Mutidimensionality and discourse structure

ESSLLI 2012 - Multidimensional Semantics - 3

Outline

- Discourse structure as a dimension: introduction to SDRT
  - From DRT to SDRT: why discourse structure
  - Formal theory
- Linguistic objects extended: reference to discourse structure
- Supplements in SDRT

Segmented Discourse Representation Theory

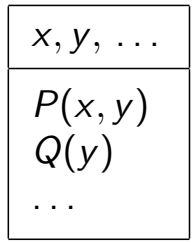
[Asher, 1993, Lascarides and Asher, 1993, Asher and Lascarides, 2003]

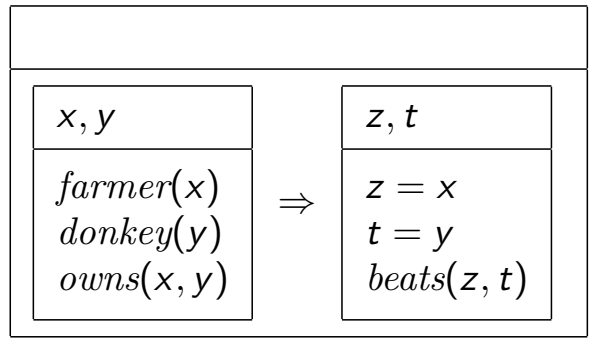
- A non-trivial extension of Hans Kamp's DRT [Kamp and Reyle, 1993]
  - Formal semantics tradition
  - Representational dynamic semantics
- A theory of discourse macrostructure
  - Additional notions from AI, NLP and Discourse Analysis traditions [Hobbs, 1985, Polanyi, 1985, Grosz and Sidner, 1986, Mann and Thompson, 1988]
  - Discourse is segmented
  - Segments are linked together by coherence or rhetorical relations, here called Discourse Relations
  - Discourse has a rich hierarchical macro-structure

Dynamic semantics: Discourse Representation Theory

[Kamp, 1981, Kamp and Reyle, 1993]

- Discourse Representation Structures (DRSs): $\langle U, C \rangle$
  - U: set of referents (Universe of discourse)
  - C: set of Conditions on U





If a farmer owns a donkey he beats it

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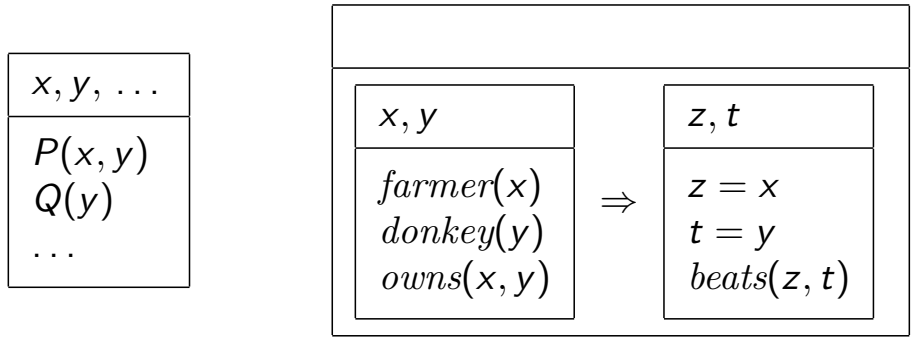

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- Construction rules based on compositional semantics and context of previous discourse
  - anaphoric pronouns $\rightarrowtail$ referent x + condition $x =?$
  - resolved according to genre, number, case constraints + accessibility constraints

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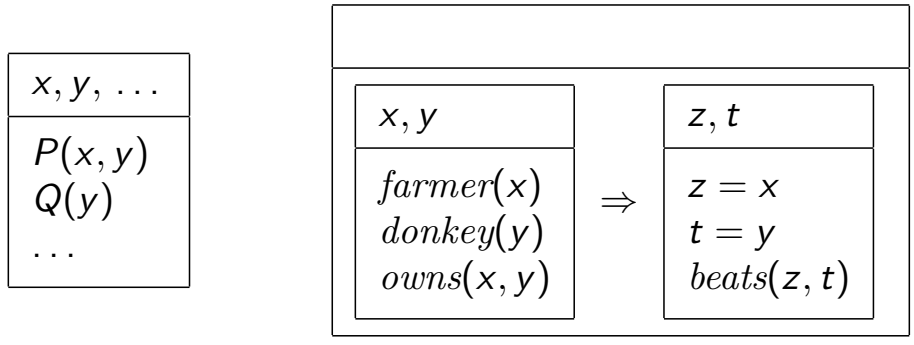

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  - tense makes use of "time pointers":
    simple past $\rightarrowtail$ event + posteriority + pointer update
    imperfect $\rightarrowtail$ state + overlap

Semantics of DRSs

[Muskens, 1994, Fernando, 1994]

- DRS formulas
  - $\exists u_1 \exists u_2 \ldots (c_1 \wedge c_2 \wedge \ldots)$, where $\wedge$ is dynamic conjunction
  - Closure under dynamic negation operator ($\neg$) and DRS subordination with conditional operator ($\Rightarrow$)
- Handling contexts within interpretation
  - Interpretation in terms of "context-change-potential"
  - Context: $\langle w, f \rangle$ world and variable assignation function
- Interpretation rules
  - $\langle w, f \rangle [\![p(x, y)]\!]^M \langle w', g \rangle$ iff $\langle w, f \rangle = \langle w', g \rangle$ and $\langle f(x), f(y) \rangle \in I_M(p)$
  - $\langle w, f \rangle [\![\phi_1 \wedge \phi_2]\!]^M \langle w', g \rangle$ iff there are w'' and h s.t. $\langle w, f \rangle [\![\phi_1]\!]^M \langle w'', h \rangle$ and $\langle w'', h \rangle [\![\phi_2]\!]^M \langle w', g \rangle$
  - $\langle w, f \rangle [\![\exists x \phi]\!]^M \langle w', g \rangle$ iff there is h s.t. $\langle w, h \rangle [\![\phi]\!]^M \langle w', g \rangle$ and $f \subseteq h$ and $dom(h) = dom(f) \cup \{x\}$
  - negation, conditional

From DRT to Segmented DRT

- Problems for DRT

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  - Sentence sequence doesn't always match event sequence, imperfect is not always overlap

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John pushed Max. He fell. / Max fell. John pushed him. Max fell. He got up. John pushed him.

From DRT to Segmented DRT

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Max entered the room. It was pitch dark.
Max turned off / on the light. It was pitch dark.

From DRT to Segmented DRT

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  - Lexical disambiguation in context

From DRT to Segmented DRT

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Did you buy the apartment?

Yes, but I rented it. / *No, but I rented it.*

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John met Mary this morning. He told her what he did his last week-end. He went to the mountain with Lea. Then they went to take a drink at Oscar's.

From DRT to Segmented DRT

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  - [Hobbs, 1985, Polanyi, 1985, Grosz and Sidner, 1986, Mann and Thompson, 1988] ...

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    - Explicit: semantic contribution of discourse markers (*but, then, because* ...)
    - Implicit: conversational implicatures (Grice)

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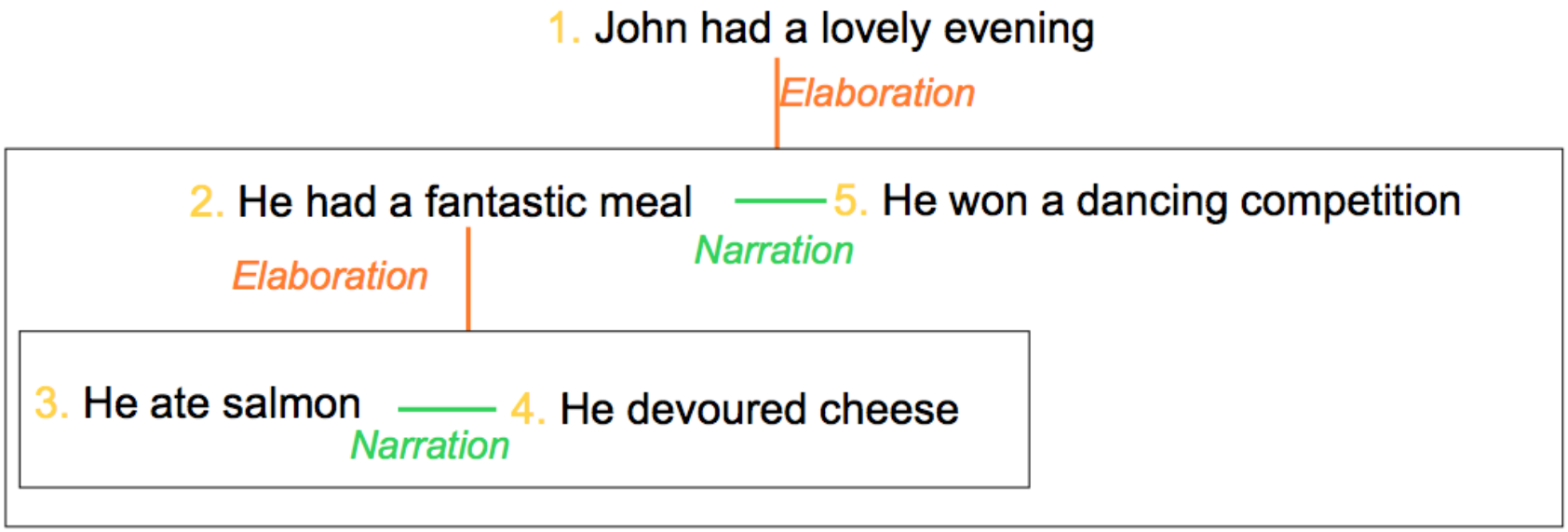
  - Discourse segmentation; Hierarchical organization
  - Discourse coherence: every segment is related to some previous one by a (at least one) discourse relation; Right-frontier constraint

Complex narratives: Segmentation and 'Discourse Pop'

(1)
a. John had a lovely evening last night.
b. He had a fantastic meal.
c. He ate salmon.
d. He devoured lots of cheese.
e. He won a dancing competition.
f. #It was a beautiful pink.

Complex narratives: Segmentation and 'Discourse Pop'



Hierarchy in discourse structure

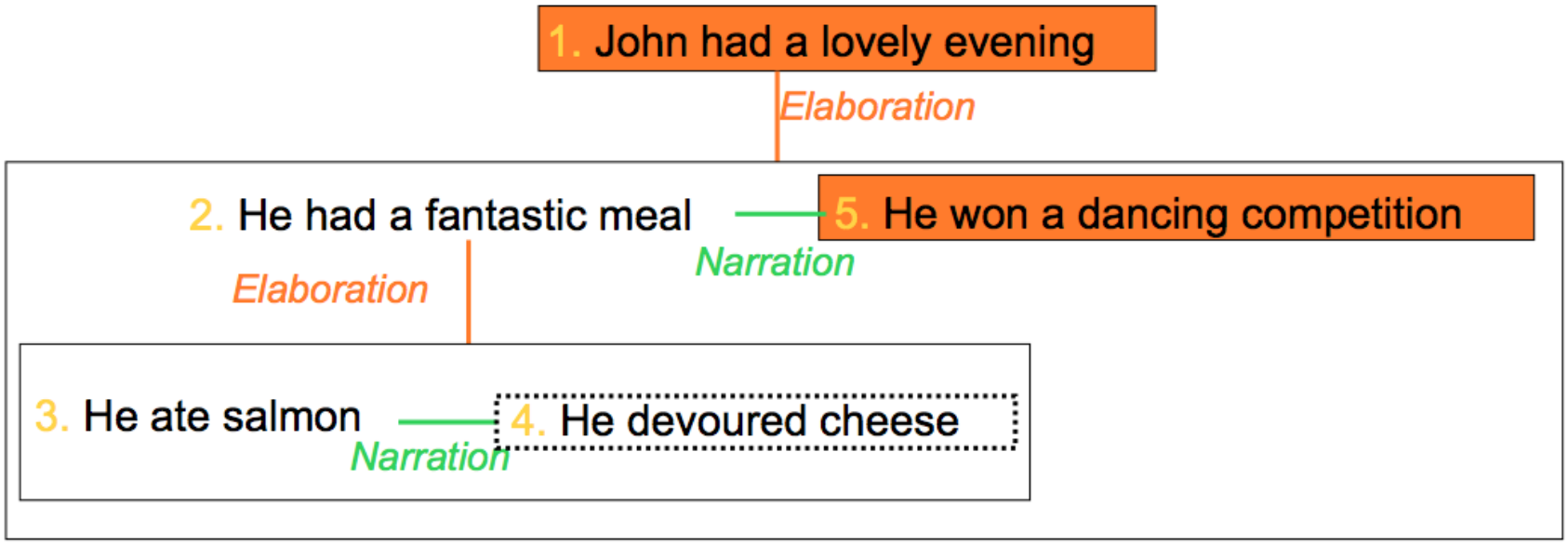
- Is based on two parameters
  - Segmentation: how sub-segments are grouped to form complex segments, and nesting
  - Distinction between subordinating (vertical) and coordinating (horizontal) discourse relations [Asher and Vieu, 2005]
    - cf. dominance and satisfaction-precedence [Grosz and Sidner, 1986], nucleus/satellite and multinuclear rels [Mann and Thompson, 1988]

$\rightarrow$ Right-frontier constraint

- Controls attachment, i.e., possible discourse continuations
- Controls anaphora resolution

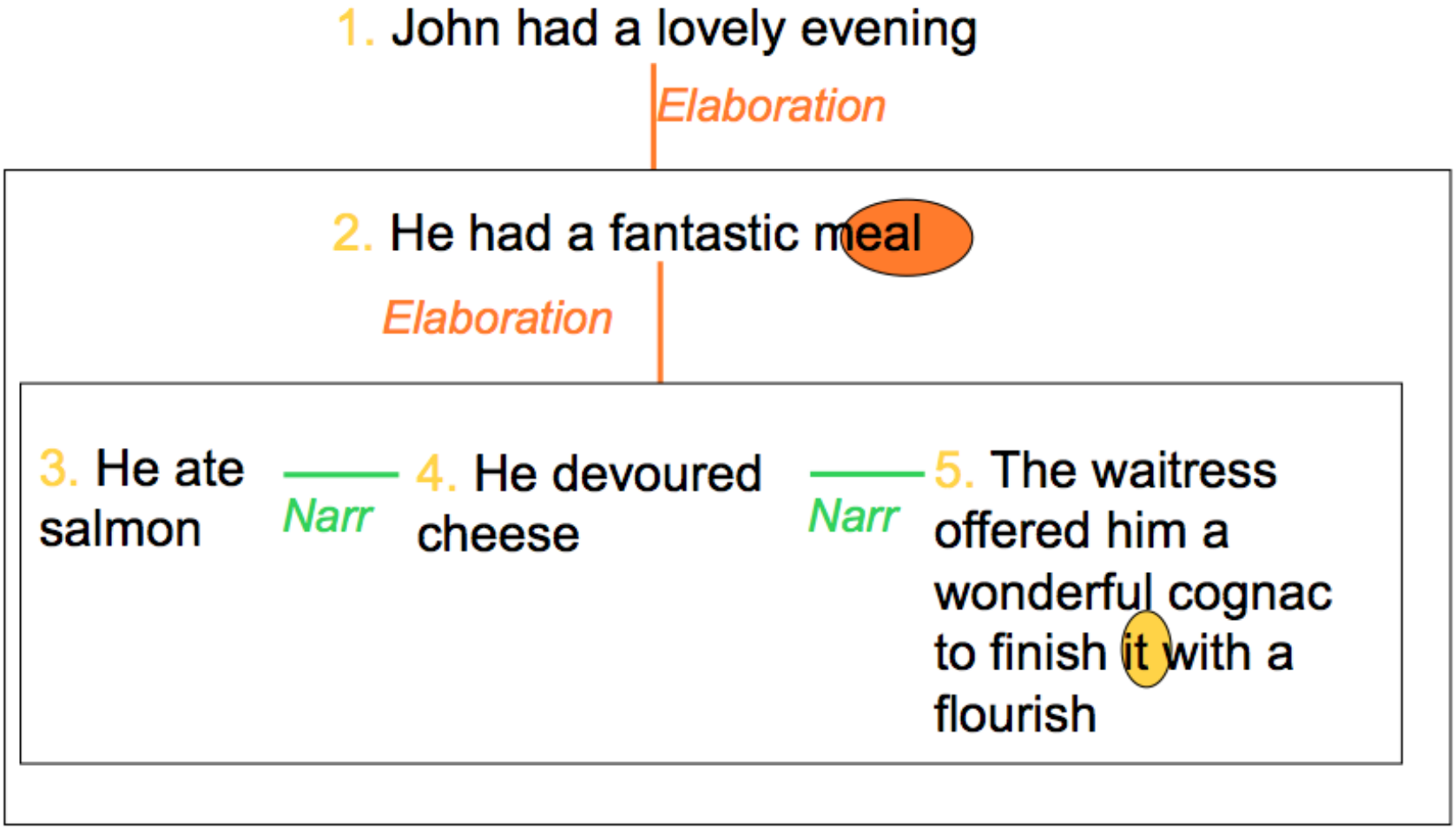
- Structure is a graph, not a tree

Right-frontier constraint: attachment and anaphora

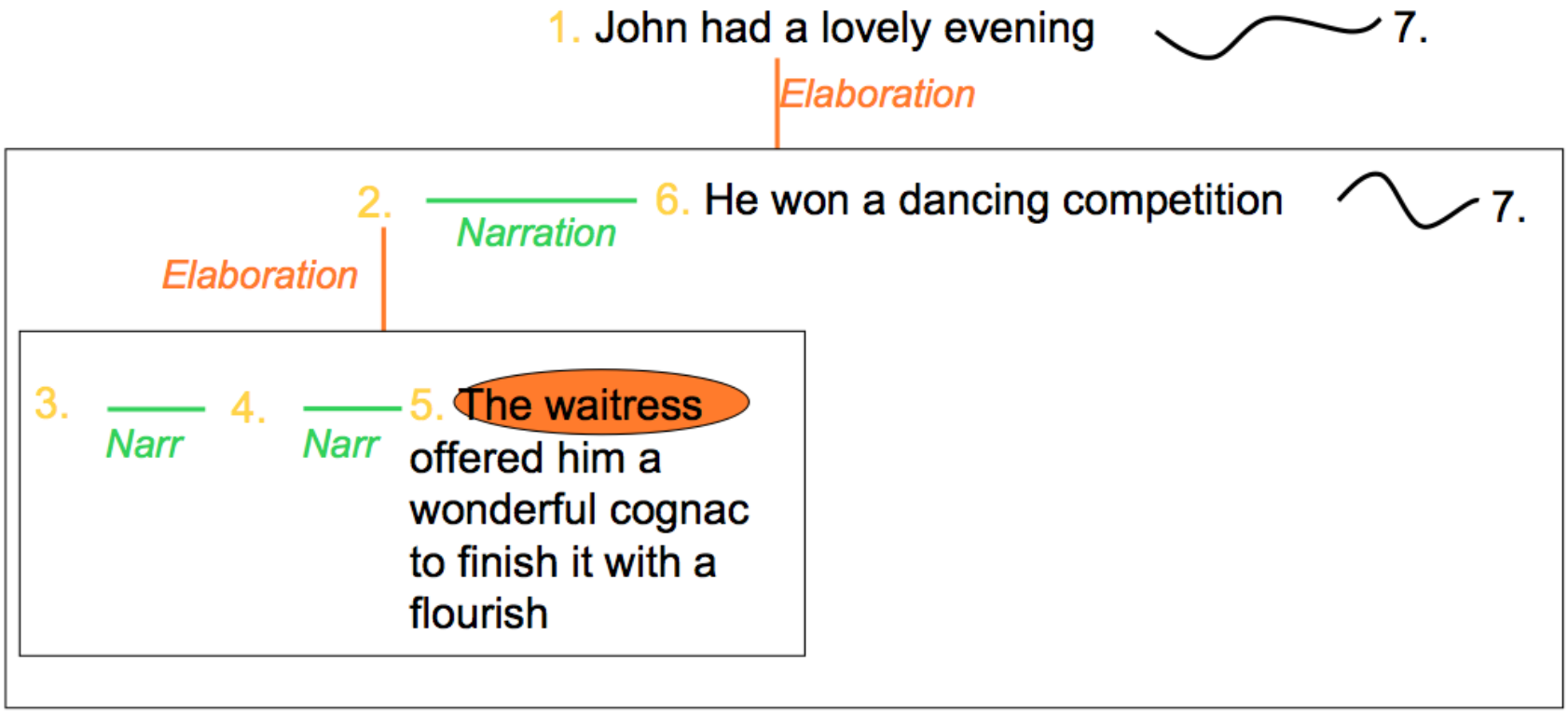


6. His partner didn't tread on his toes as usual
6. He went to bed happy
6. # The waitress offered him a wonderful cognac

Right-frontier constraint: attachment and anaphora



Right-frontier constraint: attachment and anaphora



7. # She had accompanied him to the dance hall

7. # It was a beautiful pink

SDRT, a formal theory

- SDRS definition
  - simple DRSs for elementary clauses
    - not sentences: complex sentences contribute several constituents, e.g., two constituents in (2)

      (2) Max fell because John pushed him.
  - recursive construction of SDRS for complex segments: sets of labels of SDRSs related by discourse relations
  - labeling of each segment accounts for speech acts
- SDRS semantics
  - dynamic semantic interpretation
  - contribution of discourse relations via their semantic effects
- SDRS construction within the "Glue Logic"
  - declarative rules
  - non-monotonic reasoning

Constituents and Labels

- Constituents: formulas (DRSs and SDRSs), i.e., abstract objects representing the propositional contents of clauses
  - Basic constituents: simple DRS $K = \langle U, C \rangle$
- Labels: new kind of discourse referents ($\pi_1, \pi_2 \ldots$) identifying occurrences of constituents; represent speech acts
  - Labeled constituents, $\pi : K$
  - Speaker + basic speech act type: assertion, question, request
  - Further specification of the speech act is given by the Discourse Relations
- Distinguish assertions and propositions, allow reference to propositions and to speech acts:
  Extend the domain of linguistic objects

(3) A_1 Mary pushed John.
B_2 I don't believe this.

(4) Sit down! This is an order.

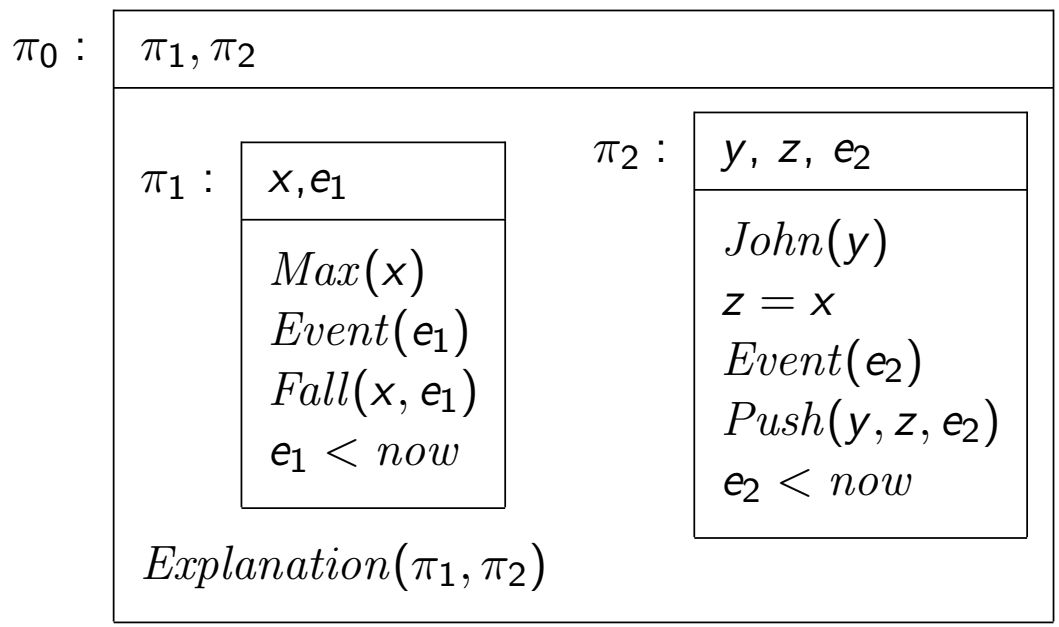
Definition of a SDRS

- SDRS: $\langle A, F, \mathit{first}, \mathit{last} \rangle$ where
  - A is a set of labels, $\{\pi_1, \pi_2, ...\}$
  - F is a mapping from A into the set of SDRS formulas
  - $\mathit{first}, \mathit{last} \in A$
- SDRS formulas:
  - $\{$dynamic formulas for atomic clauses$\} \bigcup \{R(\pi_i, \pi_j)$ s.t. $\pi_i, \pi_j \in A$ and R is a discourse relation$\}$
  - Closed under dynamic $\wedge$ and $\neg$

Example

Max fell. John pushed him.

$A = \{\pi_0, \pi_1, \pi_2\}$
$F(\pi_0) = Explanation(\pi_1, \pi_2)$
$F(\pi_1) = \exists x, e_1(Max(x) \wedge Event(e_1) \wedge Fall(x, e_1) \wedge e_1 < now)$
$F(\pi_2) = \exists y, z, e_2(John(y) \wedge z = x \wedge Event(e_2) \wedge Push(y, z, e_2) \wedge$
$e_2 < now)$



Semantics of SDRSs

- Recursive interpretation of $F(\mathit{first})$
- Interpretation of dynamic formulas for atomic clauses as for assertive DRSs (without $\Rightarrow$ subordination)
- Additional interpretation rules for questions and requests
- Additional interpretation rules for discourse relations
  - Interpretation of veridical relations:
    $\langle w, f\rangle [\![R(\pi_i, \pi_j)]\!]^M \langle w', g\rangle$ iff
    $\langle w, f\rangle [\![F(\pi_i) \wedge F(\pi_j) \wedge \Phi_{R(\pi_i,\pi_j)}]\!]^M \langle w', g\rangle$
  - Semantic effects of relations:
    $\Phi_{R(\pi_i,\pi_j)} \rightarrow \langle R\text{'s semantic effects}\rangle$
    $\Phi_{\mathit{Explanation}(\pi_i,\pi_j)} \rightarrow \mathit{cause}(e_{\pi_j}, e_{\pi_i})$

Discourse Relations (some)

Content-level relations: semantic effects on eventualities

Narration	temporal succession, same "story": same *discourse topic*
Elaboration	part-of ($\rightarrow$ temporal inclusion)
Background	temporal overlap, frame setting
Result	causation ($\rightarrow$ temporal succession)
Explanation	reverse causation

Discourse Relations affect semantic contents

(5) a. John pushed Max.
b. He fell.

$\phi_{Result(a,b)} \rightarrow cause(e_a, e_b)$ $\quad$ $cause(e_a, e_b) \rightarrow e_a \prec e_b$
with e_a, e_b main eventualities of K_a, K_b
$\phi_{Narration(a,b)} \rightarrow e_a \prec e_b$

(6) a. Max fell.
b. John pushed him.

$\phi_{Explanation(a,b)} \rightarrow cause(e_b, e_a)$ $\quad$ $cause(e_b, e_a) \rightarrow e_b \prec e_a$

Meta-talk discourse relations

- Standard content-level discourse relation

  (7) [Bill ate 5 sandwiches]$_{\pi_1}$ [because he was really hungry]$_{\pi_2}$

  $\mathit{Explanation}(\pi_1, \pi_2)$ $\mathit{cause}(e_{\pi_2}, e_{\pi_1})$

- Meta-talk discourse relation

  (8) [Bill was really hungry,]$_{\pi_3}$ [because he ate 5 sandwiches]$_{\pi_4}$

  Explaining the utterance π_3 itself: *I can assert that he was hungry because he ate so much*
  $\mathit{Explanation}^*(\pi_3, \pi_4)$ $\mathit{cause}(e_{\pi_4}, \pi_3)$

- Possible because utterances are in the domain

Structural discourse relations

- Contrast

  (9) John loves Max but he hates Bill.

- Parallel

  (10) a. John speaks French. Max speaks German.
  b. John speaks French. He speaks German too.

Constructing SDRSs

- Discourse interpretation = SDRS construction + semantic interpretation of SDRS
- SDRS construction: reasoning within the "Glue Logic"
  - "Commonsense Entailment" (non-monotonic logic)
  - Pragmatic rules
    - operating on previous SDRS and new clause
    - using lexical semantics, world knowledge, Gricean principles

Discourse relation triggers

- "Hard" rules for explicit markers of a relation: semantic contribution of discourse particles (connectives $\langle t, \langle t, t\rangle\rangle$, sentence adverbials $\langle t, t\rangle$)

  (11) Max fell because John pushed him.

  $(\langle \tau, \alpha, \beta\rangle \wedge [\mathit{because}]K_\beta) \rightarrow \mathit{Explanation}(\alpha, \beta)$

- Defeasible rules for indirect clues: pragmatic principles (conversational implicatures), discourse contents *and* world knowledge

  (6) Max fell. John pushed him.

  $(\langle \tau, \alpha, \beta\rangle \wedge \mathit{DPCause}(\tau, \alpha, \beta)) > \mathit{Explanation}(\alpha, \beta)$
  where $>$ is defeasible implication

  cf. Grice's "be relevant"

Content and discourse structure in interpretation

Strict view

- Content: Interpreted
  - Propositional content of basic constituents
  - Semantic effects of discourse relations
- Structure: Not interpreted
  - Graph of attachments and embedding:
    information packaging at the discourse level
- Both constrain construction and underspecification resolution, as part of the context, so structure *indirectly* affects contents and interpretation

Content and discourse structure in interpretation

Broad view

- Discourse relations are part of the structure
- Akin to Grice's original view on conventional implicatures (*but* and *therefore* as implicature triggers) [Bach, 1999]
- Content: Propositional content of basic constituents
- Structure: Direct propositional content of complex SDRSs (discourse relations) + Graph
- Both constrain contents through construction *and* both are interpreted

Reference to discourse structure: enumerative structures

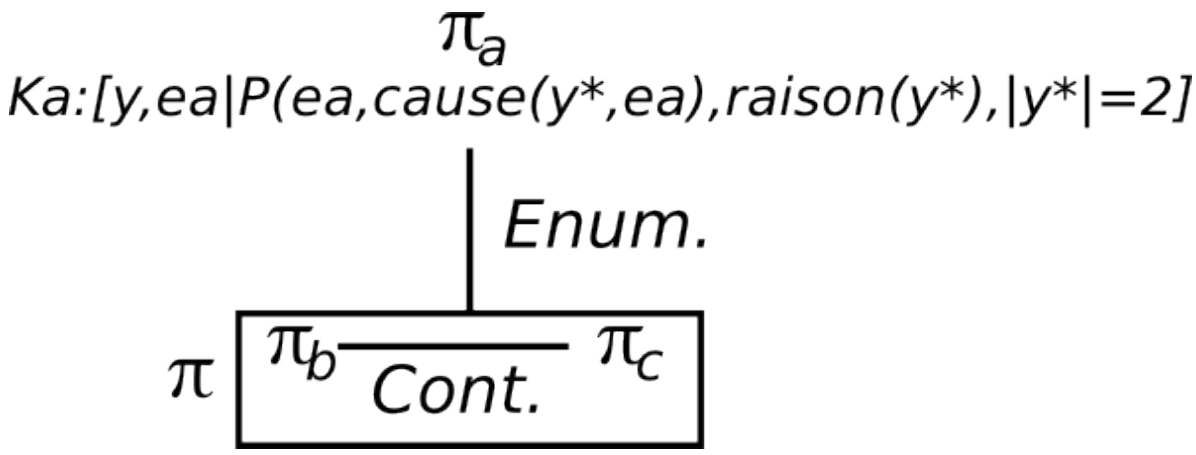
[Vergez-Couret et al., 2011]

(12) a. Domenech refuse obstinément cette concession pour deux raisons.
b. D'abord, il ne la comprend pas.
c. Ensuite, en l'acceptant, il aurait le sentiment de ruiner une autorité déjà amplement chancelante.

[*Domenech stubbornly refuses this concession for two reasons. First he does not understand it. Second, accepting it would feel like ruining his already faltering authority*.]

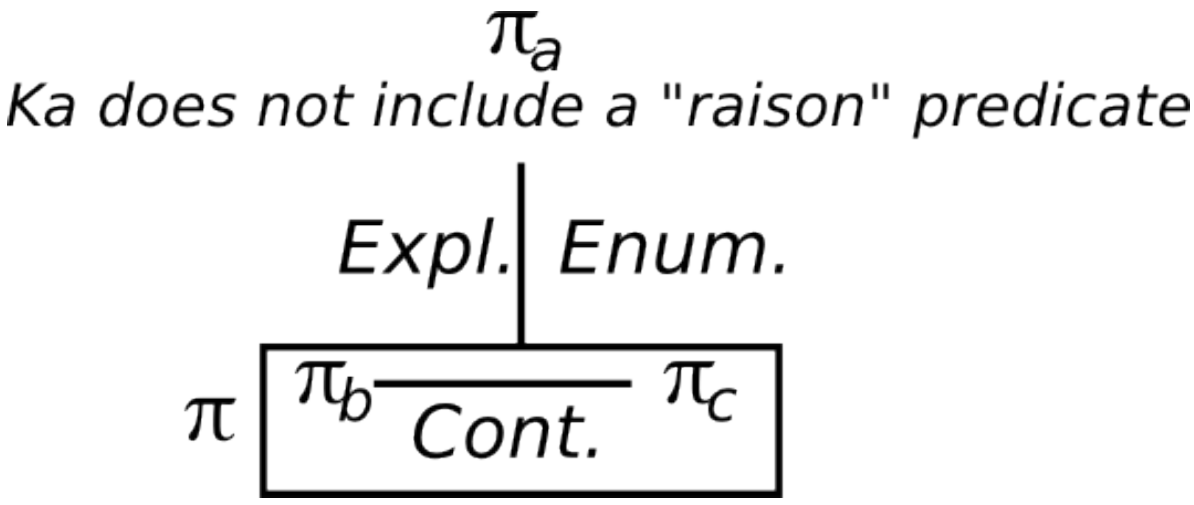
- What do *reasons*, *first* and *second* refer to?
- What is the semantic contribution of *for two reasons*?
  - To the contents of K_{π_a}?
    Modifiable (*for two important reasons*)
  - To the discourse structure?
    Triggers (together with the enumeration marker *first*) an Explanation relation, as a connective

First attempt: content



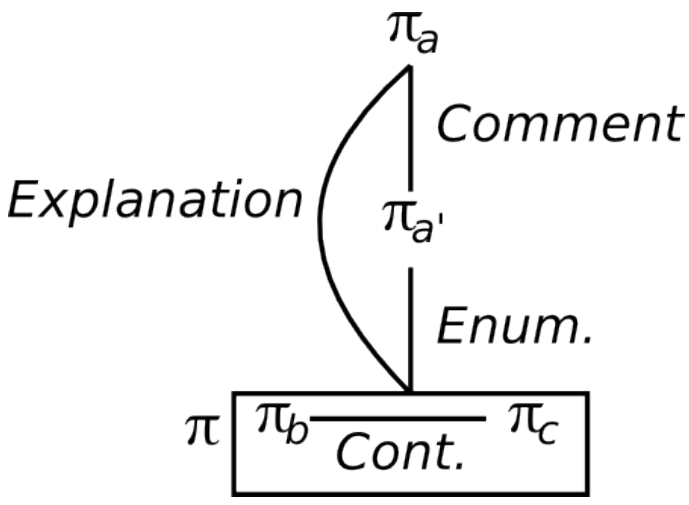
- *Reasons* refers to the linguistic object $K_{\pi_b} \bigoplus K_{\pi_c}$ (plural cataphor)
- *First* and *second* are anaphoric to *reasons* (Enumeration as a kind of Elaboration) and refer to the order between them in the complex constituent K_π (Enumeration between content-level and structural)
- No Explanation at the discourse level, causality expressed within K_{π_a} only

Second attempt: discourse structure



- Account of Explanation at discourse level
- *for two reasons* is not a connective
- Loss of information: no explicit reference to the discourse structure, no qualification of *reasons* possible
- Semantics of Enumeration void

Both content and discourse: meta-level constituent



- Detach *for two reasons* from K_{π_a} in a separate meta-level constituent $\pi_{a'}$ attached to π_a with Comment (tentative)
- Explanation correctly present
- Enumeration focussed, non void semantics

(13) Domenech stubbornly refuses this concession. And this, for two reasons. First, ... Second, ...

Comparing approaches: supplements in Potts and in SDRT

[Potts, 2005, Prévot et al., 2009, Vieu et al., 2005]

Appositives, non-restrictive relative clauses, sentence adverbials...

(14) Chuck, a psychopath, is fit to watch the kids.

(15) Ames, who stole from the FBI, is now behind bars.

(16) Confidentially, Als wife is having an affair.

Comparing approaches: supplements in Potts and in SDRT

- Both are "multiplicative" approaches
  - Potts: supplements add a new semantic contribution to the sentence
  - SDRT: as all basic clauses, supplements introduce a constituent separate from the main clause's one.
- Main difference: stretching the compositional sentential semantic framework vs. recognizing the discursive role of supplements [Amaral et al., 2007]
- Distinction at-issue / non at-issue
  - Potts: different types of contributions (t^a, t^c)
  - SDRT: general principles of information-packaging
    - Right-frontier constraint for appositives: the syntactic embedding of the supplement forces a pop-up after its attachment (always by a subordinating relation) to the main clause constituent
    - Graph-domination and scope of frame adverbials

Comparing approaches: supplements in Potts and in SDRT

- SDRT expressivity allows accounting for a variety of discourse contributions of appositives and non-restrictive relatives
  - Base-line: Entity-Elaboration

    (17) Pierre Vinken, 61 years old, will join the board as a nonexecutive director Nov. 29.

  - EELab+ Explanation

    (18) The reporter interviewed Lance Armstrong, a rider for the US Postal team, a cancer survivor.

  - EElab+Contrast

    (14) Chuck, a psychopath, is fit to watch the kids.

  - Explanation only

    (19) They shot Clyde, who is a wanted fugitive, in the head.

    (15) Ames, who stole from the FBI, is now behind bars.

Comparing approaches: supplements in Potts and in SDRT

- Presence of EElab or not based on the nature of the predicate in the supplements: "permanent" state (ILP) vs. transitory state (SLP) or event
- Discourse scope of frame-adverbials (fronted IP-adjuncts) accounted for

(20) a. Confidentially, Als wife is having an affair.
b. Confidentially, Als wife is having an affair. She's been seeing Max a lot.

(21) That summer, François married Adèle and Jean-Louis left for Brazil. Paul bought a house in the countryside.

- Supplements and utterances in the discourse structure, not separated from contents, allow for reference and anaphora. Vs. Potts's distinction between types t^a and t^c, and between L_{CI} and L_U, criticized by [Amaral et al., 2007].

Note on sub-sentential clauses in SDRT

- The sentence is not the basic unit, the clause is
  - No difference between

    (22) a. Max fell because John pushed him.
    b. Max fell. Because John pushed him.
- Clauses related by connectives, relatives
- Various non-sentential utterances: *OK*, *ahh*, *Bo?*...
- Sub-"clauses" without verbal predication
  - supplements (appositives)
  - frame-adverbials (fronted IP-adjuncts)
  - other detached adverbials, like *for two reasons*
- Further studies at the syntax-semantics-discourse interface required!

Summing up: Multidimensionality in discourse

- Discourse structure as another level of semantic contribution, separate from contents of basic clauses
- Discourse structure as a complex linguistic object that can be referred to
  - propositions (constituents)
  - utterances (labels)
  - enumerative expressions (constituents + their attachment order within the graph)
  - also, earlier, structural relations triggers (c.f. scope of *too*, *also*, Parallel triggers)
- Distinction, within the structure, between content-level relations, meta-talk relations, structural relations
- Distinction, within the structure, between content-level constituents and meta-level constituents + relations to shift levels

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