

Discourse Processing: Key Questions

- What individuates a discourse?
- What makes it coherent?

Travelers left and entered our car at every stopping of the train. We began to recite our lessons. Similar facts were observed on the 23rd of July in the same year, in the Pacific Ocean, by the Columbus, of the West India and Pacific Steam Navigation Company.

Informational Approach

Understanding Linguistic Structure is sufficient for Discourse Processing

- Lexical cohesion — patterns of sentence connectivity
- Rhetorical relations — content-based relations between sentences

Intentions and The Structure of Discourse

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Two Views on Discourse

Is the speaker in the loop?

- Informational Approach: Understanding Linguistic Structure is sufficient for Discourse Processing
- Intentional Approach: Understanding Speaker Intentions is required for Discourse Processing

Intentional Approach

Understanding Speaker Intentions is central to Discourse Processing

“Attention, Intentions, and the Structure of Discourse”(Grosz&Sidner:1986)

- Utterances are considered as actions
- The hearer’s understanding of the plan-based speaker intentions is the basis of discourse coherence

Linguistic Structure

- Constituents:
 - Discourse segments
 - Embedding relations that can hold between them
- Interaction between linguistic structure and the discourse utterances
 - Linguistic expressions reflect discourse structure
 - Discourse structure constraints the interpretation of expressions

Informational Approach

Observations:

- Amenable for computational approaches (esp. corpus-based techniques)
- Shown to be useful in some natural language processing tasks
- Independent of how humans process discourse
- Limited expressive and predictive power

Attentions, Intentions, and the Structure of Discourse

Abstract Model of Discourse Structure as a composite of three interacting constituents:

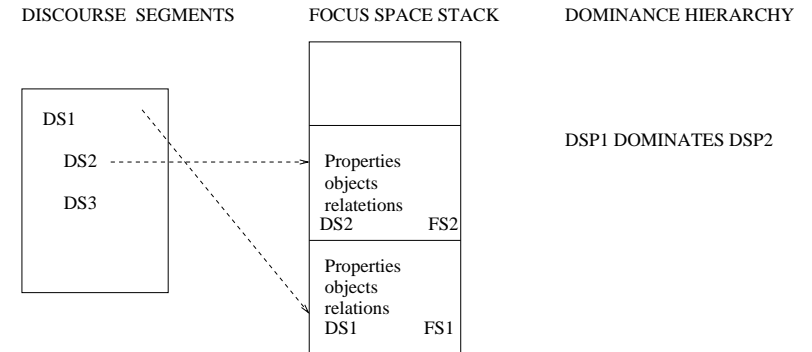
- Linguistic Structure
Discourse Utterances
- Intentional Structure
Intentions organized in hierarchical discourse structure
- Attentional Structure
Dynamically-changing model of objects, properties and relations that are salient at each point of discourse

Attentional Structure

Abstraction of participants' focus of attention

- Attentional Structure is modeled by focus spaces: objects and relations in focus of participants' attention
- Changes in Attentional Structure are modeled by a set of insertion and deletion rules

Transitions



Linguistic Structure

- (Para)-Linguistic expressions reflect discourse structure
 - Cue phrases (*For example, In the first place*)
 - Change in aspect and tense
 - Change in intonation and gesture
- Discourse structure constraints the interpretation of expressions
 - Pronoun resolution

Patterns of Entity Distribution

	Dictator	Augusto	Pinochet	London	October	Surgey	Arrest	Extradition	Warrant	Judge	Thousands	Spaniards	Hearing	Fate	Balance	Scholars
1	S	S	S	X	X	-	-	-	-	-	-	-	-	-	-	-
2	-	-	S	-	-	X	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	S	X	X	O	-	-	-	-	-	-
4	-	-	S	-	-	-	-	-	-	-	O	O	-	-	-	-
5	-	-	S	-	-	-	-	-	-	-	-	-	O	X	X	-
6	-	-	-	-	-	-	O	-	-	-	-	-	-	-	-	S

Intentional Structure

Discourse Purpose(DP) is an underlying purpose that is held by the person who initiates discourse

Discourse Segment Purpose(DSP) specifies how this segment contributes to achieving the overall discourse purpose

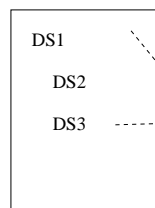
- Assumption: one DP per discourse
- No Taxonomy of Intentions (not the difference with the RST)

Examples of Intention Types

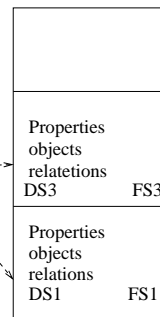
- Intend that some agent intend to identify an object
Intend that Ruth intend to identify my dress.
- Intend that some agent know some property of an object
Intend that Ruth know that my dress is red

Transitions

DISCOURSE SEGMENTS



FOCUS SPACE STACK



DOMINANCE HIERARCHY

DSP1 DOMINATES DSP3
DSP1 DOMINATES DSP2

Examples of Intention Types

- Intend that some agent intend to perform some physical task
Intend that Ruth intend to fix the flat tire.
- Intend that some agent believe some fact
Intend that Ruth believe that campfire has started.
- Intend that some agent believe that one fact supports another
Intend that Ruth believe the smell of smoke provides evidence that the campfire is started.

C1: I need to travel in May.
 A1: And, what day in May you want to travel?
 C2: OK uh I need to be there from the 12th to the 15th
 A2: And you're flying into what city?
 C3: Seattle
 A3: And what time would you like to leave Pittsburgh?
 C4: Uh hmm I don't think there's many options for non-stop
 A4: Right. There's three non-stops today.
 C5: What are they?
 A5: The first one departs PGH at 10:00 . . .
 C6: OK I'll take the 5ish flight on the night before on the 11th
 A6: On the 11th? OK. Departs at 5:55 pm
 C7: OK

Intention Hierarchy

- Dominance: I1 dominates I2, I3, I4, I5
I₁ (Intend C (Intend A (A find a flight for C)))
I₃ (Intend A (Intend C (Tell C A destination city)))
- Satisfaction-precedence: I2, I3 satisfaction-precedes I5
I₃ (Intend A (Intend C (Tell C A destination city)))
I₅ (Intend C (Intend A (A find a nonstop flight for C)))

Intention Hierarchy

Understanding Structural Relations among relations is key!

- Dominance:
 DSP₁ dominates DSP₂ if satisfying DSP₂ is intended to provide part of the satisfaction of DSP₁
- Satisfaction-precedence:
 DSP₁ satisfaction-precedes DSP₂ if DSP₁ must be satisfied before DSP₂

Intention Hierarchy

I₁ (Intend C (Intend A (A find a flight for C)))
I₂ (Intend A (Intend C (Tell C A departure date)))
I₃ (Intend A (Intend C (Tell C A destination city)))
I₄ (Intend A (Intend C (Tell C A departure time)))
I₅ (Intend C (Intend A (A find a nonstop flight for C)))

Coherent Discourse

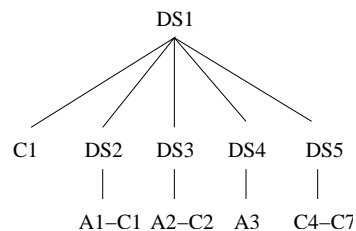
- Overall plan of the speaker ties intentions together
- Interaction between the speaker's plan and the hearer's intention comprehension
 - Intention determination — complete specification of what is intended by whom
 - Intention recognition — the processing that leads a discourse participant to identify what the intention is

Plan Representation

STRIPS BOOK-FLIGHT (A,C,F)

Constraints: $\text{Agent}(A) \wedge \text{Flight}(F) \wedge \text{Client}(C)$
Precondition: $\text{Know}(A, \text{departure-date}(F)) \wedge \text{Know}(A, \text{departure-time}(F)) \wedge \text{Know}(A, \text{origin-city}(F)) \wedge \text{Know}(A, \text{destination-city}(F)) \wedge \text{Has-Seats}(F) \wedge \dots$
Effect: $\text{Flight-Booked}(A, C, F)$
Body: $\text{Make-Reservation}(A, F, C)$

Intention Hierarchy



Informational vs. Intentional Coherence

(Moore&Pollack, 1992): informational and intentional levels of discourse analysis cannot be separated

You'll want to book your reservation before the end of the day. Proposition 143 goes into effect tomorrow.

- Intentional structure: convince the caller to book her reservation until the end of the day
- Information structure: explanation relation between two sentences

Determining Intentional Structure

Plan Representation

REQUEST-INFO (A,C,F)

Constraints: $\text{Agent}(A) \wedge \text{Client}(C)$

Precondition: $\text{Know}(C,I)$

Effect: $\text{Know}(A,I)$

Body: $B(C, W(A, \text{Know}(A, I)))$