

## Links, Tails and Monotonicity

Vallduví (1992, and subsequent work) proposes a tripartite distinction of information structure: Links, Tails and Foci, where both Links and Tails correspond to the notion of background (Jackendoff 1990), while Focus and Tail corresponds to what has been called the comment in a topic-comment (e.g. Reinhart 1995) structure. Vallduví's idea was implemented in file change semantics (Heim, 1982). The notion of file was called a "metaphor" in Heim's original approach, while Vallduví makes the structure of the filing cabinet a crucial element in his account of information structure and information packaging. Different configurations of Links, Tails and Foci translate to different update instructions which operate on the filing cabinet.

Such a step from a mere file "metaphor" to a meaningful structure which represents knowledge organisation is not an unmotivated one, as Zuo and Zuo (2001) show in what they call an "iceberg model" of knowledge representation. The Heimian file corresponds to the top of the iceberg, while its main body is what they assume to be a general model of real-word knowledge. So, according to them, the representation of a discourse is just the topmost part of what we know or (in the case of a discourse) learn about the world. Their approach is explicitly cognitive in nature, but they also present a computational model of handling discourse update.

Heim's file-change semantics have been held to be essentially equivalent to Discourse Representation Theory (DRT, Kamp and Reyle 1993), since the two approaches capture the same insights and feature similar devices to explain existential closure on the level of dialogue. Many authors have thus used the notion of the Kamp-Heimi approach (cf. e.g. Kadmon 2001). There are, however, some differences between the two models, especially concerning the dimension of representation. DRT concentrates purely on the representation of the discourse and a modeling of knowledge organisation in the sense of Vallduví and Zuo and Zuo is not possible in a straightforward way. While in Heim's approach discourse referents are tied to a file-card on which information about them is represented, in DRT the discourse referents in the universe of a DRS are simple namespaces which are there to properly bind the free occurrences in the DRS condition set. In this way, DRS elegantly represents existential closure in texts. File Change Semantics (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. In DRT, at least some information on discourse is preserved; segmented DRT (SDRT, Asher (1993) Asher and Lascarides 2003) incorporate even rhetorical relations between discourse segments. On the other hand the information on individual discourse referents is scattered all over the DRS. This information concerning referents is recoverable, but not directly accessible and this is clearly a central concern of DRT. In practice and despite the apparent differences, most authors working in DRT have been assuming that the insights of File Change Semantics can be directly 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.

Returning now to Vallduví's proposal on information packaging, it is not directly clear how this proposal can be transported from FCS to DRT, especially for the fact that it uses direct operations on file cards, an object type which is lacking in DRT. Such a move from FCS to DRT would be desirable for practical and theoretical reasons, since

DRT has been an extremely fruitful area of research over the past decade. DRT has proven to be an adequate framework to model a wide range of discourse phenomena in. For this reason I will explore an alternative account of Links and Tails within DRT, which shall not violate the spirit of Vallduví's original approach.

Decker and Hendriks (1996) present a treatment of Links within DRT and argue against Vallduví's Located version of Links on the basis of two arguments. First, DRT is, according to them, a model which presupposes less cognitive effort for the maintenance of the discourse model. Although the processing effort is arguable, this question shall not concern us here. Secondly, they observe that there are sentences which do not allow for a location of the in the FCS file, like weather sentences such as *It's raining*, which lack nominal referents to which the information content of the sentence can be attributed via an GOTO-UPDATE-instruction (there is no location/file to go to). In this case there is no nominal referent associated to a file card onto which the information "rain" will be annotated. I will not go into the question of whether this argument is valid or not.<sup>1</sup>

Although Decker and Hendrik's arguments against a FCS-account of Links can possibly be refuted, the problem they signal is valid and their alternative proposal for the treatment of Links is attractive: They reinterpret Links as non-monotone anaphora which do not have to locate and activate a filecard. The explanation of links as anaphora is not new, but it is usually not formally exploited although the idea seems highly promising. On the other hand, their account for these anaphoric elements ends here although various important questions remain:

1. If Links are anaphora, how can their antecedents be resolved?
2. If Links are anaphora, what are Tails? Most probably they should be treated as anaphora as well. Are they then monotonic anaphora?
3. What means non-monotonic for anaphora?

As far as I see, there are three cases in which Links are licensed. I use Catalan examples, since in (spoken) Catalan, Links are usually preverbal and hence easily identifiable:

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 van agradar els instruments de corda?

Did Mozart like string instruments?

- b. [ La viola ]<sub>link</sub>, segurament, li va agradar.  
 [ The viola ]<sub>link</sub>, surely it-cl he-liked

The VIOLA, he surely liked.

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<sup>1</sup>I can think of two good arguments against their point: stage topics in the sense of Erteschik-Schir (1997). (or less theory charged: file cards which represents default context information on time and space) and the representation of events as things that project their own discourse referents. In any case, Decker and Hendrik's argument is more valid as an argument against a FCS version which only treats nominal referents as being referential, as opposed to e.g. events and spatiotemporal anchors (which may in turn be parts of events). I assume that this argument extends to DRT; any discourse representation should allow for non-nominal referents, e.g. events.

- (2) a. Que 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 short.  
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 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.  
No. [ The president]<sub>link</sub> it-hates, the china of Delft.  
No. the president hates the delf china set.

Elsewhere I propose an integration of algebraic semantics into DRT. Monotonicity follows directly from the algebraic structure of semantic domains there. 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  $k'$ .' " $\leq$ " is a part-of relationship which holds for the description of kinds. For example *Spunky*, which realises the kind *dog* will also realise the kind *mamal*; the description of *dog* is part of the description of *mamal*. The reverse ( $\geq$ ) is not a monotonic inference anymore, since the kind *mamal* may be realized by the the kind *dog* as well as by *cat*, among others.<sup>2</sup> The  $\leq$ -relation also holds between individuals and plural individuals which include the former. 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 monotonic anaphora the the difference between Links and Tails is that Tails must or stand in a  $\leq$ -relation to their antecedents while Links stand in a  $\geq$ -relation. A prediction which follows from that hypothesis is that the examples 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  
[ string instruments]<sub>tail</sub> .
- (2') What do you know about Mary. I haven't MET [ friends]<sub>tail</sub> 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*. As it stands, this case can only be resolved by Vallduví's original account for Tails. 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. 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 one. In standard DRT, an accessibility-ranking does not follow directly, since accessibility is a purely structural relation which has no weights. Nevertheless, this is

<sup>2</sup>The use of kinds in this definition of monotonicity is no accident, since kinds play an important role in the resolution of background antecedents. An instance of a kind, e.g., can be anaphoric to a referent denoting the kind itself. (*Pirates are dangerous. Mary MARRIED [ a pirate]<sub>tail</sub>* ). Links and Tails are potentially type-shifting anaphora (ter Meulen 1995).

not a new problem either. 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.

In short, the  $\geq$ -relation with respect to its antecedent is a necessary, but not a sufficient condition for the realisation of a background element as a Link. In addition to this, an accessibility ranking is necessary to determine in which cases Links or Tails are licensed. In contrast to Decker and Hendrik's proposal, the current account explains includes Tails.

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