Resolving Pronominal Reference to Abstract Entities

Seminar “Resolution of anaphoric inference”
Universität des Saarlandes
February 7th, 2003

Alexander Schutz

Part I

Bonnie Lynn Webber: “Structure and Ostension in the Interpretation of Discourse Deixis”(1991)

some data

Example 1:

It's always been presumed that (2) when the glaciers receded, (3) the area got very hot. (4) The Folsum men couldn't adapt, and (5) they died out. (6) *That*'s what is supposed to have happened. It's the textbook dogma. But it's wrong.

Example 2:

(1) Using microscopes and lasers and ultrasound, (2) he removes tumors (3) that are interwined with children's brain stems and spinal cords. (4) There is only the most minute visual difference between the tumors and normal tissue. (5) Operations can last 12 hours or more. (6) The tiniest slip can kill, paralyze or leave a child mentally retarded. (7) *This* is the easy part of his job.

some data continued

Example 3:

(1) “The Manson Family verurteilt nicht”, (2) behauptet Moran, (3) “. . . sondern ist die Untersuchung eines Themas, das in sich beunruhigend ist.” (4) Und weiter: (5) “Ich wollte die Charaktere der Manson Familie als Repräsentanten derselben Archetypen zeigen, die man in der griechischen Tragödie findet.” (6) Ob *das* stimmt, darf bezeifelt werden.

discourse deixis

- what are *that*, *this* and *das* pointing to, respectively
- not a previous noun phrase
- (possibly not) a previous section of text

discourse deixis continued

- Example 1 (*that*): something that can happen
- Example 2 (*this*): something that can be part of a job
- Example 3 (*das*): something that can be true or false / a proposition

structures

- **text structure** produces
- **discourse model structure**. Both support construction of
- **tree structure**

the discourse model

- identification of salient items: **focus**
- act of ostension performed by deictic pronouns can add new DE's that were not present prior to the ostensive act: **by virtue of pointing**
- not every previous sequence of clauses can yield referents for deictic reference (consider the following example)

the discourse model continued

Example 4:

a. For his part in their joint project, John built a two-armed robot.

b. He had learned about robotics in CSE391.

c. For her part, Mary taught it to play the saxophone.

d. That took her six month.

d'. That earned them both As.

which sequences of clauses in a text (*discourse segments*) do have an interpretation accessible to deictic reference?

discourse segments

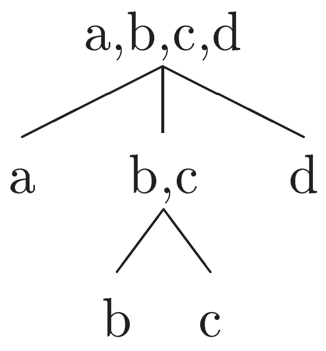
a. Do you think I can borrow your tent?

b. The one I took on my last hike leaked,

c. and I haven't had time to replace it.

d. I would of course have *the tent* cleaned before returning it to you.

note the embedded structure of discourse segments *b* and *c*:



discourse segments are recursive structures

the tree structure

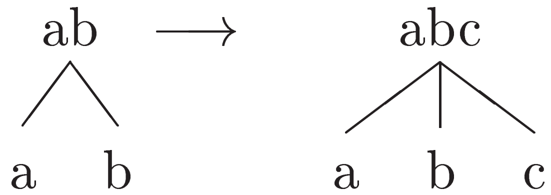
the right frontier : nodes along the path from root to tip by the sequence of rightmost daughters

attachment (as rightmost daughter): adding leaf to existing non-terminals

adjunction : creating new non-terminal (parent) node

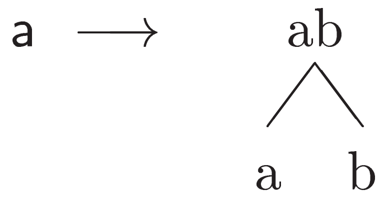
attachment and adjunction restricted to the right frontier

attachment

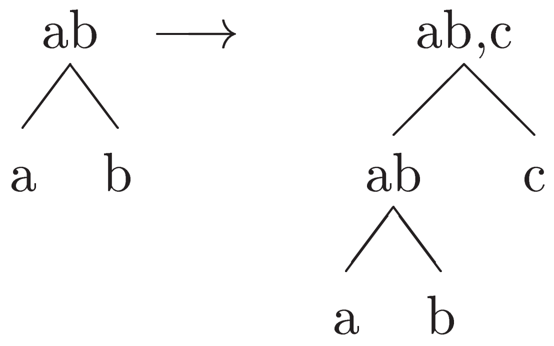


adjunction

to the root of a one-node tree (common):



to the root node (general):



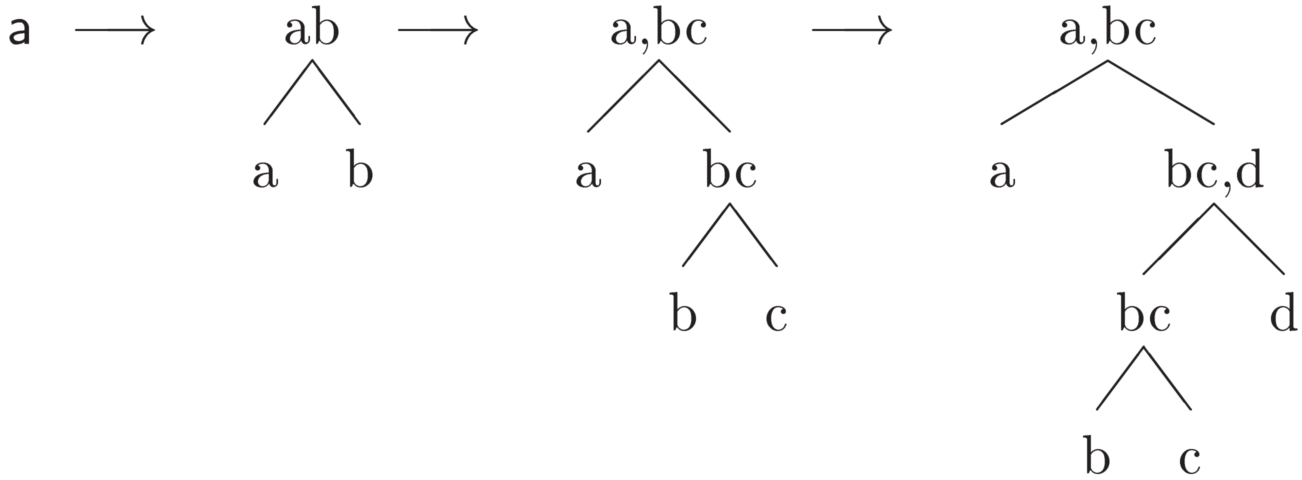
adjunction: an example

a. John hates snakes.

b. His next-door neighbour had kept snakes,

c. and he had hated his neighbours.

d. Later in college, his roommate had kept snakes.



referents of deictic pronouns

- referents correspond to nodes on the right frontier of DST
- right frontier is the only region that can provide referents
- compatibility with the meaning of the rest of the sentence

1. Segal, however, had his own problems with women: he had been trying to keep his marriage of seven years from falling apart; when *that* became impossible ...

   that $\equiv$ keeping his marriage from falling apart

2. Segal, however, had his own problems with women: he had been trying to keep his marriage of seven years from falling apart; when *that* became inevitable ...

   that $\equiv$ his marriage falling apart

referring functions

how do deictic pronouns get their referents? distinguish:

- what can be pointed to (*demonstratum*, possibly *standing proxy* for some *referent*) vs.
- what can be referred to by virtue of pointing (*referent*)

deictic pronouns can point to *focussed* regions of the discourse (regions on the right border) via *referring functions referring functions* map *demonstrata* into *intended referents*

referring functions continued

$$\mathbf{f} : \mathbf{D} \rightarrow \mathbf{R}$$

where **f** is the referring function, **D** the domain of demonstrata and **R** the range of intended referents aiding factors for the listener:

- **R** intersecting the set of things that the speaker might rationally be construed as intending to refer to in a given context (by nature of predication, morphology of demonstrative pronoun or topic of conversation)
- what stands in relationship
- that it be a more likely referring function, under the circumstance, that any other

now, back to the first examples . . .

Part II

Donna K. Byron: "Resolving Pronominal Reference to Abstract Entities"(2002)

motivation

- salience-based techniques not working for pronouns whose antecedent is not an NP
- mostly in spoken discourse
- abstract entities: actions, propositions, kinds

proposed algorithm: **PHORA** implemented in **TRIPS** spoken dialog system

terminology

- Discourse Model (DM)
- Discourse Entity (DE)
- Deixis

some data

(1) Each Fall, penguins migrate to Fiji.

(2) *That's* where they wait out the winter.

(3) *That's* when it's too cold even for them.

(4) *That's* why I'm going there next month.

(5) *It* happens just before the eggs hatch.

- what is 4 referring to?
- ...and 5?

abstract referents

- stand *proxy* for propositional content
- referring function (remember Webber)
- **claim**: are less salient than items appearing as NP's
- only available for pronominal reference in the immediately following discourse unit

the problem: demonstrative pronouns

- tendency of having clausal antecedents or NPs that are not in subject position (as seen before)
- tendency of referring to semantically complex items
- tendency of referring to entities not in focus

distinguish: *in focus* vs. *activated* status the task: finding a referring function (Vaclav's question / hopefully handled properly during the Webber part)

details of PHORA

1. Build DE proxies for Discourse Unit (DU$_n$)
2. Calculate the most general semantic type T that satisfies constraints on the predicate argument positions the pronoun appears in
3. Test DE's in salience order to find a referent that matches the pronoun's agreement features, using different search orders for personal and demonstrative pronouns. Testing each DE involves applying the referring functions in an attempt to find a referent of type T or one of its subtypes.

DM partitioned into two sets: mentioned and activated entities

mentioned DEs

- carry the interpretation of noun phrases
- are evoked as soon as the NP is interpreted
- mentioned DE is designated as the *focus*
- proper names, descriptive NP's, demonstrative, possessive and reflexive pronouns
- remain in the DM for the entire discourse

activated DEs

- other costituents (entire sentences / nominals)
- containing *proxies* for consituents
- invocation **after** interpreting each clause
- one clause might trigger multiple proxies
- invocation of referring function to coerce the proxy into a referent of desired type
- functions are sensitive to *syntactic* and *semantic* analysis of original constituent as well as it's speech act
- remain in the DM only while interpreting the next clause

speech acts

Tell : Assert the truth of a proposition

Request : Command one's partner to perform an action

WH-Question : Elicit information from one's discourse partner

YN-Question : Elicit confirmation of an assertion from one's discourse partner

Confirm : Accept an utterance made by one's partner

semantic constraints

Verb associated semantic restrictions for each argument position

Predicate NPs constrain the subject to be the same type as the complement

Predicate Adjectives constrain the possible semantic type of a pronoun in subject position

pronoun resolution

search for the first referent that satisfies semantic type constraints and agreement features for the pronoun

- backwards in the order the clauses appeared in the discourse
- *mentioned* entities are searched in left-to-right order within each clause
- distinguishing between *personal* and *demonstrative* pronouns
- *activated* entities: applying referring functions to each DE proxy in order to produce an acceptable type of referent

the order of pronoun resolution

personal pronouns

1. mentioned entities to the left of the pronoun in the *current* clause in right-to-left order
2. the focused entity of clause$_{n-1}$
3. the remaining mentioned entities
4. the activated entities from clause$_{n-1}$

demonstrative pronouns

1. the activated entities from clause$_{n-1}$
2. the focused entity only if it can be coerced to a Kind
3. mentioned entities from the entire discourse

the implemented system

- TRIPS spoken dialog system
- PHORA algorithm running as last step of semantic analysis
- model is domain-closed

evaluation

- data from TRAINS93 corpus (only 50% NPC)
- TRIPS' grammar and lexicon coverage was extended to parse dialogs
- semantic resources (type hierarchy, type constraints) were built
- resolution correct if antecedent **and** referring function were correct

evaluation

	Total PRP	Total DEM	Total
evaluation set	80	100	180
LRC Baseline	52	14	66 (37%)
semantic type constraint	58	19	77 (43%)
abstract referents	64	56	120 (67%)
diff. search order for DEM	63	67	130(72%)

constituents that evoke activated entities (DE proxies)

Trigger Constituent	Example
Infinitive or gerund phrase	**To load the boxcars/Loading them** takes an hour.
The entire clause	**I think that he's an alien**
That sentential	I think that **he's an alien**
Subordinate clause	If **he's an alien**

referring functions

Function	DE / Proxy Details	Output Types
Ident(d,t)	Any Mentioned DE if its type meets type constraints t	The train **is red**.
Kind(d,t)	Descriptive NP (not bare plural NP) meeting of type t	**That's** a great route.
Situation(d)	Sentence with tensed stative verb	**The train** is **red**.
Event(d)	Sentence with tensed eventive verb	**It** gets there **late**.
Kind$_A$(d) / Kind$_E$(d)	infinitive form of action / event	To load them **takes an hour**.
	Gerund form of action / event	Loading them **takes an hour**.
Proposition(d)	Each TELL or YN-Question	I think that he's an alien.
	that sentential	**I think that** he's an alien.
	if / when subordinate clause	**If** he's an alien.
Endtime(d)	Sentence with tensed eventive verb	Then we go to Avon.
	Gerund or Infinitive from eventive verb	I **need** to load the boxcars.