



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?**



Empirical approaches to discourse

Day 1
ESSLI 2012
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What is discourse?

Any meaning that is beyond the scope of a single clause or sentence.

From Hobbs:

Please use the toilet, not the pool.

Please use the toilet, not the pool.
The pool is for members only.

Please use the toilet, not the pool.
The pool is for members only.

Simple juxtaposition changes meaning.

Elvis once gave a concert in Opole.
I dislike spinach and hardly ever eat it.

Recent research has shown that people who regularly eat spinach have better memories for trivia.

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Our natural inclination is to look for coherence.
When natural coherence is lacking, we will search for a way to impose it.

Please use the toilet, not the pool.
The pool is for members only.

Combining some sentences has additional meaning.

Please use the toilet, not the pool.
The pool is for members only.

Combining some sentences has additional meaning.

Where does this meaning originate from?

Please use the toilet, not the pool. (**because**)
The pool is for members only.

Coherence relations
(Rhetorical/Discourse Relations)

Please use the toilet, not *the pool*.
The pool is for members only.

Please use the toilet, not *the pool*.
The pool is for members only.

Entity-based coherence

Please use *the toilet*, not *the pool*.
The pool is for *members* only.

Please use *the toilet*, not *the pool*.
The pool is for *members* only.

Lexically-based coherence

toilet – pool

pool - members

- What work counts as discourse?
- How is discourse organized?
 - What types of relationships and structures are attested?
 - What processes are affected by discourse constraints?
- How does knowing about this organization help in computational applications?
 - Applications and Research
 - Limitations
- What does it tell us about human cognition?

1

Coherence relations between sentences, propositions/ or events

- can be marked or unmarked

2

Entity-based coherence

- relationships between referents
- includes anaphora

Webber, Egg and Kordoni (2012) *Discourse Structure and Language Technology*

Stede (2004). *Does discourse processing need discourse topics?*



**Information
structure**

**Referential
structure**

**Rhetorical
structure**



Rhetorical structure

"semantic/pragmatic relations between adjacent discourse segments, ideally yielding a tree"



Information structure

"tracks aboutness and records usages of marked constituent ordering, focus particles and related instruments"

Referential structure

"records when and how entities are mentioned in discourse and thus encodes their accessibility or relative salience."

Stede (2004)

Outline

Mon: Introduction to coherence relations and discourse structure

- Hobbs
- Grosz & Sidner 1986

Tues: Rhetorical Structure Theory (RST), problems

- Kinds of relations, how many relations?
- Semantic vs. pragmatic relations

Weds: Possible solutions to problems?

- Segmented Discourse Representation Theory (SDRT)

Thu: Another solution: Penn Discourse Treebank (PDTB)

- Explicit vs. Implicit discourse relations

Fri: Cont. Explicit vs. Implicit

- Entity-based coherence
 - Information structure and lexical effects
 - Co-reference relations and discourse



Hobbs (1979). Coherence and Coreference.

John tripped Bill_{s0} so he fell. s1

Result: Infer that the state or event asserted by S0 causes or could cause the event asserted by S1.

*John tripped Bill_{S0} **so** he fell. _{S1}*

Result: Infer that the state or event asserted by S0 causes or could cause the event asserted by S1.

John tripped Bill. _{S0} He fell. _{S1}

Result: Infer that the state or event asserted by S0 causes or could cause the event asserted by S1.

John tripped Bill. _{S0} He fell. _{S1}

*John was from London. _{S0}
He lived near Big Ben. _{S1}*

Result: Infer that the state or event asserted by S0 causes or could cause the event asserted by S1.

John tripped Bill. _{S0} He fell. _{S1}

Elaboration: Infer the same proposition P from the assertions of S0 and S1

*John was from London. _{S0}
He lived near Big Ben. _{S1}*

Result: Infer that the state or event asserted by S0 causes or could cause the event asserted by S1.

*John tripped Bill. _{S0} **He** fell. _{S1}*

Elaboration: Infer the same proposition P from the assertions of S0 and S1

*John was from London. _{S0}
He lived near Big Ben. _{S1}*

Occasion:

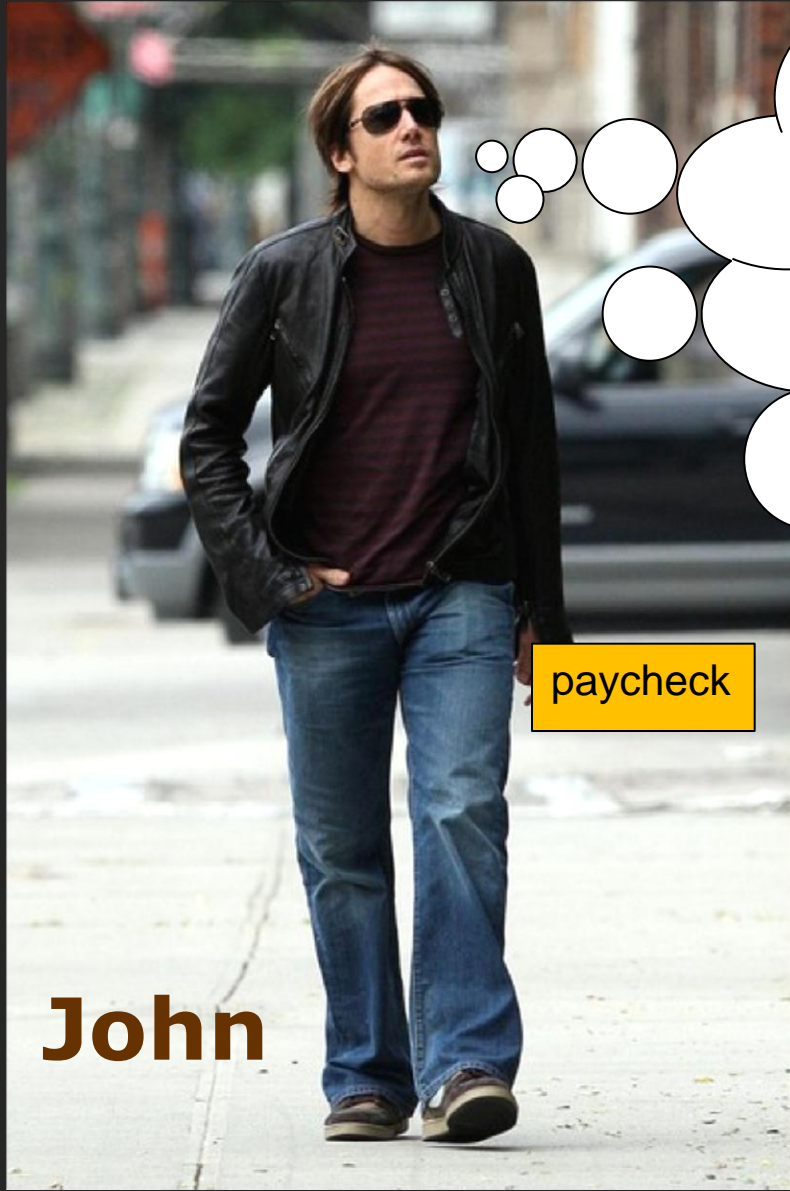
(1) A change of state can be inferred from S0, whose **final** state can be inferred from S1.

(2) A change of state can be inferred from S1, whose **initial** state can be inferred from S0.

Walk out the door of this building.

Turn left.

Go to the corner.



John

paycheck



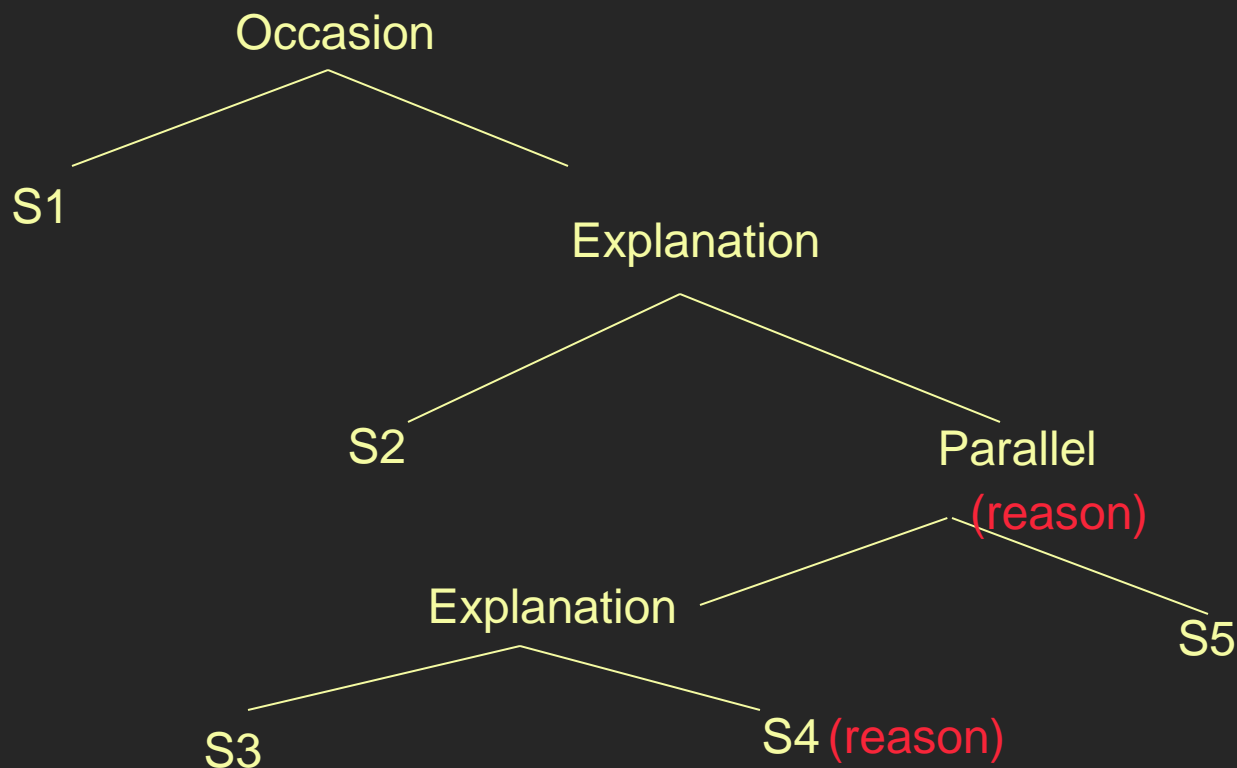
Bill



softball league

- (S1) John went to the bank to deposit his paycheck.
- (S2) He then took a train to Bill's car dealership.
- (S3) He needed to buy a car.
- (S4) The company he works for now isn't near any public transportation.
- (S5) He also wanted to talk to Bill about their softball league.

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(S2) He then took a train to Bill's car dealership.
(S3) He needed to buy a car.
(S4) The company he works for now isn't near any public transportation.
(S5) He also wanted to talk to Bill about their softball league.



- Hobb´ s structures
 - Coherence relations, rhetorical relations, discourse relations
 - Local relations that can take other relations as arguments
 - He didn´ t envision full-text annotations
 - He didn´ t discuss how lexical relations or linguistic forms related to or affected coherence relations
- But Hobbs had another point to make:

1. John can open Bill's safe. **He** knows the combination.

1. John can open Bill's safe. **He** knows the combination.
2. John can open Bill's safe. **He's** going to have to get the combination changed.
3. Bill is worried because his safe can be opened by John.
4. **He** knows the combination.

Elaboration

1. John can open Bill's safe. **He** knows the combination.

Cause-effect

2. John can open Bill's safe. **He's** going to have to get the combination changed.

Effect-cause

3. Bill is worried because his safe can be opened by John.

4. **He** knows the combination.

Hobbs (1979). Coherence and Coreference

- Pronoun interpretation is a side-effect of discourse coherence
- Proposal is coherent, logical system of coherence relations
- AI person/ linguist

Basic assumptions I skipped over

- What are the arguments to coherence relations?
 - sentences?
 - eventualities? (events or states?)
 - propositions?
- How do we determine elementary discourse units (EDU's) in running texts?
 - sentences or clauses?
 - are all parts of the sentence part of a coherence relation?
- Should every part of text be related via coherence?
 - Discourse chunking vs. Discourse parsing
 - aren't some relationships more about referents?

Grosz & Sidner (1986)

Grosz & Sidner (1986)



Google scholar cites 2943

1. Grosz & Sidner's discourse theory describes the processing of the entire discourse
2. First "computational" theory of discourse structure
3. Grosz & Sidner's theory can be considered **intention based**
 1. The concept of "intention" plays a role throughout the theory
 1. a determination to act in a certain way (Mirriam-Webster)
 2. a concept considered as the product of attention directed to an object of knowledge (M-W)

Three components

G & S identify three different types of information

1. Linguistic structure
2. Intentional structure
3. Attentional structure



Linguistic structure

Linguistic structure = the actual text

- The text is divided into **discourse segments (DS)**
- The linguistic structure doesn't contain elements like concepts, inferences, etc.
- How we decide what counts as a discourse segment is a complex problem



Intentional structure

Structure of intentions

A discourse always has one main intention: Discourse Purpose or **DP**

Every discourse segment has an intention as well:

Discourse Segment Purpose



Intentional structure

Notice:

Intentions
brings in the
idea of the
speaker
wanting to
affect
something in
the world

Structure of intentions

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Every discourse segment has an
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Discourse Segment Purpose



Attentional State

1. Attentional state includes what the focused items in the discourse are at a given moment
2. Focus Spaces represent the Attentional Structure (**FS**)
3. Includes all salient concepts
4. NOTE: Discourses have attentional states, not discourse participants

Linguistic structure

DS

Discourse
segments

Intentional structure

DSP

Discourse
segment
purposes

Attentional structure

FS

Focus
structures

Relationships between the three structures

1. Each discourse segment is ruled by one DSP
2. Each focus space is tied to a discourse segment with its associated DSP
3. Focus spaces are collected in a stack
4. The state shows dynamic relationships
5. Manipulations with the state are governed by dominance relationships.
6. Relationships between DSP are given by a dominance hierarchy which is static.





Sample G&S analysis

from Lascarides (1999)

I would like for you to assemble the compressor.

I suggest you begin by attaching the pump to the platform

Fine. Now let's see if it works.

- It seems natural to treat each sentence as a discourse segment.



After segmenting

DS0 I would like for you to assemble the compressor.

DS1 I suggest you begin by attaching the pump to the platform

DS2 Fine. Now let's see if it works.

What is the intention of DS0?

- DSP0 Agents wants the user to put together a compressor

- This is probably the intention of the entire discourse

Now we need focus spaces...



Keep track of attentional state with stack

DS0 I would like for you to assemble the compressor.



DSPO Agent want to get user to correctly set up compressor

DS1 I suggest you begin by attaching the pump to the platform

DS2 Fine. Now let's see if it works.

Focus stack

Intentional Structure

Compressor,
DSPO FSO

DSPO

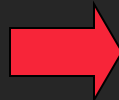
FSO gets "pushed" on the stack



Purpose of DS1

DS0 I would like for you to assemble the compressor.

DS1 I suggest you begin by attaching the pump to the platform



What is the purpose of the DS1?

DS2 Fine. Now let's see if it works.

DSP1: Agent wants to get the user to do a part of the assembly



Dominance relationship

DS0 I would like for you to assemble the compressor.

DS1 I suggest you begin by attaching the pump to the platform

DS2 Fine. Now let's see if it works.

DSP1: Agent wants to get the user to do a part of the assembly

DSP 1 is dominated by DSP0
DS1 is "embedded" in DS0

The embedding of DS's is decided by the dominance relationship between the segments on an intentional level

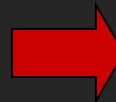


Dominance relationship

DS0 I would like for you to assemble the compressor.

We know this because we understand the task-structure, and can therefore identify the purpose of each segment!

DS1 I suggest you begin by attaching the pump to the platform



DSP1: Agent wants to get the user to do a part of the assembly

DSP 1 is dominated by DSP0
DS1 is "embedded" in DS0

DS2 Fine. Now let's see if it works.

The embedding of DS's is decided by the dominance relationship between the segments on an intentional level



Dominance relationship

DS0 I would like for you to assemble the compressor.

DS1 I suggest you begin by attaching the pump to the platform

DS2 Fine. Now let's see if it works.

DSP1: Agent wants to get the user to do a part of the assembly

Focus stack

Intentional

Pump, Platform
DSP1, FS1

Compressor,
DSPO FSO

DSPO

DSP1

FS1 gets pushed on the stack on top of FSO

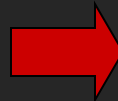


Purpose of DS2

DS0 I would like for you to assemble the compressor.

DS1 I suggest you begin by attaching the pump to the platform

DS2 Fine. Now let's see if it works.



What is the purpose of the DS2?

DSP2: Agent wants user to check if the compressor has been put together correctly



Cue phrase signal

DS0 I would like for you to assemble the compressor.

DS1 I suggest you begin by attaching the pump to the platform

DS2 Fine. Now let's see if it works.

The purpose of DS2 is dominated by DS0 rather than DS1

“Fine” is a **linguistic signal**, a **cue phrase**

The cue phrase signals that we should “**pop**” the focus space for DS1 (FS1) because we have satisfied its intention.

DS1 is now closed off here



Popping the stack

DS0 I would like for you to assemble the compressor.

DS1 I suggest you begin by attaching the pump to the platform

DS2 Fine. Now let's see if it works.

DSP0 dominates DSP2

FS1 is popped from the stack

Focus stack

Compressor,
DSPO FSO

Intentional Structure

DSP0

DSP2

DSP0

DSP1

The pump can't be an antecedent for "it"

Notice:

1. **Discourse segmenting** is hard to do without an idea about what the intentional structure is
2. The **embedding** of a segment is determined from the intentional structure
3. **All three structures are partially isomorphic with each other**
 - If you know something about one, you know something about the others
4. **Intentional structure** seems to be primary
 - but to what degree is this dependent on the genre...?
 - in a task-oriented dialogue, the speaker's intentions towards the hearer are central...

Notice also:

- **Attentional structure**
 - This limits possible dominance relationships. New discourse segments can only have a relationship with something on top of the stack
- **Linguistic signals**
 - steer push or pop operations on the stack

Intention-based

1. The stack manipulation is controlled by the dominance hierarchy. This means the entire discourse structure that is built up is grounded in how intentions are fulfilled
2. Grosz & Sidner have worked with “task-oriented dialogue”
 1. Their theory may work best with this type of dialogue
 2. Question: How well does this model describe e.g. small talk?
 3. How well does it describe newswire?

Two types of relationships between intentions

1. Dominance

1. DSP1 dominates DSP2

2. DSP1 dominates DSP2 if it is necessary to satisfy DSP2 in order to be able to satisfy DSP1

2. Satisfaction precedes

– DSP1 satisfaction precedes DSP2 if DSP1 has to be satisfied before DSP2

Example of “satisfaction precedes”

1. How do you register for a course at Stockholm University? **DSO**
2. Fill in the registration form. **DS1**
3. Send the form to “Admissions”. **DS2**

Filling in the form necessarily precedes sending in the form

DSP0 dominates DSP1

DSP1 satisfaction precedes DSP2

DSP0 dominates DSP2

How to do a G&S analysis?

Partially adapted form Lascarides (1999)

1. Decide what you will consider a discourse segment (DS)
2. Decide what the underlying purpose of the discourse segments are (DSP)
3. What relationship holds between each DSP and the other DSPs in the discourse
 - Domain information, plans etc. can be used here as well
4. Divide the discourse into discourse segments that reflects this
5. Manipulate the stack if necessary, I.e. pop? If not, push the focus space for the DS on the stack.

How has G & S's theory been used?

1. Barbara Grosz: studied the relationship between discourse structure and prosody, goal: improve speech synthesis
2. Candy Sidner: works with developing better systems for "collaborative dialogue systems" between humans and machines, using a modified version of G&S (1986)
3. Text-generation: specially work with cue-phrases

Shortcomings of G&S (1986)

- G&S recognize only two types of relationships between segments, dominance and satisfaction precedes
 1. information used to determine the structure is kept “behind the scenes”
 2. This information might be useful
 3. These two categories seem to be too general, I.e. it is not a natural or intuitive task to categorize relationships between segments at this high level