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Discourse Structure (beyond DRT)

Semantic Theory, SS 2008

Manfred Pinkal & Stefan Thater & Michaela Regneri



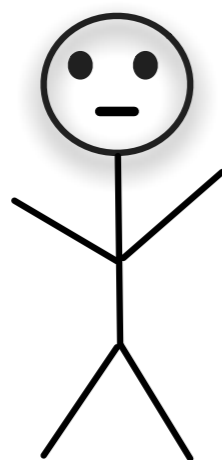
Motivation

John frowned. Mary kissed him.



Motivation

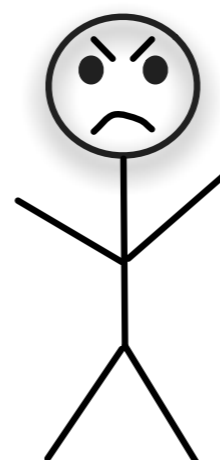
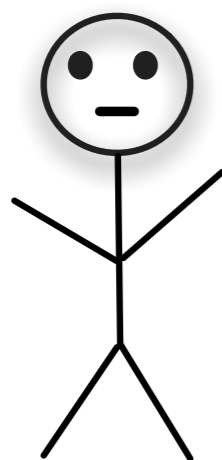
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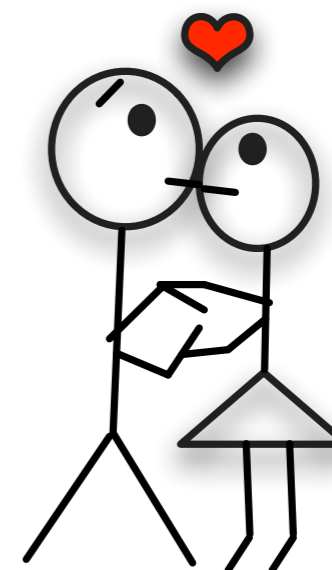
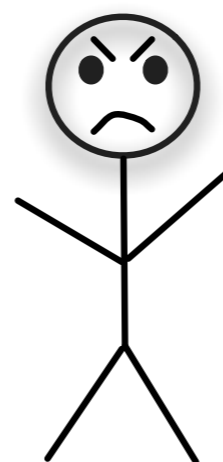
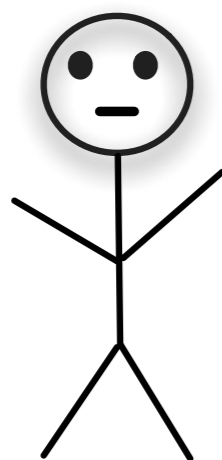
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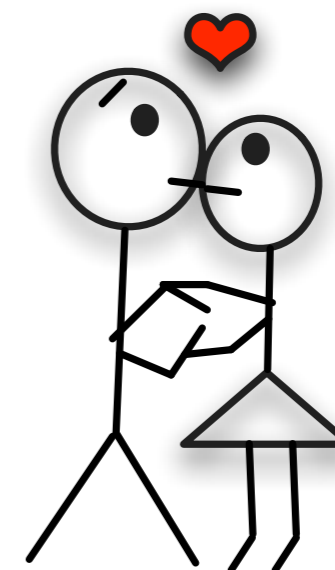
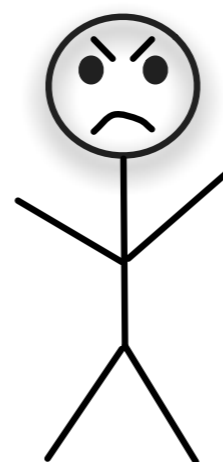
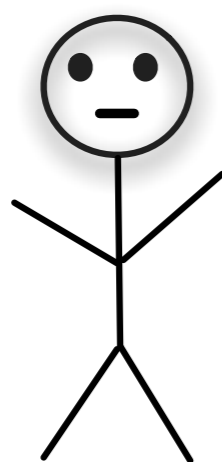
John frowned. Mary kissed him.





Motivation

John frowned. Mary kissed him.



events in a sequential relation:
frowning → kissing



Motivation

John frowned. Mary kissed him.



Motivation

John frowned. Mary kissed him.

Mary →





Motivation

John frowned. Mary kissed him.

Mary →



events in a causal relation:
kissing → frowning



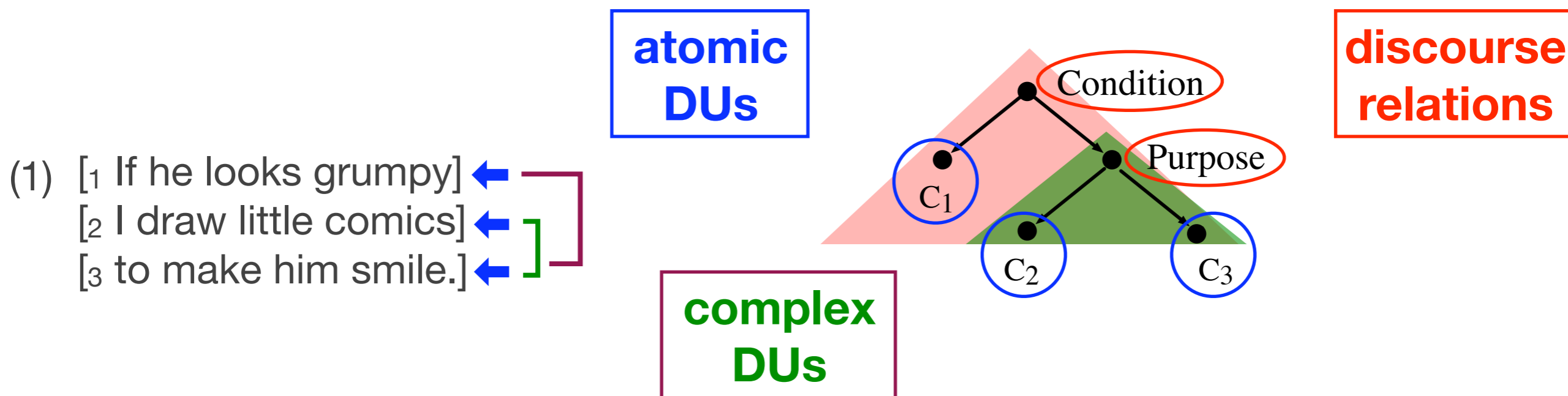
Outline

- Discourse Structure
- Segmented DRT
- Rhetorical Structure Theory
- Some current issues



Discourse Structure

- ...explains how clauses form a coherent text
- **discourse relations** mark semantic or textual relations
- **discourse units** (DUs) are hierarchically ordered:
 - atomic DUs (also: *discourse segments*) are elementary units
 - complex DUs consist of several [atomic or complex] DUs connected by a discourse relation

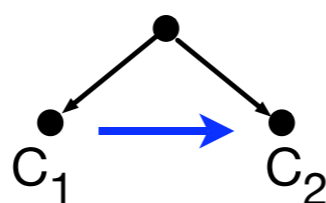




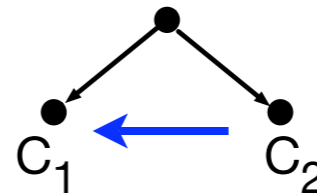
Ambiguity in Discourse Structure

- (2) [1 John frowned.]
[2 Mary kissed him.]

sequence



cause

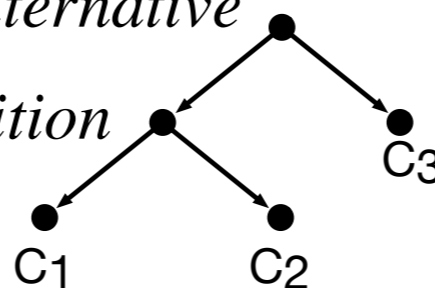


ambiguous
relation

- (3) [1 I try to read a novel]
[2 if I feel bored]
[3 or I am unhappy.]

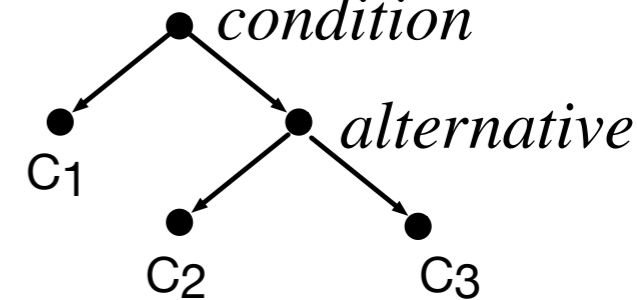
alternative

condition



condition

alternative



ambiguous hierarchical structure



Theories on Discourse Structure

- ...differ (mainly) with respect to
 - discourse relations: different sets (names, number) of discourse relations
 - hierarchical constitution: the kinds of valid structures (trees, more general graphs, connected or not connected, ...)
 - thus also different theoretical foundations, different aims, and different tasks for which they are appropriate (or not)
- we sketch two of them: *Segmented DRT* (SDRT) and *Rhetorical Structure Theory* (RST)



From DRT to SDRT

- Discourse relations between SDRSs as straight-forward extension of logical relations between DRSs (\vee, \Rightarrow)

(4a) [₁ If John smiles]
[₂ Mary kisses him.]

K_1 :

K_2 :

j
j = john smiles(j)

\Rightarrow

K_3 :

m, h
m = mary kisses(m, h) h = j

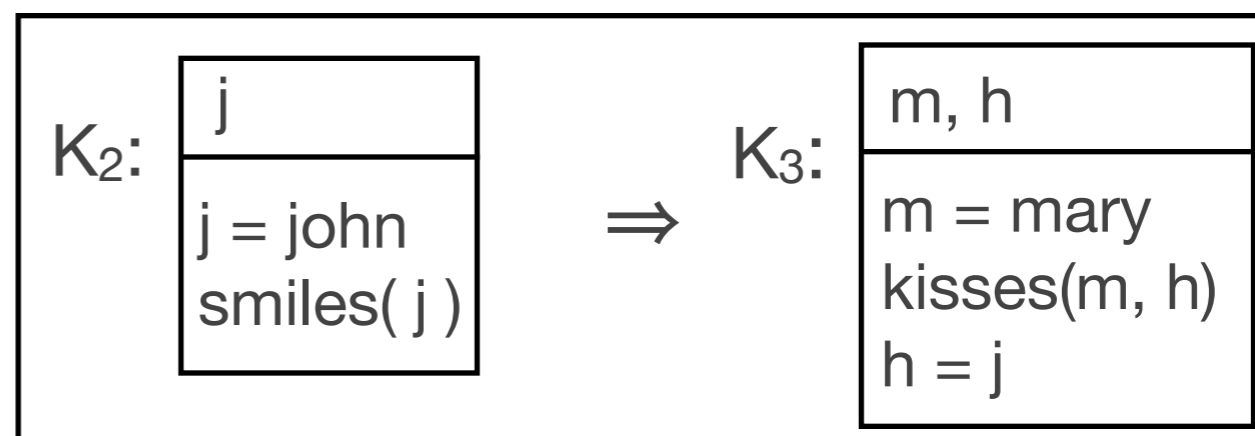


From DRT to SDRT

- Discourse relations between SDRSs as straight-forward extension of logical relations between DRSs (\vee, \Rightarrow)

(4a) [1 If John smiles]
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K_1 :



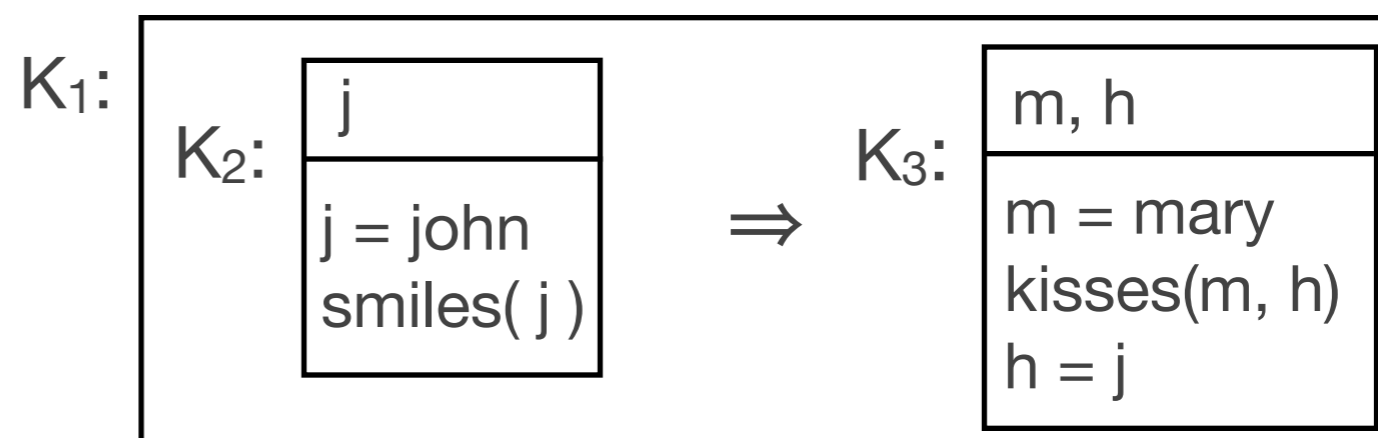
(4b) [1 John smiles]
[2 because Mary
kissed him.]



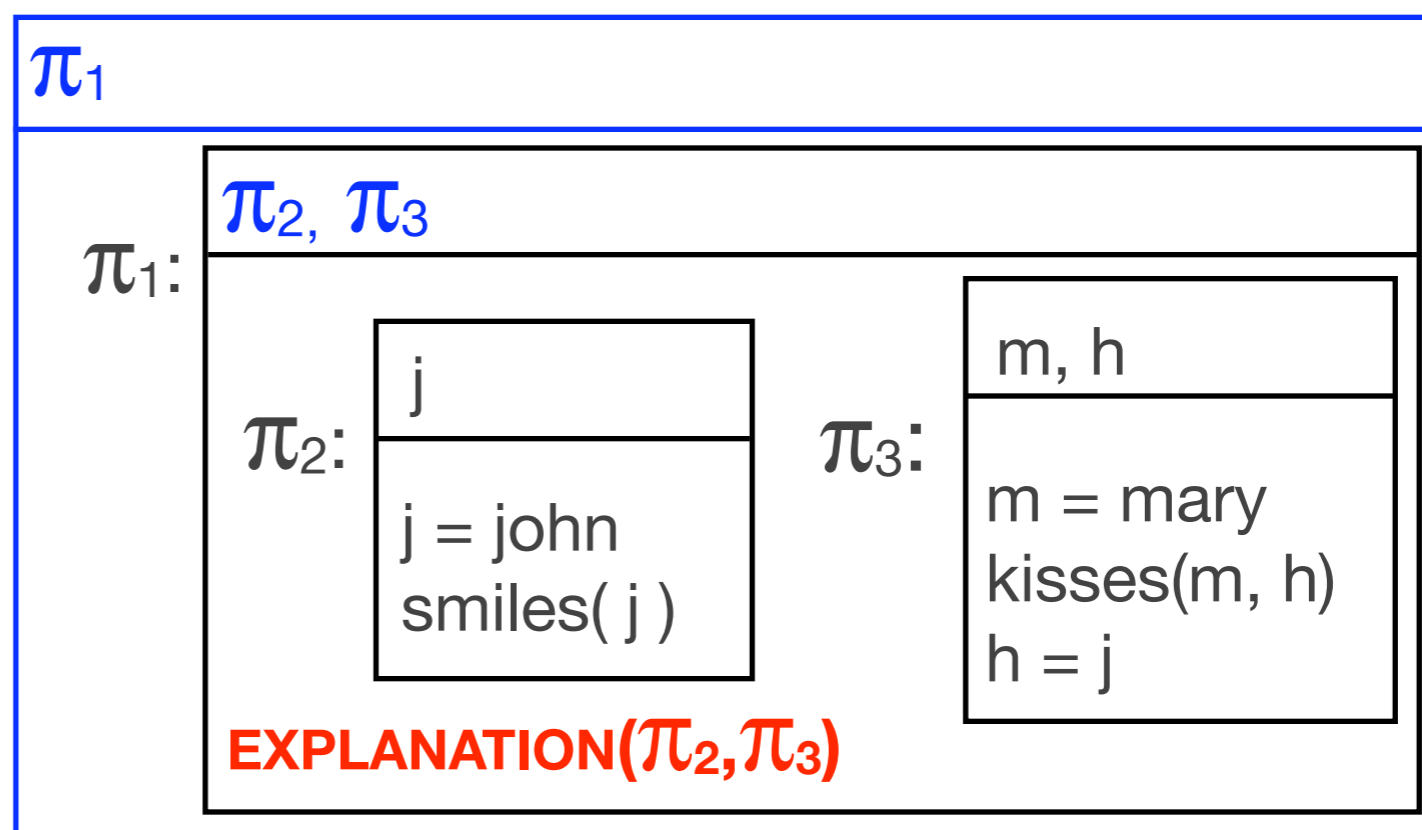
From DRT to SDRT

- Discourse relations between SDRSs as straight-forward extension of logical relations between DRSs (\vee, \Rightarrow)

(4a) [1 If John smiles]
[2 Mary kisses him.]



(4b) [1 John smiles]
[2 because Mary
kissed him.]





SDRT - Discourse Relations (1)

- ...are always binary; the main distinction:

Subordinating Relations:

π_1 : John smiles

π_2 : because Mary kisses him.

EXPLANATION(π_1, π_2)

- one DU (π_1) is more central, the other one (π_2) gives additional information

Coordinating Relations:

π_1 : John smiles π_2 : then Mary kisses him.

NARRATION(π_1, π_2)

- both DUs contribute equally weighted parts to the discourse
- some coordinating relations require an explicit common topic of the SDRSs (more on topics later)

- there may be more than one relation between two EDUs, but they have to be of the same type



SDRT - Discourse Relations (2)

Subordinating relations:

- EXPLANATION(π_1, π_2): π_2 gives the cause for the effects in π_1 .
 - Nothing in π_1 may have happened before anything in π_2
 - If there are discrete events in π_2 , they all must have happened before anything π_1 .

Examples:

(5a) [₁ John smiles] [₂ because Mary kissed him.]

(5b) [₁ John was not there] [₂ because he was sick.]



SDRT - Discourse Relations (3)

Subordinating relations:

- ELABORATION(π_1, π_2): π_2 gives more details about the topic of π_1 .

Example:

(6) [₁ Max had a lovely meal last night.] [₂ He ate lots of salmon.]

- BACKGROUND(π_1, π_2): π_2 gives more information about the surrounding state of affairs of π_1 .

Example:

(7) [₁ Max opened the door.] [₂ The room was pitch dark.]



SDRT - Discourse Relations (4)

Coordinating relations (* = topic constraint):

- * NARRATION(π_1, π_2): A temporal sequence (with π_1 before π_2)

Example: (8) [₁ We first saw a movie] [₂ and had a beer afterwards.]

- RESULT(π_1, π_2): π_1 gives the cause for the effect in π_2 . (= the reversal of EXPLANATION).

Example: (9) [₁ John was sick] [₂ so he could not come.]

- CONSEQUENCE(π_1, π_2): same as $\pi_1 \Rightarrow \pi_2$



SDRT - Discourse Relations (5)

Coordinating relations (* = topic constraint):

- $\text{CONTRAST}(\pi_1, \pi_2)$: both SDRSs have a similar structure, and contrast in a particular theme.

Example: (10) [₁ John loves sports,][₂ but he hates football.]

- $\text{ALTERNATION}(\pi_1, \pi_2)$: same as $\pi_1 \vee \pi_2$
- * $\text{CONTINUATION}(\pi_1, \pi_2)$: some abstract coherence; both SDRSs say something about the same topic.

Example: (11) [₀ The cat disappeared.] [₁ I searched in the flat.]
[₂ Dad checked the garden.]

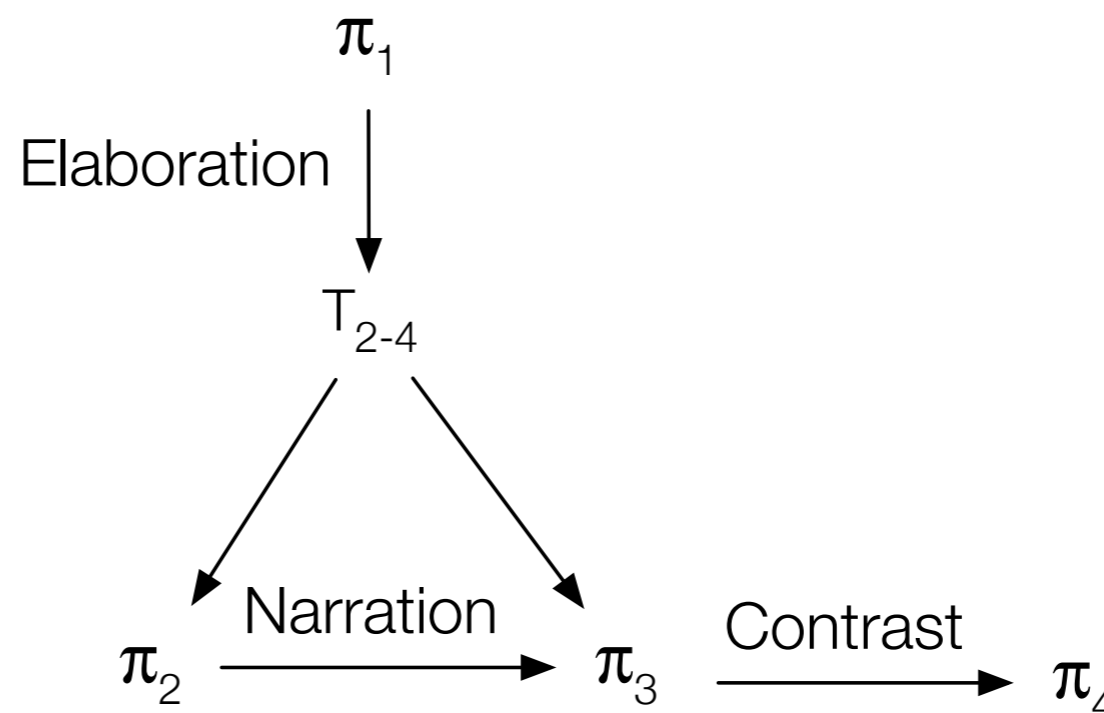


SDRT - Building Discourse Structures (1)

- for reading / writing convenience, we display SDRSs as graphs with SDRS labels and discourse relations (not the full (S)DRS):

(12) [1 Max had a lovely meal.] [2 He ate lots of salmon.]
[3 He then ordered a big desert] [4 but he could not finish it.]

subordinating relations
drawn downwards
(„domination“)



coordinating relations drawn sideways



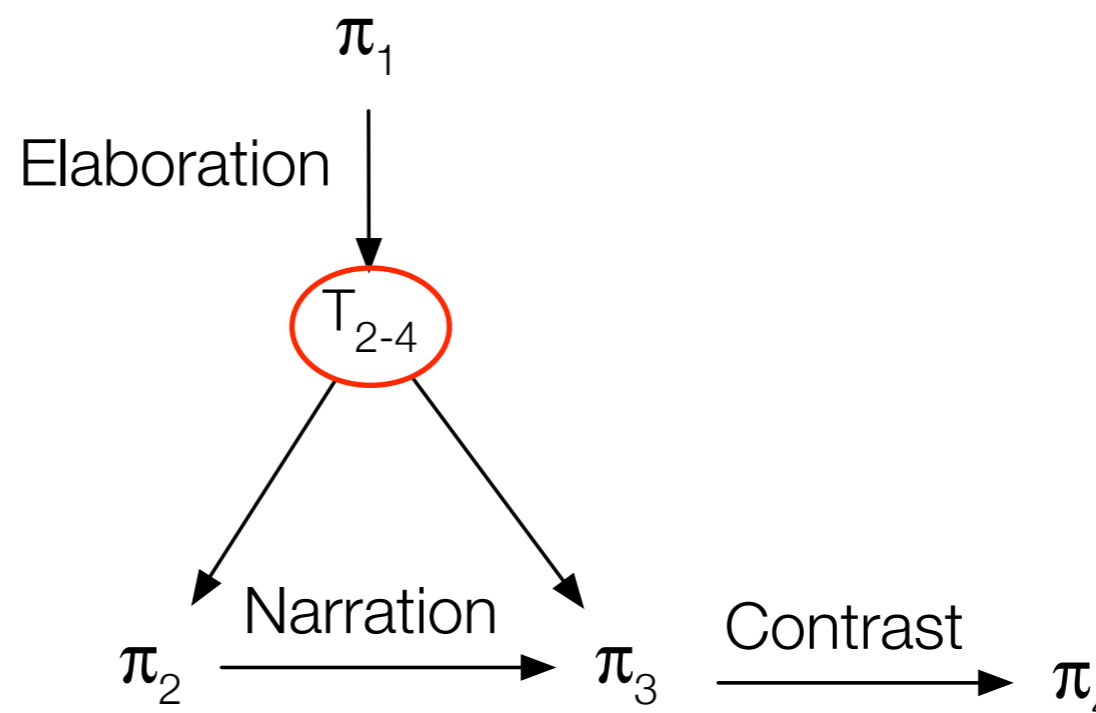
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topic node for
coordinating
relations with
topic constraint



coordinating relations drawn sideways



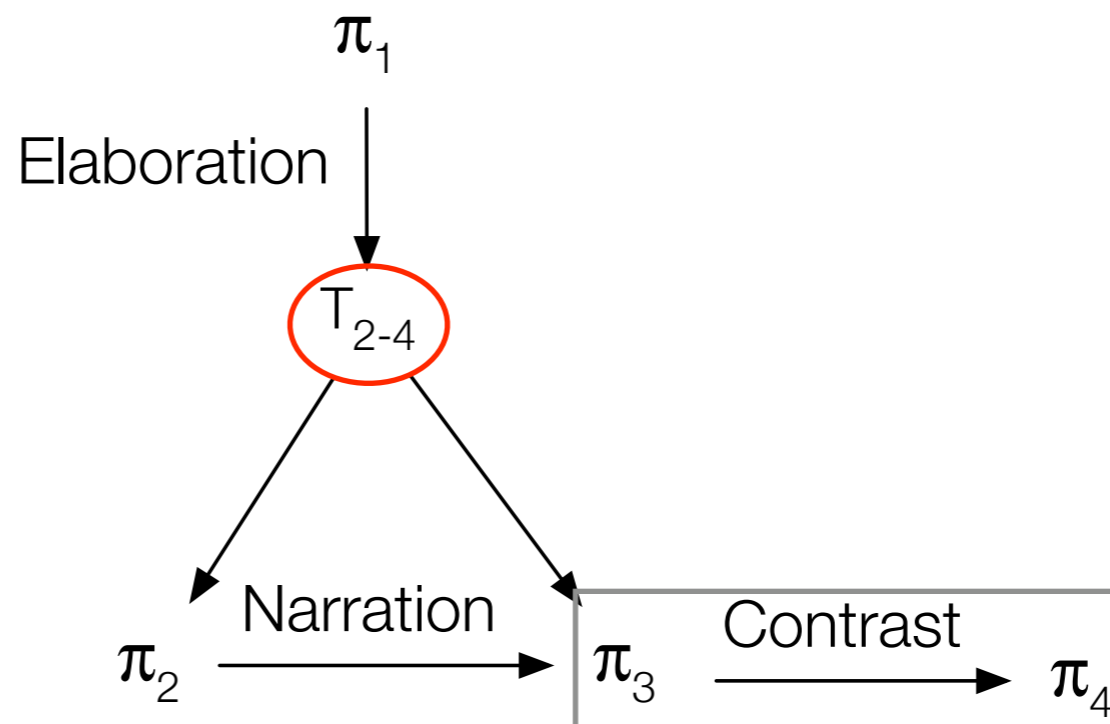
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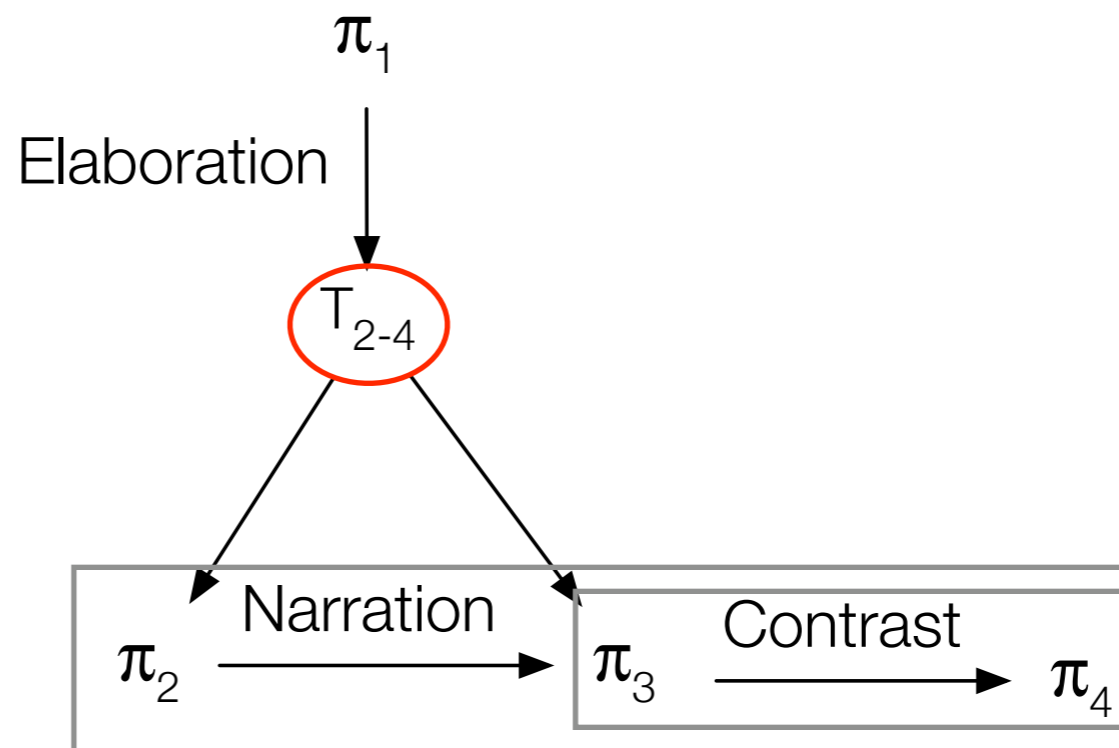
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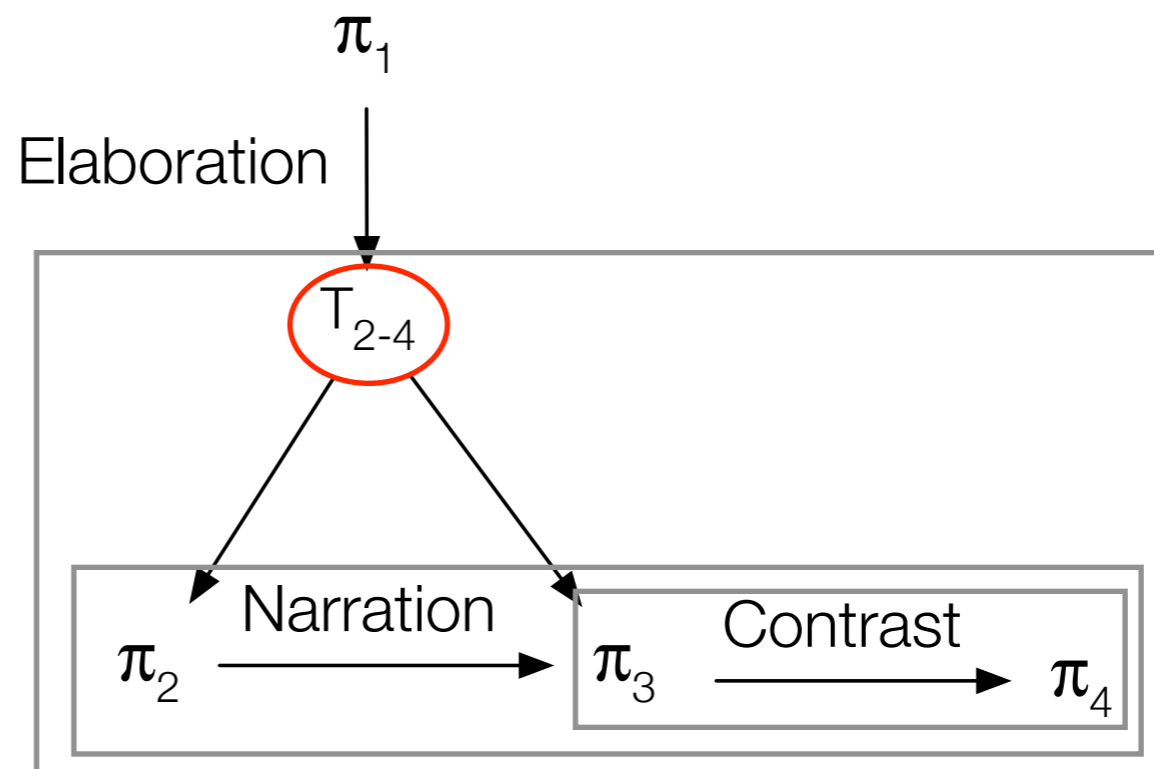
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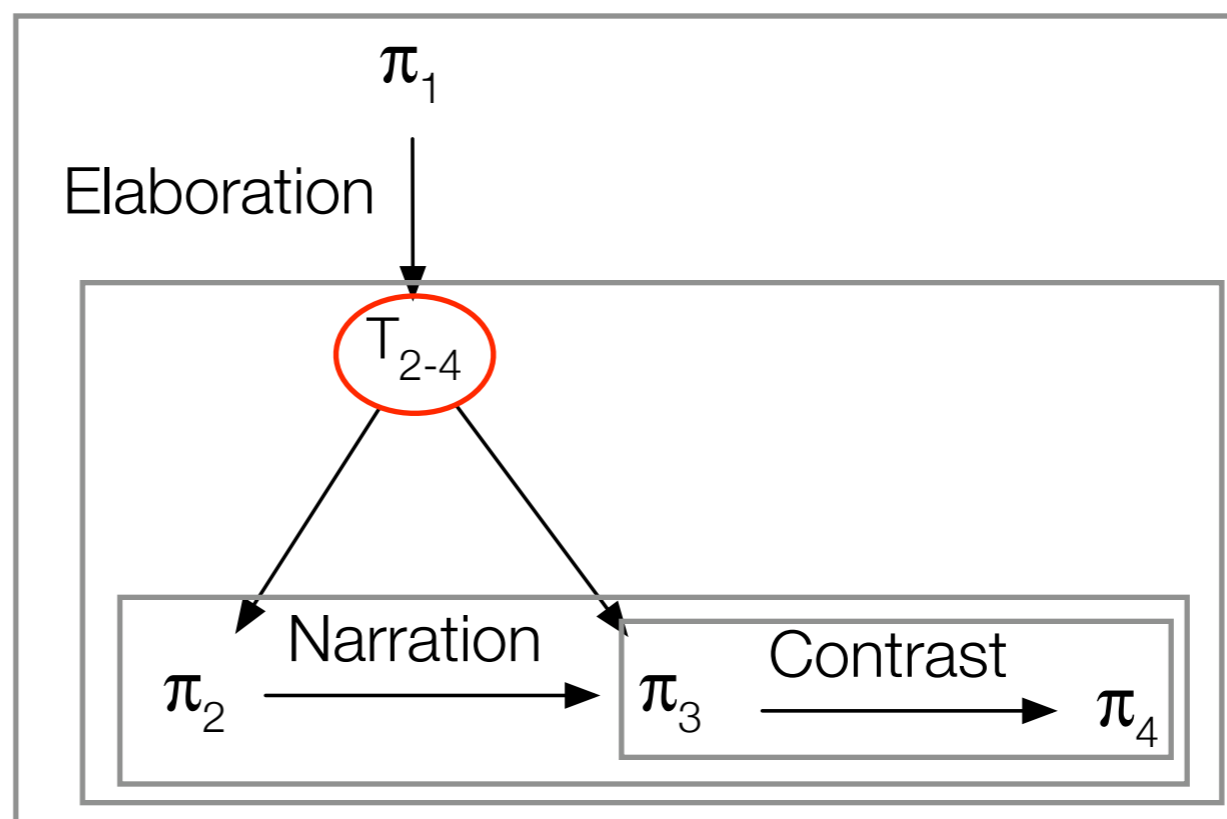
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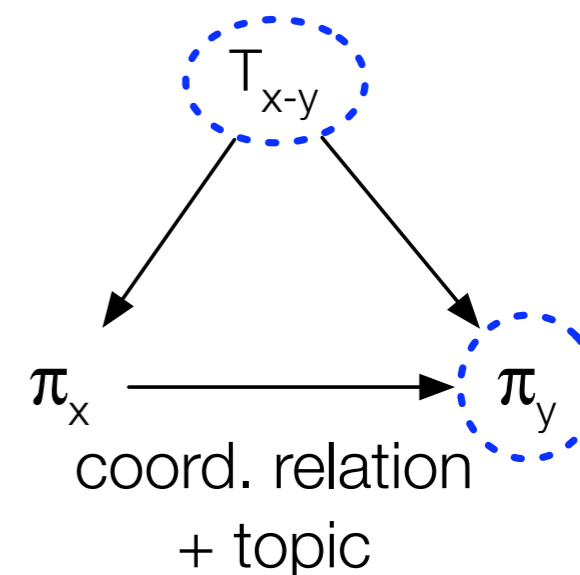
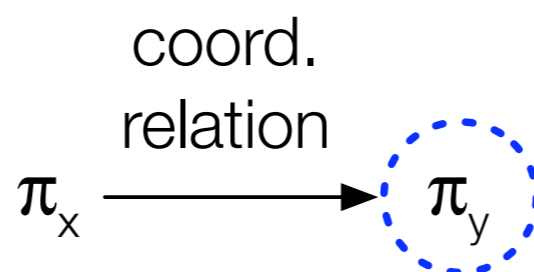
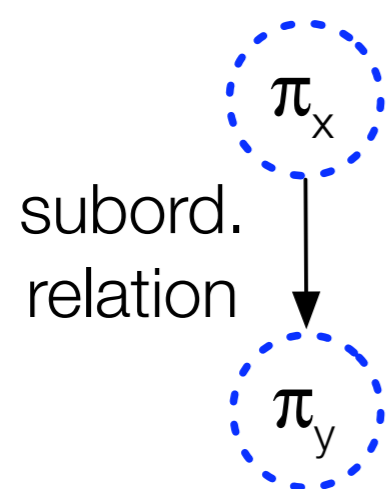


coordinating relations drawn sideways



SDRT - Building Discourse Structures (2)

- incremental build-up (in textual order); new DUs are attached to some allowed attachment point
- the attachment point corresponds to the SDRS in which the new SDRS will be (immediately) embedded
- schemata for attachment:



allowed attachment points for following DUs



SDRT - Building Discourse Structures (3)

- an example:

- (13) [1 Max had a lovely evening last night.]
[2 He had a great meal.]
[3 He ate salmon]
[4 and devoured lots of cheese.]
[5 He then won a dancing competition.]

π_1

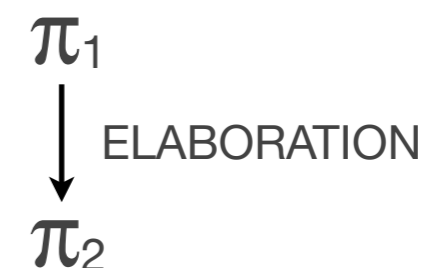
Coordinating:	Subordinating:
ALTERNATION CONTRAST CONSEQUENCE CONTINUATION(*) NARRATION(*) RESULT	BACKGROUND ELABORATION EXPLANATION



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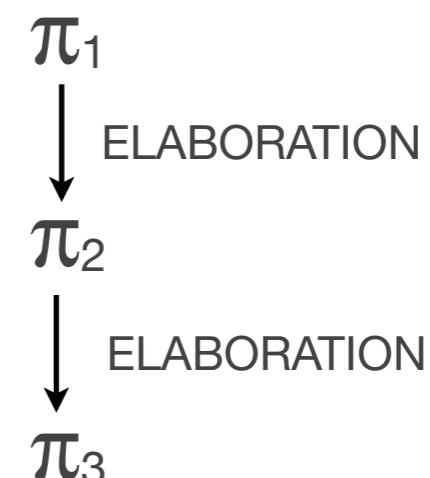


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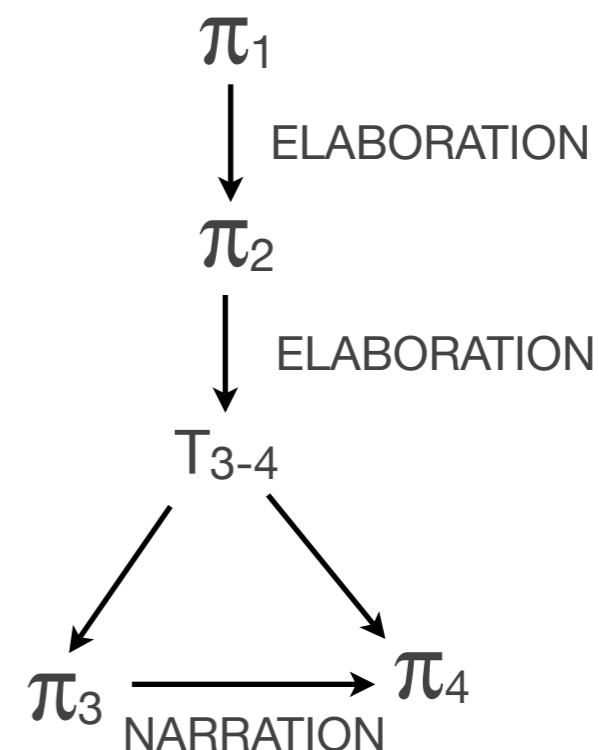


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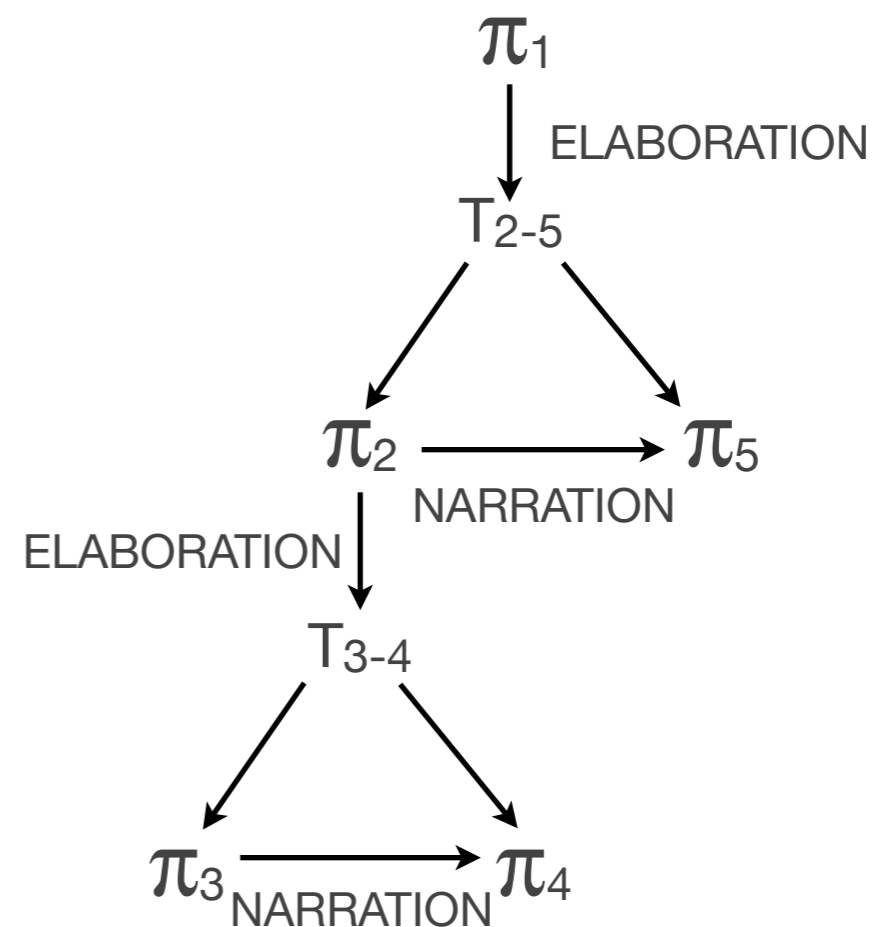


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Coordinating:	Subordinating:
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SDRT - Topics

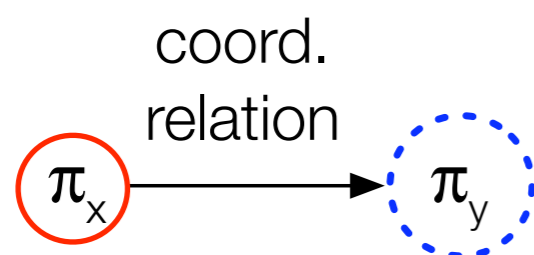
- topics represent a common theme of the SDRSes they dominate
- they might be explicit (represented as / in some DU - see Max's evening and Max's meal)
- they might also be implicit, then they have to be inferred (but in presence of NARRATION or CONTINUATION, they have to be there)

[₁ Today was the last exam.] [₂ Afterwards I packed my stuff]
[₃ and hurried to the airport.] [₄ The shore was waiting for me.]
- the relations of SDRSs and their topics counts as subordinating relation (topic dominates the other SDRSs)



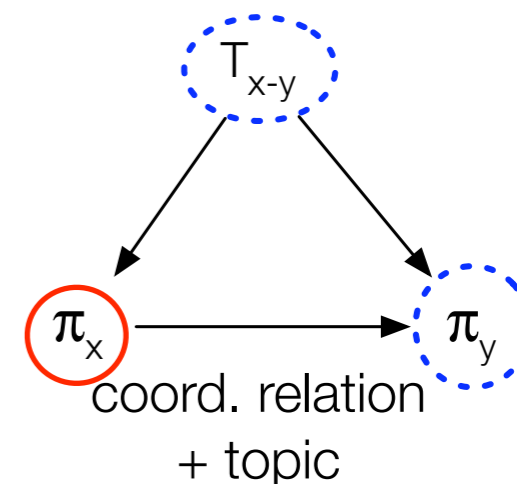
SDRT - The Right Frontier Constraint

- attachment restrictions for coordinating relations:
nothing in the following discourse may attach to the first participant or anything dominated by the first participant
- This constraint also restricts anaphoric accessibility:
no referent of the first participant (or anything dominated by it) is accessible for the following discourse



closed for
attachment
and anaphora

open for
attachment
and anaphora





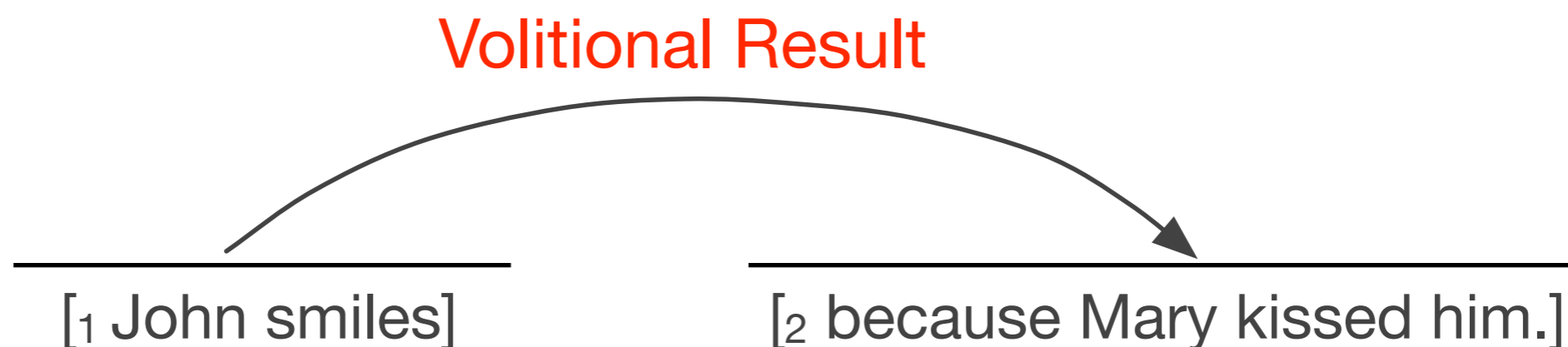
SDRT - Summary

- discourse formalism on top of DRT
- discourse relations (either coordinating or subordinating) as binary predicates connecting two SDRSs
- simplified graph representation reducing the displayed information to discourse relations and structure
- constraints on valid discourse structures (right frontier constraint, topic constraint, type-equality if more than one relation holds between two DUs)
- discourse structure interacts the semantic representation



Rhetorical Structure Theory

- independent from any semantic formalism; DUs are simply plain text
- more fine-grained set of discourse relations than in SDRT (see <http://www.sfu.ca/rst/01intro/definitions.html>)
- main constraint on discourse structures: relations may only connect adjacent DUs (not necessarily the case in SDRT, but it *is* the case in all our examples)





RST - Discourse Relations (1)

- *mononuclear* and *multinuclear* relations
- in mononuclear relations, the more central part is called *nucleus*, the supplemental part is called *satellite*
- mononuclear relations are usually binary; however, there are multi-satellite constructions, in which a single nucleus has more than one satellite (all attached with the same relation)
- in multinuclear relations, all participants have equal status (several nuclei)
- multinuclear relations can in general be n-ary, but some particular ones must be binary (CONTRAST e.g.)



RST - Discourse Relations (2)

Examples for „Presentational“ (text-structural) relations, mononuclear:

- BACKGROUND (cf. SDRT)
- CONCESSION
(14) [₁ Tempting as it may be,]
 [₂ we shouldn't do that.]
- JUSTIFY
(15) [₁ Let's be clear:]
 (Some re-stated arguments)
- MOTIVATION
(16) [₁ Buy our stuff!]
 [₂ It's neat and cheap and good!]
- PREPARATION
(could be a text's title e.g.)
- RESTATEMENT
(repeating the content of a previous statement, often title and first sentence e.g.)
- SUMMARY
(summing up previous statements; nucleus has to consist of more than one atomic DU)



RST - Discourse Relations (2)

Examples for „Presentational“ (text-structural) relations, mononuclear:

- BACKGROUND (cf. SDRT)

- PREPARATION

- CONCESSION

(14) [1 Temptation
[2 we should not follow it]

CONCESSION:
The writer acknowledges a potential or apparent incompatibility between nucleus and satellite; recognizing the compatibility between nucleus and satellite increases the reader's positive regard for N

(title e.g.)

content of a
ment, often title
e.g.)

- JUSTIFY

(15) [1 Let's be clear:]
(Some re-stated arguments)

- SUMMARY

(summing up previous statements; nucleus has to consist of more than one atomic DU)

- MOTIVATION

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RST - Discourse Relations (3)

Examples for „Subject-Matter“ (semantic) relations, mononuclear:

- CAUSE (volitional or non-volitional): Nucleus = cause
- OTHERWISE
(18) [1 He has to see the match]
[2 or he will become very grumpy.]
- CIRCUMSTANCE
(17) [1 I had the best pizza of my life
yesterday]
[2 when we got lost in Florence.]
- PURPOSE
(19) [1 I draw little comics]
[2 to make him smile.]
- CONDITION (If...then)
- RESULT (volitional or non-volitional): Nucleus = result
- ELABORATION (cf. SDRT)



RST - Discourse Relations (4)

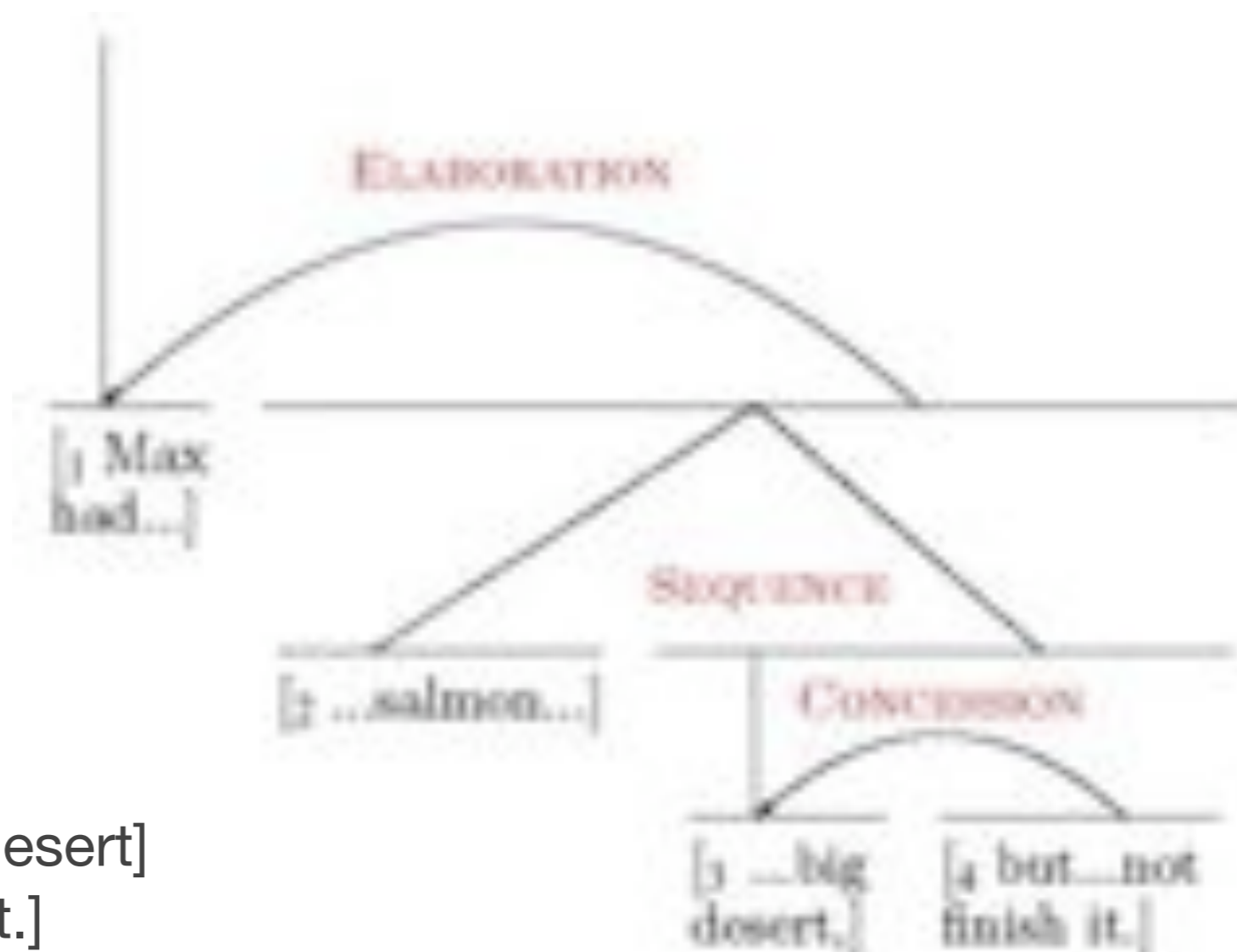
Multinuclear relations:

- CONJUNCTION
(20) [₁ They all were very kind]
 [₂ and explained everything
 patiently.]
- CONTRAST (cf. SDRT)
- DISJUNCTION (logical \vee)
- JOINT
(adjacent units with no other
relation between them)
- LIST
(roughly SDRTs Continuation)
- MULTINUCLEAR RESTATEMENT
(like restatement, but both units
are of equal importance)
- SEQUENCE
(roughly SDRT's narration)



RST - Building Discourse Structures (1)

- the graph notation indicates nucleus marking:
 - arrows point (sidewards) from satellite to nucleus
 - lines (downwards) connect DUs of multinuclear relations



- (21) [1 Max had a lovely meal.]
[2 He ate lots of salmon.]
[3 He then ordered a big desert]
[4 but he could not finish it.]



RST - Building Discourse Structures (2)

- a DU is attached to some adjacent DU, order of build up does not matter
- valid attachment points are the (atomic or complex) DUs direct to the left and direct to the right
- thus the order in which the DUs are grouped resolves potential ambiguity (see example on next slide)



RST - Building Discourse Structures (3)

- an (ambiguous) example:

[₁ I try to read a novel]

[₂ if I feel bored]

[₃ or I am unhappy.]

[₁ I try to read a novel]

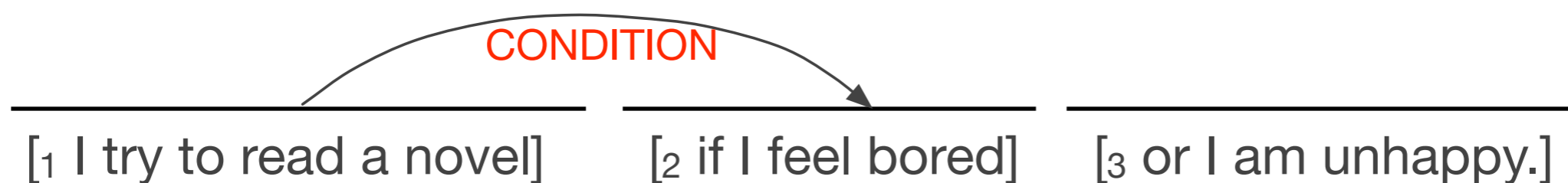
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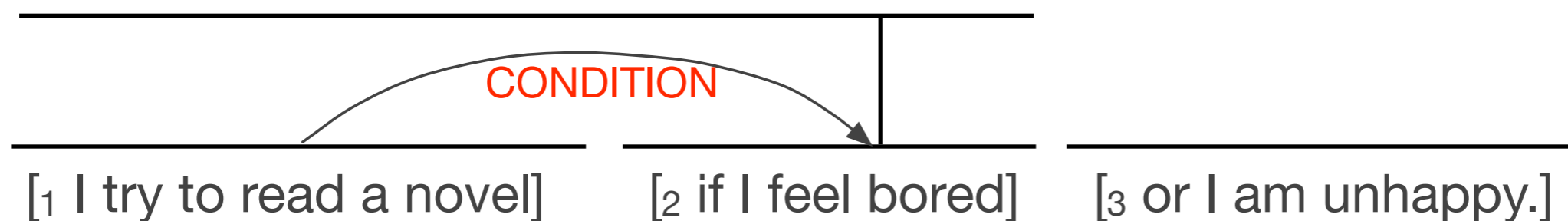
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RST - Building Discourse Structures (3)

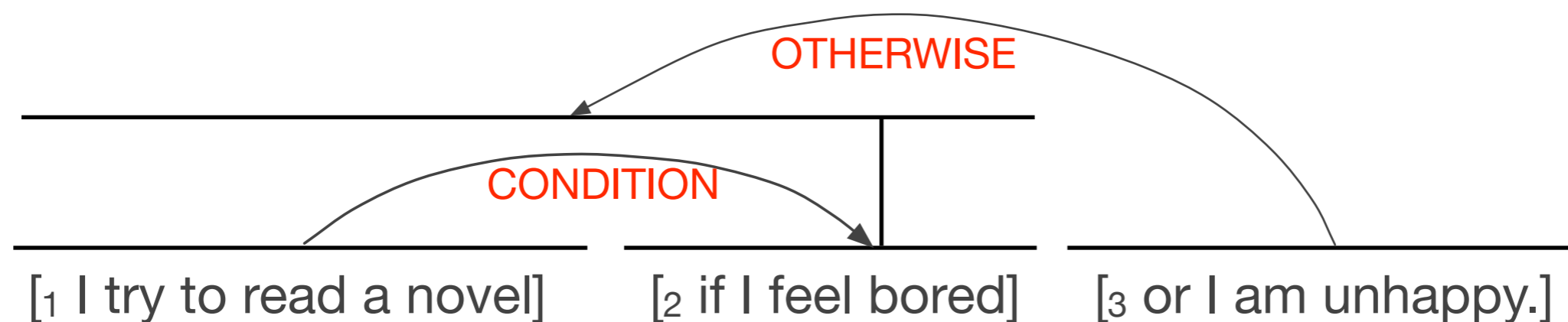
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RST - Building Discourse Structures (3)

- an (ambiguous) example:



[1 I try to read a novel]

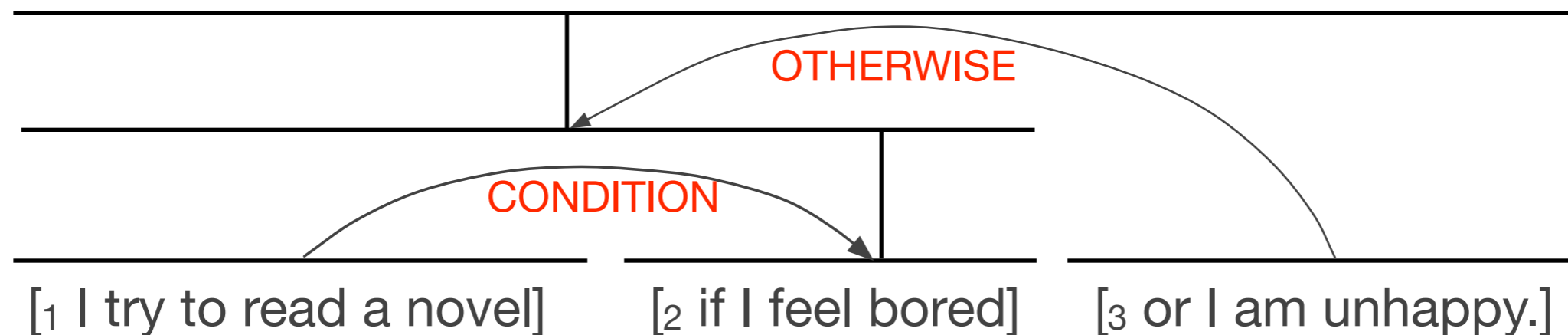
[2 if I feel bored]

[3 or I am unhappy.]



RST - Building Discourse Structures (3)

- an (ambiguous) example:



[1 I try to read a novel]

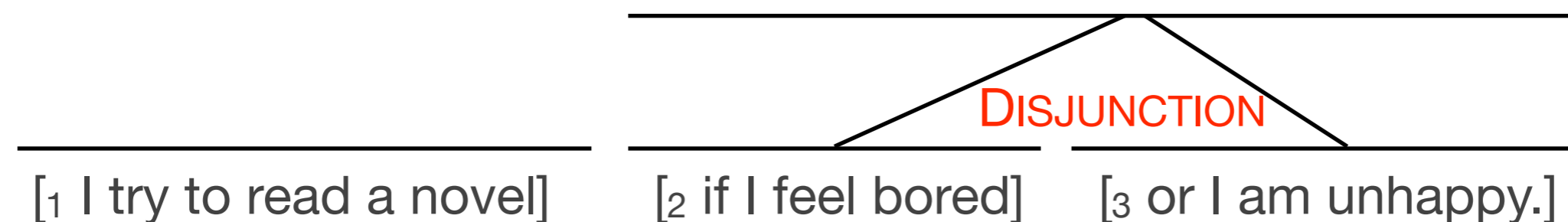
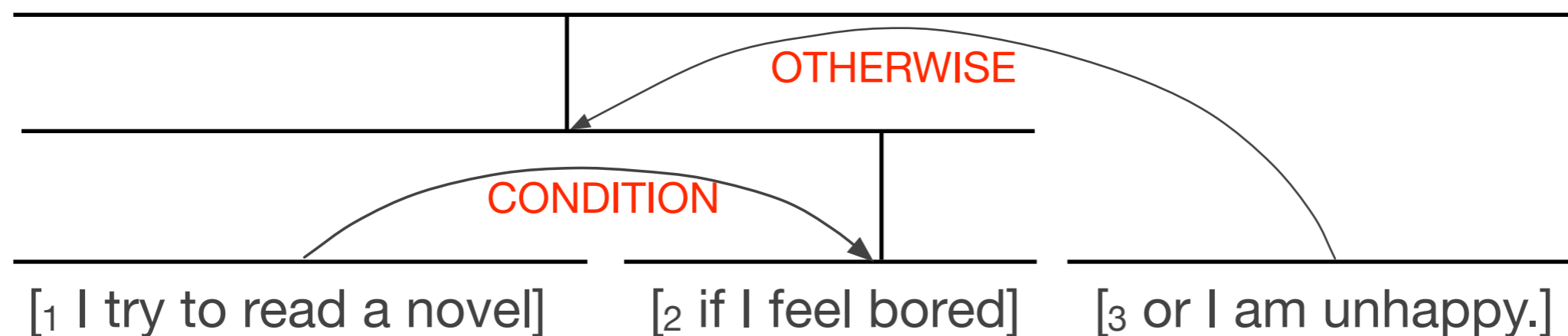
[2 if I feel bored]

[3 or I am unhappy.]



RST - Building Discourse Structures (3)

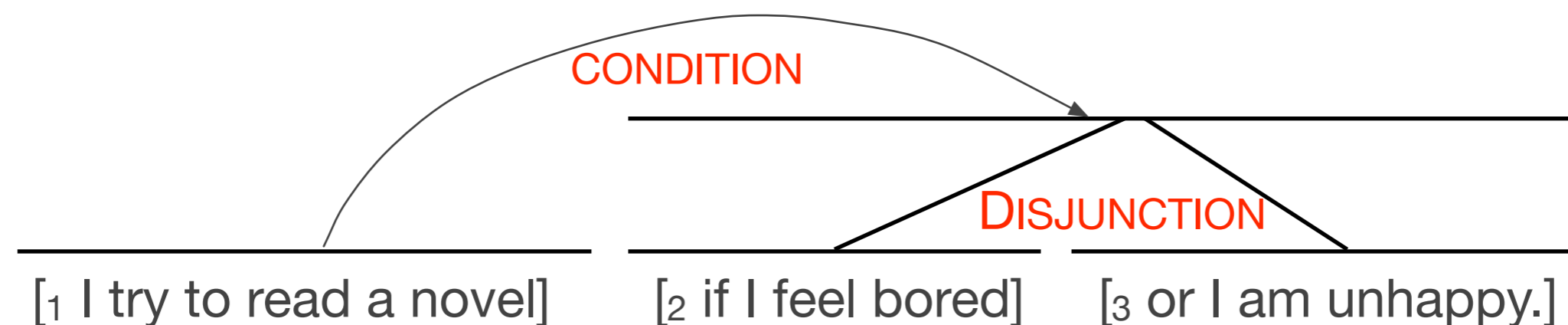
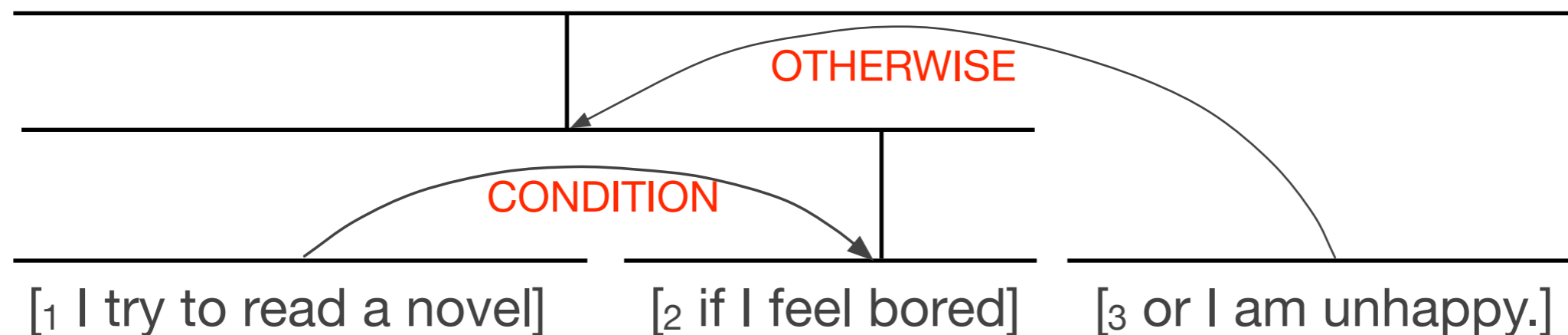
- an (ambiguous) example:





RST - Building Discourse Structures (3)

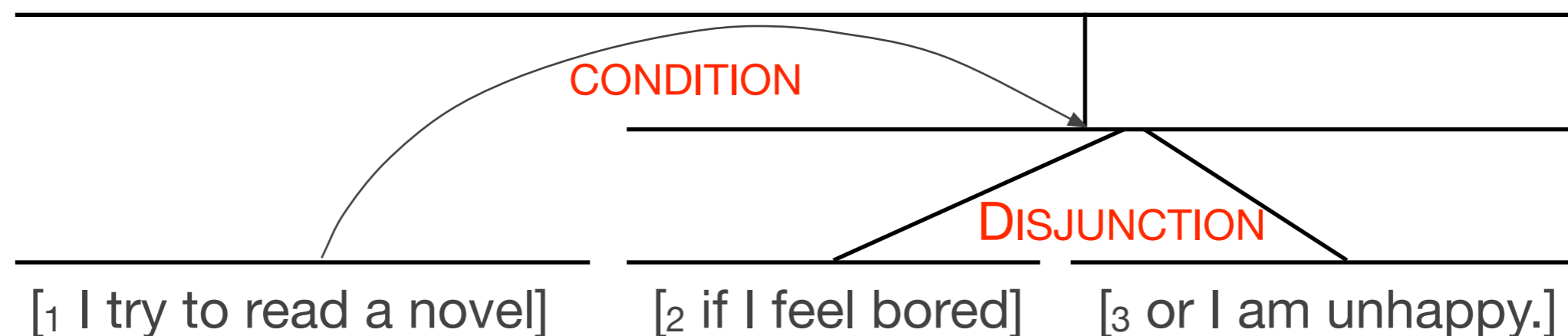
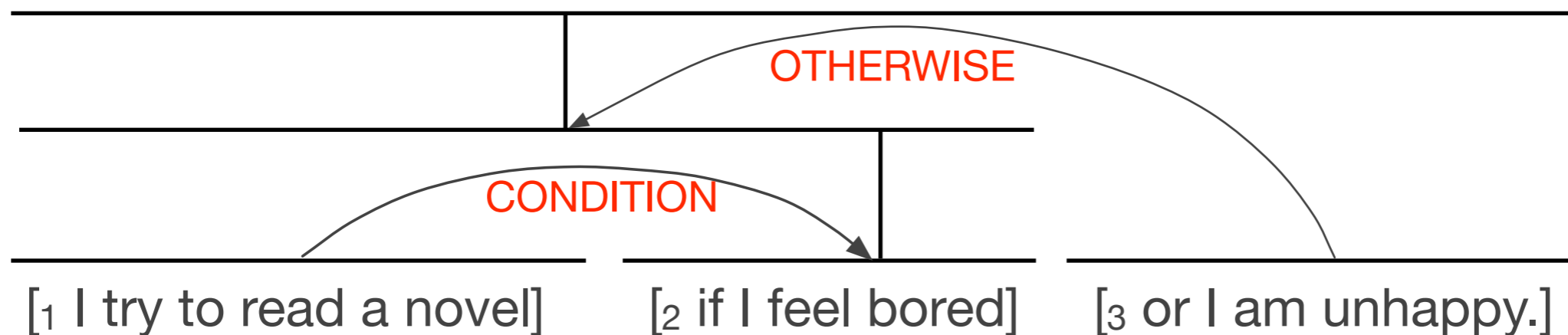
- an (ambiguous) example:





RST - Building Discourse Structures (3)

- an (ambiguous) example:





RST - Summary

- discourse formalism operating with textual representations (rather than semantic representations)
- discourse relations connect a nucleus and a satellite, or multiple nuclei
- very fine-grained relation-set, no formal semantic definitions for relations
- adjacency constraint: relations may only connect „neighboring“ discourse units



Additional Notes on SDRT and RST

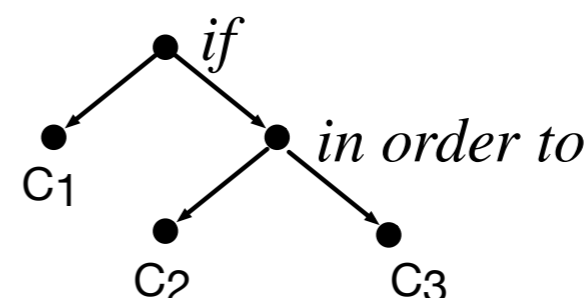
- SDRT bases on a sound logical framework, all relations have formal truth conditions, and their incremental assignment is exactly defined (a default reasoning approach)
- SDRT has also a couple more discourse relations, however, most of them are derivatives of the ones introduced here, slightly modified in their truth conditions for the case of dialog e.g.
- for RST, there are a lot more discourse relations, some people even expanded the original set (for annotation purposes, cf. the RST Discourse Treebank, Carlson et al. 2002)
- most people working with RST (in discourse parsing) chose a reduced set of relations



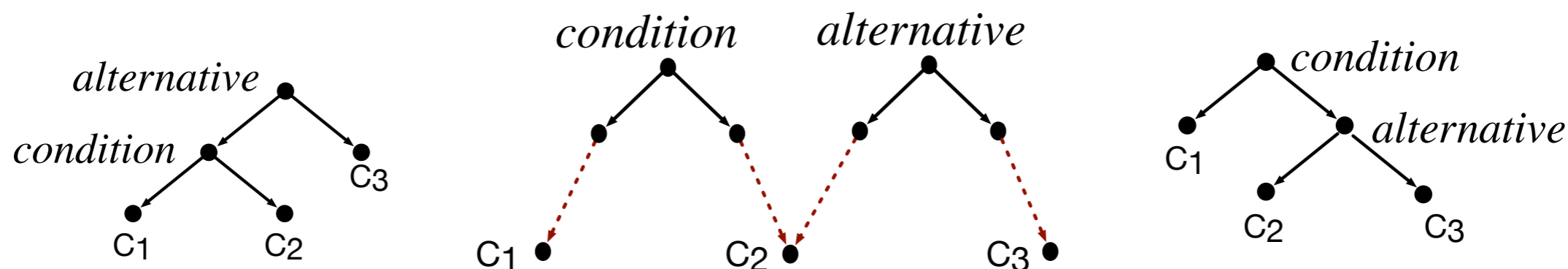
Some Current Issues

- an „ultimate“ set of discourse relations; one more of the alternatives: (cf. Penn Discourse Treebank, Cresswell et al. 2003):

[₁ If he looks grumpy]
[₂ I draw little comics]
[₃ in order to make him smile.]



- underspecification formalisms for discourse representations:



[₁ I try to read a novel] [₂ if I feel bored] [₃ or I am unhappy.]



Summary

- Discourse structure shows how clauses form a coherent text
- Different kinds of ambiguity: relations, arrangement of DUs
- Two discourse formalisms:
 - SDRT, on top of DRT
 - RST
- A short outlook