Intentions and The Structure of Discourse

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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.
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
Informational Approach

Understanding Linguistic Structure is sufficient for Discourse Processing

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

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Intentions and The Structure of Discourse
Transitions

DISCOURSE SEGMENTS

DS1
DS2
DS3

FOCUS SPACE STACK

Properties
objects
relations
DS2
FS2

Properties
objects
relations
DS1
FS1

DOMINANCE HIERARCHY

DSP1 DOMINATES DSP2

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Transitions

DISCOURSE SEGMENTS

DS1
DS2
DS3

FOCUS SPACE STACK

DSP1 DOMINATES DSP3
DSP1 DOMINATES DSP2

DOMINANCE HIERARCHY

Properties
objects
relations
DS3 FS3

Properties
objects
relations
DS1 FS1
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 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.
Examples of Intention Types

- Intend that some agent intend to identify an object
  \textit{Intend that Ruth intend to identify my dress.}

- Intend that some agent know some property of an object
  \textit{Intend that Ruth know that my dress is red}
Understanding Structural Relations among relations is key!

- **Dominance:**
  \( \text{DSP}_1 \) dominates \( \text{DSP}_2 \) if satisfying \( \text{DSP}_2 \) is intended to provide part of the satisfaction of \( \text{DSP}_1 \)

- **Satisfaction-precedence:**
  \( \text{DSP}_1 \) satisfaction-precedes \( \text{DSP}_2 \) if \( \text{DSP}_1 \) must be satisfied before \( \text{DSP}_2 \)
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

$I_1$ (Intend C (Intend A (A find a flight for C)))
$I_2$ (Intend A (Intend C (Tell C A departure date)))
$I_3$ (Intend A (Intend C (Tell C A destination city)))
$I_4$ (Intend A (Intend C (Tell C A departure time)))
$I_5$ (Intent C (Intend A (A find a nonstop flight for C)))
Intention Hierarchy

- Dominance: $I_1$ dominates $I_2$, $I_3$, $I_4$, $I_5$
  $I_1$ (Intend $C$ (Intend $A$ (A find a flight for $C$)))
  $I_3$ (Intend $A$ (Intend $C$ (Tell $C$ A destination city)))

- Satisfaction-precedence: $I_2$, $I_3$ satisfaction-precedes $I_5$
  $I_5$ (Intent $C$ (Intend $A$ (A find a nonstop flight for $C$)))
Intention Hierarchy

DS1

C1  DS2  DS3  DS4  DS5

A1–C1  A2–C2  A3  C4–C7
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
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
STRIPS BOOK-FLIGHT (A,C,F)

Constraints: Agent(A) ∧ Flight (F) ∧ Client (C)
Precondition: Know (A,departure-date(F)) ∧ Know (A,departure-time(F)) ∧ Know (A, origin-city(F)) ∧ Know (A, destination-city(F)) ∧ Has-Seats (F) ∧ ...
Effect: Flight-Booked (A, C, F)
Body: Make-Reservation (A, F, C)
Plan Representation

REQUEST-INFO (A,C,F)

Constraints: Agent(A) \land Client (C)
Precondition: Know (C,I)
Effect: Know (A, I)
Body: B(C, W (A, Know (A, I))))
Determining Intentional Structure