Twitter is a service for friends, family, and co-workers to communicate and stay connected through the exchange of quick, frequent answers to one simple question: **What are you doing?**

---

**The Daily B**

Sunday, August 30, 2006

**Martians invade earth**

Incredible as it may seem, it has been confirmed that a large martian invasion fleet has landed on earth tonight.

First vessels were sighted over Great Britain, Denmark and Norway already in the late evening from where, as further reports indicate, the fleet headed towards the North Pole and Santa Claus was taken hostage by the invaders.

Afterwards they split apart in order to approach most relevant major cities around the then earth. The streets filled as behind thousands fled their homes, many only wearing their pajamas...
Outline

1. Penn Discourse Treebank

2. Implicit vs. Explicit
   - When is something really implicit?
     * are there more subtle clues than “the usual suspects”
   - Do genres differ on how explicit or implicit they are?
   - What’s the difference between the same relationship when marked vs. unmarked?
   - quantitative or qualitative?

3. Experiments looking at the difference
   - Marcu & Echihabi, Spoorleder & Lascarides, Lin et al.
Why do people want to create annotated corpora?

• To get accurate distributional information

• To use as input to supervised machine learning in order to eventually automatically rerecognize the annotated categories
But annotation is difficult

• How do you know if you are really annotating what you think you are annotating?

• People’s intuitions are vague here

• SOLUTION: Let people annotate what they already know
Penn Discourse Treebank (PDTB 2.0)

• Annotation of explicit and implicit relations and their arguments in the Wall Street Journal corpus of the Penn Treebank

• Connective-based annotation
  • Lexically-based = theory neutral
  • For each connective, its sense is identified, disambiguating different usages
  • When no connective is present, annotators are asked to add the most appropriate connective
  • Local coherence relations only
  • Based on idea of connectives as discourse structural projectors
Verbs and argument structure

**intransitive verbs**

*sleep:* John sleeps.
(takes one agent argument)

**transitive verbs**

*meet:* John met Mary.
*buy:* John bought some gum.
(takes two arguments, one agent and one patient)

**ditransitive verbs**

*offer:* John offered Mary some gum.
(takes 3 arguments, agent, patient and goal)
She saw a dog **while** she was eating lunch.

“Connectives are discourse level predicates which project predicate-argument structure on a par with verbs at the sentence level”

Webber and Joshi (1998; DLTAG), Webber et al. (1999b) and Webber et al. (2003)
Connective based annotation

• Connective take two abstract objects as arguments:
  – events
  – states
  – propositions
• Each annotation relates a connective with two arguments (Arg1 and Arg2)
• Arg2 is the clause syntactically bound to the connective.
Explicit and implicit connectives

**EXPLICIT:** *because*, Contingency.Cause.Reason

*Arg1:* In addition to the extra privacy of these trades, the transactions can often be less expensive to execute *because*

*Arg2:* the parties don't have to pay a floor brokerage fee or a specialist's fee

**IMPLIED:** *because*, Contingency.Cause.Reason

*Arg1:* Using small electrical shocks applied to her feet, they were able to monitor sensory nerves *(because)*

*Arg2:* The shocks generated nerve impulses that traveled via spine to brain and showed up clearly on a brain-wave monitor, indicating no damage to the delicate spinal tissue
Three levels of Sense Tags

• Sense tagset:
  - CLASS
    - Four major classes
    - Comparison, Contingency, Temporal & Expansion

• TYPE
  - 16 types
  - Only 10 of these occur more than 200 times in sections 2-22

• SUBTYPE
  - TYPE Cause contains SUBTYPES Reason & Result
  - Marks the type of ARG2, which is linearly after ARG1
Three levels

- Sense tagset:
- **CLASS**
  - Four major classes
  - Comparison, Contingency, Temporal & Expansion
- **TYPE**
  - 16 types
  - Only 10 of these occur more than 200 times in sections 2-22
- **SUBTYPE**
  - TYPE Cause contains SUBTYPES Reason & Result
  - Marks the type of ARG2, which is linearly after ARG1
  - However, this is often predictable from the connective (though not always)
Use of dispersants was approved when a test on the third day showed some positive results, officials said.

In addition, its machines are typically easier to operate, so customers require less assistance from software.
Classes in the PDTB 2.0

- **CONTINGENCY**
  - The situations described in Arg1 and Arg2 are causally influenced

- **TEMPORAL**
  - The situations described in Arg1 and Arg2 are temporally related

- **COMPARISON**
  - The situations described in Arg1 and Arg2 are compared and *differences* between them are identified (*similar situations do not fall under this CLASS*)

- **EXPANSION**
  - The relevant to the situation described situation described in Arg2 provides information deemed in Arg1
Level 2 and 3: Types, Subtypes and senses (1)

- **TEMPORAL: Asynchronous**
  - Precedence
  - Succession

- **TEMPORAL: Synchronous**
  *No subtypes*

- **CONTINGENCY: Cause**
  - reason
  - Result

- **CONTINGENCY: Condition**
  - hypothetical
  - general
  - factual present
  - factual past
  - unreal present
  - unreal past
Level 2 and 3: Types Subtypes or senses (2)

- COMPARISON: Contrast
  - Juxtaposition
  - Opposition

- COMPARISON: Concession
  - expectation
  - contra-expectation

- EXPANSION: Restatement
  - Specification
  - Equivalence
  - Generalization

- EXPANSION: Alternative
  - Conjunctive
  - Disjunctive
  - Chosen alternative
Linear order?

- **Arg2** is the sentence/clause with which connective is syntactically associated.
- **Arg1** is the other argument.

- No constraints on relative order. Discontinuous annotation is allowed.

• **Linear:**
  The federal government suspended sales of U.S. savings bonds because Congress hasn't lifted the ceiling on government debt.

• **Interposed:**
  Most oil companies, when they set exploration and production budgets for this year, forecast revenue of $15 for each barrel of crude produced.
Explicit connectives

- Subordinating conjunctions (e.g., *when*, *because*, *although*, etc.)

  *The federal government suspended sales of U.S. savings bonds* **because** *Congress hasn't lifted the ceiling on government debt.*

- Coordinating conjunctions (e.g., *and*, *or*, *so*, *nor*, etc.)

  *The subject will be written into the plots of prime-time shows*, **and** *viewers will be given a 900 number to call.*

  - **Arg1** and **Arg2**
• Discourse adverbials (e.g., then, however, as a result, etc.)

*In the past, the socialist policies of the government strictly limited the size of ... industrial concerns to conserve resources and restrict the profits businessmen could make. As a result, industry operated out of small, expensive, highly inefficient industrial units.*
Implicit Connectives

No Explicit connective? Infer a relation based on adjacency.

Some have raised their cash positions to record levels. Implicit=because (causal) High cash positions help buffer a fund when the market falls.

The projects already under construction will increase Las Vegas's supply of hotel rooms by 11,795, or nearly 20%, to 75,500. Implicit=so (consequence) By a rule of thumb of 1.5 new jobs for each new hotel room, Clark County will have nearly 18,000 new jobs.

Insert the connective that “best” captures the relation.
Paired connectives

• Take the same arguments:

- **On the one hand,** Mr. Front says, *it would be misguided to sell into "a classic panic."*  
  **On the other hand,** it's not necessarily a good time to jump in and buy.

- **Either** sign new long-term commitments to buy future episodes or risk losing "Cosby" to a competitor.

  ▪ Treated as complex connectives – annotated discontinuously
  ▪ Listed as distinct types (no head-modifier relation)
Non-insertion: AltLex

1. AltLex

A discourse relation is inferred, but inserting a connective would be redundant.
Other lexical information (in the form of a non-connective expression) signals the same relation.

New rules force thrifts to write down their junk to market value, then sell the bonds over five years.
AltLex = (result) That’s why Columbia just wrote off $130 million of its junk and reserved $227 million for future junk losses.
Non-insertion: EntRel

- **EntRel**: Coherence is created by an entity-based relation

- *Hale Milgrim, 41 years old, senior vice president, marketing at Elektra Entertainment Inc., was named president of Capitol Records Inc., a unit of this entertainment concern.** EntRel **Mr. Milgrim succeeds David Berman, who resigned last month.**

Deals with the problem of whether or not ELABORATION should be a discourse relation.
Non-insertion: NoRel

NoRel: Neither discourse nor entity-based relation is inferred.

*Jacobs is an international engineering and construction concern.* NoRel *Total capital investment at the site could be as much as $400 million, according to Intel.*
What can be an argument?

- Clauses or sentences (standard)
- Discourse deictic expressions (references to abstract objects)
  - Airline stocks typically sell at a discount of about one third to the stock market’s price-earnings ratio – which is currently about 13 times earnings. [That’s] because [airline earnings, like those of auto makers, have been subject to the cyclical ups-and-downs of the economy].

- Textual spans from which arguments can be derived
  - [No price for the new shares has been set]. Instead, [the companies will leave it up to the marketplace to decide].
How much material should an argument include

- Originally: only tags CONN, ARG1, ARG2
- SUP1 and SUP2: new tags added for information the annotator considered useful
  - Although [started in 1965], [Wedtech didn’t really get rolling until 1975] (when Mr. Neuberger discovered the Federal Government’s Section 8 minority business program)

- the Minimality Principle in PDTB argument selection: be conservative in identifying ARG1 and ARG2
Attribution features

• Annotated for
  • Explicit connectives
  • Implicit connectives
  • AltLex

34% of discourse relations are attributed to an agent other than the writer.
Attribution

• Relation of “ownership” between Agents and Abstract Objects
  – Abstract Objects: beliefs, facts, propositions
• Not a discourse relation
• Shows how discourse relations and their arguments can be attributed to different individuals:

When Mr. Green won a $240,000 verdict in a land condemnation case against the state in June 1983, [he says] Judge O’Kicki unexpectedly awarded him an additional $100,000.

⇒ Relation and Arg2 are attributed to the Writer.
⇒ Arg1 is attributed to another agent.
Summary PDTB 2.0

- All WSJ sections (25 sections; 2304 texts; 1 million words)
- 100 distinct types of relations
  - Subordinating conjunctions – 31 types
  - Coordinating conjunctions – 7 types
  - Discourse Adverbials – 62 types
- About 20,000 distinct tokens

<table>
<thead>
<tr>
<th>PDTB Relations</th>
<th>No. of tokens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explicit</td>
<td>18459</td>
</tr>
<tr>
<td>Implicit</td>
<td>16224</td>
</tr>
<tr>
<td>AltLex</td>
<td>624</td>
</tr>
<tr>
<td>EntRel</td>
<td>5210</td>
</tr>
<tr>
<td>NoRel</td>
<td>254</td>
</tr>
<tr>
<td>Total</td>
<td>40600</td>
</tr>
</tbody>
</table>
PDTB style annotation

Relatively easy?

1. No embedded structures. (unlike RST!)
2. Very high level categories:
   - Almost seems as if they planned to avoid difficulties
   - Only major ambiguities seem to be when the connective itself is ambiguous
3. Connective based annotation
PDDB first annotation experiments
Miltsakaki, Prasad, Joshi and Webber(2004)

- How difficult is it to identify ARG1 and ARG2?
- 10 connectives (2717 tokens)
  - subordinating conjunctions: *because, although, even though, when, so that*
  - discourse adverbials: *nevertheless, therefore, as a result, instead, otherwise*
- Explicit tokens: 2717
- Implicit tokens: 386
- 2 annotators
- Kappa statistic requires into discrete categories, but the PDDB annotation tokens are spans and connectives, so not appropriate
Inter-annotator agreement

- All argument annotations, treating ARG1 and ARG2 as independent tokens
  - total 5434 (twice # of relations)
- Agreement exact match criterion
  - 90.2% agreement (4900/5434 tokens) for all
  - ARG1 Agreement: 86.3%
  - ARG2 Agreement: 94.1%
<table>
<thead>
<tr>
<th>CONNECTIVES</th>
<th>AGR No.</th>
<th>Conn. Total</th>
<th>%AGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>when</td>
<td>1877</td>
<td>2032</td>
<td>92.4%</td>
</tr>
<tr>
<td>because</td>
<td>1703</td>
<td>1824</td>
<td>93.4%</td>
</tr>
<tr>
<td>even though</td>
<td>194</td>
<td>206</td>
<td>94.1%</td>
</tr>
<tr>
<td>although</td>
<td>635</td>
<td>704</td>
<td>90.1%</td>
</tr>
<tr>
<td>so that</td>
<td>66</td>
<td>74</td>
<td>89.2%</td>
</tr>
<tr>
<td>TOTAL SUBCONJ</td>
<td>4469</td>
<td>4834</td>
<td>92.4%</td>
</tr>
<tr>
<td>nevertheless</td>
<td>56</td>
<td>94</td>
<td>59.6%</td>
</tr>
<tr>
<td>otherwise</td>
<td>44</td>
<td>46</td>
<td>95.7%</td>
</tr>
<tr>
<td>instead</td>
<td>172</td>
<td>236</td>
<td>72.9%</td>
</tr>
<tr>
<td>as a result</td>
<td>110</td>
<td>168</td>
<td>65.5%</td>
</tr>
<tr>
<td>therefore</td>
<td>49</td>
<td>56</td>
<td>87.5%</td>
</tr>
<tr>
<td>TOTAL ADV.</td>
<td>431</td>
<td>600</td>
<td>71.8%</td>
</tr>
<tr>
<td>OVERALL TOTAL</td>
<td>4900</td>
<td>5434</td>
<td>90.2%</td>
</tr>
</tbody>
</table>

Table 1: Distribution of Agreement by Connective, with ARG1 and ARG2 Annotations Counted Independently
Inter-annotator agreement

For Implicit connectives:

- Connectives divided into 5 groups (based on Knotts work):
  - a) **additional information**
    - (e.g., ‘furthermore’, ‘in addition’)
  - b) **cause-effect relations**
    - (e.g., ‘because’, ‘as a result’),
  - c) **temporal relations**
    - (e.g., ‘then’, ‘simultaneously’),
  - d) **contrastive relations**
    - (e.g., ‘however’, ‘although’),
  - e) **restatement or summarization**
    - (e.g., ‘in other words’, ‘in sum’).

- 72% agreement on added connectives
In the released annotation (PDTB 2.0)

- What was the distribution of connectives like?
  - how ambiguous were connectives?
Explicit relations: the most frequent relation for a given connective accounts for over 90% of the discourse relations
  - most connectives are unambiguous
  - (Miltsakaki et al., 2005; Pitler et al., 2008).
Connective ambiguity by the four sense classes:

- Discourse connectives that occur with their most common sense by connective CLASS

<table>
<thead>
<tr>
<th>Sense Class</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison</td>
<td>93.43%</td>
</tr>
<tr>
<td>Contingency</td>
<td>94.72%</td>
</tr>
<tr>
<td>Temporal</td>
<td>84.10%</td>
</tr>
<tr>
<td>Expansion</td>
<td>97.63%</td>
</tr>
</tbody>
</table>
### Comparison Class

Pitler et al. [Easily identifiable discourse relations](#) Coling 2008

<table>
<thead>
<tr>
<th>connective</th>
<th>#</th>
<th>% with most frequent meaning</th>
</tr>
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<tbody>
<tr>
<td><em>but</em></td>
<td>3308</td>
<td>97.19%</td>
</tr>
<tr>
<td><em>while</em></td>
<td>781</td>
<td>66.07%</td>
</tr>
<tr>
<td><em>however</em></td>
<td>485</td>
<td>99.59%</td>
</tr>
<tr>
<td><em>although</em></td>
<td>328</td>
<td>99.70%</td>
</tr>
<tr>
<td><em>though</em></td>
<td>320</td>
<td>100.00%</td>
</tr>
<tr>
<td><em>still</em></td>
<td>190</td>
<td>98.42%</td>
</tr>
<tr>
<td><em>yet</em></td>
<td>101</td>
<td>97.03%</td>
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(only connectives n > 50 in corpus)
Comparison Class

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(only connectives n > 50 in corpus)
Explicit versus Implicit coherence relations
PDTB is connective based annotation:

**Explicit Relation**
John is very tired *because* he played tennis all morning.

**Implicit Relation w/ implicit connective**
John is very tired. He played tennis all morning.

- Taboda (2009) argues that all relations may be explicit.
  - because people seem to interpret relations with relative ease, so there must be signals guiding them

- Taboada (2009) argues that all relations may be signalled in some way
  - people seem to interpret ‘unmarked’ relations easily, so there must be some clue

- Two problems:
  - How do we discover which cues are signaling relations?
  - How do we test if relations are cognitively represented in the minds of hearers and readers?
    - We know from annotation experiments that identifying coherence relations is not trivial. Do we always identify these connections?
Kim
Kim quit her job.
She was tired of the long hours.
Kim quit her job *because* she was tired of the long hours.
Strong, causal relationship?

Kim quit her job *because* she was tired of the long hours.
Kim quit her job.
She was tired of the long hours.
Kim quit her job.
She was tired of the long hours *anyway.*
No clear causal relationship.

Kim quit her job. She was tired of the long hours *anyway*. 
Unmarked relations common

• In the PDTB (ignoring other relations)
  – 53% Explicit (18459 relations)
  – 47% Implicit (16224 relations)

• RST sources (Taboada) over 50% of relations do not have a `traditional’ discourse marker
  – analyses on the RST website (Mann & Taboada, 2007), very diverse collection of 187 texts: 72% of the relations had no discourse marker
  – Taboada (2006) study (mostly discourse markers, but also mood, finiteness and punctuation)
    • In conversation; relations signaled 31% of the time
    • In newspapers: 44% had discourse marks, although a few other signals are discussed in that paper
What `signalling mechanisms’ identify the coherence relations between discourse segments? (besides discourse markers):

- morphology
- syntactic structures
- semantic and pragmatic information
- discourse particles
- real world knowledge
[S] Some entrepreneurs say the red tape they most love to hate is red tape they would also hate to lose.

[N] They *concede* that much of the government meddling that torments them is essential to the public good, and even to their own businesses.

(Concession, RST Discourse Treebank)
What do we find in the PDTB?

- How often are connectives present in the PDTB?

<table>
<thead>
<tr>
<th>CLASS</th>
<th>Explicit (%)</th>
<th>Implicit (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison</td>
<td>5590 (69%)</td>
<td>2505 (31%)</td>
<td>8095</td>
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<td>Contingency</td>
<td>3741 (47%)</td>
<td>4261 (53%)</td>
<td>8002</td>
</tr>
<tr>
<td>Temporal</td>
<td>3696 (80%)</td>
<td>950 (20%)</td>
<td>4646</td>
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<tr>
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- How often are connectives present?

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• What do these distributional differences tell us? Do they make sense?

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Binary classification of CLASS

- Pitler et al. Easily identifiable discourse relations
- Can you distinguish one class from the other three?
  - Connective info only, “All” includes implicit connectives
  - Decision Tree classifier, binary classification task

<table>
<thead>
<tr>
<th>CLASS</th>
<th>All</th>
<th>Explicit only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison</td>
<td>91%</td>
<td>97%</td>
</tr>
<tr>
<td>Contingency</td>
<td>84%</td>
<td>94%</td>
</tr>
<tr>
<td>Temporal</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>Expansion</td>
<td>77%</td>
<td>98%</td>
</tr>
</tbody>
</table>
Four-way classification of CLASS

- Pitler et al. Easily identifiable discourse relations
- Can you distinguish CLASS with connective info alone?
  - Decision Tree classifier,

<table>
<thead>
<tr>
<th>CLASS</th>
<th>Precision</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison</td>
<td>0.84 [0.84]</td>
<td>0.72 [0.90]</td>
</tr>
<tr>
<td>Contingency</td>
<td>0.66 [0.97]</td>
<td>0.98 [0.96]</td>
</tr>
<tr>
<td>Temporal</td>
<td>0.95 [0.95]</td>
<td>0.37 [0.844]</td>
</tr>
<tr>
<td>Expansion</td>
<td>0.93 [0.93]</td>
<td>0.67 [0.97]</td>
</tr>
</tbody>
</table>
• What does this tell us about the difference between implicit and explicit relations?
  – Does it look as if some implicit relations show more connective ambiguity than explicit relations of the same type?

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<td>0.67 [0.97]</td>
</tr>
</tbody>
</table>
What does this mean?

• If connectives are present...
  – Determining CLASS easy
    • BUT is CLASS enough information?
    • CLASS is very vague

  “Level 1 classes are too general and coarse-grained for downstream applications while Level 3 subtypes are too fine-grained and are only provided for some types.” (Lin et al 2009)

• If there is no connective
  – CLASS identification is not so easy
  – Implicit relation recognition for TYPE most useful
Implicit vs. Explicit relations

• Are implicit and explicit relations the same?
  – fact that Explicit relations occur with a cue phrase suggests that they might need to be signaled
  – implicit relations may have clearer features than Explicit relations
  – research that manipulates Explicit relations to try to find features for Implicit relations might be on the wrong track
Evidence that Implicit relations are qualitatively different

- different senses occur with Explicit versions and Implicit versions of the same connectives
  - suggests that certain senses may be only possible with Explicit relations.
- Anderson & Spenader (ms.)
  - suggest a qualitative difference between Implicit and Explicit PURPOSE examples, but not between Implicit and Explicit RESULT relations.
  - To even be recognizable as an Implicit PURPOSE additional features are necessary, e.g. cues like a modal auxiliary, explicit connectives,
  - Contrasts with RESULT relations. When the event pairs are RESULT, 84% to 99% of the time with or without the connective the relation will be identified as a RESULT.
  - Explicit and Implicit versions of RESULT are identified equally as well.
Getting a decent set of implicit relations to study is hard.
Marcu & Echihabi (2002).
Sporleder & Lascarides (2008)

Create **synthetic** examples of implicit relations
It really looked like rain **but** I didn’t take my umbrella.

ARG1 but ARG2
It really looked like rain but I didn’t take my umbrella.

ARG1       but       ARG2

*but* seems to be an unambiguous marker of a CONTRAST relation
It really looked like rain but I didn’t take my umbrella.

ARG1 but ARG2

*but* seems to be an unambiguous marker of a CONTRAST relation

Note: in PDTB = Comparison.Concession: contra-expectation
It really looked like rain.....I didn’t take my umbrella.

ARG1                        ARG2

[Arg1, Arg2] = synthetic implicit CONTRAST relation
Marcu & Echihabi

- Bag-of-words type language model
- Naïve Bayes learning
- Model of what occurs on either side of a given connective

- Such standards would preclude arms sales to states like Libya, which is also currently subject to a U.N. embargo.
- **But** states like Rwanda before its present crisis would still be able to legally buy arms.
<table>
<thead>
<tr>
<th>CONTRAST</th>
<th>CAUSE-EXPLANATION-EVIDENCE</th>
<th>ELABORATION</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTITHESIS (M&amp;T)</td>
<td>EVIDENCE (M&amp;T)</td>
<td>ELABORATION (M&amp;T)</td>
<td>CONDITION (M&amp;T)</td>
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<tr>
<td>CONCESSION (M&amp;T)</td>
<td>VOLITIONAL-CAUSE (M&amp;T)</td>
<td>EXPANSION (Ho)</td>
<td></td>
</tr>
<tr>
<td>OTHERWISE (M&amp;T)</td>
<td>NONVOLITIONAL-CAUSE (M&amp;T)</td>
<td>EXEMPLIFICATION (Ho)</td>
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</tr>
<tr>
<td>CONTRAST (M&amp;T)</td>
<td>VOLITIONAL-RESULT (M&amp;T)</td>
<td>ELABORATION (A&amp;L)</td>
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<tr>
<td>VIOLATED EXPECTATION (Ho)</td>
<td>NONVOLITIONAL-RESULT (M&amp;T)</td>
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<tr>
<td>(CAUSAL</td>
<td>ADDITIVE ) -</td>
<td>EXPLANATION (Ho)</td>
<td></td>
</tr>
<tr>
<td>(SEMANTIC</td>
<td>PRAGMATIC ) -</td>
<td>RESULT (A&amp;L)</td>
<td></td>
</tr>
<tr>
<td>NEGATIVE (K&amp;S)</td>
<td>CAUSAL -</td>
<td>EXPLANATION (A&amp;L)</td>
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<tr>
<td></td>
<td>(SEMANTIC</td>
<td>PRAGMATIC ) -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>POSITIVE (K&amp;S)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Relation definitions as union of definitions proposed by other researchers (M&T – (Mann and Thompson, 1988); Ho – (Hobbs, 1990); A&L – (Lascarides and Asher, 1993); K&S – (Knott and Sanders, 1998)).
• Raw Corpus: 1 billion words, 41 million sentences
• BLIPP corpus = 1.7 million sentences
• 5000 examples of each collapsed relation class:
  – Contrast: simulated with *but, although*
  – CEV = cause-explanation-evidence
  – COND = condition
  – ELAB = elaboration
• Binary classification problem
• Naïve Bayes classifier
## Table 3: Performances of classifiers trained on the Raw corpus. The baseline in all cases is 50%.

<table>
<thead>
<tr>
<th></th>
<th>CONTRAST</th>
<th>CEV</th>
<th>COND</th>
<th>ELAB</th>
<th>NO-REL-SAME-TEXT</th>
<th>NO-REL-DIFF-TEXTS</th>
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</thead>
<tbody>
<tr>
<td>CONTRAST</td>
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<td>74</td>
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<td>64</td>
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<tr>
<td>COND</td>
<td>89</td>
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<td>69</td>
<td>76</td>
<td>75</td>
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<tr>
<td>ELAB</td>
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<td>76</td>
<td>69</td>
<td>76</td>
<td>75</td>
<td>64</td>
</tr>
<tr>
<td>NO-REL-SAME-TEXT</td>
<td>89</td>
<td>76</td>
<td>69</td>
<td>76</td>
<td>75</td>
<td>64</td>
</tr>
</tbody>
</table>

## Table 4: Performances of classifiers trained on the BLIPP corpus. The baseline in all cases is 50%.

<table>
<thead>
<tr>
<th></th>
<th>CONTRAST</th>
<th>CEV</th>
<th>COND</th>
<th>ELAB</th>
<th>NO-REL-SAME-TEXT</th>
<th>NO-REL-DIFF-TEXTS</th>
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<td>COND</td>
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<tr>
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<td>66</td>
<td>65</td>
</tr>
<tr>
<td>NO-REL-SAME-TEXT</td>
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<td>78</td>
<td>66</td>
<td>78</td>
<td>66</td>
<td>65</td>
</tr>
</tbody>
</table>
Pretty amazing results!

- Maybe it shows that if we have enough data, we can build lexical models that will identify in general terms, coherence relations!

We couldn’t find strong evidence that WordNet antonyms would help much in identifying contrastive relations.