Lecture 26: Structured discourse models, applications

Henry S. Thompson
(Based in part on slides by Johanna Moore and Bonnie Webber)
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1. Richer structure

Discourse structure is not (always) just ODTAA

- That is, it’s not flat

And sometimes detecting this structure really matters

Welcome to word processing;
That’s using a computer to type letters and reports
Make a typo?
No problem
Just back up, type over the mistake, and it’s gone
And, *it eliminates retyping
And, it eliminates retyping

2. Topic is not the only way dimension of discourse change

Topic/sub-topic is not the only structuring principle we find in discourse

- Different genres may mean different kinds of structure

Some common patterns, by genre

Expository
  Topic/sub-topic

Task-oriented
  Function/precondition

Narrative
  Cause/effect, sequence/sub-sequence, state/event

But note that some of this is not necessarily universal
• Different scholarly communities may have different structural conventions
• Different culturals have different narrative conventions

Cohesion sometimes manifests itself differently for different genres

3. Functional Segmentation

Texts within a given genre

• News reports
• Scientific papers
• Legal judgements
• Laws

generally share a similar structure, independent of topic

• sports, politics, disasters
• molecular biology, radio astronomy, cognitive psychology

That is, their structure

• reflects the function played by their parts
• in a conventionalised structure

4. Example: news stories

The conventional structure is so 'obvious' that you hardly notice it

• Known as the inverted pyramid

In decreasing order of importance

• Headline
• Lead paragraph
  ◦ Who, what, when, where, maybe why and how
• Body paragraphs, more on why and how
• Tail, the least important
  ◦ And available for cutting if space requires it

5. Example: Scientific journal papers

In particular, experimental reports

• Your paper will not be published in a leading e.g. psychology research journal if it doesn't look like this

Highly conventionalised

Front matter
  Title, Abstract

Body
  (or, mnemonically, IMRAD
  • Introduction (or Objective), including background
  • Methods
  • Results
  • Discussion
Although the major divisions (IMRAD) will usually be typographically distinct and of explicitly labelled
  • Less immediately distinctive, more equivocal, cues give evidence for finer grained internal structure

6. Theories of discourse structure

Early discourse resources were task-oriented
  • For example, an engineering explaining to an apprentice how to repair a pump
And the structure of task-oriented discourse often mirrored the structure of the task
Pre-computational theories had focussed on narrative structures
  • Story grammars, so-called, basically taxonomic and flat
These gave way to structurally rich generative models
  • Grosz and Sidner’s Discourse Theory
  • Mann and Thompson’s Rhetorical Structure Theory (RST)
    ◦ Not me, Sandra Thompson
Both were expressed in terms of coherence relations
  • Also sometimes called discourse relations
  • Between the interpretation of sentences/utterances
    ◦ After some amount of abstraction
Still depending on observable phenomena (cohesion) to detect/identify them

7. Grosz and Sidner’s Discourse Theory (GSDT)

GSDT approaches the hierarchical nature of discourse at three levels
  • Linguistic structure
    ◦ What is actually said/written
  • Intentional structure
    ◦ Speaker’s goals and purposes
    ◦ Organised into a relational structure
    ◦ I.e. this is where discourse relations come in
  • Attentional structure
    ◦ Speaker’s focus of attention

8. GSDT: Intentional structure

There is an overall discourse purpose (DP)
  • The basic purpose of the whole discourse
A discourse consists of discourse segments (DS)
  • Each segment has one or more discourse segment purposes (DSP)
    ◦ How a segment contributes to the DP
As well as **segment relations**

- **satisfaction-precedence**  DSP1 must be satisfied before DSP2
- **dominance**  DSP1 dominates DSP2 if fulfilling DSP2 constitutes part of fulfilling DSP1

9. **Attentional state**

Attention is represented in terms of a **focus stack**

- A stack of **focus spaces**
  - Each containing objects, properties and relations salient during its corresponding DS
  - As well as its DSP
- That is, content plus purpose

The discourse focus is always on the focus space at the top of the stack

State changes are modeled by transition rules controlling the addition/deletion of focus spaces

- Information at lower levels may or may not be available at higher levels

Focus spaces are pushed onto the stack when a new DS is detected

- And popped when they are completed

10. **Discourse structure influences coreference**

Consider our earlier example:

```
Welcome to word processing
[push]
That's using a computer to type letters and reports
Make a typo?
[push]
No problem
Just back up, type over the mistake, and it's gone
[pop]
And, it eliminates retyping
```

Or this
11. Detecting subtopics/Identifying discourse relations

There are a variety of cues that make these structures easier to recognise

- **implicit** lexical chains, tense and aspect
- **explicit** cue phrases
- **conjunctions** 'because', 'but'
- **conjunctive adverbials** 'nevertheless', 'instead'
- **temporal adverbials** 'then', 'afterwards'
- **suprasegmental** intonational variation

Different cues, different actions

- push
- pop
- chain
  - That is, pop then push

12. Learning cues

The Penn Discourse TreeBank provides a resource for supervised learning of cues

- Annotated with connectives, their arguments, and the senses they convey
- Approximately 18,000 explicit connectives and 16,000 implicit ones
As with many other linguistic phenomena, the distribution of connectives follows Zipf's law:

<table>
<thead>
<tr>
<th>Connective</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>but</td>
<td>3308</td>
</tr>
<tr>
<td>and</td>
<td>3000</td>
</tr>
<tr>
<td>if</td>
<td>1223</td>
</tr>
<tr>
<td>because</td>
<td>858</td>
</tr>
<tr>
<td>while</td>
<td>781</td>
</tr>
<tr>
<td>however</td>
<td>465</td>
</tr>
<tr>
<td>therefore</td>
<td>26</td>
</tr>
<tr>
<td>otherwise</td>
<td>24</td>
</tr>
<tr>
<td>as soon as</td>
<td>20</td>
</tr>
<tr>
<td>accordingly</td>
<td>5</td>
</tr>
<tr>
<td>if and when</td>
<td>3</td>
</tr>
<tr>
<td>conversely</td>
<td>2</td>
</tr>
</tbody>
</table>

The corpus isn't large enough to have all the connectives we might expect.

13. Discourse relations

What kinds of things are we looking for?

- Kinds of coherence

How do discourse segments "hang together"?

Essentially an **abductive** question

- Abduction is reasoning to the best explanation

Which often *is* explanation

Compare

- John hid Bill's car keys. He was drunk
- John hid Bill's car keys. He likes spinach

Here's a list from Mann & Thompson:

- Circumstance
- Solutionhood
- Elaboration
- Background
- Enablement and Motivation
  - Enablement
  - Motivation
- Evidence and Justify
  - Evidence
  - Justify
- Relations of Cause
  - Volitional Cause
  - Non-Volitional Cause
  - Volitional Result
  - Non-Volitional Result
- Purpose
- Antithesis and Concession
  - Antithesis
  - Concession
- Condition and Otherwise
  - Condition
14. RST, cont'd

Relations defined by constraints on the **nucleus** and **satellite**

- With respect not only to **N** and **S**
- But also the writer (**W**) and the reader (**R**)

For example, the **Evidence** relation

<table>
<thead>
<tr>
<th>Relation Name</th>
<th>Constraints on N</th>
<th>Constraints on S</th>
<th>Constraints on N+S</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence</td>
<td>R might not believe N to a degree satisfactory to W</td>
<td>R believes S or will find it credible</td>
<td>R's comprehending S increases R's belief of N</td>
<td>R's belief of N is increased</td>
</tr>
</tbody>
</table>

Relations may be either symmetric (e.g. Contrast) or asymmetric (e.g. Purpose)

- There’s a set of graphical conventions for diagramming relations and their overall pattern in a discourse

![Discourse Tree Diagram](image)

*Figure 21.4* A discourse tree for the *Scientific American* text in (21.23), from Marcu (2000a). Note that asymmetric relations are represented with a curved arrow from the satellite to the nucleus.
15. Contrasting approaches to coreference in discourse

A motivating antecedent to Grosz’s discourse work was Hobbs’s 1978 pronoun resolver

- Purely syntactic
- Gender, person, number checks
- Carefully-crafted search order
  - *Up* from the pronoun
  - *Across* left-to-right, breadth-first, for each S or NP as you go up
  - *Back* to the previous sentences

Grosz (at SRI) and Sidner (at MIT) moved from a flat approach to one dependent on hierarchical discourse structure

- Called **Centering theory**
- Key roles for two kinds of center:
  - One **backward-looking**
  - Multiple **forward-looking**
- And rules associated with push, pop etc. for updating these

See J&M 21.6.1 and 21.6.2 for detailed expositions of these two approaches