Einführung in Pragmatik und Texttheorie

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Discourse Coherence

Lecture Plan:

- Discourse cohesion and coherence
- Discourse Phenomena
- Sources of discourse structure and coherence
  - embodied in a domain
  - intentional
  - resource-bounded
- Discourse Structure Theory (Grosz&Sidner'86)
  - intentional structure
  - attentional structure
  - linguistic structure
- Coherence relations (Hobbs 1979, 1985)

Basic reading: Grosz et al. 1990; Grosz and Sidner 1986; Hobbs 1979, 1985; Jurafsky et al. 2000 [Chapter 16]

Discourse

What constitutes a discourse?

- Units of language and language use, consisting of more than a single utterance.

- More than an arbitrary collection/sequence of well-formed utterances.

- Connected in some way, e.g. by some system of related topics or by context situation.

  (1) John hid Bill's car keys. He was drunk.

  (2) John hid Bill's car keys. Whales are mammals.

Discourse Coherence and Cohesion

Parts of discourse are tied together:

Cohesion non-structural text-forming relations, e.g., reference (esp. anaphora), ellipsis, conjunction, lexical cohesion. The interpretation of elements is inter-dependent.

Coherence structural relations between elements/segments of discourse, involving functional predicate-argument or modification relations, e.g., explanation, result, justification, etc.

What mechanisms make certain sequences of utterances coherent and cohesive and others not?

How does context affect the use and understanding of various kinds of linguistic expressions?

Discourse-Level Phenomena

Linguistic communication is rife with phenomena which operate at the discourse level.

- reference:
  - individual, temporal, spatial, "abstract entity" anaphora
  - ellipsis
  - tense/aspect/mood dependencies
- lexical cohesion: related words
- conjunction: cue phrases / discourse markers
- conversation sequences (cf. previous lecture)
- discourse/coherence/rhetorical relations

Anaphoric reference

- **individual anaphora**:
  - pronominal:
    (3) I habe Heute einen Acura Integra gesehen.
    Er war weis.
  - nominal (definite NP):
    (4) I habe Heute einen Acura Integra gezehen.
    Das Auto war weis.
  - demonstrative:
    (5) I habe Heute einen Acura Integra gezehen.
    Dieser war weis, aber ein ander war schwartz.
  - "one"-anaphora:
    (6) I habe Heute einen Acura Integra gezehen.
    Ich möchte seehr gern eine haben.

Anaphoric reference

- **temporal anaphora**:

  (7) I habe am Montag einen Acura Integra gefährt.
  a. Ich war dann seehr stolz.
  b. Ich war in dem Moment seehr stolz.

- **spatial anaphora**:

  (8) I habe am Montag einen Acura Integra nach Köln gefährt.
  a. Da hab ich sie an einen Kunde gegeben.
  b. In der City hab ich sie an einen Kunde gegeben.

Anaphoric reference

- **"abstract entity" anaphora**:

(9) According to John, Bob bought Sue an Integra, and Sue bought Fred a Legend.

(10) a. But <u>that</u> turned out to be a lie.
b. But <u>that</u> was false.
c. <u>That</u> struck me as a funny way to describe the situation
d. <u>That</u> caused Sue to become rather poor.
e. <u>That</u> caused them both to become rather poor.

The antecedent of the anaphor is

1. speech act
2. proposition
3. kind of description
4. event
5. combination of multiple events

Anaphoric reference

Ellipsis:

(11) Ich mag moderne Autos. Ich fahre gern snell. Peter auch.

Tense/Aspect/Mood dependencies:

(12) a. Peter fell. Max kicked him.
b. Peter fell. Max had pushed him.
c. Peter fell. Max pushed him.

(13) A wolf might come in. It would eat you.

(14) If the light is red, stop.
a. Otherwise you might get run over.
b. Otherwise you can go straight on.

Discourse Markers

Express (or at least signal or constrain) relations that can hold between utterances.

(15) On the one hand, John is very generous. For example, if you need money, you only have to ask him for it. On the other hand, he is very hard to find.

(16) Well, John loves barollo. So he ordered three cases of the '97. But then he had to cancel the order, because he discovered he was broke.

Discourse Relations

Discourse relations add semantic (propositional) content. They are predicates that take other bits of propositional content as arguments. They reflect the meaning of discourse markers, but they are present and meaningful also when they are not explicitly signalled by discourse markers.

(17) A:

a. John went to jail.

b. He was caught embezzling funds from the pension plan. Explanation

B:

a. Yes, John was caught embezzling funds.

b. But he went to jail

c. because he was convicted of tax fraud.

B':

a. No, that's not right.

b. Although John was caught embezzling funds,

c. he went to jail

d. because he was convicted of tax fraud.

Discourse Segmentation

Discourses have hierarchical structure consisting of segments. Discourse segments are a source of antecedents for anaphors and arguments for discourse relations.

(18) a. One plaintiff had never received full pay.
b. Another had been passed over for promotion three times.
c. Yet another had been denied a job because of his race.
d. *These people were really badly treated.*
e. But the jury didn't believe *this*.

(19) a. One plaintiff had never received full pay.
b. He had also been passed over for promotion three times.
c. Moreover, he had been denied a job because of his race.
d. *He's been really badly treated.*
e. *Nevertheless* he had never filed a complaint until now.

Sources of Discourse Structure

- Discourse participants are embodied in a **domain**: Discourse concerns some domain, which has its own internal structure. The speaker/hearer are aware of the domain structure, and use it this knowledge to produce/interpret the discourse.

- Discourse participants have **intentions**: They are engaged in tasks and have communicative goals. Speaker wants to communicate something to the hearer, she wants the hearer to recognize her **communicative purpose(s)**, such making H believe p, making H adopt some action/plan; an intention may depend on the satisfaction of another intention.

- Discourse participants have **limited resources**: Both speaker and hearer only have limited short-term memory, and therefore there are limits to what they can recover from what has been previously said; however, this may not be a purely sequential matter, hierarchical organization seems to play a role.

Sources of Discourse Structure

(20) Q. Can you please describe your house?
A. . . . then in the kitchen . . . there's a large window which faces the backyard with two smaller windows directly flanking it and . . . if we're facing . . . towards the backyard now on the righthand side is . . . a sliding glass door and a small window . . . on the left is a stove and a refrigerator . . .

(21) . . . Melt the butter in a large pan
and add the vegetables;
saute them for 7-8 minutes,
but don't let them brown,
then add the butter beans,
water or stock,
the milk and
the bouquet garni.
Simmer gently, with lid half on the saucepan, for about 1.25 hours, or until the butter beans are tender.
. . . Reheat the soup,
but don't let it boil.

Sources of Discourse Structure

(22) E. Good morning. I would like for you to re-assemble the compressor.

. . .

E. I suggest you begin by attaching the pump to the platform.

[other subtasks]

E. Good. All that remains then is to attach the belt housing cover to the belt housing frame.

A. All right.

I assume the belt housing cover opens to the pump pulley rather than to the motor pulley.

E. Yes, that is correct. . . .

A. All right, the belt housing cover is on and tightened down.

(30 min, and 60 utterances after beginning)

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

Sources of Discourse Structure

(Uttered on April 10th)

(23) A. Let's have the one-day workshop in July.

B. OK.

B. Are you available on the 15th?

A. I'm afraid not.
But I am free on the 17th.

B. OK. Let's meet at 10 a.m.

B. How about the HCRC seminar room?

A. It's not available on the 17th.

B. So let's meet in 6BP.

Approaches to Discourse

- resolution of anaphoric reference: various approaches to restricting the search space, i.e., non-linear precedence and heuristics

- determination of discourse structure: theories of discourse structure postulate different types of information as central to the computation of discourse structure.
  - a notion of discourse grammar analogous to sentence grammar
  - recognition of communicative intentions using a set of rhetorical/textual/coherence relations
  - inference based on domain-specific or commonsense knowledge
  - planning & action

Discourse Structure Theory (Grosz and Sidner 1986)

Three inter-related and co-constraining aspects of discourse structure:

Linguistic: discourse segments and their relations (e.g., embedding) are signalled in the linguistic form of expressions: cue phrases, intonation, etc.

Attentional: at every point in the discourse, a set of entities is salient (i.e., in the center of attention); there are transitions between attentional states

Intentional: each discourse segment has a unique purpose (DSP); there are relations between DSPs (satisfaction-precedence vs. dominance)

These supply the information needed by discourse participants to determine *how an individual utterance fits with the rest*, i.e., why it was said and what it means. Also, certain *expectations* about what is to come are thus formed.

Discourse understanding relies on recognizing DSPs and the relations among them.

Linguistic Structure

- basic elements are *utterances*, they get aggregated into *discourse segments*

- *embedding relationship* can hold between segments

- discourse segmentation has been observed accross a wide range of discourse types: task-oriented dialogues, descriptions of appartments, Watergate transcripts, informal debates, explanations, therapeutic discourse, narratives

- two-way interaction between discourse segment structure and utterances
  - utterances can convey information about structure: cue phrases, intonation, etc.
  - structure can constrain interpretation of utterances: referring expressions

Intentional Structure

- *Discourse segment purpose* (DSP): the intention that leads to the initiation of a new discourse segment (other intentions are not part of Intentional Structure), e.g. int. that some agent: intends to perform some task; believes some prop.; intends to identify an object; knows some property of an object.

- DSPs are intentions that are meant to be recognized, i.e. recognition of the DSP is essential to its achieving its intended effect (cf. "meaning-nn" in (Grice 1969))

- structural relations among DSPs:
  - DSP_1 dominates DSP_2 if the satisfaction of DSP_1 comes (in part) from the satisfaction of DSP_2
  - DSP_1 satisfaction-precedes DSP_2 if DSP_1 must be satisfied before DSP_2

- Subsequently, G&S focus on the kinds of plans underlying dialogue, which must involve both

participants: i.e., **collaborative plans**: dialogue collaboration requires that participants make clear to one another how their discourse actions will coordinate and contribute to the discourse purpose.

- Intention, planning, action.

Intentional Structure

- DSPs form a tree-structure of sub-intentions eventually grounded in communicative actions.

- A discourse segment can only serve a single DSP, though a later DSP can take advantage of what has been achieved by an earlier one.

- Isomorphism between explicit realization of DSPs and embedding of discourse segments.

- Discourse understanding relies on recognizing DSPs and the structural relations between them. To interpret a discourse, incrementally:
  - Determine illocutionary force and DSP.
  - Work out the relation between this DSP and the preceding DSPs. (use domain plans)
  - Work out what is in focus of attention.

Attentional State

- = an abstraction of the participants' focus/center of attention as their discourse unfolds

- Modelled by a set of *focus spaces*, arranged in a *stack*.

- A focus space is associated with each discourse segment. It contains those entities that are *salient* (explicitly mentioned or implicitly involved).

- Dynamics: transition rules specifying conditions for adding (=PUSH) and deleting (=POP) spaces.

- The relationships among DSPs, i.e., intentional structure, determine pushing and popping of focus spaces.

Attentional State

- While the intentional structure provides a complete record of the DSPs, the attentional state only contains information relevant to purposes in a portion of the intentional structure.

- Normally, the attentional state is empty at the conclusion of a discourse.

- It is the attentional state that can directly constrain the interpretation of referring expressions.

Application of the Theory: "Interruptions"

Because processing an utterance requires ascertaining how it fits with previous discourse, it is crucial to decide which parts of the previous discourse are relevant to it and which cannot be.

- **true interruption**: different unrelated purposes, different entities,i.e., spearate focus spaces
- **flashback and filling in missing places**: DSP satisfaction-precedes the DSP of the interrupted segment and is dominated by another segment's DSP
- **digression**: separate DSP, but overlapping focus spaces
- **semantic returns** (noninterruptions): explicit reintroduction of entities and/or DSP

Application of the Theory: Cue Words

Discourse segment boundaries and/or transitions in intentional and/or attentional structure can be signalled by linguistic means. For example:

- segment boundary:
  (i) opening: "now", "well";
  (ii) closing: "anyway", "OK"

- new dominance: "for example"

- new satisfaction-precedence: "first", "second", "further", . . . , "finally", etc.

Discourse (Coherence) Relations

(24) a. John took the train from Paris to Istanbul.
b. He likes spinach.

In interpreting a discourse, one asks what utterance U_i has to do with the preceding context, i.e., how it is *related* to it, and thus tries to construct an explanation of why the discourse is *coherent*.

(25) a. John hid Bill's car keys.
b. He was drunk.

(26) a. John hid Bill's car keys.
b. He likes spinach.

Coherence in terms of coherence relations

(Hobbs, 1979, 1985) Definition of a set of coherence relations in terms of *inferences*, i.e., in terms of what is implied by the asserted proposition(s) in each sentential unit.

Four groups of coherence relations according to the source of discourse coherence:

1. coherence of events in the world/situation.

2. a need to relate what has been said to some goal of the communication.

3. relating what has been to interlocutor's previous knowledge

4. expanding the discourse "in place"

Occasion (class 1)

(i) A change of state can be inferred from the assertion of S_0, whose final state can be inferred from S_1
(ii) A change of state can be inferred from the assertion of S_1, whose initial state can be inferred from S_0

(27) a. Walk out the door of this building.
b. Turn left.
c. Go to the corner.

(28) a. Decrease n by one.
b. If it is zero, reset it to max.

Special cases of occasion: **cause**, **result** and **enablement**.

Evaluation (class 2)

(i) From S_1 infer that S_0 is a step in a plan for achieving some goal of the discourse.
(ii) From S_0 infer that S_1 is a step in a plan for achieving some goal of the discourse.

(29) a. Did you bring your car today?
b. My car is at the garage.

(30) The funniest thing happened to me yesterday. (story)

Explanation (class 3)

Infer that the state or event asserted by S_1 causes or could cause the state or event asserted by S_0.

(31) a. He was in foul humor.
b. He hadn't slept well that night.
c. His electric blanket hadn't worked.

(32) a. I thought, well, maybe I can bum enough to get a cup of coffee and get into a movie,
b. 'cause I was exhausted.
c. My junk was running out.

Background (class 3)

S_0 provides a "ground" against which S_1 places a "figure".

(33) a. And one Sunday morning about five o'clock in the morning I sat down in the Grand -no no, not in the Grand Central, in the Penn Station,

b. and while I was sitting there a young cat came up to me, ...

Expansion relations

- positive: parallel (special case: elaboration), generalization, exemplification

- negative: contrast (special case: violation of expectation)

Parallel (class 4)

Infer $p(a_1, a_2, \ldots)$ from the assertion of S_0 and $p(b_1, b_2, \ldots)$ from the assertion of S_1, where a_i and b_i are similar, for all i.

(34) a. Set stack A empty
b. and set link variable P to T.

(35) a. The ladder weighs 100 lb with its center of gravity 20 ft from the foot,
b. and a 150 lb man is 10 ft from the top.

Elaboration (class 4)

Infer the same proposition P from the assertions of S_0 and S_1.

(36) a. Go down Washington Street.
b. Just follow Washington Street three blocks to Adams Street.

(37) Initialize. Set the stack pointer to zero, and set link variable P to ROOT.

(38) a. This immense tract of time is only sparsely illuminated by human relics.
b. Not enough material has yet been found for us to trace the technical evolution of East Asia.

(39) a. Al Haig's never been in politics-
b. he can't even spell the word "vote".

Exemplification (class 4)

Infer $p(A)$ from the assertion of S_0 and $p(a)$ from the assertion of S_1 where a is a member or subset of A.

(40) a. This algorithm reverses a list.
b. If its input is "A B C", its output is "C B A".

(41) a. We cannot affirm that the technical evolution of East Asia followed the same course as it did in the West.
b. Certainly no stage corresponding to the Mousterian tradition has been found in China.

(The **generalization** relation corresponds to exemplification in reverse.)

Contrast (class 4)

(i) Infer $p(a)$ from the assertion of S_0 and $\neg p(b)$ from the assertion of S_1, where a and b are similar.
(ii) Infer $p(a)$ from the assertion of S_0 and $p(b)$ from the assertion of S_1, where there is some property q such that $q(a) \wedge \neg q(b)$

(42) a. You are not likely to hit the bull's eye,
b. but you are more likely to hit the bull's eye than any other equal area.

(43) a. Research proper brings into play clockwork-like mechanisms,
b. discovery has a magical essence.

(44) a. A. I was hitchhiking in Norway, and nobody would pick me up.
b. B. I found the Norwegians I met very friendly.

Violated Expectation (class 4)

Infer P from the assertion of S_0 and $\neg P$ from the assertion of S_1.

(45) John is a lawyer, but he's honest.

(46) This paper is weak, but interesting.

(47) a. The conviction is widespread among Republicans that Mr. Nixon must clear himself by early in the new year.

b. But they commonly doubt that the message is getting through to the President.

Occam's Razor

[**?**]:

> It is tempting to speculate that these coherence relations are instantiations in discourse comprehension of more general principles of coherence that we apply in attempting to make sense out of the world [. . .] principles that rest ultimately on some notion of cognitive economy. We get a simpler theory of the world if we can minimize the number of entities by identifying apparently distinct entities as different aspects of the same thing.

Coherence and Coreference

[**?**]:

It is frequently the case that discourse can be recognized as coherent, i.e., as satisfying the formal definition of (at least) some coherence relation, if only we could assume certain noun phrases to be coreferential.

(48) a. John can open Bill's safe.
b. He knows the combination.

(49) a. Bill is worried because his safe can be opened by John.
b. He knows the combination.

Abduction in Recognizing Discourse Coherence

First, model coherence relations by axioms:

- $\forall e_i, e_j \, Explanation(e_i, e_j) \Rightarrow CoherenceRel(e_i, e_j)$
  $\forall e_i, e_j \; cause(e_j, e_i) \Rightarrow Explanation(e_i, e_j)$

- $\forall e_i, e_j \, Elaboration(e_i, e_j) \Rightarrow CoherenceRel(e_i, e_j)$
  $\forall e_i, e_j, e \, gen(e_i, e) \wedge gen(e_j, e) \Rightarrow Elaboration(e_i, e_j, e)$

- etc.

Second, model world knowledge by axioms:

- fear causes diswanting

- diswanting an effect causes diswanting its cause

- demonstrations cause violence

- authorities prohibit what they diswant

- etc.

Abduction in Recognizing Discourse Coherence

(50) a. The police prohibited the women from demonstrating.

b. They feared violence.

Coherence and Discourse Structure

$\forall w, e\ sentence(w, e) \Rightarrow Segment(w, e)$

$\forall w_1, w_2, e_1, e_2, e\ Segment(w_1, e_1) \wedge Segment(w_2, e_2) \wedge CoherenceRel(e_1, e_2, e) \Rightarrow Segment(w_1, w_2, e)$

To interpret a coherent discourse W, we must prove that it is a segment:
$\exists e\ Segment(W, e)$