Seminar: Discourse phenomena

(http://www.dfki.de/~horacek/disc-phen.html)

Time and place: Wednesday, 16-18 seminar room 001, bldg. E1.7
(begin/introduction 5.11.)

Topics include

Conversational implicature, presupposition,
speech acts, conversational structure,
coherence, reference interpretation

Students interested in the seminar please contact

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Some central notions

Discourse
Coherent piece of text, with length of several sentences/paragraphs
Comprises dialogs and monologs

Pragmatics
Issues that reach beyond sentence boundaries
Issues of language use, interpretations consistent with the real world
Several definitions in the literature, some are debatable

Context
Setting/embeddings relevant for the interpretation of utterances

Inference
Makes information entailed by the content of utterances explicit
Some properties of discourse/pragmatics

Differences to syntax/semantics
- Structure mapping not such a dominant factor
- Compositionality frequently not an adequate principle
- Impact of expectations, effects of utterances seriously matter

What makes discourse analysis difficult
- Relevant factors of the context hard to grasp
- Human inferences are often complex, subtle, and subjective
- Detailed world knowledge sometimes indispensable
- Human conversation is inherently fallible
Motivations for research on discourse/pragmatics

Discrepancies between human and machine adequate communication

<table>
<thead>
<tr>
<th>Machine</th>
<th>Human</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>mostly uniform</td>
</tr>
<tr>
<td>Explicitness</td>
<td>entirely explicit</td>
</tr>
<tr>
<td>Granularity</td>
<td>mostly uniform</td>
</tr>
</tbody>
</table>

Challenges for discourse processing

Differences between form and content sometimes considerable

Adaptation to human preferences may increase the effectiveness of systems

Balancing between the costs underlying formal models and their impact
Theories about discourse

The formalist approaches
Discourse exhibits internal structure, encapsulate closely related semantic units
Theories used to explain pronominalizations and quantifier scoping effects
Weak on actual contents (precise interrelationship, communicative purpose)
Prominent representative: Discourse Representation Theory (DRT)

The functionalist approaches
Discourse segments are defined by communicative purposes
Theories focus on interrelationships between segments (how they fulfil goals)
Complementary to formalist approaches in terms of strenghts and weaknesses
Prominent representative: Rhetorical Structure Theory (RST)

A (combined) theory of discourse (Grosz and Sidner 1986)
Segmentation of the utterances (formalist view)
Structure of the interlocutor intentions (functionalist view)
Attentional state (record of referentially available objects)
Reference

Function

Expression refers to an entity in the discourse

“referring expression” denotes a “referent”

Purposes: identification and information about a referent

Forms of referring expressions

Personal pronouns, proper names

Definite NPs, indefinite NPs, demonstrative NPs, quantified NPs

Challenges in processing referring expressions

Interpretation of pronouns (structural preferences vs. world knowledge)

Generation of human-adequate expressions
Presupposition

Felicity of sentences

“The king of France is wise”

presupposes there is a king of France

Frege's theory

(i) referring phrases and temporal clauses do refer
(ii) sentence and its negations share propositions
(iii) presuppositions must be satisfied for a sentence to be either true or false

A simple view justified by distinction between sense and reference

Challenged by Russell

Presuppositions are defeasible

Relevant for evaluating database queries cooperatively
Presupposition properties

Triggers of presuppositions (selection)

Referential: “The chancellor decides”
-> There is a chancellor

Lexical: “John has opened the window again”
-> The window was closed, John has opened it before

Syntax-driven: “Who has eaten the cake”
-> Someone has eaten the cake

Defeat of presuppositions

Presuppositions that occur in negation, modal contexts, or discourse:

John does not regret that Mary is married. Mary is single.

* John regrets that Mary is married. Mary is single.
Conversational implicature

Beyond what is said explicitly

“Can you tell me the time”

“Well, the milkman has come”

Grice's theory of implicature based on general cooperative principle, 4 Maximes

(i) Quality – say what you believe to be true
(ii) Quantity – say exactly as much as required
(iii) Relevance – say only relevant things
(iv) Manner – avoid ambiguity and obscurity, be brief

Implicatures are defeasible

Relevant for (inference-rich) discourse, indirect answers
Conversational implicature - examples

Scalar implicatures

“John has three children”  \(\rightarrow\) (not more than three)
“Some of the candidates passed”  \(\rightarrow\) (not all of them passed)
“I am sometime late”  \(\rightarrow\) (I am not always late)

Special/general implicatures

“I went into a house”  \(\rightarrow\) (not my house)
“Did you see the steak?”  
“The dog looks very happy”  \(\rightarrow\) (the dog has eaten the steak)

Explanation

“Why has A been assigned to B”
“Group leaders go to single rooms”  \(\rightarrow\) (A is a group leader, B a single room)
Metaphor

Examples

(1) “Ctrl-z kills the process”
(2) “This boxer is a tank”

One entity stands for another one to which it is related

(1) metaphoric use of verb
(2) transferring essential meanings from physical domain

Metaphoric relation must be transferred
Literal reading preferred, if meaningful

Metaphors are creative

Relevant for processing discourse appropriately
Metonymy

Examples

1. “The Boston office called”
2. “The ham sandwich is waiting for his check”

One entity stands for another one to which it is related

1. purely semantic phenomenon, regularities
2. pragmatic justification

Metonymic extensions make implicit item explicit

Literal reading preferred, if meaningful

Metonymies are chainable

Relevant for evaluating database queries appropriately
Discourse relations

A example

Jones has lots of experience.
He has been on the board for 10 years.
And he 's refused bribes.
So he's honest.
He would really make a good president.

[Cohen 1987]

Diagnosis

• Relations between facts/assertions not explicitly expressed
• Cue phrases (here: and, so) only contribute to a limited extent – ambiguous!

Challenges

• Reconstructing the intended argumentative structure (in analysis)
• Presenting arguments in a natural and understandable form (in generation)
Intentional approach (Grosz and Sidner)

Three dimensions of discourse

Linguistic structure

- The utterances themselves
- Expressions that indicate discourse structure (cue phrases, aspect, tense, intonation, gesture)

Intensional structure

- Hierarchy of intentions (dominance and precedence)
- Purpose/intention held by discourse initiator (assumption: one per discourse)

Attentional structure

- Model of objects, properties and relations according to their salience
- Participants' focus of attention modeled by focus spaces
Rhetorical structure theory (Mann and Thompson)

Model of discourse

- Relations between discourse units (mostly binary relations)
- Domain-independent rhetorical structure, compositionally built trees
  (cue phrases, aspect, tense, intonation, gesture)

Examples of relations

- Nucleus/satellite: elaboration, condition, purpose, result
- Multi-nuclear: contrast, sequence, joint

Limitations

- Repertoire of relations not determined, singularity of relations problematic
- Issues of dialog, overall structure of the discourse
Generation – presenting discourse relations

Some possible variations

PRE-ORDER
1. Jones would make a good president.
2. He has lots of experience.
3. He has been on the board for 10 years.
4. And he's honest.
5. He's refused bribes.

HYBRID
1. Jones would make a good president.
2. He has lots of experience.
3. He has been on the board for 10 years.
4. And he's refused bribes.
5. So he's honest.

POST-ORDER
1. Jones has been on the board for 10 years.
2. He has lots of experience.
3. And he's refused bribes.
4. So he's honest.
5. He would really make a good president.

Methods

• Ordering and cue-phrase selection, embedded in sentence planning
  (e.g., [Grote, Stede 1998])

• Decisions guided by heuristics expressing aspects of linguistic/rhetorical adequacy
  (e.g., [Scott, de Souza 1992])
Speech acts (Searle)

Simultaneous acts of a speech act
- Locutionary act – sense and reference of an utterance
- Illocutionary act – statement or promise through conventional force of act
- Perlocutionary act – effects on the audience

Categories of speech acts
- Representatives – entail a commitment of the speaker to the truth of content
- Directives – attempt to get the hearer to do something
- Commissives – commitment the speaker to some future form of action
- Expressives – expresses a psychological state
- Declarations – effect changes state of institutional affairs
Symbolic methods

Processing on surface-near levels
   Use of automata, cascaded compositions

Representations
   Expressing generalizations, use of inheritance methods (also non-monotonic ones)
   Attribute-value structures, unification

Reasoning
   Rule-based inferencing, planning

Tools
   Morphological analysis and generation, syntactic parsing, surface generation
Statistical methods

Development
Data-based methods may be promising where rules are hard to build
Increasingly more areas, dominating in the meantime

Typical areas
Word sense disambiguation, syntactic disambiguation, bi-lingual machine translation

Techniques
Different learning methods are effective in dependency of linguistic data structures

Tendency
Statistical, corpus-based techniques are increasingly overtaking
Reference resolution

Constraints
  Agreements
  Syntactical constraints
  Selectional restrictions

Preferences
  Recency
  Grammatical role
  Repeated mention
  Paralellism
  Verb semantics
Centering theory (Grosz, Joshi, Weinstein 1995)

**Major ingredients**

- each utterance has one backward looking center $C_b$
  and an ordered set of forward looking centers $C_f$

- proposed $C_f$ ordering $\text{Subj} < \text{Obj} < \text{Other}$
  (various other proposals considered in the literature)

- the most highly ranked item on $C_f$ is the $C_p$,
  i.e., the preferred $C_b$ for the next utterance

- types of center-transitions depending on whether backward looking center is
  maintained or changed: continuation, retaining, shift
Preference rules

If any item is pronominalized, then $C_b$ is pronominalized

Preference for sequences of center continuation, or smooth (gradual) shift

<table>
<thead>
<tr>
<th>$C_b(U_i) = C_p(U_i)$</th>
<th>$C_b(U_i) = C_b(U_{i-1})$</th>
<th>Smooth Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_b(U_i) \neq C_p(U_i)$</td>
<td>Continue</td>
<td>Rough Shift</td>
</tr>
<tr>
<td>Retain</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$C_b(U_k)$ — backward looking center of utterance $U_k$

$C_f(U_k)$ — (partially) ordered list of forward looking centers of utterance $U_k$

$C_p(U_k)$ — highest ranked item on $C_f(U_k)$, the preferred (next) center
Information structure

Theme - given information, anchoring in the discourse (purpose, topic)

Rheme - new information, advances the discourse

Focus - emphasis within an utterance

Expressive means differ across languages

(e.g., word order, syntactic form, intonation)

A famous example

The good news is that Czechs made revolution,

the bad news is that revolution is made by Czechs
Dialog systems
“Make an appointment for Tuesday”

What time is your appointment?

“215”

OK, I can create your meeting. Note that you already have an appointment at 2:15 pm. Shall I schedule it anyway?

“No”

To continue, you can Confirm, Cancel, Change the Time, or Change the Title.

OK. You’re probably way too busy anyway, Dan.
“Find restaurants near me”
tap to edit

I found fifteen restaurants fairly close to you:

15 Restaurants

Emmy's Spaghetti Shack 0.2 mi
18 Virginia Ave
Italian, $$$$
★★★★★ 1101 Reviews

ICHI Sushi 0.2 mi
3369 Mission St
Japanese, Sushi Bars, $$$$$
★★★★★ 260 Reviews

“Tell me more about the second one”
tap to edit

I’m sorry, Dan, I’m afraid I can’t do that.
“Find restaurants near me”
tap to edit

I found fifteen restaurants fairly close to you:

15 Restaurants

Emmy's Spaghetti Shack 0.2 mi
18 Virginia Ave
Italian, $$$$ ★★★★★ 1101 Reviews

ICHII Sushi 0.2 mi
3369 Mission St
Japanese, Sushi Bars, $$$$$ ★★★★★★ 260 Reviews

“My web search turned this up:

Web Search
Are any of them Italian

any - Dizionario inglese-italiano
WordReference
www.wordreference.com

English-Italian Dictionary | any ... of any sort adj (of an unspecified variety) di qualsiasi

Italian language - Wikipedia, the free
Dialogue System Architecture

- Speech Recognition
- Natural Language Understanding
- Dialogue Manager
- Task Manager
- Text-to-Speech Synthesis
- Natural Language Generation
ARCHITECTURES FOR DIALOG MANAGEMENT

Finite state

- Reliable in general, but inflexible
- Compiled versions resulting from more abstract models useful

Frame-based

- Domain-specific target structure
- Requires processing component to interpret state of the frame

Information state

- Theoretically motivated model
- Based on force of speech acts, central notion discourse obligations
- No generally agreed vocabulary
- Theroretical elaborations for selected discourse phenomena/situations
- Used in some experimental systems (GODIS)
A SIMPLE EXAMPLE

Airline travel system

Asking required about

- Departure city
- Destination city
- Time
- Single- or round trip
Finite State Dialog Manager

1. What city are you leaving from?
2. Where are you going?
3. What date do you want to leave?
4. Is it a one-way trip?
   - Yes: Do you want to go from <FROM> to <TO> on <DATE>?
   - No: What date do you want to return?
5. Do you want to go from <FROM> to <TO> on <DATE>?
   - No: Book the flight
   - Yes: Do you want to go from <FROM> to <TO> on <DATE> returning on <RETURN>?
   - Yes: Book the flight
   - No: No
ASSESSMENT OF THE FINITE STATE APPROACH

Conceptually

- Completely controls the dialog, asking a series of questions
- Ignores or misunderstands anything that is not a direct answer

Technically

- Easy to build
- Expectations usable by speech recognition and language analysis

Usability

- Only for very simple tasks
- Very tedious, ineffective dialogs
Frame-based Dialog Management

Dialog control extensions
Answering several questions at once possible
Specifying

Conceptual extensions
Multiple frames, e.g.,
flights, hotels, rental cars
multiple-leg flights, general information about airline policy

Additional problems
Scope of specifications may sometimes be a concern/problematic
Recognition of implicit topic shifts challenging
(a) Bathroom-design application          (b) Talking head

Figure 1: Components of the COMIC interface
### THE COMIC SYSTEM

<table>
<thead>
<tr>
<th>User</th>
<th>Tell me about this design <em>click on Alt Mettlach</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>COMIC</td>
<td><em>Look at screen</em></td>
</tr>
<tr>
<td></td>
<td>THIS DESIGN is in the CLASSIC style.</td>
</tr>
<tr>
<td></td>
<td><em>circle tiles</em></td>
</tr>
<tr>
<td></td>
<td>As you can see, the colours are DARK RED and OFF WHITE.</td>
</tr>
<tr>
<td></td>
<td><em>point at tiles</em></td>
</tr>
<tr>
<td></td>
<td>The tiles are from the ALT METTLACH collection by VILLEROY AND BOCH.</td>
</tr>
<tr>
<td></td>
<td><em>point at design name</em></td>
</tr>
</tbody>
</table>

Figure 2: Sample COMIC input and output
HANDLING DISJUNCTIVE INPUTS (White 2006)

Motivation

Language planning components produce sets of reasonable expressions

- Paraphrases with no preferences among them
- Alternatives within context widely interchangable
- Surface realizer may decide

Representation alternatives

Underspecified expressions

Explicit disjunctions (the alternative used here)

Functionality

Generate most alternatives in parallel (overlapping substructures)

Decide on the basis of corpus frequencies of surface expressions
“The design is based on the Funny Day collection by Villeroy and Boch”
Semantic dependency graph for

“The design is based on Villeroy and Boch's Funny Day series”
Disjunctive Semantic dependency graph covering

“The design is based on (the Funny Day (collection | series)
by Villeroy and Boch | Villeroy and Boch's Funny Day (collection | series))”
THE PROCEDURE (SKETCH)

Flattening
Preprocessing step - array of elementary predications, alternations and options
Through tree traversal with incrementally building alternative groups

Edges
Edges associated with bit vectors to record coverage of alternatives

Lexical instantiation
Returns non-overlapping matches with coverage indicating bit vectors

Derivation
Edges may be introduced as alternatives
Edge combination involves a coverage check

Unpacking
Realizations recursively unpacked, filtering duplications
Some System Features

Dialog management

- High-level, modality-independent specifications (input and output)
- Simple stack architecture with a control structure
- Topics and are pushed onto and popped off of the stack as the dialog proceeds

Natural language generation

- Opportunistic processing
- Delaying decisions, producing compact intermediate representations
- Decisions about alternatives at the very end, whenever possible