

The Moving Right Frontier

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Abstract

This paper analyzes systematic cases of revision of the discourse structure entailing a modification of the right frontier. We show that the coordinating or subordinating nature of discourse relations plays a major role in this revision, examining in particular a relation typical in narratives, *Result*, as well as a family of dialogues relations: content-relations introduced by interrogatives. Their complex behaviour shows that the RIGHT FRONTIER CONSTRAINT, a major principle in most discourse theories, needs to be handled with care. We also generalize the discussion about problems due to the multiplication and the sophistication of discourse principles operating within SDRT, in particular the MAXIMIZE DISCOURSE COHERENCE principle which constitutes an important improvement of the theory but also introduces some methodological issues.

1 Introduction

The RIGHT FRONTIER CONSTRAINT (RFC) on accessibility and possible discourse continuations, introduced in [Webber, 1988, Polanyi, 1988], is exploited in several theories of discourse. The notion of *right frontier* refers to the tree-like structure of a discourse representation, which in all theories involves the notion of complex segment. In SDRT [Asher, 1993, Asher and Lascarides, 2003], the theory that will be discussed in this paper, discourse segments are represented by *constituents* which accordingly are either (i) simple constituents having a propositional content, typically representing a single sentence or utterance, or (ii) complex constituents corresponding to larger segments, that are some kind of container for other (sub-)constituents and the *discourse relations* that relate them.

Like SDRT, most discourse theories do use discourse relations, and in several of them, such relations also affect the hierarchical discourse structure and as a result the definition of the right frontier. For instance, LDM [Polanyi, 1988], Grosz and Sidner’s theory [Grosz and Sidner, 1986], RST [Mann and Thompson, 1987] and SDRT all make use of two kinds of relations behaving differently in the discourse structure. SDRT has extensively exploited this difference in behavior to explain many phenomena at the semantics-pragmatics interface [Asher and Lascarides, 2003]. In SDRT, a *coordinating* relation pushes the right frontier to the right, closing-off its attachment point, while a *subordinating* relation extends the right frontier downward¹ and leaves open its attachment point for further attachments.

In order to discuss the RFC on clear solid ground, we propose in Def 1 our definition of the constraint directly inspired from [Asher and Lascarides, 2003]:pp148.²

Def 1 RIGHT FRONTIER CONSTRAINT

The available attachment points in the discourse structure for a new constituent are those of the right frontier, i.e.,

1. *the last simple constituent introduced in the structure, and*
2. *any constituent dominating the last one,*

where dominance between constituents is defined by the transitive closure of direct dominance: A constituent β is directly dominated by a constituent α iff β is attached to α by a subordinating relation, or β is a sub-constituent of the complex constituent α .

The discourse referents available for anaphora resolution are those which are DRT-accessible³ within the constituents of the right frontier from the attachment point up.

The “coord/subord” distinction is considered by most authors to be part of the definition of the discourse relations in a stable way. In other words, a given relation is by essence of a given kind. However, studying the actual substance of the “coord/subord” distinction, [Asher and Vieu, 2005] have shown that there are cases in which coordinating relations may become subordinating. This means that a given continuation can make a coordinating attachment become subordinating. It can revise the structure and change the right frontier, opening an attachment point that was closed.

We will see in this paper that the opposite change can occur as well. In dialogs, questions are attached to the context with a Rel_q , the question version of the relation Rel that would have attached an answer to the question

¹Without necessarily introducing a complex segment, a difference with other theories.

²The original definition makes use of other concepts that we will like to pass over for the sake of concision since they do not concern our point here.

³See [Kamp and Reyle, 1993] for the notion of accessibility in DRT.

to the same context. Answering the question brings in both a relation between the question and the answer (*QAP*), and the relation *Rel* between the context and the answer. Since relations Rel_q are proved to be subord (see [Asher and Lascarides, 2003]:pp332), if the corresponding assertive relation *Rel* is coord, answering a question modifies the right frontier, closing off an open attachment point.

In the next section we will describe and discuss the right frontier change when a coordinating relation, *Result*, becomes subordinating. Then, we will examine the dialog relations *Narration_q* and *Explanation_q* to show how, in some cases, answering a question alters the right frontier. We will end this paper by more general methodological questions on how theoretical discourse constraints such as the RFC can be evidenced and formulated, especially in the case of theories making use of several interdependent such constraints.

2 Chameleon relations in monologic discourse

In [Asher and Vieu, 2005], several criteria to decide whether a given relation is coordinating or subordinating are proposed, most of them relying on possible or impossible cases of anaphora resolution. On the basis of these criteria, it is also shown that some relations are only coordinating by default. Punctuation and coordination particles can force them to become subord, as shown for *Result* on two examples taken from [Asher and Vieu, 2005] reported below:

- (1)
 - a. Lea screamed (π_1), so the burglar ran away (π_2).
 - b. Lea screamed (π_1), so the burglar ran away (π_2). Max woke up (π_3). #She also got a sore throat (π_4).
 - c. Lea screamed (π_1), so the burglar ran away (π_2) but Max woke up (π_3). She also got a sore throat (π_4).

In (1b), that Max woke up can't be seen as a result of Lea's scream. It is simply understood as a continuation of the story that is being told, i.e., π_3 is attached by *Narration* to π_2 . This is shown by the impossibility to continue the text with π_4 , for the anaphora in the parallel-marker *also* can't be solved. This contrasts with (1c) in which the punctuation and the connective *but* force the attachment of π_3 to π_2 by *Contrast* as well as some kind of *Continuation*, creating a complex segment which can be seen as collecting all the consequences of Lea's scream. In this context, it is now possible to continue to extend this complex segment with π_4 . We see on example (1c) that *Result* changes from coord to subord. As a result, the structure built with the attachment of π_2 to π_1 , Fig.1:(1a), is *revised* when attaching π_3 to obtain that of Fig.1:(1c)1-3. The right frontier is modified, reopening π_1 .

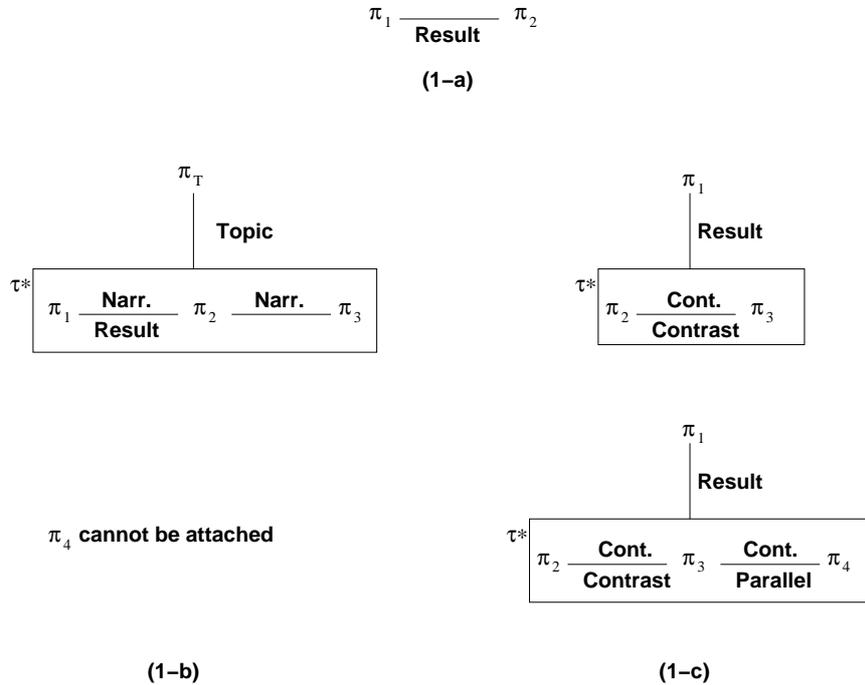


Figure 1: Chameleon relations in example 1

We would like to emphasize that we are not facing a new *Result* relation when its coord/subord nature changes. The relation keeps the same triggering rules and the same semantic effects. The semantics of a relation belongs to the information content level and remains unchanged with chameleon transformations. In fact, what changes only belongs to the information packaging level.⁴ The information-packaging level is generally considered as dealing with defeasible information, and this alone suggests that it is not absurd to consider that the coord/subord nature of a relation may change. As we have seen, *Result* changes in our example because of the presence of punctuation and connectives, which clearly affects information packaging; and it is very likely that the nature of a relation interacts with other information packaging ingredients, as intonation for instance.

In [Asher and Vieu, 2005], it is suggested to handle chameleon phenomena by stating that some relations (e.g., *Result*) are by default coordinating, and that this default can be overridden by more specific discourse clues such

⁴In other theories, for instance in RST, the distinction corresponding to the coord/subord one in SDRT has been taken to be closely linked to the semantics of the relation. SDRT showed from the start the need to distinguish e.g., *Result* (coord) from *Explanation* (subord) whose semantic contents both refer to causality between eventualities.

as punctuation and structural discourse markers (*but* and *also* in our examples). This proposal is not formally implemented in SDRT yet, but it would actually involve using revision mechanisms. Since revision mechanisms are in general best avoided, and since it would with no doubt be theoretically simpler to assume that a given relation is always of a given hierarchical nature, we would like to examine now two possible alternative explanations. The first one extensively uses the notion of discourse topic while the second one tries to handle these problems with underspecification.

2.1 Topic Insertion?

In the case at hand, exemplified in (1-c), we have (i) two constituents (π_2 and π_3) that should be attached with the same relation to the third one (π_1), and (ii) this relation is *coord*. If the relation was *subord*, as we have just suggested, there would be no structural problem (cf. Fig.2:A). A solution that may come to mind, for keeping *Result* *coord*, would be to group the two constituents (π_2 and π_3) into a complex constituent dominated by a topic and to relate this topic constituent to π_1 with the original *coord* relation as shown on figure 2:B.

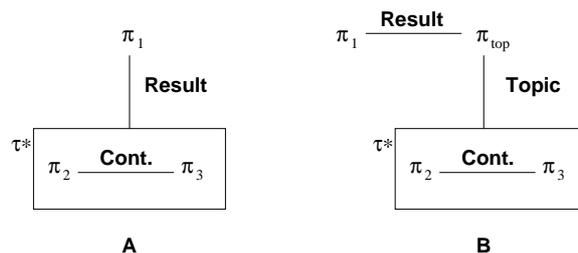


Figure 2: Topic insertion in example 1

In SDRT, discourse topics are assumed to be propositional and are integrated in the discourse structure like any other constituent. Some discourse topics are explicit (e.g., when we have an *Elaboration*), but others are only implicit and have to be built from the contents of the segment it is a topic of, by some kind of subsuming operation [Asher, 1993, Asher, 2004]. In SDRT, discourse topics are essential ingredients of the discourse structure. For example, where a *Narration* is inferred, it is necessarily dominated by a discourse topic (either explicit or implicit).

A solution based on discourse topics as sketched above, raises two problems. First, the two structures depicted in 2:A and 2:B do not have the same availability properties. More precisely, in 2:A the referents in π_1 are available for π_3 while this is not the case in 2:B. Example (1-c) suggests that this availability link exists and therefore indicates 2:A as a more adequate solution.

The second point concerns the content of the topic constituent π_{top} . The relation *Continuation* does not have a semantics by itself; it is only a mark of the continuation of the *Result* relation in this span of discourse. Therefore the topic has to be built taking into account the *Result* relation. However, this relation holds between π_1 and π_2 and π_1 and π_3 but not between π_2 and π_3 . This implies that the potential topic constituent (π_{TOP}) must somehow include some information from π_1 (what is shared between π_2 and π_3 is that they both are consequences of π_1) which is clearly odd from a discourse topic building viewpoint. More precisely, in this case, π_{TOP} does not include π_1 and cannot therefore be the topic of π_1 , but only of what happened once e_1 (the main eventuality of π_1) occurred.

For both these reasons, this approach does not seem suitable. In addition, let's note that, if we start using topics in such a way, there would be little point in keeping subordinating relations other than *Topic* in SDRT since this mechanism could apply to any subord relation.

2.2 Underspecification?

Another way of handling this issue could be to exploit the relatively recent MAXIMIZE DISCOURSE COHERENCE (MDC) constraint of SDRT [Asher and Lascarides, 2003]:p230. Equipped with such a tool, an option consist in questioning the established coord nature of *Result* and attributing to it an underspecified nature. Then it is possible to use additional clues to decide on the nature of the relation, possibly with the help of subsequent clauses. In this way, if the context supports an additional inference to *Narration*, as in (1-b), *Result* will be coord. But if the updated context supports the creation of a complex segment gathering several "results", as in (1-c), *Result* will be subord. The version of MDC (Def 2) we use is based on the gloss given in [Asher and Lascarides, 2003]:pp234.

Def 2 MAXIMIZE DISCOURSE COHERENCE

MDC is based on a coherence partial order on discourse structures. Maximizing coherence amounts to prefer discourse structures with the smallest number of nodes, the fewest semantic and pragmatic clashes, the largest number of rhetorical relations and the fewest number of underspecifications.

The introduction of MDC resulted in an important improvement of SDRT, allowing accounting for new phenomena and significantly simplifying the account of others. However, with this principle we have lost the possibility of accounting for the total incoherence of a given discourse. One structure is simply better than another one. Particularly for an unacceptable discourse it is possible to say that the best structure representing it still has some clashes and similar problems but not to reject it as incoherent by not being able to build any representation, as was done in earlier versions of SDRT.

The interesting counterpart of this potential problem is to offer the possibility of leaving discourse relations underspecified after an update, delaying the decision until enough information is available. This allows to deal with example (2), awkward at first but perfectly alright once completed (adapted from [Caenepeel, 1991] and [Asher and Lascarides, 2003]).

- (2) a. Joe was released from hospital (π_1). ?He recovered completely (π_2).
- b. Joe was released from hospital (π_1). He recovered completely (π_2) and they needed the bed (π_3).
- c. Joe was released from hospital (π_1). He recovered completely (π_2), then he resumed training (π_3).

In this example, the relation between π_1 and π_2 is underspecified before the utterance of π_3 , which makes clear in (2-b) that it is an *Explanation*, a subord relation, and in (2-c) a *Narration*, a coord relation.

[Asher and Lascarides, 2003] do not discuss how to deal with such underspecification in details, although it is quite clear that this case is not resolved with the construction of a number of alternative SDRSs, as for truly ambiguous discourses. The constituent π_2 is surely attached to π_1 but since the relation is left underspecified, its nature is underspecified as well. One wonders then what are the sites available after this attachment, i.e., where is the right-frontier of such a discourse?

The formal definition of SDRS update in [Asher and Lascarides, 2003] considers that only coord relations induce a constraint; so an underspecified relation is dealt with as a subord one, leaving all the sites available. This seems quite reasonable in this example. But if the same is applied for the “underspecification” of the nature of *Result*, it amounts to consider *Result* as subord by default, rather than coord by default. This apparently clashes with the intuition that *Result* is usually coord, as assumed up to now in SDRT on the basis of quite a number of examples.

We consider therefore that one should admit that there are such things as chameleon relations, to be dealt with some sort of revision mechanism. Changes are fortunately not so frequent, and always triggered by specific clues. [Asher and Vieu, 2005] suggests that *Narration*, a prototypical coordinating relation in narratives, is always coordinating, and that no subordinating relation can be turned into a coordinating one. We do not take issue on this precise point here, but, examining dialogs, we will now see that something very close to turning a subordinating relation into a coordinating one can occur and alter the right frontier accordingly.

3 Content relations and interrogatives

Some questions require from their answers to satisfy a given rhetoric relation with the previous discourse context. These questions (introducing relations like *Explanation_q*, *Narration_q*...) have been briefly presented in [Asher and Lascares, 2003] but we believe that the structural aspect of their treatment in SDRT requires more attention, as it has been spotted in [Prévot et al., 2002, Prévot, 2004]. In order to show this, we are going to consider interrogatives introducing subordinating or coordinating relations. We will pay a special attention to the state of the right frontier after the question resolution.

3.1 *Narration_q* versus *Elaboration_q*

Narration and *Elaboration* are among relations that are assumed not to exhibit a chameleon behaviour [Asher and Vieu, 2005]. *Narration* is coordinating while *Elaboration* is subordinating. *Narration_q*, *Elaboration_q* and *QAP* have been shown to be subordinating [Asher and Lascares, 2003].

In example (3), the subordinating nature of *Elaboration*, *Elaboration_q* and *Background*⁵ is coherent and predicts correctly that π_5 is open for pursuing the story (see fig 3).

- (3)
- A₁ Yesterday I visited Fez, it was great!
 - B₂ Really? Where did you go?
 - A₃ In the morning, I've been in the medina. (π_3)
 - A₄ I started by getting lost (π_4)
 - A₅ and then a child guided me to the souk. (π_5)
 - B₆ The tanner's souk? (π_6)
 - A₇ No the shoemaker's one. (π_7)
 - A₈ There were some wonderful babouches there! (π_8)
 - B₉ He took you to his uncle's shop, right? (π_9)

In example (4) the interrogative in (B6) introduces a *Narration_q*.

⁵In [Vieu and Prévot, 2004], we applied the test proposed in [Asher and Vieu, 2005] and we found out that *Background* was a subordinating relation, contrary to what had been proposed up to now in SDRT but in agreement with RST's viewpoint.

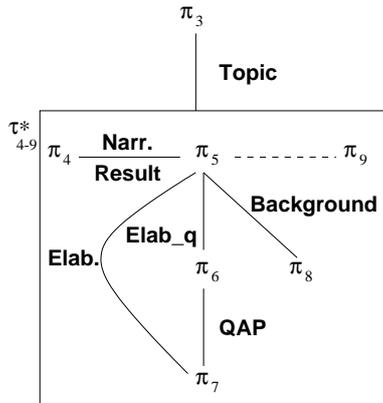


Figure 3: Discourse structure for (3): $A_3 - B_9$

- (4)
- A_1 Yesterday I visited Fez, it was great!
 - B_2 Really? Where did you go?
 - A_3 In the morning, I've been in the medina. (π_3)
 - A_4 I started by getting lost (π_4)
 - A_5 and then a child guided me to the souk. (π_5)
 - B_6 Then, what did you do? (π_6)
 - A_7 There I recognized the place (π_7)
 - A_8 and I went to the shoemaker's of the other day. (π_8)
 - B_9 # He took you to his uncle's shop, right? (π_9)

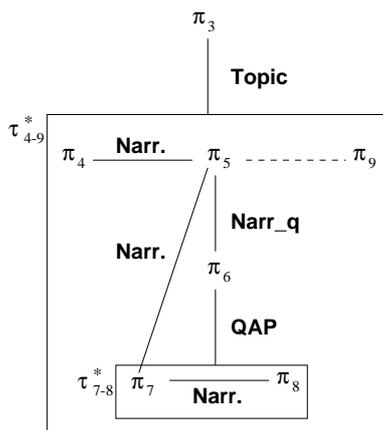


Figure 4: Discourse structure for (4): $A_3 - B_9$

In this case, the standard SDRT analysis [Asher and Lascarides, 2003] faces two problems. Firstly, the structure predicts wrongly the availability of π_5 for further attachments, for instance for π_9 , which is unacceptable (see figure 4). Secondly, the subord nature of $Narration_q$ and QAP results in a puzzling subord $Narration$ between π_5 and π_7 , $Narration$ being the prototypical coord relation.

These two problems point toward the necessity of a coordinating attachment between π_5 and some other node. Indeed, since π_5 is not available for π_9 in example (4), the hypothesis that there is some node on its right would explain the blocking. We conjecture, as we will see now, that this additional node needs to be attached to π_5 , instead of the answer, by a $Narration$ relation.

3.2 A solution using a question-answer topic

The solution proposed, as presented in [Prévot et al., 2002, Prévot, 2004] is to assume that the question-answer pair generates a dominating discourse topic. This topic is a simple constituent whose content is the resolved question/answer pair. In case of simple answers, the content of elliptical answers to questions is already reconstructed in the answer constituent and therefore the topic is only a copy of the answer. But in case of complex answers the topic is built as an abstraction over the answers, just as for narrative topics. The establishment of the QAP relation generates this topic over the question-answer sequence and this topic is attached to the previous discourse with the expected assertive relation, with its expected type of attachment. In figure 5, (A) corresponds to a subord relation after question resolution while B corresponds to a coord relation. In this figure, γ is the target of the question α , and β is the answer to α . The *Topic-Question* relation associates two constituents: τ^* , which is a complex constituent for the segment consisting of the question and the answer, and τ , which is the topic itself, a simple constituent built from the question and its answer(s).

With our solution, what changes is the importance of the $Relation_q$ in the structure. It is in a first time crucial for tackling the coherence of the dialogue. And it becomes secondary once the structure is updated by the establishment of a satisfying answer to the question. The relation between γ and β is actually established between γ and τ .

Surely $Narration_q$ still holds between π_5 and π_6 in example (4) but it is no more important for availability issues. This $Narration_q$ is only part of the dialogue history but still helps increasing the overall coherence for the MAXIMIZE DISCOURSE COHERENCE constraint which prefers discourse interpretations offering the highest number of rhetorical links (among other criteria). Instead, $Narration$ between π_5 and τ takes on a more important role for the RIGHT FRONTIER CONSTRAINT.

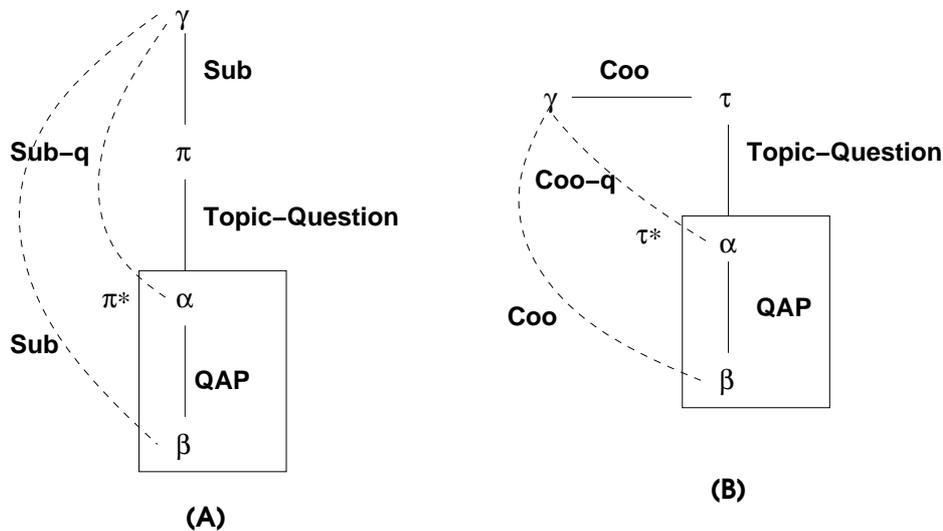


Figure 5: Question-Answer attachment in the case of a simple Q-A pair

Applying our proposal to examples (3) and (4) leads to the discourse tree represented on figures 6 and 7 respectively. Figure 7 shows that we correctly model the fact that π_5 is not available anymore for further attachment once the question π_6 is answered and closed. We correctly capture the unavailability of the discourse referents introduced in this constituent for pronominal anaphora resolution.

4 More general and methodological issues

For accounting of the subtleties that appeared around the RFC, we proposed solutions that introduced modifications of the discourse structure. In particular, we use more and more implicit discourse topics that are not directly corresponding to the surface form. Such method is also followed in [Asher, 2004],[Asher, this volume], essentially for dealing with definite descriptions. In Asher’s proposal, binding definite descriptions whose antecedents are not on the right frontier might force the creation of new implicit discourse topics. This path toward sophistication seems unavoidable but raises three main issues.

Methodological confusion The profusion of theoretical constraints and principles that could be extended or altered forces to choose among potential modifications for explaining any new phenomena at hand. For example, as we saw in the section 2, in order to explain the availability of discourse referents in example (1) one might decide to introduce chameleon relations,

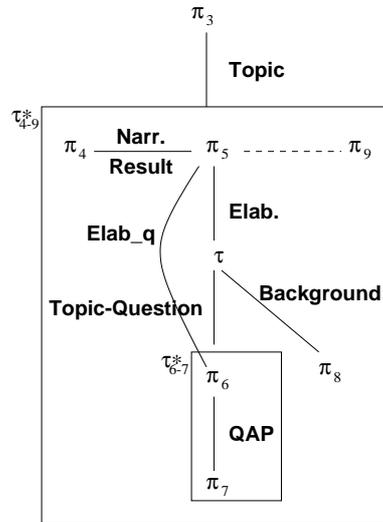


Figure 6: New structure for (3): $A_3 - B_9$

another person to introduce more sophisticated topic management rules, while another might just let MDC do the job and simply introduce more underspecification. As we have seen, there seems to be reasons for preferring the first option, but we still believe that a clear methodological line for deciding when, where and how we should preferably integrate new elements into the system is lacking.

Principle Interdependence More sophistication results in a variety of principles that are more difficult to handle. Their complex interaction is difficult to deal with since all the constraints may move simultaneously. Namely, RFC, MDC, topic construction rules and the coord/subord distinction have all important consequences for the discourse structure and therefore for referent availability. We saw that topic construction rules and chameleon relations have important effects on the right frontier. Similarly, introducing more implicit topic nodes in the representations affects MDC, as this yields less preferred structures. If we modify these constraints without taking care of their interaction the risk is high to enter a long chain of modifications without succeeding in stabilizing the system.

Acceptability criterion The sophistication of the theory is unavoidable for accounting for more linguistic phenomena, i.e. analyzing a larger number of acceptable discourses as coherent. However extending the theory in this direction often means releasing constraints. And while releasing constraints, we have to make sure to remain able to analyze unacceptable discourses as incoherent. In particular, the MAXIMIZE DISCOURSE COHERENCE principle

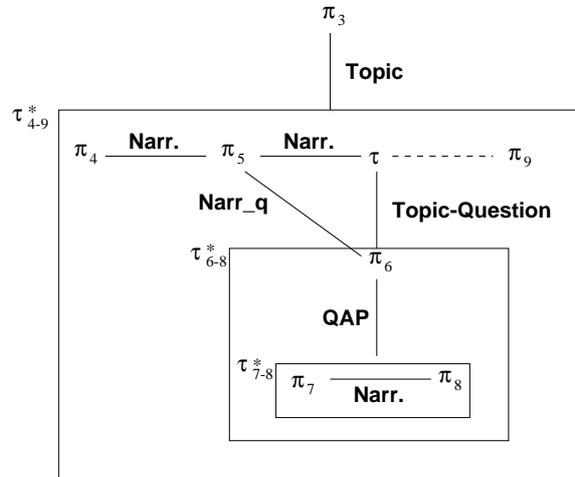


Figure 7: New structure for (4): $A_3 - B_9$

made us lose what was once our basic methodological rule: being able to account for the acceptability or unacceptability of a given discourse, analyzing it as coherent or incoherent (see Def. 2).

In spite of—and because of—its recent move introducing MDC, SDRT today requires a general reflexion on how to handle the scalarity of discourse acceptability. Some anaphora links seem to manage to violate RFC, as in example (5). Similarly, when looking for examples with interrogatives (for Section 3), we actually ended up many times finding examples that were strangely acceptable in spite of the theoretical unavailability of discourse referents. We believe that this is often due to complex phenomena occurring in the construction of discourse topics (not only for question-answer pairs), so, in essence, we agree with [Asher, this volume]. But overall, such difficulties point toward the scalarity in the acceptability of discourses, based on some kind of scalarity of availability of referents for anaphora resolution. This point constitutes a strong argument in favor of the MDC, although apparently at the cost of releasing RFC, at least in its referent availability point. Such a move is argued against in [Asher, this volume].

- (5)
- a. This morning, in the subway, I almost got robbed.
 - b. At some point a man started pulling at my purse.
 - c. I just froze.
 - d. A woman screamed,
 - e. and the pickpocket escaped.
 - f. I wanted to thank **her** but she had disappeared.

- (6)
- π_1 On his birthday, John had a great evening.
 - π_2 He started by winning a dance competition.
 - π_3 His partner was very seductive
 - π_4 and she gave him her phone number.
 - π_5 Then he had a great dinner and party with some friends.
 - π_6 The entire next day John kept hesitating about calling **her**.

In fact, according to [Asher, this volume], the pronouns in bold in examples (5) and (6) yield unacceptable discourses, while the same examples with definite descriptions would be acceptable. We agree that such discourses are more awkward than others but we believe that a deep corpus search is bound to exhibit similar examples⁶. Moreover it is important that the theory explains why such forced examples are still better than very bad examples like (7).

The scalarity of acceptability is also signalled by the fact that disagreements exist between naive readers (both on French and English language examples) according to the acceptability. What needs to be discovered is whether such scalarity is part of RFC or is accounted by MDC, less satisfactory “forced” anaphoras bringing less satisfactory structures. The second option looks more elegant but we need to be sure that it can explain why examples like (5)-(6) are less acceptable than perfectly “well-formed” discourses and more acceptable than totally mistaken ones such as (7). In order to do so, MDC, i.e., the coherence partial order on discourse structures which combines several possibly non-converging criteria, needs now to be more systematically tested, including on corpus examples.

- (7) [Asher and Lascarides, 2003]
- π_1 John had a great evening last night.
 - π_2 He had a great meal.
 - π_3 He ate salmon.
 - π_4 He devoured lots of cheese.
 - π_5 He then won a dancing competition.
 - π_6 # It (# The salmon) was a beautiful pink.

⁶It is clear that finding authentic corpus examples of similar anaphora patterns is necessary. However spotting such phenomena is rather difficult because there are a lot of pronouns in the data and most of them do not qualify for testing our propositions. Most pronouns are either clearly linked to a referent in the discourse topic or in the last utterance. In order to facilitate the research one needs a corpus annotated with anaphoric links, discourse structure, and more particularly discourse pop-ups.

5 Conclusion

This paper has shown some limit cases for the RIGHT FRONTIER CONSTRAINT. RFC in SDRT is founded on the coordinating/subordinating nature of relations and we explained that this nature, situated at the information packaging level, is not as stable as believed. Moreover the importance of a given coherence relation might evolve during the interpretation of discourses, as shown on content-level relations introduced by interrogatives in dialogues. RFC is therefore a discourse principle that needs to be used with care. In order to make its use more reliable, we must (i) examine systematically each relation under the light of [Asher and Vieu, 2005] tests for their nature, (ii) clarify the interaction between the nature of relations and other information-packaging phenomena and, (iii) propose a new revision mechanism to be integrated within SDRT for dealing with chameleon relations. We then need to pursue the work on topic construction started by Asher in [Asher, 2004], [Asher, this volume], as the insertion of implicit topics in discourse structures, a crucial method for handling a number of phenomena in SDRT, also affect RFC.

However, we also discussed the difficulties due to the multiplication of interacting principles when elaborating SDRT for increasing its coverage of acceptable discourses, as we have just done in this paper. In particular, we noticed the loss of clear-cut acceptability/unacceptability criterion with MDC. This last principle is powerful but requires from our point of view a systematic evaluation of its application on various examples of good, merely correct and odd discourses.

This paper thus contributes to show that a sophisticated theory like SDRT is in need of general methodological principles on how to handle the evolution of its own foundations, i.e, discourse constraints such as RFC and MDC. This is especially true now that the use of SDRT is spreading in the community.

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