (5.4%) were so labelled.

(17) **In the coming decade U.S.-Japanese relations will be tested**, <u>as</u> **Tokyo comes to terms with its new status as the region's economic behemoth**. (wsj_0043)

- TEMPORAL.SYNCHRONY ⇒ **(repeated) testing of relations** occurs at the same time as **coming to terms with new status**
- CONTINGENCY.CAUSE.REASON ⇒ **coming to terms with new status** is reason for **(repeated) testing of relations**

Such multiple assignments are probably under-annotated.

Concurrent relations annotated in the PDTB 2.0

An earlier experiment with one explicit connective allowed
annotators to use the paired label TEMPORAL/CAUSAL as well as
TEMPORAL or CAUSAL alone, when annotating the 184 relations
headed by *since* in the WSJ corpus [Miltsakaki et al, 2005].

T/C FREQUENCY

Sense	Annot 1	Annot 2	PDTB 2 frequency
since	11.3% (21)	8.6% (16)	5.4% (10)

Concurrent relations may be under-annotated in the PDTB2
because paired senses weren't an option and annotators weren't
encouraged to consider concurrent relations. They were just told
that they could assign ≥ 1 sense label.

Concurrent relations annotated in the PDTB 2.0

In addition, 530/16053 implicit connectives (3.2%) were annotated with concurrent relations, either by labelling one connective with ≥ 1 sense (359 tokens)

(18) **Prosecutors alleged that she was trying to bolster students' scores to win a bonus under the state's 1984 Education Improvement Act**. (implicit=<u>because</u>) **The bonus depended on her ability to produce higher student-test scores**. (wsj_0044)

- EXPANSION.RESTATEMENT.SPECIFICATION $\Rightarrow$ **Arg2** describes **bolstering students scores to win a bonus** in more detail

- CONTINGENCY.CAUSE.REASON $\Rightarrow$ **Arg2** is the reason for **trying to bolster students' scores**.

Prologue: Discourse Relations
Corpus Evidence
Experimental Evidence

PDTB 2.0
PDTB 3.0
Google N-grams

Concurrent relations annotated in the PDTB 2.0

or by labelling each sense with its own implicit connective (171 tokens):

(19) **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.**(wsj_0553)

- implicit=<u>so</u>, Contingency.Cause.Result (**Arg2** ≡ result of **Arg1**)
- implicit=<u>instead</u>, Expansion.Alternative (**Arg2** ≡ chosen alternative to **Arg1**.

Prologue: Discourse Relations
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PDTB 3.0
Google N-grams

Concurrent relations annotated in the PDTB 2.0

(20) CBS expects to make modest profits, **but rivals contend that it will take a beating**. **ABC lost $75 million on the 1988 Winter Games, partly because of its $309 million rights fee**. [wsj_1057]

- implicit=<u>because</u>, Contingency.Cause.Reason
- implicit=<u>previously</u>, Temporal.Asynchronous.Succession

(21) **Accessories not only sell faster than whole bikes, they also offer profit margins nearly double the 25% to 30% or so on sales of complete cycles**. **To get a piece of the business, Nike Inc., Beaverton OR, introduced a line of mountain-bike shoes**. [wsj_0367]

- implicit=<u>thus</u>, Contingency.Cause.Result
- implicit=<u>for example</u>, Expansion.Restatement.Specification

Penn Discourse TreeBank 3.0 (PDTB 3.0)

In 2014, the National Science Foundation (NSF) granted funding
to create an enriched version of the PDTB that contains

- an extended and simplified sense hierarchy;
- discourse relations annotated **within** sentences (e.g., between conjoined verb phrases, conjoined clauses, free adjunct and matrix clause, etc.);
- relations annotated aross paragraphs;
- **concurrent discourse relations**.

We aim to deliver the PDTB 3.0 to the community in mid-2017.

Prologue: Discourse Relations   PDTB 2.0
Corpus Evidence   **PDTB 3.0**
Experimental Evidence   Google N-grams

PDTB 3.0 Sense Hierarchy

- The sense hierarchy retains the same four Level-1 senses.
- Rare and/or difficult-to-annotate Level-3 senses have been eliminated.
- Level-3 is now only used to encode the **direction** of asymmetric relations:
    - CONDITION.ARG1-AS-COND
    - CONDITION.ARG2-AS-COND
- Additional senses have been added for annotating intra-sentential relations.

PDTB 3.0 Sense Hierarchy: Revised Contingency sub-tree

- Cause
  - Reason
    (Arg1-as-result)
  - Result
    (Arg2-as-result)
- Cause+Belief
  - Reason+Belief
  - Result+Belief
- Cause+SpeechAct
  - Reason+SA
  - Result+SA
- **Purpose**
  - Arg1-as-goal
  - Arg2-as-goal

- Condition
  - **Arg1-as-cond**
  - Arg2-as-cond
- Condition+SpeechAct
- **Negative-condition**
  - Arg1-as-negcond
  - Arg2-as-negcond
- **Negative-condition+SpeechAct**

New rels in **blue**

Prologue: Discourse Relations   PDTB 2.0
Corpus Evidence   **PDTB 3.0**
Experimental Evidence   Google N-grams

Examples of new Contingency relations

Purpose.Arg2-as-goal:

(22) These "active suspension systems" **electronically sense road conditions** <u>and</u> **adjust a car's ride** [wsj_0956]

Condition.Arg1-as-cond

(23) **Give television a chance to cover live any breaking of the law**, <u>and</u> **no second invitation will be required**. [wsj_0290]

Negative-Condition.Arg1-as-negcond

(24) The National Institutes of Health policy would require researchers to **cut financial ties with health-care businesses** – <u>or</u> **lose their government money**. [wsj_0975]

⇒ If they didn't cut their financial ties . . . , they'd lose their money.

PDTB 3.0 Sense Hierarchy: Revised Expansion sub-tree

- Conjunction
- Disjunction
- Specification
    - Arg2-as-detail
      (specification)
    - Arg1-as-detail
      (summarization)
- Equivalence
- Exception
    - Arg1-as-excpt
    - Arg2-as-excpt
- **Substitution**
    - Arg1-as-subst
    - Arg2as-subst

- **Manner**
    - Arg1-as-manner
    - Arg2-as-manner
- Instantiation

New relations in **blue**.

Prologue: Discourse Relations   PDTB 2.0
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Examples of new Expansion relations

Substitution.Arg1-as-subst

(25) ERC International Inc., . . . , is **refining its defense niche**, **not retreating from it**. [wsj_0799]

Substitution.Arg2-as-subst

(26) "We've got to **get out of the Detroit mentality** <u>and</u> **be part of the world mentality**," declares Charles M. Jordan, . . . [wsj_0956]

Manner.Arg2-as-manner

(27) Some residents **defied orders** <u>and</u> **returned to "red" buildings to retrieve goods**. [wsj_1435]

PDTB 3.0 Sense Hierarchy: Revised Comparison sub-tree

- Contrast
- **Similarity**
- Concession
    - Arg1-as-denier (Expectation)
    - Arg2-as-denier (Contra-Expectation)
- **Concession + SpeechAct**
    - Arg2-as-denier + SpeechAct

New relations in **blue**.

Prologue: Discourse Relations   PDTB 2.0
Corpus Evidence   **PDTB 3.0**
Experimental Evidence   Google N-grams

Examples of new Comparison relations

Comparison.Similarity

(28) <u>Just as</u> **the 1980s bull market transformed the U.S. securities business**, <u>so too</u> **will the more difficult environment of the 1990s**," says Christopher T. Mahoney, a Moody's vice president. [wsj_0128]

Concession+SA:Arg2-as-denier+SA

(29) Congress **closed this loophole last year**, <u>or</u> **thought it did**. [wsj_1574]

Concurrent relations in the PDTB 3.0

Only the annotation of conjoined verb phrases (VPs) is complete.

Of 4633 conjoined VPs, 1047 have been annotated with concurrent discourse relations (23%)

Sense	Frequency
Conjunction + Result	402
Conjunction + Precedence	378
Conjunction + Arg2-as-subst	51
Conjunction + Arg2-as-detail	44
Result + Arg1-as-manner	41
OTHER	131
TOTAL	**1047**

Prologue: Discourse Relations
Corpus Evidence
Experimental Evidence

PDTB 2.0
PDTB 3.0
Google N-grams

Pairs of conjunctions and discourse adverbials

Pairs of a conjunction and a discourse adverbial are not uncommon (Google N-grams).

Instead	13555890	instead	42759917
Instead of	5135343	instead of	27030733
Instead ~~of~~	8420547	instead ~~of~~	15729184

And instead ~~of~~	8033	and instead ~~of~~	1053928
But instead ~~of~~	101505	but instead ~~of~~	1510409
So instead ~~of~~	71646	so instead ~~of~~	78585
[Conn] instead ~~of~~	181184	[conj] instead ~~of~~	2642922
	(∼1.2%)		(∼16.8%)

Total: ∼11.7% of instead tokens co-occur with and/but/so

Discourse Adverbials (Google N-grams)
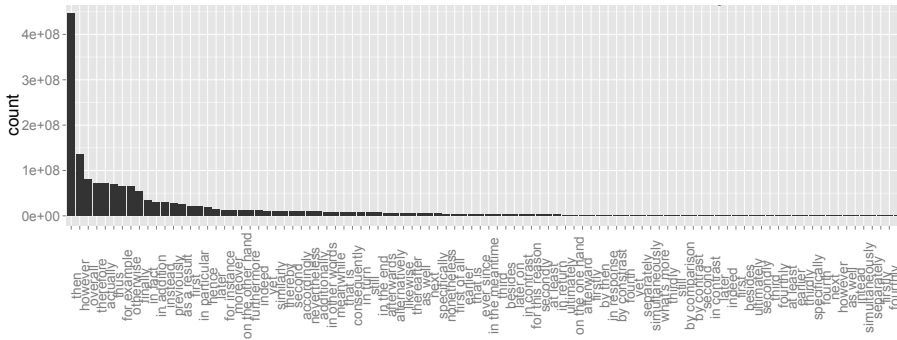
Zipfian distribution: Sentence-initial, complete phrase

Adverbials and their Preferred Conjunctions

- Google N-grams show that all discourse adverbials occur most frequently alone,
- but next to a conjunction, some adverbials show preferences
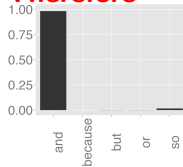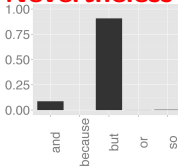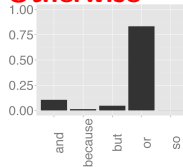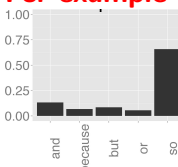
Adverbials and their Preferred Conjunctions

- while Google N-grams show that other adverbials have a more even distribution.
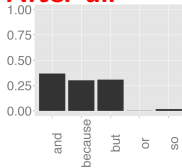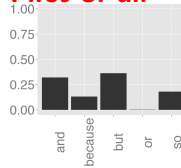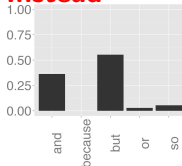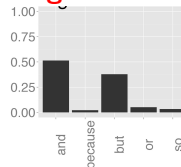
ConnText Project

- Funded by small grant from **Nuance Foundation** (Aug 2014 - Feb2017)
- Overall goal: Characterize discourse adverbials in terms of the concurrent relations they co-occur with.
- Because judgments of concurrent relations may vary and be hard to get, we are using:
    - a large number of judges (via **crowd-sourcing**)
    - **indirect evidence** of what, if any, conjunctions judges would use to express the sense(s) in which a clause is connected to context.
- Later move to more direct judgements of sense(s).

ConnText: Phase 1 Stimuli

- Explicit passage: Author-given Conjunction removed from passage
- Implicit passage: Author didn't use a Conjunction
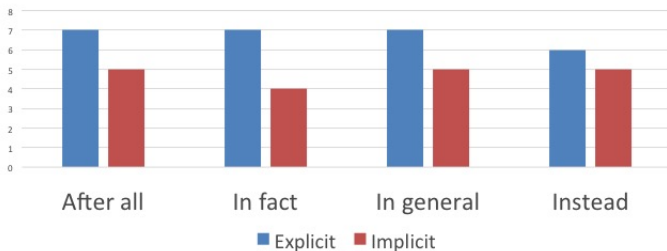
Interface: Presenting stimuli

Interface: Confirming stimuli

Phase 1: Participants

- Recruited 70 participants with U.S. addresses through Mechanical Turk: Equal number of men/women.
- Each annotated 50 passages (27 explicit passages, 23 implicits).
- Removed participants who worked very quickly or had a high level of disagreement with other participants: Analysis based on remaining 58 judgments / passage.

Phase 1: Explicit passages

Author Participant	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 conjunctions.

Phase 1: Explicit passages

Author / Participant	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

But not always: Differences are also of interest.

Phase 1: Explicit response distribution for *Instead*

Author Participant	AND	BUT	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	2	3

Author-selected AND got participant *so* responses.

Do participants attributing meaning select more specific in preference to underspecified *and*?

Phase 1: Explicit response distribution for *After all*

Author Participant	AND	BECAUSE	BUT	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

Participants chose *because* for Author-selected AND and BUT.

Does anything else show that *after all* prefers *because*?

Phase 1: Implicit passages – Results per adverb

	after all	*in fact*	*in general*	*instead*
Participant				
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*, participants do favor *because*.

(With the other three adverbials, responses are more varied.)

After all: Author BUT $\Rightarrow$ Participant BECAUSE

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

(31) 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.

Choose from: And   Because   But   Or   [other]   None

After all: Author BUT ⇒ Participant BECAUSE

(32) It has never worked before because after all, nothing ever works until it works. (21/58 responses)

(33) Yes, I suppose there's a certain element of danger in it, that you can't get around / because after all, there's a certain amount of danger in living, whatever you do. (22/58 responses)

Next steps

- Have data from same 28 participants on another 16 discourse adverbials (phase 2)
- Phase 2 data have been analysed and a paper has been submitted to *LAW 2016*.
- Currently crowdsourcing Phase 3 data on a final set of 35 adverbs from 25 participants.
- Though results are interesting, still need to distinguish actual concurrent discourse relations from redundant evidence for the same discourse relation.
- We are therefore designing a Phase 4 experiment that makes a more direct link between participant judgments and their inferred sense(s).

Conclusions (1)

- It has been customary to assume that the semantic relation between a clause or sentence and its context **either** is marked explicitly **or** involves inference.

- Evidence from corpus annotation and crowdsourcing, however, suggests that often **both** are involved.

- We have called the result **concurrent discourse relations**.

Conclusions (2)

- Our work on corpus annotation has shown where expert annotators infer more than one sense holding between a clause and its context, where the clause itself may contain **no** discourse connective or ≥ 1 discourse connective.

- Our crowd-sourcing experiments have used many more judges. However, because they are not experts, we must use **indirect** means of assessing whether they take ≥ 1 discourse relations to hold between a clause or sentence and its context.

- These experiments are revealing interesting patterns of responses that should be taken into account in **relation extraction** tasks.