



# **Coherence relations and DRD identification: theory and analysis**

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# This course

1. State-of-the-art in discourse coherence
2. With a focus on coherence relations and DRDs (connectives, cue phrases)
3. research-oriented: includes methodology
4. Converging evidence:
  - theory
  - text analysis
  - corpus research
  - experimental studies on processing and acquisition
5. Special interest in: analyzing and coding relations



# Coherence: Discourse representation

- Coherence relations
- “the building blocks of discourse structure”,  
e.g. Cause-Consequence, List, Contrast  
Hobbs, Kehler, RST, Sanders et al
- DRDs Linguistic signals of coherence:  
connectives and cue phrases
- Converging evidence:
  - Linguistic analyses
  - Corpus-based analyses
  - Acquisition
  - Processing, representation



# Program

## This morning

Introduction; cognitive approach to coherence

A way to analyze relations; Try coding together.

## This afternoon

Coding at work; reliability and statistics

## Tomorrow

Statistics continued

Converging evidence: Acquisition and processing

# Program

But before we start... a quick round:

- What's your name?
- Where are you from?
- What is the topic of your research project ( in one sentence...)
- Please write your first name on a paper and put this in front of you.



# Overview of today

## 1. Basic introduction

- Discourse: the way people communicate
- Central questions in discourse studies
- Cohesion versus coherence
- Various existing approaches to annotation

## 2. Toward a cognitive theory of coherence

- Classifying coherence relations





# Discourse

*She speaks three languages. She is a linguist.*

*The winter of 1963 was very cold. A lot of barn owls died.*

- Fundamental, constituting characteristic of discourse:
- Discourse is more than a random set of sentences
- Discourse shows connectedness



# Classical Research Questions

- How can this connectedness be described?  
(linguistic: semantics and pragmatics)
- How do language users produce and understand connected discourse?  
(processing and representation - psycholinguistic)





# Cohesion (Halliday & Hasan, 1976)

- The interpretation of one linguistic element depends on another element in the same text.



# Cohesion: some examples

- Substitution
  - Dan wanted a beer. Al took one too.
- Ellipsis
  - Dan wanted a beer. Al too.
- Reference
  - Dan lived near a bar. Every night he went there.
- Conjunction
  - Dan is getting fat because he drinks too much.
- Lexical cohesion
  - Dan is thirsty. The bar is next door.



# How about this?

- Dan drinks a lot in summer. Summer, winter, fall and spring are the seasons. For seasons, Armstrong was one of the best cyclists. They have a hard time in Spain. Spain will win tonight. [...]
- It's cohesive....
- But it does not show connectedness
- Cohesion is not a sufficient condition for connectedness.



## And this?

*John was happy. It was a Saturday.*

*Greenpeace has obstructed a nuclear transport  
in the South German state of Bavaria.  
Demonstrators chained themselves to the  
rails.*

- It's a discourse; shows connectedness, but no cohesion
- So: cohesion is not a necessary condition for connectedness either  
(Sanders & Pander Maat, 2006)



# Coherence

- We need a focus on 'underlying' conceptual connectedness rather than on the overt linguistic elements
- Following Hobbs (1979), the terms coherence and coherence relations are used to develop such an account (see Kehler, 2002 etc).
- Hobbs (1979) shows that coherence determines coreference, not the other way around.



# A cognitive account of coherence

- Coherence is
  - a cognitive, i.e. mental, phenomenon
  - rather than an inherent property of text or discourse
  - Hence: the connectedness is located at the level of the cognitive representation

A cognitive approach to coherence  
(Sanders & Spooren, 2001, 2007, 2009)





# Two types of coherence

- Referential coherence
  - Repeated reference to a person or object (*The man, he, zero*)
- Relational coherence
  - Conceptual relations between utterances (*Cause-Consequence, List*)
- Major issue: relationship between
  - the linguistic surface code (the text)
  - the meaning representations



# Two types of coherence

- Both for referential and relational coherence, linguistic indicators / markers can be identified, which are taken as processing instructions:
  - Referential: pronouns, anaphors...
  - Relational: DRDs like connectives, lexical markers, cue phrases.
- For both types there is
  - linguistic work showing the regularities in grammatical coding
  - psycholinguistic work demonstrating relevance in processing



# Example of an approach to relational coherence: PDTB

- Penn Discourse TreeBank
- Impressive amount of work in discourse annotation on corpora
- In various languages
- Just released a new version
- This is the previous one:
- Prasad, Rashmi, Nikhil Dinesh, Alan Lee, Eleni Miltsakaki, Livio Robaldo, Aravind Joshi and Bonnie Webber (2008). The Penn Discourse Treebank 2.0. *Proceedings of the 6<sup>th</sup> International Conference of Language Resources and Evaluation (LREC 2008)*, Marrakech.



# Relations in Penn Discourse Treebank

## TEMPORAL

- Synchronous
- Asynchronous
  - precedence
  - succession

## COMPARISON

- Contrast
  - juxtaposition
  - opposition
- *Pragmatic Contrast*
- Concession
  - expectation
  - contra-

expectation

- *Pragmatic Concession*

## CONTINGENCY

- Cause
  - reason
  - result
- *Pragmatic cause*
  - justification
- Condition
  - hypothetical
  - general
  - unreal present
  - unreal past
  - factual present
  - factual past
- *Pragmatic condition*
  - relevance
  - implicit assertion

## EXPANSION

- Conjunction
- Instantiation
- Restatement
  - specification
  - equivalence
  - generalization
- Alternative
  - conjunctive
  - disjunctive
  - chosen

alternative

- Exception
- List

# Example of an approach to relational coherence: RST

- Rhetorical Structure Theory
- Mann & Thompson, 1986, 1988; a functional theory of text organization
- Taboada & Mann, 2006a, 2006b
- Later applied to corpora in discourse annotation
- Carlson et al, 2001
- Taboada et al



# RST: central thesis

- In addition to propositions explicitly presented in the text, i.e. that are expressed in independent clauses in the text, there are also propositions that arise from combinations of these clauses:  
Relational propositions
  - I'm hungry. Let's go to China gardens.
  - I'm officer Krupke. You're under arrest.





# RST: goals and example

- Descriptively adequate model of text structure ("a descriptive framework for the organization of text"; "an analytic tool").
  - *Maggie must be eager for a promotion. She has been working late three days in a row.*



# RST: goals and example

*Relation name:* Evidence

*Constraints on N:* The reader might not believe N to a degree satisfactory to the writer

*Constraints on S:* The reader believes S or will find it credible

*Constraints on the N + S combination:*

The reader's comprehending S increases the reader's belief of N.

*The effect:* The reader's belief in N is increased.

*Locus of the effect:* N



# The product of an RST-analysis

- The meaning of the relation between segments is determined (*Evidence*, *Solutionhood*, *Contrast*)
- The hierarchical structure is shown
- Examples, see Mann & Thompson 1988; Sanders, 1997; Taboada & Mann, 2006, and elsewhere.



# RST: goals

- Descriptively adequate model of text structure ("a descriptive framework for the organization of text"; "an analytic tool").
- But RST pretends more than just that
  - Cognitive theory of coherence  
“...we find that if we imagine a way of reading one of our texts without its relational propositions, we do not have a coherent text...”  
Mann & Thompson (1986)



# Toward a cognitive theory of discourse coherence

- Ultimate Aim:  
To explain for the relationship between
  - Discourse as a linguistic object
  - Its cognitive representations
  - The cognitive processes of production and understanding



# Coherence relations

- A coherence relation is an aspect of the meaning of two or more discourse segments that cannot be described in terms of the meaning of the segments in isolation.
  - In other words: it is because of this coherence relation that the meaning of two discourse segments is more than the sum of the parts.
- The essential property of coherence relations is that they establish coherence in the cognitive representation people have or make of a discourse.  
(Sanders, Spooren & Noordman, 1992, 1993).





# Clustering of relations

- Why?
  - Cognitive argument
  - Linguistic argument
  - Economical argument
- How?
  - Four meaning aspects shared by all relations
    - Additive – causal (– temporal)
    - Subjective – Objective (Semantic – pragmatic)
    - Positive – negative
    - Basic – non-basic order
- Categorization of relations: “taxonomy”



# Four primitives

- **1. Basic Operation: additive or causal**
  - (a) John is ill. Pete does not feel well either.
  - (b) John is ill. He had bad beef for dinner.
- **2. Source of Coherence: Objective (semantic) or Subjective (pragmatic)**
  - (b) John is ill. He had bad beef for dinner.
  - (c) John is ill. His mother called this morning.
  - (d) Theo was exhausted because he had run to the university
  - (e) Theo was exhausted because he was gasping for breath.



# Four primitives (cont'd)

## 3. Polarity: positive or negative

- all earlier ones.
- (f) Jan is ill. He looks healthy.



# Greta Garbo



## Four primitives (cont'd)

### 3. Polarity: positive or negative

- (She was already a legend during her life and her myth grew by her completely isolated existence in a New York apartment. In 1951 she became an American citizen, three years later she received an Oscar of honour.)

(g) Although Greta Garbo was called the yardstick of beauty, she never married.

[Volkskrant, 17/4/90]



## Four primitives (cont'd)

### 4. Order of the segments:

- **basic or non - basic order**

(b) John is ill. He had bad beef for dinner.

(h) John is ill. So he won't be at work.

- The combination of these 4 primitives produces a classification scheme, in which all coherence relations 'fit'.

- A taxonomy, showing relations among relations





Basic op.	Source of coh.	Order	Polarity	Class	Relation
Causal	Semantic	Basic	Positive	1a	Cause-consequence
				1b	Condition-consequence
Causal	Semantic	Basic	Negative	2	Contrastive cause-consequence
Causal	Semantic	Non-basic	Positive	3a	Consequence-cause
				3b	Consequence-condition
Causal	Semantic	Non-basic	Negative	4	Contrastive consequence-cause
Causal	Pragmatic		Positive	5a	Argument-claim
				5b	Condition-claim
Causal	Pragmatic		Negative	6	Contrastive argument-claim
Causal	Pragmatic	Non-basic	Positive	7a	Claim-argument
				7b	Claim-condition
Causal	Pragmatic	Non-basic	Negative	8	Contrastive claim-argument
Additive	Semantic	-	Positive	9	List
Additive	Semantic	-	Negative	10a	Opposition
				10b	Exception
Additive	Semantic	-	Positive	11	Enumeration
Additive	Semantic	-	Negative	12	Concession

# On the plausibility of this classification

- It is productive
- Experimental testing
  - Fill in connectives
  - Labeling of relations
  - Ordering of relations
- Describes developments
  - Language Acquisition
  - Diachronic
- Relevant in processing
- Converging Evidence (tomorrow)



# Applying CCR to corpora of language use

- There is evidence for the cognitive relevance of these 4 categories,
- but can they also be used to systematically analyze coherence relations?
- What's the gain?
- Reconsider a scheme like PDTB



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## PDTB scheme

- Conceptually related relations fall in different categories in the scheme.
- For example: contrastive relations that are expressed with *but* fall in two different classes: *comparison* and *expansion*.
- Issues:
  1. This maybe something to avoid for theory/internal reasons;
  2. Such counter-intuitive aspects can be confusing for annotators
- A more systematically organized set of relations might be theoretically attractive, and useful in discourse annotation.



# Applying CCR to corpora of language use

- Similarly to RST and PDTB
- Substitution tests:
  - Connectives signal certain types of relations
  - E.g.: *because* signals a causal relation, *meanwhile* a temporal relation and *but* a negative relation.
  - Substitution tests can test the semantic intuitions and thus guide an annotator
- Paraphrase tests:
  - Two paraphrases both restate the meaning of the segments in a simpler form
  - E.g.: 'segment 1 presents the cause; segment 2 presents the consequence' OR 'segment 1 presents the consequence, segment 2 presents the cause'





# Annotation experiment

- Can the systematical approach based on CCR be applied to discourse annotation?
- Idea: Systematic approach and substitution and paraphrase tests might make annotation process easier
- Most discourse annotation experiments make use of trained, expert annotators who study extensive manuals
- But maybe the CCR-method could work with relatively untrained analysts?
- That would have practical advantages...



# Annotation experiment

Scholman, Evers-Vermeul & Sanders (in press)

- Instead of well-trained experts:
- Are naïve (non-expert, non-trained) annotators capable of annotating coherence relations using the cognitive categories method?
- Subjects: 40 advanced BA-students
  - Received a manual and taxonomy
  - Annotated a sample corpus of 36 fragments using an instruction



# Annotation experiment: Instructions

- Explicit instruction
  - Relies on annotator's knowledge of the categories, connective properties, paraphrase tests and substitution tests



# Example of explicit instruction: substitution test

1. If a relation contains a connective, take this out of the relation. Do take the original connective in consideration while you are interpreting the relation.
2. Can you use *but* to connect the segments?
  - Yes, then the polarity is negative. Continue to 2a.
  - No, then the polarity is positive. Continue to 3.

(For causal relations *because*; for conditional relations *if*, for additive relations *and*; for temporal relations *when*)



## Example of explicit instruction: paraphrase test

2b. Can you paraphrase the relation between S1 and S2 as option A or B below?

A: S1 is the cause, S2 is the consequence

OR

B: S1 is the consequence, S2 is the cause

- Paraphrase A, then the relation has a forward order. You are done with this relation.
- Paraphrase B, then the relation has a backward order. You are done with this relation.

(*Claim* and *argument* were used for subjective relations)



# Annotation experiment: Processing the data

- Kappa-scores for agreement with original annotations (done by an expert annotator)
  - Almost perfect agreement ( $\kappa > 0.81$ ) indicates a reliable method
  - Substantial agreement ( $0.61 < \kappa < 0.81$ ) allows for tentative conclusions to be drawn
  - Everything below substantial agreement ( $\kappa < 0.61$ ) indicates that the method is not reliable enough





# Annotation experiment: Results (1)

Agreement with original annotations: kappa statistics

Primitive	Overall	Implicit instruction	Explicit instruction
Polarity	0.86 (95%)	0.82 (94%)	0.90 (96%)
Basic operation	0.49 (68%)	0.45 (63%)	0.52 (71%)
Source of coherence	0.31 (56%)	0.33 (57%)	0.29 (54%)
Order	0.61 (74%)	0.55 (70%)	0.66 (78%)

- Almost perfect agreement for polarity
- Tentative conclusions for order of the segments
- Agreement on basic operation and source of coherence is not adequate



## Annotation experiment: Results (2)

- Significant difference between two instructions ( $p < .001$ )
- Explicit instruction led to more agreement than implicit instruction for primitives polarity, basic operation and order
- No significant difference between the conditions for source of coherence
  - Paraphrase test didn't help the annotators



# Annotation experiment: Results (3)

- F-scores showed that:
    - Temporal relations were often mistaken for additive relations
    - All values of SoC were problematic
    - Relations with NA order often coded as basic order
- Could be an effect of the step-wise approach?
- Making a mistake in one step (temporal vs additive), leads to a mistake in the next step as well (basic order vs NA) ...



## Annotation experiment: Results (4)

- Taking only fragments where the previous primitive was annotated correctly, percentages of agreement rise greatly:
  - 70% of agreement for SoC (compared to 56%)
  - 86% of agreement for Order (compared to 74%)
- Hence, a step-wise approach leads to systematical annotation process...
- But the hierarchical structure also leads to higher disagreement.



# Annotation experiment: Conclusion

- Cognitive approach allows for a systematical, step-wise annotation process with which non-trained, non-expert annotators can yield considerable amounts of agreement
- Moreover: an explicit instruction which includes substitution and paraphrase tests benefits annotator agreement



# Excercises for today: CCR-coding in practice

- We ask you to make groups of 2
- Analyze 20 fragments from the PDTB-corpus
- according to the CCR-manual
- Fill in an excel-file
- This afternoon we compute whether we agree etc.
- Here are some examples from the corpus, that we try together, **now**





# Annotating text: fragment 1

In the opening episode we learn that Michelle, a junior bond trader, has indeed pulled off another million before lunch. Trouble is, she has lost it just as quickly. Rather than keep the loss a secret from the outside world, [S1 Michelle blabs about it to a sandwich man] [DRD while] [S2 ordering lunch over the phone.] Little chance that Shane Longman is going to recoup today.

Polarity

Basic operation

Source of Coherence

Order



## Annotating text: fragment 2

Reduction, if not the total cessation, of drug consumption is the requirement for victory. Much is being done in Colombia to fight the drug cartel mafia. [S1 Luxurious homes and ranches have been raided by the military authorities,] [DRD and] [S2 sophisticated and powerful communications equipment have been seized.] More than 300 planes and helicopters have been impounded at airports, and a large number of vehicles and launches has been confiscated.



## Annotating text: fragment 3

Suburban deals are not without their delays and complications – inner-city deals just have more of them. Security at a typical Haagen inner-city center is impressive, but unobtrusive. [S1 The entire site is enclosed by a 6-to-8-foot-high ornamental iron fence with a small number of remote-controlled gates.] [S2 Shrubs and flowers give it a pleasing and non-fortress-like appearance.] Infrared motion detectors and closed-circuit TV cameras monitor the entire center; lighting levels are three to five times the industry standard.



## Annotating text: fragment 4

"As far as the FAA is concerned," says Matt Fincane, air safety director at the Association of Flight Attendants, "flight attendants can work an unlimited number of hours." Experts say [S1 such long hours for attendants pose a safety risk.] [DRD For instance,] [S2 tired flight attendants might not react quickly enough during an emergency evacuation.] "At the end of their day, they are zombies," says John Galipault, president of the Aviation Safety Institute.



## Annotating text: fragment 5

Commercials will highlight heart-rendering scenes of Texas and chest-swelling, ain't-it-great-to-be-a-Texan music. But in introductory material for the campaign, the trade group urges members to "arm" for a "revolution" against big, out-of-state bank-holding companies. [S1 A video sent to association members, featuring shots of the Alamo, cowboys, fajitas and a statue of Sam Houston, doesn't mince words.] [S2 "Texans can sniff a phony a mile away," the narrator warns outsiders.] "So, don't come and try to con us with a howdy y'all or a cowboy hat."



# See you after lunch

Please have a look  
at the manual  
during your lunch !

