

# Links, tails and monotonicity

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## 1 Introduction: Links, locus of update and non-monotonicity

Vallduví (1992, Vallduví & Engdahl 1996) proposes a threefold partition of information structure on the sentence level: Links, Tails and Foci, where Links and Tails correspond to the notion of background (Jackendoff 1990), while Foci and Tails correspond to what has been called the comment in topic-comment structures (e.g., Reinhart 1995).<sup>1</sup>

Vallduví's account is implemented in file change semantics (FCS, Heim 1982). While the notion of file is called a 'metaphor' in Heim's original approach, Vallduví makes the structure of the filing cabinet a crucial element in his account. Different configurations of Links, Tails and Foci translate to different update instructions which operate on the filing cabinet. Links trigger a GOTO-instruction which locates a file card, activates it and prepares it for an update. The content of the update is transmitted by the focus of the sentence.

An important feature of Vallduví's theory is that his update instructions crucially depend on the existence of file cards as a unit which can be located and manipulated. File cards are, however, a concept which is highly dependent on FCS as a framework and they have no correspondence in Discourse Representation Theory (DRT, Kamp & Reyle 1993), its most important alternative framework. In this paper I want to explore the possibility of reinterpreting the function of Links without having to assume the existence of file cards. I will interpret them as anaphora, following Hendriks & Dekker (1996), who claim that Links are non-monotone anaphora. I will revise the non-monotonicity condition and show that this condition is not a necessary one for Links. Instead, I will suggest that Links signal a change of discourse topic and the monotonicity condition follows from that. I will also discuss whether the locus-of-update analysis of Vallduví's original proposal can be maintained in another form, considering that the locus of update is a discourse topic instead of a file card. Under such a reinterpretation the account would prove to be transportable from FCS to DRT. I will also show that this account of backgrounds can be extended to an analysis of Tails.

FCS has been said to be essentially equivalent to DRT, since the two approaches capture the same insights and feature similar devices to explain existential closure on the level of texts. There are, however, some differences between the two models, especially concerning the dimension of representation. FCS offers a simple database structure, which represents the knowledge transmitted during a discourse, while the structure of the discourse itself is lost once the information has been annotated on the corresponding file card. This has been shown to allow a cognitive modelling of the knowledge store (Zuo & Zuo 2001), although the file card as a *linguistic* unit does not seem to have a purely linguistic motivation. In fact, Heim referred to the file merely as a *metaphor*.

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DRT, on the other hand, concentrates on the representation of the discourse and does not intend to directly model the knowledge state of the discourse participants. In DRT the discourse referents in the universe of a DRS are simple namespaces which are there to properly bind the free occurrences of variables in the DRS condition set and, thus, guarantee existential closure on the text level. On the other hand, the information on individual discourse referents is scattered all over the DRS. The information concerning referents is recoverable, but not directly accessible as in FCS. In practice and despite the apparent differences, most authors working in DRT have assumed that the insights of FCS can be modeled in DRT, a claim which is true for most of the data which was taken as evidence for the two theories, especially the resolution of anaphora and the definition of their accessibility conditions (cf., e.g., Kadmon 2001).

Returning now to Vallduví's treatment of information packaging, it is not directly clear how his proposal can be transported from FCS to DRT because of the fact that it uses direct operations on file cards (which have no equivalent in DRT). A move from FCS to DRT would be desirable for practical and theoretical reasons. DRT has been an extremely fruitful area of research over the last decade and it has proven to be an adequate framework to model a wide range of discourse phenomena. From a theoretical point of view, it is doubtful if a data structure like file cards should be present in a linguistic representation if they are not needed for the explanation of genuinely linguistic facts. It is nevertheless also important to stress that eliminating file cards from linguistic representations does not necessarily entail abandoning a locus-of-update interpretation for Links. The only necessary consequence of abandoning file cards is that file cards cannot be the locus of update.

Hendriks & Dekker (1996) present an alternative treatment of Links within DRT and argue against Vallduví's located version of Links on the basis of three arguments. First they argue that DRT is a model which presupposes less cognitive effort for the maintenance of the discourse model. Second, they observe that there are sentences which do not allow for an appropriate location in the FCS file, e.g., weather sentences like *It's raining*, which lack nominal referents to which the information content of the sentence can be attributed via an GOTO-UPDATE-instruction (since there is no location/file card to go to in DRT). In this case there is no nominal referent associated to a file card onto which the information 'rain' will be annotated. A third and related argument is the difficulty to represent negated, quantified and disjunctive information.

Their argumentation goes against file cards as a linguistic unit as well as against a located interpretation of Links in general. I will follow them in assuming that file cards do not have a higher linguistic status than the one of a metaphor, but I would like to question the claim that Links do not signal a location. Their criticism is mainly based on the problems that arise if only nominal referents can serve as a location for Links. If a wider range of discourse referents is assumed, including events, spatiotemporal anchors and other abstract objects, their arguments are considerably weakened.

Although Dekker and Hendrik's arguments against a locus-of-update analysis can be questioned, the problem they signal with respect to file card representations is valid and their alternative proposal for the treatment of Links is attractive: They reinterpret Links as non-monotone anaphora, and as such they don't have the need to locate and activate a file card. I will follow them in assuming that Links are anaphora. On the other hand, I will survey various questions which their account leaves open:

1. If Links are anaphora, how can their antecedents be resolved and which factors constrain the anaphoric relationship?
2. If Links are anaphora, what are Tails? Most probably they should be treated as anaphora as well. Are they then monotone anaphora?
3. What does it mean for an anaphor to be monotone or non-monotone? How can the relation between background (Links and Tails) and antecedent be modelled?

I will not pursue a detailed integration of Information Structure in DRT here and will rather concentrate on an account which does not recur to file cards, the main reason why Vallduví's original account is not transportable to DRT. In the next section I will critically revise the non-monotonicity requirements on Links and give an alternative formulation which extend to Tails. In section 3 I will return to the locus-of-update problem. I will sketch a proposal which treats discourse (segment) topics as the locus-of-update update for Links.

## 2 Data and discussion: The non-monotonicity condition revisited

The examples of link-construction in the literature fall broadly into three categories. I use Catalan examples, since in Catalan, Links are usually preverbal and separated by an intonational pause; hence they are easily identifiable and can hardly be confused with other constructions:

1. Links overspecify (are more specific than) their antecedent (cf. (1), modelled on an example by van Deemter 1993)
  2. Links are part of a plural individual antecedent (cf. (2))
  3. Links pick up a discourse referent which is not as high in the accessibility ranking as a conflicting alternative antecedent (cf. (3))
- (1) a. A Mozart, li agradaven els instruments de corda?  
Did Mozart like string instruments?
- b. [La viola]<sub>link</sub> segurament li agradava.  
[The viola]<sub>link</sub> surely it-cl he-liked  
The VIOLA, he surely liked.
- (2) a. Què en saps, dels teus amics?  
What do you know about your friends?
- b. [La Maria]<sub>link</sub> , la vaig veure fa poc.  
[ART Maria]<sub>link</sub> , her have-seen ago little.  
Mary, I have seen recently.
- (3) A: He vist que el president té una col·lecció de porcellana de Delft. He comprat una nova peça per a la col·lecció. Creus que ha estat bona idea?  
I have seen that the president has a collection of Delft china. I bought a new piece for his collection. Do you think this was a good idea?
- B: No. [El president]<sub>link</sub> l'odia, [la porcellana de Delft]<sub>tail</sub> .  
No. [The president]<sub>link</sub> it-hates, [the china from Delft]<sub>tail</sub> .  
No. The president hates the Delft china set.

Let us now discuss the non-monotonicity condition. Hendriks and Dekker (H&D hereafter) offer the following hypothesis for Links as non-monotone anaphora:

- (4) NonMonotone Anaphora Hypothesis (NAH, Hendriks & Dekker 1996): Linkhood (marked by L+H\* accent in English) serves to signal nonmonotone anaphora. If an expression is a link, then its discourse referent Y is anaphoric to an antecedent discourse referent X such that  $X \not\subseteq Y$ .

This hypothesis is expressed in terms of sets: The set corresponding to the antecedent is not a subset of the set corresponding to the Tail. This prediction is met in (2), since  $\{Maria\} \subset \{x : friend(x)\}$  and the second is not a subset of the first. Also (1) might be explained by the NAH: both *string instruments* and *viola* are kind referring. If we assume that kind referents are organised in sets with subsets and supersets then the set of kinds  $\{x : string\_instrument(x)\}$  is not a subset of  $\{viola\}$ .

The NAH also affects identity and it follows that  $X \neq Y$ , which seems to be empirically inadequate in the light of (3), because *president* is the antecedent for *president*. In contrast to (3), H&D discuss examples where a identity reading is blocked by virtue of an NP being phonologically marked as a Link (and L+H\* accent, represented by bold face characters), as the one in (5). I assume that the difference between (3) and (5) has to do with condition 3 for Tails from above, the accessibility ranking of antecedents.

- (5) Ten guys were playing basketball in the rain. [**The fathers**]<sub>link</sub> were having FUN.

Further on, there is one more complicating factor, mentioned by Hendriks and Dekker, but not discussed in detail there: the anaphoric link between an individual and the kind it is an instantiation of (and vice versa). They shortly discuss the following example, under the name of **Kind Introduction**:

- (6) a. Few men joined the party. They are very conservative.  
 b. Few men joined the party. [**Men/Humans**]<sub>link</sub> are very conservative.

The relevant reading of (6a) is the one in which *they* as well as the NP *men* in (6b) is referring to the kind *men*, meaning roughly that *men in general are conservative*. Even the super-kind *humans* is licensed as a Tail with the antecedent *men*. The problem which this example poses for the NAH is that kinds are not the same as the set of their extension (Carlson 1977). In a harmless sentence with a kind-denoting bare plural, such as *lions have manes*, a set-treatment of the NP *lions* will render the prediction that the sentence itself is false, since many members of the set (lionesses, the majority of *lions*) have no manes. This means that the NAH in its set-theoretic version does not predict the anaphoric link in the kind referring readings of (6) since the discourse referent for the kind *men* does not refer to a set.

In Bott (in preparation) I propose an integration of algebraic semantics into DRT. There monotonicity follows directly from the algebraic structure of semantic domains. For the time being we can define monotonic entailment in the following way, along the lines of ter Meulen (1995): ‘If  $x$  realises (a kind)  $k$  and  $k \leq k'$  then  $x$  realises  $k'$ .’ ‘ $\leq$ ’ indicates a part-of relationship which holds for the description of kinds. For example *Spunky*, which realises the kind *dog* will also realise the kind *mammal*. The reverse ( $\geq$ ) is not a monotonic inference anymore, since the kind *mammal* may be realized by the kind *dog* as well as by *cat*, among others. Nevertheless the relationship between  $k$  and  $k'$  is constrained in that one must be a subkind of the other. Note that the not-subset formulation of the NAH requires no other condition for a Link than not being a superset of the antecedent. Here we opt for a positive and more constrained requirement, which allows for identity between Link and its antecedent (probably the reason for H&D’s negative condition) and leave

cases like (5) to be ruled out by an independent requirement, which implies accessibility ranking and/or discourse structure. We will return to this issue shortly. Now observe that the  $\leq$ -relation also holds between individuals (like *Ringo*) and plural individuals (like *the Beatles*) which include the former. Individual referents may form part of plural referents. Plural referents do not necessarily correspond to the set of its members, they can also be treated as an algebraic object. Such an object is a single entity, although it is the referent for a plural individual, such as *my neighbours*. A plural referent then connects to the individuals which are part of it (its ‘members’ in a set definition) by a  $\leq$ -relation. This results in a lattice structure, as proposed by Bach (1986) and Carlson (2001).

In addition to the fact that superkinds can be monotonically inferred from their subkinds, we need to say something about the relation that holds between a kind  $k$  and all the individuals that instantiate  $k$ . I assume that given an individual  $x$ , the existence of the corresponding kind  $k$  is a monotonic inference. This is also implicit in ter Meulen’s definition above, since in order to know what a superkind of a given instance  $x$  is, we have to know to which kind  $k$   $x$  belongs to. Note that the under this assumption neither of the Links in (6) is a non-monotone anaphor, a problem which mirrors the case of (3).

In the light of this (simplified) definition of monotonicity, we can now return to the examples above. If Links are non-monotonic a  $\geq$ -relationship must hold between the Link and its antecedent, and that is what we find:  $\llbracket \text{string instruments} \rrbracket \geq \llbracket \text{viola} \rrbracket$  and  $\llbracket \text{friends} \rrbracket \geq \llbracket \text{maria} \rrbracket$ . If we hypothesize that Tails are monotone anaphora the difference between Links and Tails is that Tails must stand in a  $\leq$ -relation to their antecedents, the opposite of the  $\geq$ -relation which holds for Links. This would predict that the examples which involve a  $>$ -relation above are reversible. In fact, this is what we can observe in the case of (1) and (2):

- (1') Mozart wrote many pieces for the viola. He must have LOVED  $\llbracket \text{string instruments} \rrbracket_{\text{tail}}$ .
- (2') A: What do you know about Mary? B: I haven't MET  $\llbracket \text{friends} \rrbracket_{\text{tail}}$  recently.

In other cases, however, this seems not to be enough, e.g., in (3). Here the criterion of choice between realisation as a Link or as a Tail seems to be the existence of a more accessible intervening and conflicting discourse referent, i.e., *nova peça*. The  $\geq$ -relation holds here, since  $\llbracket \text{president} \rrbracket \geq \llbracket \text{president} \rrbracket$ . But this relation alone cannot account for the status as a Link since the anaphoric relation is a monotonic one. What such cases seem to suggest is that we need, in addition, a definition of what it means for one discourse referent to be more accessible than another. In standard DRT, an accessibility-ranking does not follow directly, since accessibility is a purely structural relation which has no weights. Nevertheless, this is not a new problem. For example Blackburn and Bos (1999) integrate a centering algorithm in DRT in order to choose between conflicting antecedents in the case of plain pronouns. Most probably discourse segmentation and structuring plays an important role for accessibility conditions as is the case for the accessibility of plain pronouns (Grosz & Sidner (1986) and following work). For the time being I will assume a simplistic no-possible-higher-rated-conflicting-discourse-referent condition, but I assume that accessibility ranking is closely tied to discourse structuring.<sup>2</sup>

Resuming the discussion so far we arrive at the following anaphoricity condition for Links and Tail:

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<sup>2</sup>I am thankful to an anonymous reviewer for pointing out that this perspective should be embedded in model of conversational interaction. I will suggest such an integration in section 3 but I will have to leave a more detailed explanation for future work.

- (7) Anaphoricity conditions for Tails and Links:
- a. If an expression  $\Xi$  is marked as a Link, its discourse referent  $X$  may be anaphoric to a discourse referent  $Y$  if  $X \geq Y$ .
  - b. If an expression  $\Xi$  is marked as a Tail, its discourse referent  $X$  may be anaphoric to a discourse referent  $Y$  if  $X \leq Y$ .
  - c. If an expression  $\Xi$  is marked as a Tail, its discourse referent  $X$  may be anaphoric to a discourse referent  $Y$  if there is no grammatically matching possible antecedent discourse referent  $Y'$  for  $X$  and  $Y'$  is more accessible for  $X$  than  $Y$ .
  - d.  $\leq$  is a partial order relation.
  - e.  $X$  can be non-monotonically inferred from  $Y$  if  $X > Y$ .
  - f.  $X$  can be monotonically inferred from  $Y$  if  $X \leq Y$ .

### 3 Links, contrast and identity

In the last section I have argued that Links with non-identical antecedents are indeed non-monotone anaphora. But cases like (3B) are problematic where the Link *el president* is anaphoric to *el president* in (3A). The NAH would predict wrongly that both NPs have different referents, i.e., that we are talking about two different presidents. In turn, the anaphoricity conditions in (7) allow for a identity between Link and its antecedent and (7c) rules out a Tail realisation of *el president*'s discourse referent. What is unsatisfactory about (7) is that it predicts that a discourse referent may be both realised as a Link or a Tail if it is identical to its antecedent. And worse than being unsatisfactory, it renders the wrong prediction in the case of (5), where an identity reading is blocked by virtue of being a (L+H\*-accented) Link and an identity reading of this example is only possible if the NP *the fathers* is realised as Tail and carries no accent.

Before we try to resolve this problem, note that (7) does not rule out that an identical referent may be either realised as a Link or a Tail. And in fact, we find cases like (8), where both a Link or a Tail realisation is possible (the English translations differ in placing a Link-associated accent on *Enric* or not in (8b) and (8b'), respectively)

- (8) a. Saps alguna cosa de l'Enric?  
Do you have any news about Enric?
- b. [De l'Enric]<sub>link</sub> no en sé res.  
[About art-Enric]<sub>link</sub> not cl I-know nothing.  
No, I don't know ANYTHING **about Enric**.
- c. Però la seva germana sí que l'he vist  
But art his sister yes that her-I-have seen  
But I have SEEN **his sister** .
- b'. No en sé res, [de l'Enric]<sub>tail</sub> .  
Not cl I-know nothing [About art-Enric]<sub>tail</sub> .  
No, I don't know ANYTHING about Enric.

Again the marking of *Enric* as a Link in (8b) does not signal non-identity with its antecedent. What it does mark is contrast (in the sense of Büring 1999). This makes (8c) a natural continuation. Actually such a continuation is somehow expected by the hearer after the (8b) has been uttered. Also (1), (2), (5) and (6) show this contrastivity effect.

We could now include some contrastivity condition to (7), but there is nothing in the formulation of (7) which makes this more than an ad-hoc solution. And on the contrary to (8b), example (3) does not seem to show such a contrastivity effect. So either not all Links are contrastive topics or contrastivity follows (only in some cases) from some other feature of Links. I will explore the second option and assume together with Brunetti (2006 and this volume) that Links are shifting topics: They (necessarily) signal a shift from one discourse topic (or discourse segment topic) to another (van Kuppevelt 1997) . In most of the cases we have seen, it is clear what such a shift means. In (1) the shift happens from the discourse referent of *instruments de corda* to the one of *viola*, in (2) the change is from *amics* to *la Maria* and in (3) there is a change from *col·lecció de porcellana de Delft* to *el president*. In the former two cases a contrast is evoked because the ‘contrast set’ is given by the context since the (discourse referent of the) Link forms part of the (discourse referent of) its antecedent. In (3) there is no context given contrastive set and, accordingly, we do not observe a contrastive effect.

Now, what about the shift of discourse topic (d-topic) in (8b)? It looks as if this example displays a null shift from the d-topic *Enric* to *Enric*. This would make us infer that *Enric* is not identical to *Enric*, which is half-true, since the first *Enric* is an individual and the second *Enric* is an individual which is part its contrastive set. Still, *Enric* is equal to *Enric*.

I would like to propose the following solution, following Brunetti’s analysis: Let  $y$  be the discourse referent of *Enric*. The fact that both the d-topic of (8a) and the signalled d-topic of (8b) are the same (i.e.,  $y$ ) violates the shifting requirement for Links and triggers the creation of a further d-topic: the discourse referent  $x$ , such that  $x \geq \llbracket \text{Enric} \rrbracket$ .  $x$  is now temporally the current d-topic and with that it is maximally accessible. The d-topic has now shifted from  $y$  to  $x$ , and since *Enric* is the Link of (8b), it must shift back to  $y$ , *Enric*’s referent. Note that  $x$  corresponds to the alternative set of *Enric*. Note further, that *his sister* in (8c) will also be anaphoric to  $x$ , since her referent will also be part of  $x$  and is in the contrastive set of  $y$ . If, in turn, *Enric* is realised as a Tail in (8b’) no d-topic  $x$  for the contrastive ‘set’ of *Enric* will not be created and (7c) will not be violated. No topic shifting occurs with Tails.

Now, what about (5)? Under the current proposal, the Linkhood of *the fathers* signals a shift of the d-topic. To avoid a null shift the referent of *fathers* will be interpreted as being non-identical to the referent of *ten guys* or else the Link would violate its shifting requirement. In this example no referent for the alternative set needs to be created, since *ten guys* already constitute an alternative set.

What advantages does an analysis present that claims a topic shift trigger of Links? First, the contrastive effect is explained since  $y$  is interpreted in contrast with its alternative set  $x$ . The contrastive effect follows from the fact that the d-topic shifts from  $x$  to  $y$ . So (8) can be now explained on a par with (3). The difference between (8) and (3) is that the (3) implies no double shift and no alternative set is created implicitly. Hence (3) shows no contrastivity effect. Also the non-identity reading of (5) can be explained because of the obligatory d-topic shift. Secondly, Links can be explained as shifting (or locus-of-update redefining) topics, which preserves the essence of Vallduví’s original account of Links as triggering a GOTO instruction. In this account no file card will be located, but a d-topic. And finally, the difference to the Tail-construction (8b’) can be explained, since the presence of the discourse referent  $x$ , which becomes maximally accessible after it has been created with the status of a d-topic will block a Tail-realisation of  $y$ , by virtue of (7c), i.e., the contrastive set as a referent blocks the Tail-realisation. The Linkhood of

*l'Enric* does not signal non-identity with its antecedent, nor does it require a contrastive interpretation *per se*. Instead, the realisation of *x* as a Link signals a shift of the d-topic, which necessarily has to result in a double shift by virtue of the identity between the Link (referent) and its antecedent.

#### 4 Conclusion and outlook

In this paper I have argued for an anaphoric treatment of Links and Tails. I have shown that the Links may be non-monotonic, but I have also shown that this is not a necessary condition, since some Links may be antecedent-identical. The discussion of referent-identical Links in section 3 is only roughly sketched, but the data strongly suggests that Links must be explained in terms of accessibility conditions and/or discourse segmentation. The explanation of Link referents as being part of their antecedent referents and contrastivity could both probably be the consequence of the structure of discourse.

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