

Implicitness of Discourse Relations

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Introduction

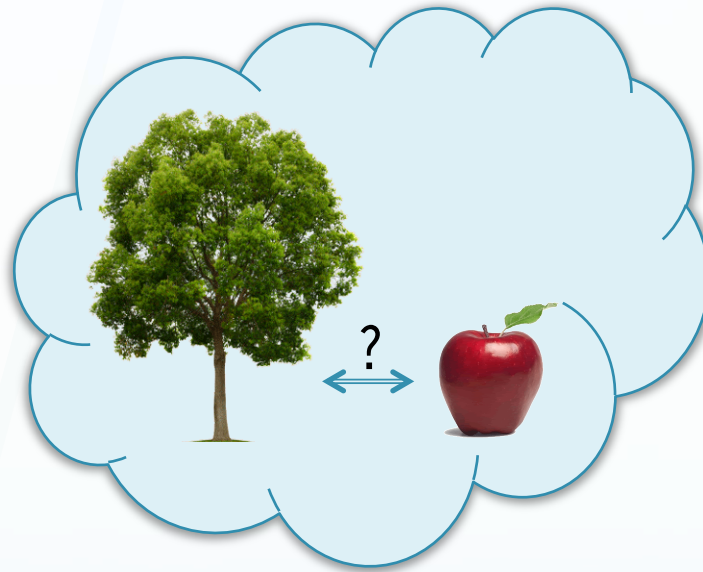
Discourse relations in a text are relation between propositions which are usually expressed as independent clauses or sentences.

- Additive
- Temporal
- Causal
- Adversative...



Introduction

Expectation for **a specific type of** discourse relation?



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Previous Experimental Work

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Expectation for a **specific type of** discourse relation?



Previous Experimental Work



A new corpus-based approach

Previous Work

Continuity Hypothesis: readers expect a sentence to be causally **congruent** and **continuous** with respect to its preceding context.

-- Segal et al. 1991, Murray 1997

Causality Hypothesis: readers start out assuming the relation between two consecutive sentences is a **causal** relation.

-- Sanders 2005

Continuity & Causality

Causal

Forward

Gary's daughter was sick so he took her to the hospital
cause consequence

Backward

Gary took his daughter to the hospital because she was sick
consequence cause

Concessive

Forward

Gary's daughter was sick but he sent her to the kindergarten
cause neg-consequence

Backward

Gary sent his daughter to the kindergarten although she was sick
neg-consequence cause

Experimental Studies

Segal et al. (1991): tendency to identify continuous relations between adjacent sentences

Murray (1994): more reading facilitation by signals of discontinuity (continuity is already expected)

Murray (1997): more salient effect of inappropriate discontinuous discourse markers + tendency to choose causal sentence completion

Kuperberg et al. (2011): semantic processing difficulty (bigger N400) reading causally unrelated sentences.

Experimental Studies

Murray (1997)

Sentence completion: completions were consistent with the connective.

Ronny cleaned up the house for his girlfriend's visit.
[so, also, nevertheless]



Experimental Studies

Murray (1997)

Sentence completion: more causal completions than adversative or additive.

Ronny cleaned up the house for his girlfriend's visit.

...

Natural Data Exploration

How to relate natural production data to reader's expectations?

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Uniform Information Density (Frank & Jaeger 2008): humans tend to spread information evenly across a text. Optional discourse markers should be omitted or decreased to avoid a valley in the information density.

Natural Data Exploration

How to relate natural production data to reader's expectations?

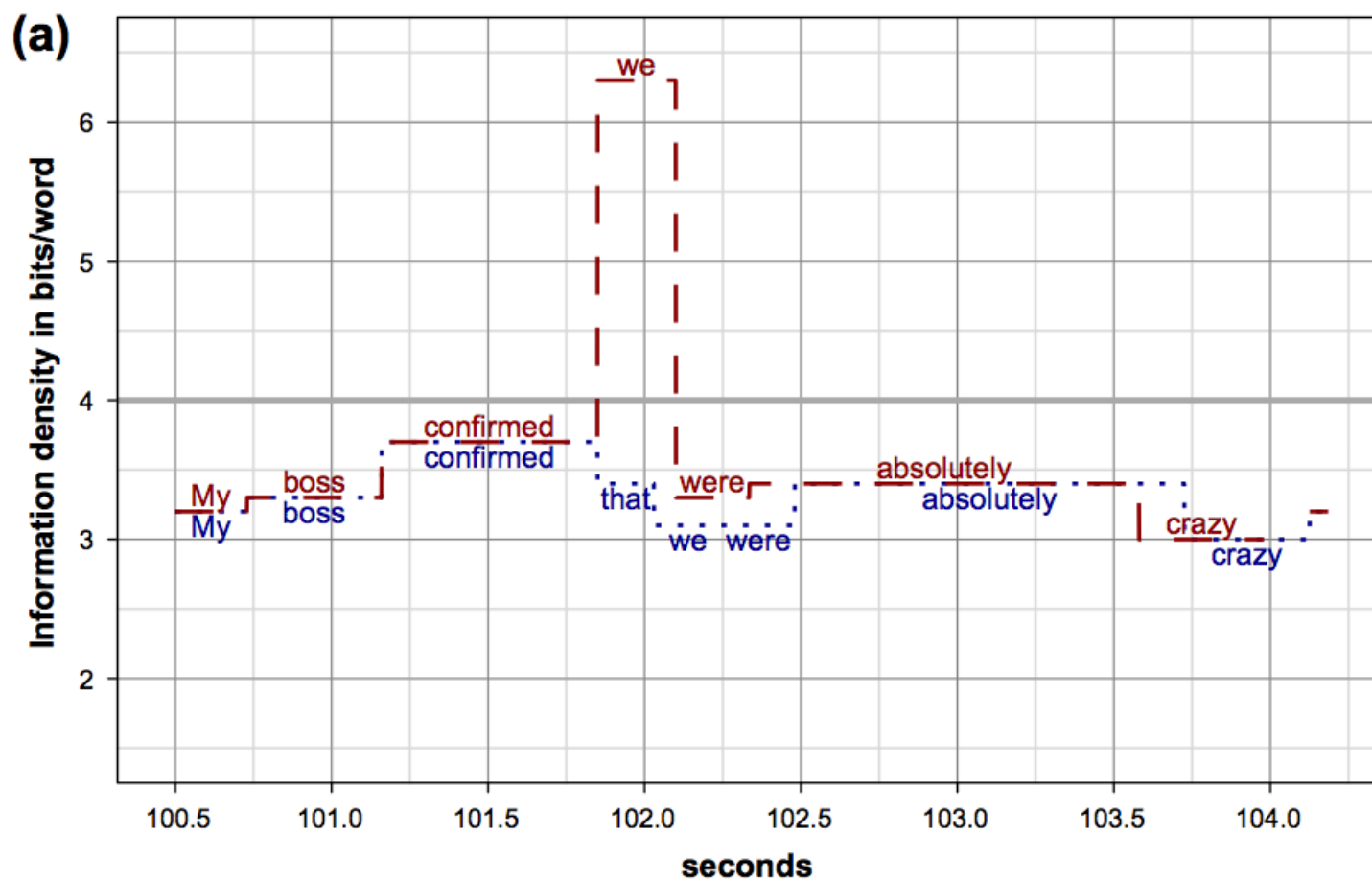
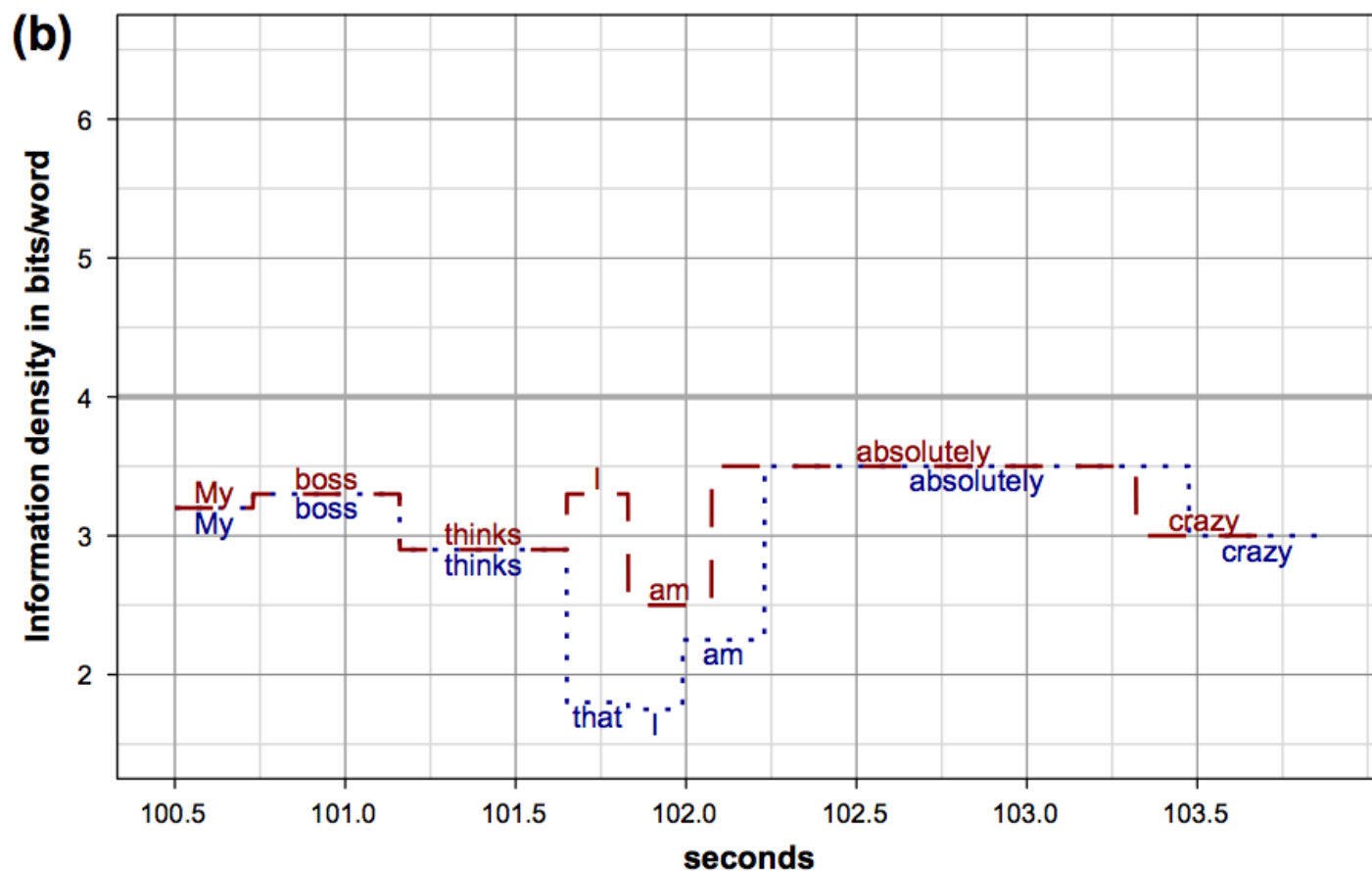


Fig. from Jaeger 2010

Natural Data Exploration

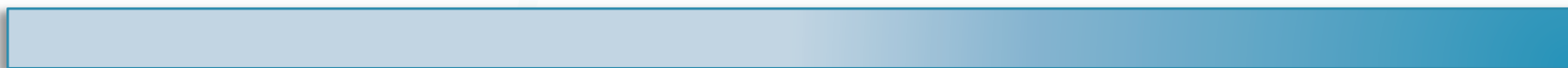
How to relate natural production data to reader's expectations?



Our Hypotheses

Implicit

Explicit



Continuous
Causal
Forward temporal

Discontinuous
Adversatives
Backward temporal

Penn Discourse Tree Bank

Relations in 25 sections of WSJ	Frequency
Explicit	18459
Implicit	16224

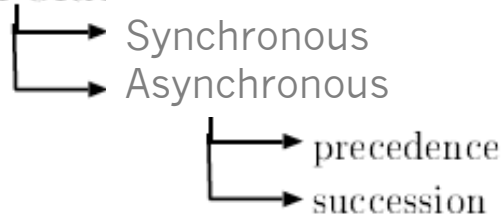
- Explicit relations:

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

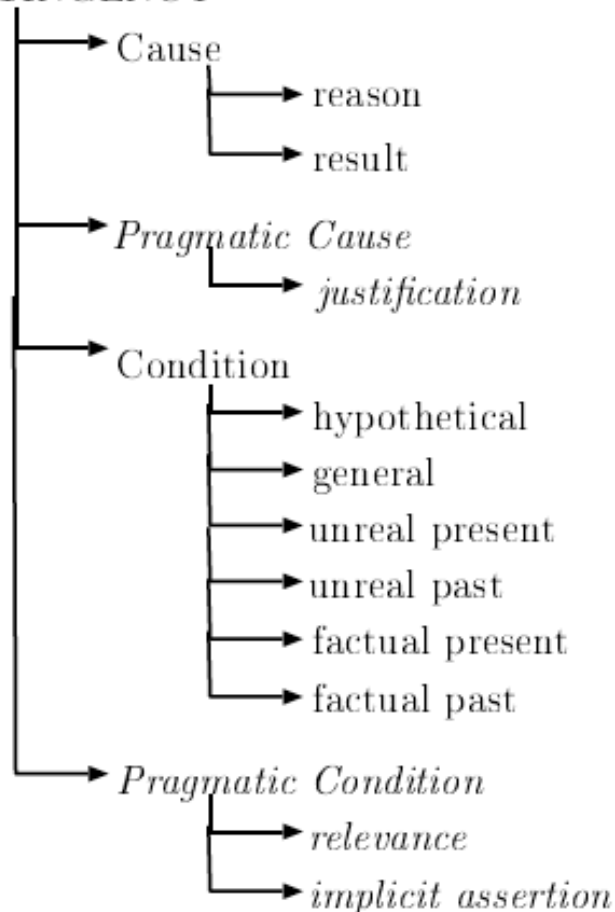
- Implicit relations:

"The market was dragged up by the scruff of its neck by Wall Street and by market markers getting caught short. [**but**] No one wants stock on their books."

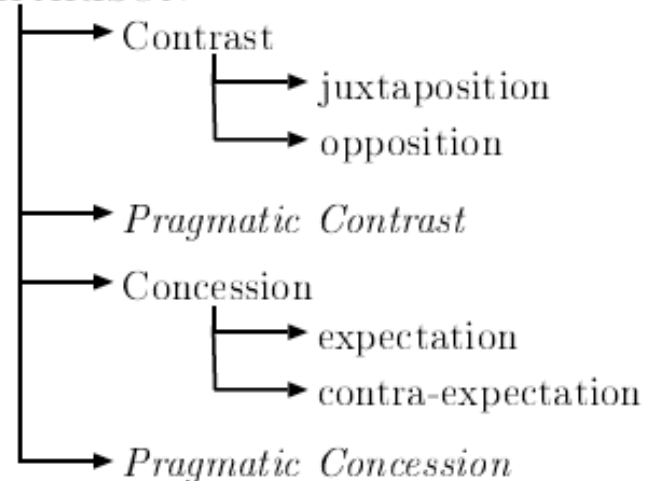
TEMPORAL



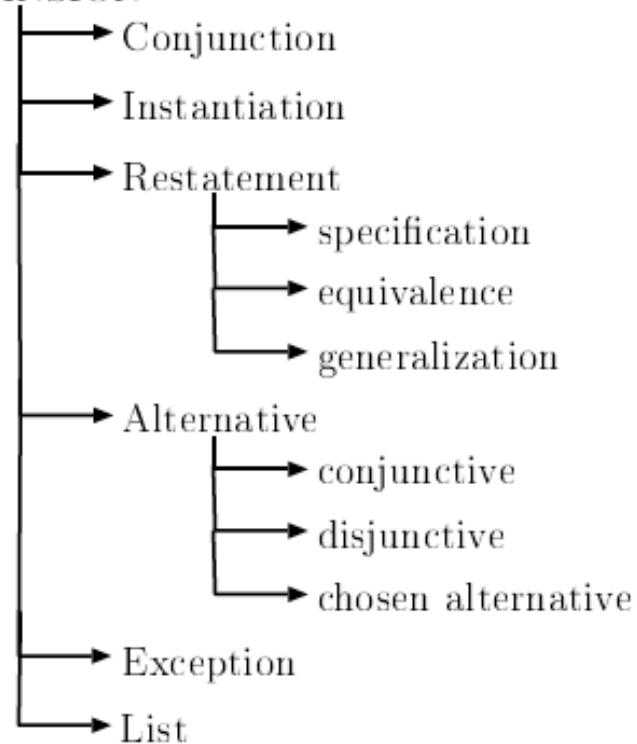
CONTINGENCY



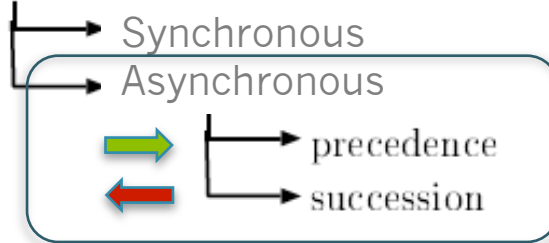
COMPARISON



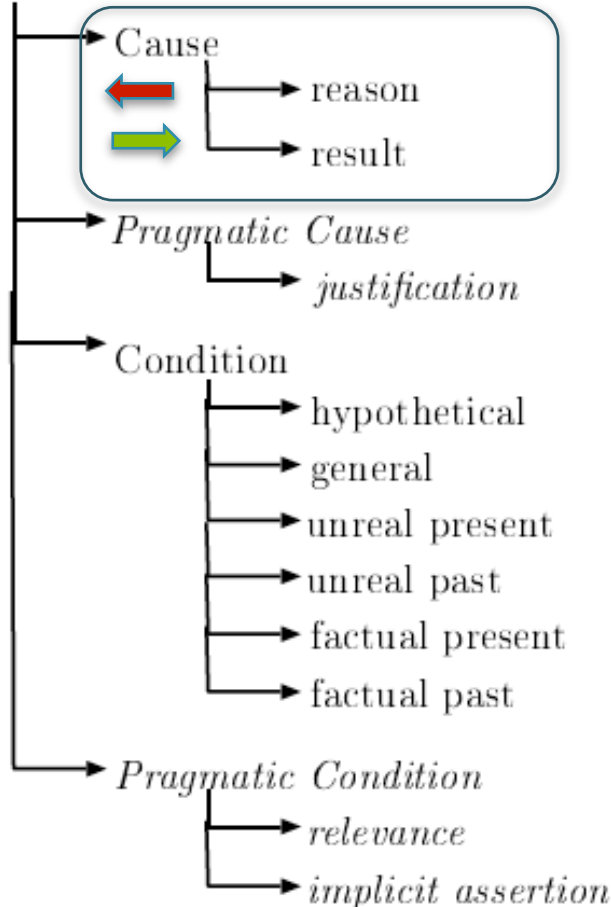
EXPANSION



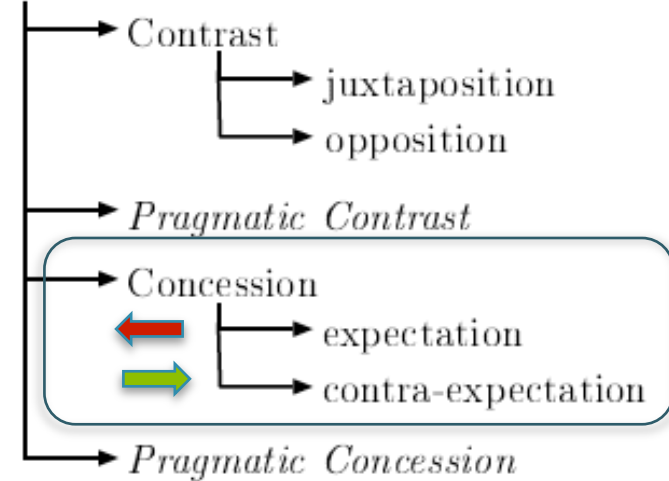
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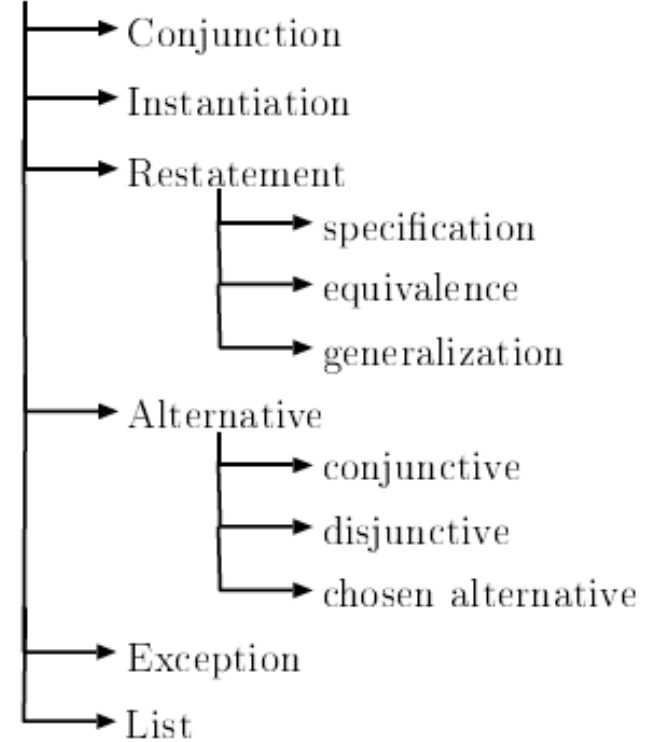
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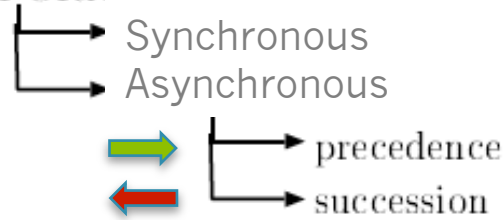
COMPARISON



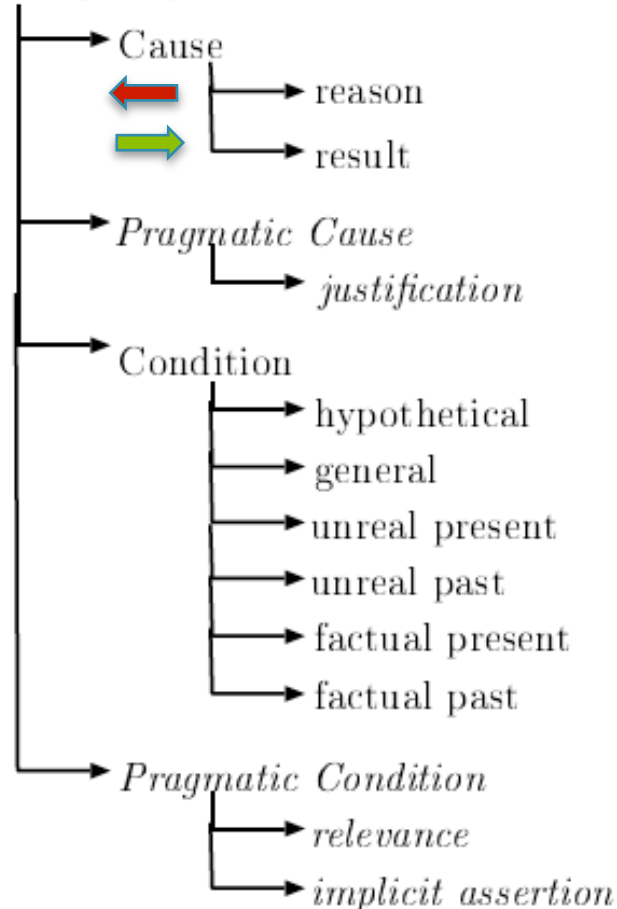
EXPANSION



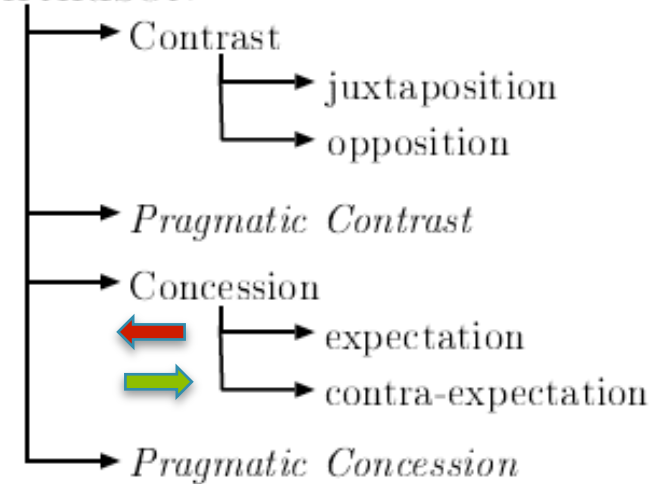
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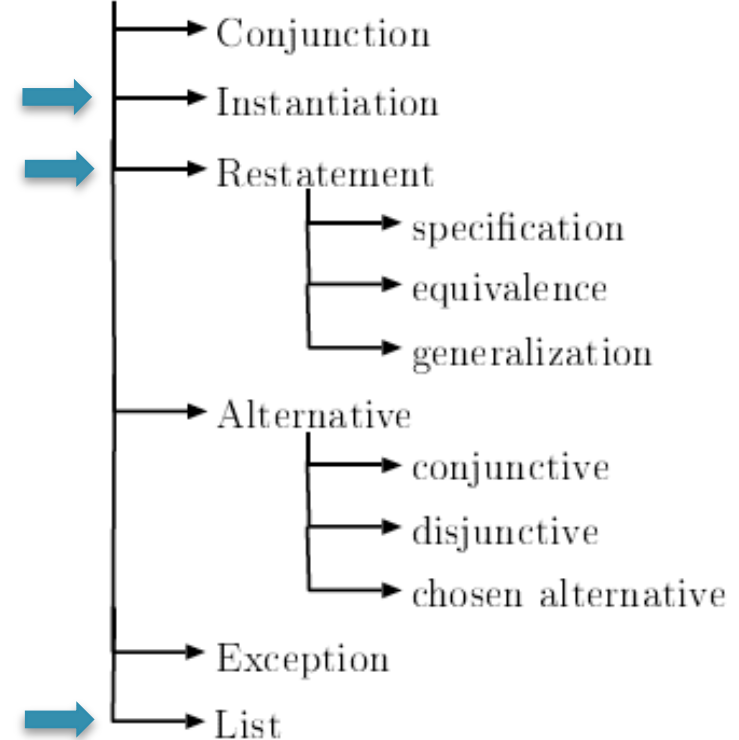
CONTINGENCY



COMPARISON



EXPANSION

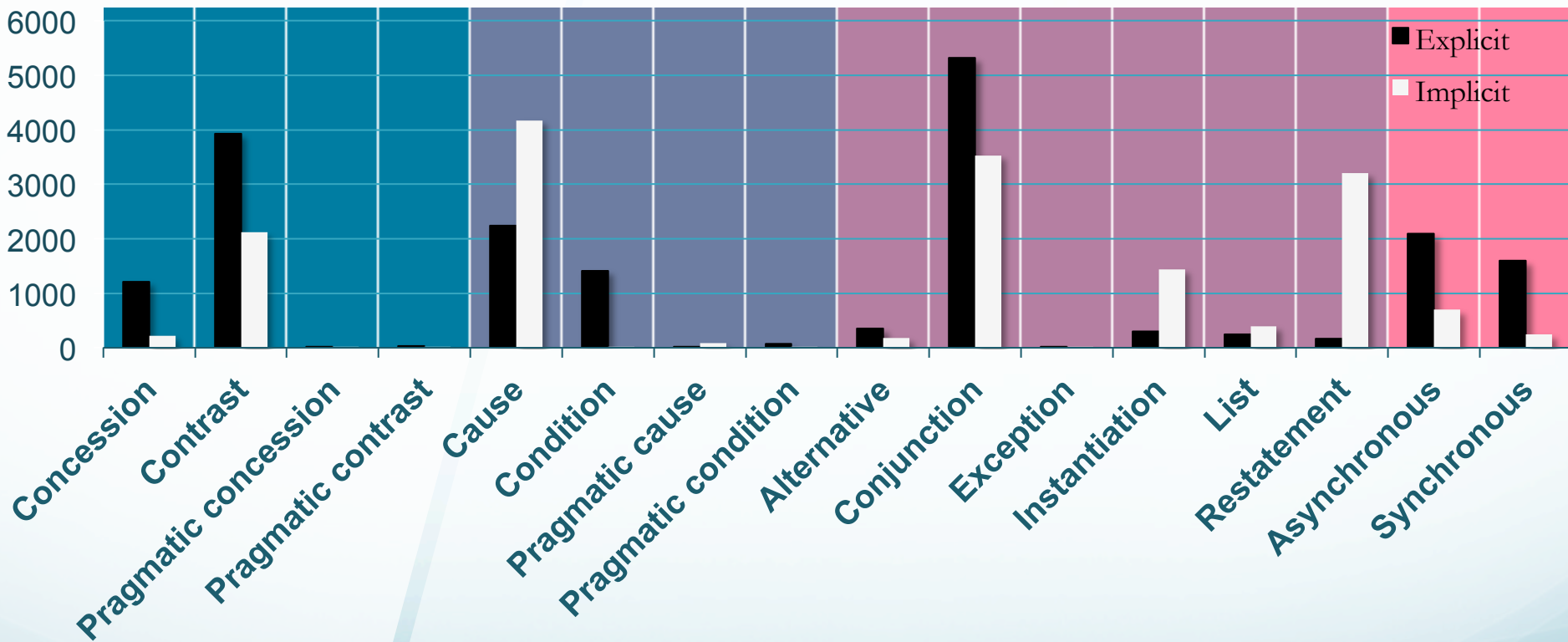


Implicitness Measure

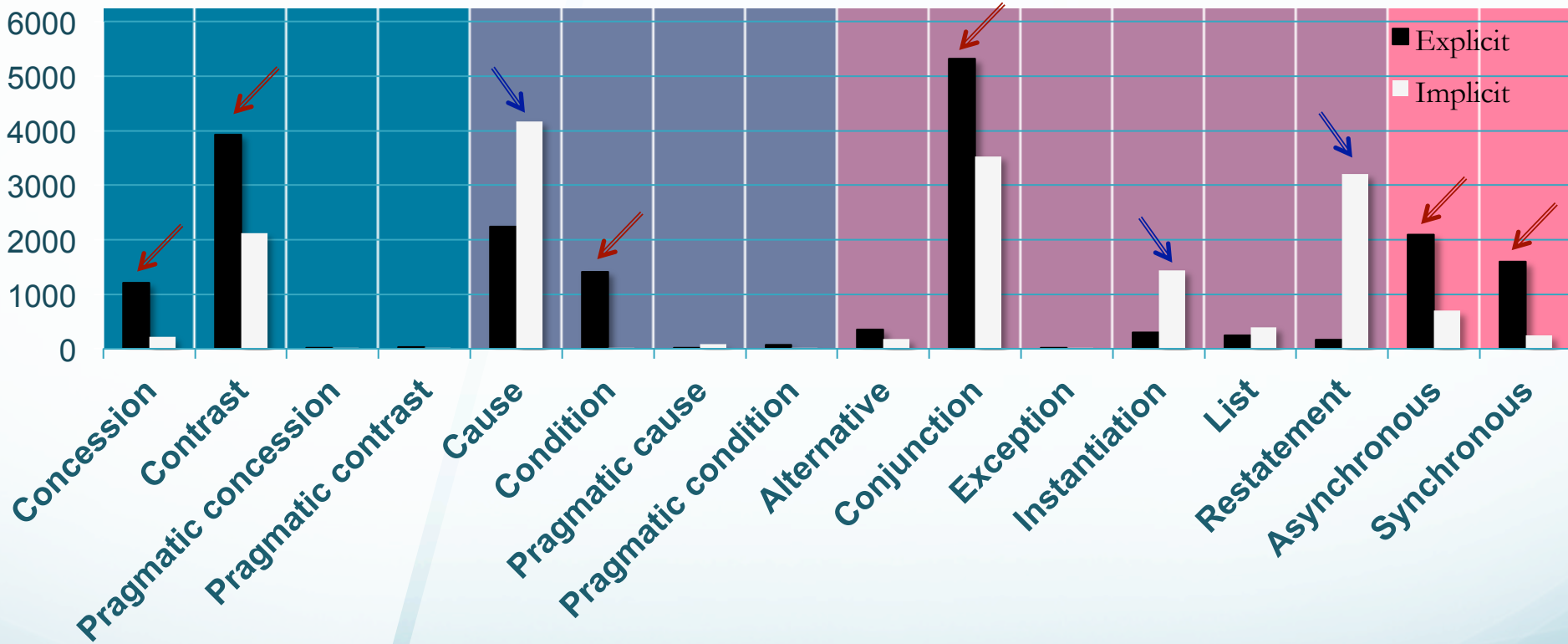
$$\text{Implicitness (relation)} = \frac{\# \text{ implicit occurrences of the relation}}{\# \text{ all occurrences of the relation}}$$



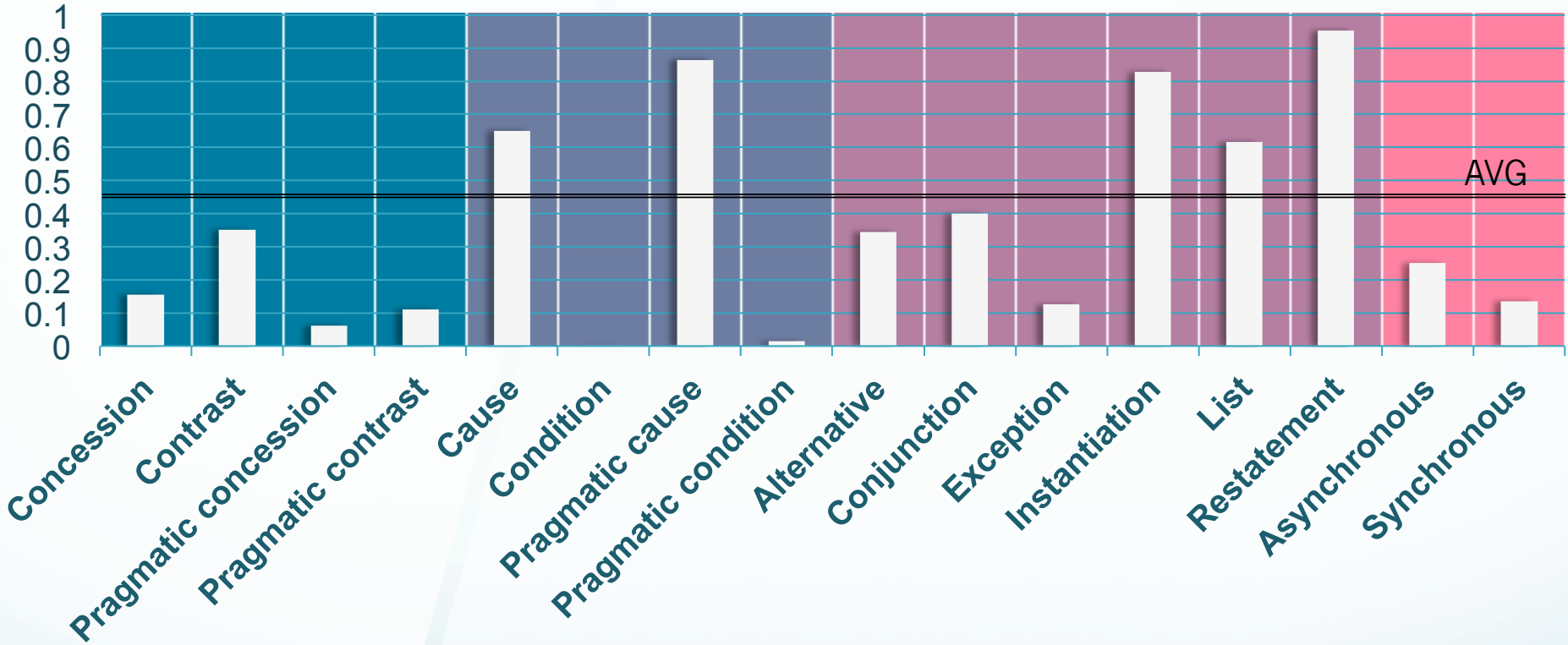
Raw Frequencies of Relation Senses



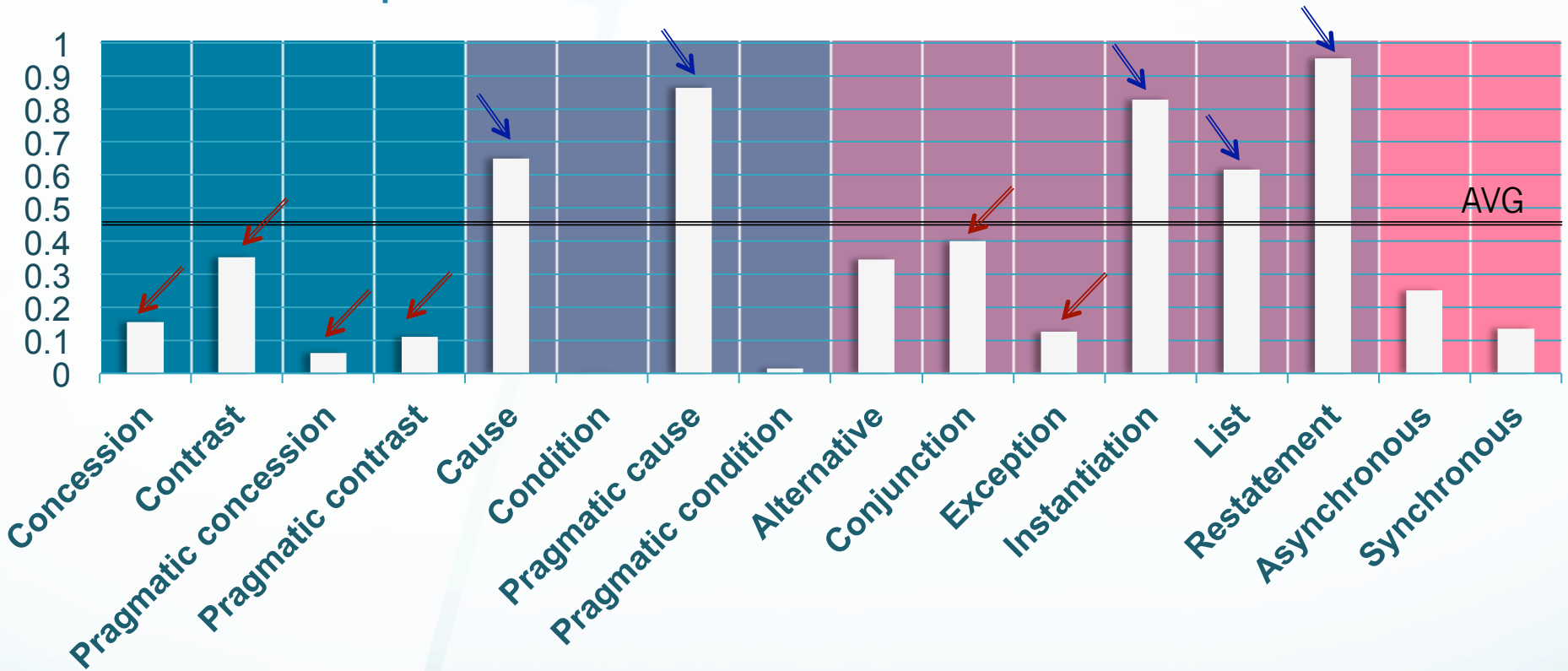
Raw Frequencies of Relation Senses



Implicitness of Relation Senses

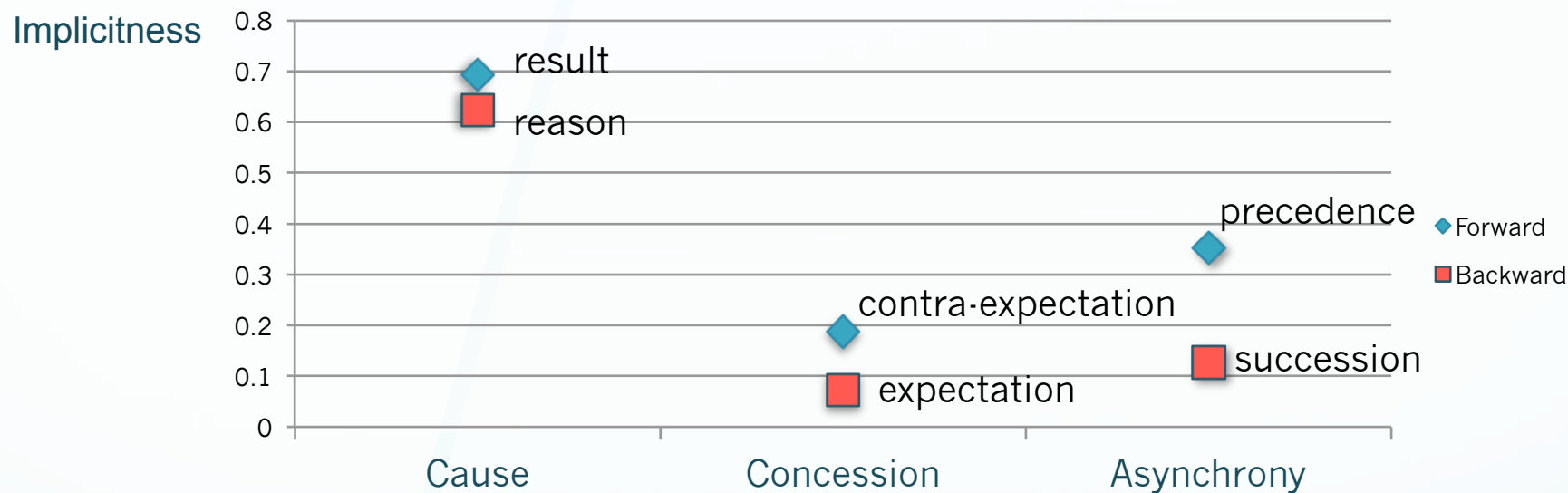


Implicitness of Relation Senses



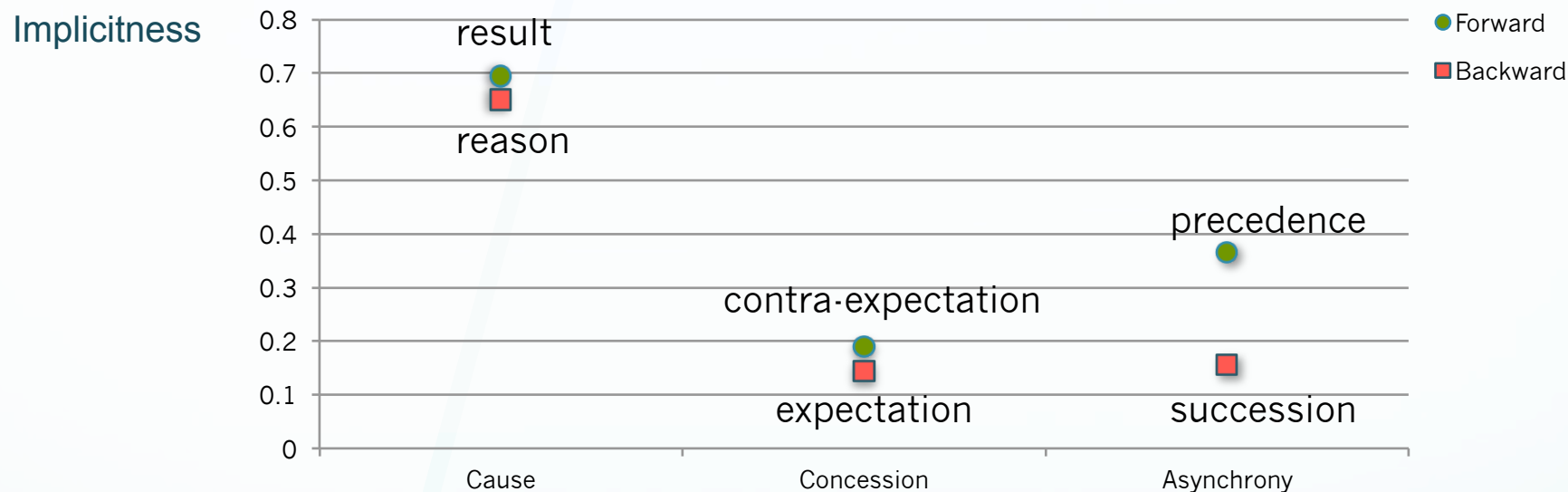
All differences between blues and reds were significant.

Implicitness of Relation Senses



- Forward subtypes are more implicit than backward subtypes
- Positive subtypes are more implicit than negative subtypes

Implicitness of Relation Senses



- Only considering ordered arguments still forward is more implicit
- More re-ordering of backward relations ($p < 0.001$)
- Temporal linearity ~ presence of the cue (chi-square)

Local Factors (IC Verbs)

Rohde & Horton (2010)

IC verbs in a sentence trigger expectation for a reason to come next.

Dawn amazed Malcom...

She was playing the piano with her eyes closed.
He applauded her talents.

Local Factors (IC Verbs)

Questions:

- Do IC verbs precede reason relations?
- Do they give rise to the implicitness?

	Total	IC verb in Arg1
Implicit: reason relations	2462	153 (manually checked)
Explicit: reason relations	1324	96 (manually checked)
Implicit: all relations	15682	910 (automatically extracted)
Explicit: all relations	16147	1034 (automatically extracted)

Local Factors (IC Verbs)

- Do IC verbs precede reason relations? **Yes**, 14% probability of a reason after an IC verb vs. 11.7% after other verbs ($p < 0.01$)
- Do they give rise to the implicitness?

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Local Factors (IC Verbs)

- Do IC verbs precede reason relations? **Yes**, 14% probability of a reason after an IC verb vs. 11.7% after other verbs ($p < 0.01$)
- Do they give rise to the implicitness? **No**, 61% implicitness given IC verb vs. 65% given other verb.

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Conclusions

By applying UID we connected natural production data to cognitive theories:

- ✓ Continuous relations are expressed more implicitly than discontinuous ones.
- ✓ Forward temporal ordering is left implicit over different types of relations.

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By applying UID we connected natural production data to cognitive theories:

- ✓ Continuous relations are expressed more implicitly than discontinuous ones.
- ✓ Forward temporal ordering is left implicit over different types of relations.
- ✓ Causal relations are one of the most implicit relation types, but, there exist other continuous types of relations which tend to appear with no explicit marker more than causal relations.
- ✓ Causal relations are more probable in presence of IC verbs, but, these verbs don't give rise to the implicitness (in terms of connective omission)

Conclusions

For future:

- Other markers of causality and continuity (e.g., AltLex: "the reason is")
- Different types of continuity (according to Segal et al. 1991)
- Inter-relation neighborhood (Pitler et al. 2008)
- More accurate investigation of IC verbs (e.g., passive tense)

Thank You!



“In silence there is eloquence. Stop weaving and see how the pattern improves.” — Rumi

Thank You!

References:

- 1) Kuperberg, Paczynski, & Ditman (2011). Establishing causal coherence across sentences: An ERP study. *Cognitive Neuroscience*.
 - 2) Frank & Jaeger (2008). Speaking rationally: Uniform Information Density as an optimal strategy for language production. *Cogsci*.
 - 3) Prasad, Dinesh, Lee, Miltsakaki, Robaldo, Joshi & Webber (2008). The Penn Discourse Treebank 2.0.
 - 4) Sanders (2005). Coherence, causality and cognitive complexity in discourse. *SEM*.
 - 5) Murray (1997). Connectives and narrative text: The role of continuity. *Memory & cognition*.
 - 6) Murray (1995). Logical connectives and local coherence. *Sources of Coherence in Reading*.
 - 7) Segal, Duchan & Scott.(1991). The role of interclausal connectives in narrative structuring: Evidence from adults' interpretations of simple stories. *Discourse Processes*.
- ❖ Images were taken from public domain images.google.com