
Information Structure and Discourse Modelling

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Thesis submitted for the degree of Doctor of Philosophy.
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Universitat Pompeu Fabra
Barcelona, December 2007

Abstract

In this dissertation I argue that there is a very close relation between discourse structure and information structure. Information structure is seen here as a mediating level between discourse structure and discourse semantics. On the one hand, information structure is crucially dependent on context, which is represented by discourse structure. On the other hand, the linguistic realisation of information structure gives important clues on how to parse discourse structure.

As for the context dependency of information structure, the dissertation proposes a strictly anaphoric treatment of background elements. Anaphoricity is taken to be the central mechanism which relates information structure to the context, which is represented by a discourse tree. I make use of the distinction between links and tails, as two different parts of the sentence background, proposed by Vallduví (1992). This distinction receives strong support from Catalan data and data from other romance languages. In Catalan links are typically left dislocated by a syntactic operation, while tails are typically right dislocated. I further assume that the sentence background is not a monolithic unit and may be built up out of separate links and tails. Since links and tails are assumed to be anaphoric separately they must be bound separately by a suitable antecedent discourse referent. The sentence background is built up from these independent units and it is therefore not necessarily anaphoric to only *one* single discourse antecedent. In this way the proposal consequently abandons an en-bloc treatment of backgrounds.

The dissertation also tries to show that different anaphoric binding conditions hold for links and tails. Links and tails are descriptive linguistic units and their exact descriptive content may be partially different from the description of the antecedent. Tails usually require an identity relation to their antecedents, but they may also be descriptively more general in a way that the referent projected by the tail includes the referent of the antecedent. In turn, discourse referents projected by links (which are taken to be identical to what has also been called contrastive sentence topics) are never fully identical to their antecedent. Instead, a linguistic realisation of a constituent as a link signals that the link referent is only a part of its antecedent. If there is an apparent identity relation between surface descriptions of a Link and a possible antecedent, the non-identity requirement is responsible for the contrastive interpretation of the link.

The distinction between links and tails has important effects on the relation between a sentence and the structure of the discourse context in which it is uttered. The apparent inability of links to be fully identical to their antecedent is finally reinterpreted as a constraint on discourse structure: links must be bound by a contrastive set, which may be created by means of accommodation if it is not explicitly introduced. Such contrastive sets are identical to the abstract topics of the discourse segments they dominate. Contrastivity of links is in this manner derived as a structural property of the discourse.

I assume that a referential notion of '*discourse topic*' is needed and that every discourse segment must be associated with such a discourse topic. Links, but not tails, must be bound by the topic of the discourse segment in which they occur. The requirement

for links of being more specific than their antecedent can be related to this binding condition: links have to be bound by a – possibly abstract – antecedent which is more general in its description. In order to meet this requirement the structure of discourse must often be adjusted and the contrastivity effect which holds for links can so be derived from a more general requirement for the structure of discourse. I also argue that the *question under discussion* (in the sense of Roberts, 1996), which holds for every discourse segment, must be derived from the discourse topic and other material which is salient within the corresponding discourse segment. The linguistic realisation of links and tails has a decisive effect on the determination of a question which is being addressed.

Acknowledgements

I would like to thank everyone who has contributed to this dissertation. First of all, I would like to thank my thesis director Enric Vallduví who guided me through the whole process of writing this work and also helped me to convert it into a coherent document. I would also like to thank everyone at the *Departament de Traducció i Filologia* of the *Universitat Pompeu Fabra* which helped with discussion and comments. I would especially like to thank Louis McNally who was always available when I had questions and problems. The discussions I had with her, including the seminars and reading groups she organised, contributed in many ways to this dissertation. Many thanks also to Lisa Brunetti, with who I had very fruitful discussions. I am also thankful to the members of the semantics reading groups which was organised in collaboration with the University of Barcelona, especially to Josep Macià. I was able to present part of the content of dissertation in this reading group and I benefited greatly from the feedback given there. I am also grateful to Toni Badia and the computational linguistics research group (Glicom) which provided me with a fabulous work environment. I would also like to thank the cognitive science department in Osnabrück who hosted me for two months. Special thanks to Carla Umbach and Peter Bosch who discussed many of the theoretical issues of this dissertation with me and helped me find a better organisation of this work. I am also grateful to the people who initially arose my interest in information structure when I wrote my master's thesis at the University of Tübingen: Hans Bernhard Drubig, Susanne Winkler and Edward Göbbel. Also the organisers and participants of the 9th Language and Logic Conference 2006 in Besenyőtelek (Hungary) deserve my thanks, a conference where I learned a lot about information structure and had many fruitful discussions, apart from enjoying the nice working atmosphere. I would also like to thank Oriol Valentin, my table neighbour who works in the framework of Type Logical Grammar and made some of the formal aspects of categorial grammar accessible to me, and Gemma Boleda who gave me many practical tips of how to finish this document. Last, but not least, I want to thank Toni Carbajo, the person who was closest to me during all this time, especially during the last month of the preparation of this dissertation. This work also received support from different institutions. The *Generalitat de Catalunya* supported me with a FI grant and the *Departament de Traducció i Filologia* of the *Universitat Pompeu Fabra* with a research grant. I was able to work there in the NOCANDO project (financed by the Spanish Ministry of Education and Science, MEC HUM2004-04463) and form part of the research group UR-LING (Unitat de Recerca de Lingüística, recognised by the Generalitat de Catalunya, 00067). Working in these environments made important contributions to my dissertation in the form of data, constructive criticism and discussions. Finally, I would like to everyone else who contributed to this work in any way. Without all of the mentioned persons and institutions, writing this dissertation would not have been possible.

This dissertation was typeset in L^AT_EX, using TeXnicCenter.

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Chapter 0

Introduction

Studying information structure is often like observing the behaviour of a poltergeist. We have to assume that it is there, but we cannot observe it directly; we only observe the *effects* it causes. Whenever a poltergeist is present, the ghost itself is not visible, the only things observable are objects which move or fall from the walls. Sometimes a ghost is simply there and does nothing. And there is no way of telling what it looks like, either. We do not know his shape and what parts of his body it uses to cause the observable effects. If a cup falls to the floor we cannot tell if it pushed it with its hands, its feet or its elbows. We do not even know for sure whether poltergeists have elbows at all. Similar things happen with information structure: we never see the structure itself, we only see things (constituents) moving around, some traces (pitch accents) and few more other phenomena which lets us deduce that the poltergeist structure is at work. It is simply impossible to observe information structure directly. We can only infer its presence and shape from the overt phenomena which are caused by it. Even if this is true for other types of meaning, it is especially true for information structure, since we cannot even relate the overt effects of information structure to different truth conditions. That makes investigating information structure a challenging task.

The purpose of this thesis is to investigate information structure (IS) in relation to the structure of discourse. I will argue that sentence level IS can only be fully understood when a sufficiently large part of the context is taken into consideration. This will often require us to take quite large parts of the textual material and even extra-textual information into consideration. In turn, I will also argue that overt marking of IS is very important to understand the way discourse is structured and the way in which information is conveyed in an ordered and coherent way.

The term information structure here is to be understood as a partitioning between the focus and the background of a sentence. One of the few things on which practically all researchers working on IS completely agree on, is that the terminology with which IS has been described is highly inconsistent and confusing. The term information structure is usually used in a way roughly equivalent to the theme-rheme, the focus-background or the topic-comment distinction. But this is not the only possible use of the term information, since it can also describe the general way in which information (of whatever type it may be) is structured. Another well-known example of a highly controversial term is '*focus*' which has at least three different, sometimes even contradictory uses: the focus of attention (e.g. Grosz and Sinder, 1986, also called *cognitive* or *AI-focus*), the highly informative part of a sentence (e.g. Haliday, 1967, 1970, Jackendoff, 1972, amongst many others) a concept closely related to rhematicity), and phonological focus (i.e. the main stress of a sentence or phonological phrase, e.g. Selkirk, 1984, Steedman, 1991, 2000a, 2000b). The problem has to do largely with what I said in the first paragraph above: things which are not directly visible, like ghosts and information structure, are hard to describe. I will concentrate here on the function of information structure as the interface which mediates between the linguistic

surface (phonology, syntax and morphology) and discourse semantics (discourse interpretation) and discourse segmentation. Other functions of IS have been proposed, however: The mediating module between phonology and syntax (Rochemont, 1986), phonology and semantics (Rooth, 1985) or even the disambiguation device for spurious ambiguities right in the heart of syntax (Steedman, 2000b). Although I will use Steedman's grammar formalism - *Combinatory Categorical Grammar* - as a syntactic basis for the study of IS, the other functions will not be in the scope of this proposal.

The sentence level analysis of IS will be built on a model which distinguishes between three basic units: foci, links and tails. Links and tails together form the sentence background (Vallduví, 1992). While the term focus, as used here, corresponds to the new information that a sentence carries, links correspond to what is often called *topics* in other approaches and usually receive a contrastive interpretation within the discourse context. They determine what the sentence is *about* (Reinhart, 1995), in a sense to be further defined. Finally, tails expresses additional background material which anchors a sentence in its context without influencing 'aboutness' and without being contrastive. A central hypothesis of the proposal is that background elements, both links and tails, are *anaphoric* in nature. The concept of anaphoricity is to be understood in a quite literal sense: backgrounds are subject to locality constraints and have to correspond to a limited set of semantic types like other anaphora. Links and tails differ in their anaphoric behaviour and the function they have with respect to discourse structure (DS). Although I claim that backgrounds are anaphoric, I will argue that anaphoricity is a necessary but not a sufficient condition for a constituent to be licensed as part of the sentence background: anaphoric constituents may form part of the sentence focus, but this is restricted to cases with requirements imposed by the discourse context.

Discourse structure is a concept which is not much easier to define than information structure. I understand discourse structure here as the way discourse is organised thematically and segmented according to this organisation. Discourse structure is a supra-sentential syntactic structure (along the lines of Grosz and Sidner, 1986, Webber, 1977, Asher and Lascarides, 2003). It is organised in the form of a tree. Discourse itself can be largely described with a context-free grammar (although, like sentence-level syntax, it has to be assumed to be mildly context sensitive, i.e. to treat flash-back interruptions (Grosz and Sinder, 1986, Webber, 2004)).

When I started the research for this dissertation, I was mainly interested in the way discourse information must be modelled in order to allow IS disambiguation in cases where no other -especially phonetic - information can be used for such a task. I soon realised that the relation between discourse and sentence level information is one of mutual influence. Although, in many cases, IS realisation, e.g. the placement of pitch accents, is more or less predictable within and determined by a given discourse environment, there are also many other cases where this IS realisation is not predictable at all. In these cases IS marking carries additional information. Often this additional meaning does not affect the truth conditions of a sentence, but it tells us how information has to be related to other information within a discourse. The relation between pieces of information, in turn, is one of the decisive factors for structuring a discourse segment, in one way or another. The type of information that IS carries tells us what the discourse environment should be like.

This dissertation is structured in the following way: In chapter 1 I will give a short introduction to the problems I will deal with. I will show that the resolution of infor-

mation structure - the determination of the informational division point between focus and background - is crucially dependent on context, not only in a very general way (as is often assumed), but in a very specific manner: I will introduce one of the central hypotheses of this work, namely that background elements are strictly anaphoric. Background anaphors resemble other anaphora, like pronouns, in many ways: without the proper resolution of their antecedents a complete semantic interpretation is impossible. They are also subject to locality restrictions, which are, in turn, dependent on the structure of discourse. The strict anaphoricity approach also implies that only elements of specific semantic types are allowed to enter anaphoric relations. The set of anaphoric elements in natural language is limited and if we assume that background elements are anaphoric, we also have to assume that the set of possible background elements are semantically restricted to a limited set of types, too. In the second part of chapter 1 I will shortly describe some of the ways in which natural languages realise the marking of IS elements. I will concentrate here on English, Catalan and German, the languages I will use for the argumentation.

Chapter 2 will describe the central theoretical foundations which will be needed in order to understand the proposal within the right research context. I will give a short introduction into CCG (Combinatory Categorical Grammar), the grammar formalism which I use as the syntactic basis of this approach. I will review some arguments which lead me to concentrate on the study of sentence backgrounds (as opposed to foci) as the units which explain information structure within discourse. Especially I will discuss the concept of *givenness*. I will finally argue that, although presupposition approaches (Geurts and van der Sandt, 2004a, Roberts, 1996) to IS seem to explain the same set of data, backgrounds are better analysed as being strictly anaphoric. I will argue that they cannot be explained by presuppositional behaviour alone. Concerning the structure of discourse, I will argue that discourse has to be seen as a structured two-dimensional object. Traditional dynamic approaches to semantics like File Change Semantics (Heim, 1982) or Discourse Representation Theory (Kamp, 1981, Kamp and Reyle, 1993) (DRT) cover mostly the horizontal dimension of discourse. They explain accessibility restrictions for anaphora in a linear way while respecting purely logical constraints, such as quantificational islands and embedding under modality and negation. This class of theories have laid the foundations which allow us to study inter-sentential anaphoric relations of different sorts. On the other hand, discourse segmentation represents the vertical dimension, the depth of a discourse. Anaphoric accessibility is highly constrained by this dimension. Both views at discourse can be combined (as in Segmented Discourse Representation Theory, Asher, 1995, Asher and Lascarides, 2003) and a combination of the two is necessary to understand the role of IS.

Chapter 3 and 4 form the heart of the present proposal. Chapter 3 investigates in which way the information given in the discourse context lets us deduce the partitioning of a sentence into different informational units. I will present empirical and theoretical support for the assumption of the application of strict anaphoricity to backgrounds, including the assumption that backgrounds, like other anaphora, are restricted to a limited set of semantic types. I will go on to investigate under which conditions a sentence constituent may count as informationally given and anaphorically accessible within the immediate context. This will include the resolution of partial anaphoric matches and the explanation of why the anaphoric relation between backgrounds and their antecedents can seemingly violate island boundaries created by donkey sentences and

other modal or quantificational islands. Finally, a closer look at backgrounds which partially match their antecedent will reveal an interesting asymmetry between links and tails : While links, as contrastive background elements, can further specify a given antecedent, tails may only generalise over their antecedents. This finding will receive an interesting interpretation in chapter 4 where it is placed in a theory of discourse organisation and segmentation.

Chapter 4 will bring in the dimension of vertically segmented discourse structure, which has been largely neglected throughout chapter 3. The model of discourse structure developed here will be information driven in very important respects. I will argue that both linguistically realised links and tails play a prominent role in that they locate the right attachment point in the discourse structure (Polanyi and Scha, 1983, 1984, Grosz and Sidner, 1986, Webber, 2004, Asher, 1995, Asher and Lascarides, 2003). Assuming that DS can be represented as a tree, this will require to locate the right node to which a new segment is attached. Links, which can be described as the linguistic representation of a sentence topic, have to be bound by the topic of the discourse segment by which they are dominated. On the other hand, all elements of a sentence background will be argued to form part of a *question under discussion* (QUD, Roberts, 1996, Ginzburg, 1995a, 2005, Ginzburg and Sag, 2000) which holds for a discourse segment. The QUD of a discourse segment will be treated as a derived notion which follows both from information that stems from the discourse itself and the linguistic surface IS realisation of each sentence. According to these two information sources, I will argue that there is a set of more or less predictable questions which can be addressed at each point in the discourse. I will call this set *a predictive QUD set*. The sentence level information structure will finally pick out one of the possible questions from the set and determine the question which is addressed in the discourse segment to which the sentence has to be attached. I will also argue that in certain discourse situations this question is hardly predictable at all. In this case a QUD has to be accommodated. The accommodation of a QUD is only licensed in case the coherence of the in interrogation strategy (in Roberts' sense) is guaranteed. That means that an accommodated QUD must be construable as an element of the predictive QUD set.

Chapter 1

Data and Problems

This dissertation is about information structure in its relation to discourse structure. I will investigate both structures and place special emphasis on the function and functioning of the interface between the two. Information structure is to be understood here as a level of meaning which does affect felicity of sentences within a context, rather than truth conditions. These different felicity conditions correlate with different linguistic realisations. In the literature it is generally assumed that (sentence level) information structure crucially depends on context information. In this sense, saying that IS is context-sensitive is probably the least controversial claim that one can make in this respect. These context-dependent changes in linguistic surface realisation – phonological, syntactic or morphological – have always been one of the central concerns of research on IS. This is not surprising, since these are the only phenomena which are directly observable and constitute the empirical basis for any study of IS. The standard test for the determination of the focus-background partitioning (and also for the theme-rheme and topic-comment distinctions) is to place a target sentence in a minimal context, often represented by a context question.

Before I discuss some of the problems presented by the data I would like to define first what I mean by information structure and explain the tests I will use to identify the different informational parts of the example sentences. I assume that there is a cross-linguistically stable set of IS units. This is a common assumption. As a taxonomy I will use Vallduví (1992), and Vallduví and Engdahl's (1996b) tripartite distinction of IS units, given in (1).

(1)

| | | | |
|------------|------|-------|-------------------------|
| Link/Topic | Tail | Focus | tripartite articulation |
| Background | | Focus | focus-background |

Under this articulation, each sentence can contain up to three different information types: links, tails and foci. Links and tails together correspond to what has been called the background of a sentence. Since links and tails share the important property of being anaphoric and must necessarily be anchored in the context I will often also refer to the background of a sentence (Jackendoff, 1972) when I speak about the combination of links and tails. Both background units are optional parts of a sentence while the focus is its only necessary part. On the other hand, the combination of tails and the sentence focus correspond to what has been called the comment in topic-comment structures (e.g. Reinhart, 1995), although the comment has no independent status in this articulation. I will assume that links correspond to what most researchers mean when they use the term (contrastive) topic. I also consider that links correspond to marked themes in the sense of Steedman (2000a, 2000b, cf. 2.1.1, 2.1.3). Like any other articulation of IS, the tripartite model might have some disadvantages, but it combines the focus-background and the topic-comment traditions in a coherent way and is sufficiently

rich to express the data which are of interest here.¹

While it uncontroversial to assume that the information structure of a sentence depends on context, it is not clear in which ways this context-dependence works exactly. There are good reasons to assume that dependence on context is more complex than has generally been assumed. Although there is good work which investigates this dependency, treating it either as an instance of presupposition (Jackendoff, 1972, Geurts and van der Sandt, 2004a), generalised anaphoricity (Rochemont, 1986) or entailment from the context (Schwarzschild, 1999), there are many detail problems which are hard to solve.

In this dissertation I will use strict anaphoricity as a basis to model the relation of given material within a sentence to the sentence context. I will try to convince the reader that anaphora resolution, which is a simple and independently studied mechanism, provides enough tools to resolve IS, i.e. to find the right way to separate the sentence focus from the background and identify the sentence topic, if it is linguistically realised. On the other hand, dependency on context can only be successfully treated if the context itself is properly modelled. We have to know, for example, which classes of linguistic units may be anaphoric and which not. In addition, there are good reasons to assume that limiting the study of sentence-level information structure to minimal contexts will result in a limited understanding of the phenomenon itself. I will assume that in many cases more context is better context. Context is not just an unordered set of already transmitted information. Some antecedents are more salient than others. The degree of salience is crucial for IS resolution, since given material may occur in the focus of a sentence if it is not salient enough (Erteschick-Shir, 1998). There is a recently growing interest in the integration of a theory of IS within a theory of discourse (e.g. Roberts, 1996, Asher, 2004, Büring, 2003). A central concern of the present study is to show that IS is not only dependent on context in a weak sense, but also that IS cannot be *fully* understood without taking into account in which ways a discourse is structured and how it progresses. On the other hand, I will show that IS gives important clues about DS and allows the (human) parser to infer the correct segmentation of texts.

In this introductory chapter I will present some of the data which shall be analysed in the course of the dissertation, especially in chapter 3 and 4. Here I will describe the problems that these data present, but I will not try to give a definite solution, postponing the in-depth discussion to the theoretic sections of this study. The purpose of the present chapter is rather to provide an orientation and to show that there is a series of problems which force us to use an elaborate model of discourse. Context is taken here to be the crucial basis for the resolution of IS. In many cases, context information does not only require a specific information partitioning at the sentence level (and the corresponding linguistic realisation), but also is the *only* completely available information source which lets us determine in which ways a sentence is informationally organised and relates given to novel information. Furthermore, I will argue that the structure of discourse must be properly modelled in order to allow access to the information

¹Steedman 2000a, 2000b develops a richer system where the theme/rheme and the focus/background distinctions are orthogonal to each other (cf. 2.1.3). Such a system might have advantage that it can explain certain additional facts about foci. Since I am more concerned about backgrounds here, I consider this further refinement not important for the present purpose. Vallduví and Vilkuña (1998) establish an IS category '*kontrast*' which sheds light on certain irregularities found in the treatment of foci. Again, since I am not primarily concerned with the category *focus* here, I opt for the tripartite link-tail-focus distinction.

needed for disambiguation. A proper model of discourse will, among other things, have to make explicit which elements may allow anaphoric reference (i.e. serve as antecedents for the non-focused part of the sentence.) I will also present some data which suggests that the influence between IS and DS is mutual: While IS depends on structured information from the context, the way a discourse structure is built depends, in turn, on the way information is presented on the sentence level. Finally I will give an overview of the linguistic realisation of IS in the three language I will use as a empirical basis for the proposal which is made in this dissertation.

1.1 How does context influence information structure?

The question addressed in this section is: How can we model context and its influence on information structure? In order to understand the organisation of information within sentences, we must have a good idea of how information is organised within larger linguistic units, such as narrations, dialogues or argumentations. The term *discourse* should be understood here as a cover term for such larger linguistic units which are coherent and cohesive pieces of linguistic material. The basic function of IS will be assumed here to relate information on a larger scale (given in the discourse) to the organisation of information within a sentence.

1.1.1 Information structure ambiguity

As noted, sentential IS depends on the context in which it is uttered. In this section I will present some data which illustrates this dependency and which shows that the representation of context must be sufficiently structured. I will also address some of the theoretical difficulties that the data presents. The central problem for the proper resolution of IS can be seen as one of ambiguity: The majority of sentences are ambiguous between various focus-background partitioning possibilities. The probably best-known instance of this problems is so-called focus projection (Selkirk, 1984, 1995, Rochemont, 1986, Gussenhoven, 1993, Drubig, 2003, among others). (2), an example from Rochemont (1986) illustrates the phenomenon.²

(2) [Laurie [followed Ralph into [the BEDroom.]]]

Here the nucleus of the sentence focus is marked with an accent on *bedroom*. The whole focus, however may extend over more material than just the NP. Depending on the different context questions in (3) the focus may include the object NP, the VP or the whole sentence. The pitch accent on *bed* (in *bedroom*) does not sufficiently disambiguate the partitioning of the sentence into focus and background.

As noted, material from the background is in some way discourse-given and focus material must be novel, non-inferable or highly informative. The terms *given* and *new* will have to be properly defined. In a very intuitive sense, the focus of (2) depends on

²I follow the established tradition here in representing the main sentence accent, which marks the nucleus of the focus, in capital letters. I will represent topic- or link identifying accents with bold face and in italics. The square brackets mark the boundaries of the sentence focus and sentence backgrounds.

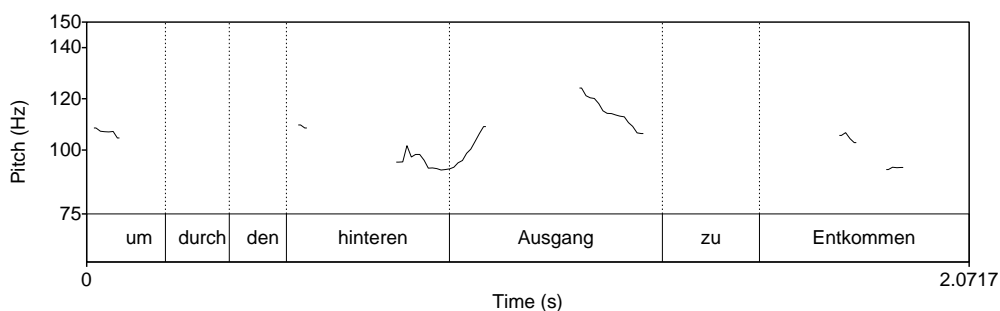
The great majority of sentence are left abiguous by phonology. To make things worse, we cannot even be sure that phonological pitch accents can be observed at all. This is the situation we find when parsing written texts. (5) is an example from an internet news article about a hijacked plane:

- (5) Diese Situation nutzen andere Fluggäste, um durch den hinteren Ausgang zu entkommen.
 this situation used other flight-passengers, in-order through the rear exit to escape
 'Other passengers used this situation to escape through the rear exit.'
 (German, tagesschau.de 18.08.2007)

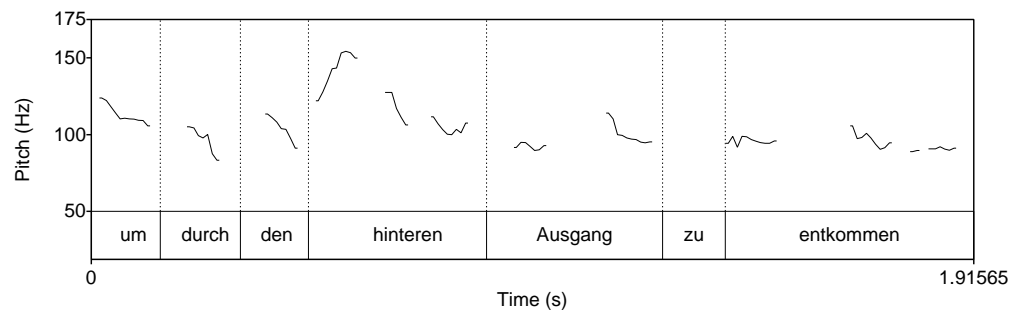
If this example is read aloud, the most natural intonation would be one with the focus identifying accent on the noun *Ausgang* and a less prominent secondary accent on the verb *entkommen*. But this sentence is taken out of context. The context out of which it was taken is as in (6). When the sentence is read within this context, the main sentence stress must fall on the adjective *hinteren*.

- (6) a. Auf dem Flughafen von Antalya wollten die beiden Täter einige Passagiere am vorderen Ausgang freilassen.
 On the airport of Antalya wanted the both perpetrators various passengers at the front exit release.
- b. Diese Situation nutzen andere Fluggäste, um durch den hinteren Ausgang zu entkommen.
 this situation used other flight-passengers, to through the rear exit to escape
 'When they arrived at the airport of Antalya the two perpetrators let various passengers go into freedom though the front exit. Other passengers used this situation to escape through the rear exit.'
 (tagesschau.de 18.08.2007)
 (German)

- (7) ... um durch den hinteren AUSGANG zu entkommen.



- (8) ... um durch den HINTEREN Ausgang zu entkommen.



What (5) shows, is that when given a sentence like (5) in isolation, hearers reconstruct a most plausible context of utterance, which in this case would not be similar to the context in (6).

Human readers seem to parse IS in written texts quite effectively. Information structure has meaning the intonation contour is not just ornamental. Human parsers effectively reconstruct this meaning, even from written texts. Although this meaning usually affects only felicity conditions, the reconstructed information structure can even alter the truth conditions of a sentence, I am not primarily interested in such alternations of truth conditions, but such alternations show that human parsers reconstruct both the felicity and truth conditions in the absence of phonological focus marking. This can be seen in in example (9), which is also taken from a written news article. The target sentence in isolation reads as follows:

- (9) Wir haben nicht auf das Schiff geschossen.
 We have not at the ship shot.
 'We did not fire at the ship'
 (tagesschau.de 27.10.2006)
 (German)

In isolation the object *Schiff* would receive the main sentence accent and the Verb *geschossen* would receive a secondary pitch accent, marking them both as part of the focus.

- (10) Wir haben nicht auf das SCHIFF GESCHOSSEN.
 We have not at the SHIP FIRED.
 (tagesschau.de 18.08.2007)
 (German)

But the situation changes if the sentence is read within the original context: In the context of (11), (9) must receive accent on *Schiff*, like in (11c). The accent on the object *Schiff* is stronger than in (10) and the verb *geschossen* is necessarily deaccented:

- (11) a. Dass im Verlauf des Zwischenfalls aus israelischen
 that in-the course of-the incidence out-of Israeli
 Kampfflugzeugen geschossen worden ist, wurde von Regev nicht
 fight-jets shot has been, was of Regev not
 mehr dementiert.
 longer denied.

'It was not longer denied by Regev that in the course of the incident there was shooting.'

- b. Wörtlich betonte er vielmehr:

Literally emphasised he in-turn

'In turn, he emphasised literally.'

- c. "Wir haben nicht auf das SCHIFF geschossen."

"We have not at the SHIP shot."

' "We did not fire at the ship" '

(12) Wir haben nicht auf das Schiff GESCHOSSEN.

We have not at the ship GESCHOSSEN.

(10) and (11c) do not only differ in their discourse appropriateness, but also in their truth conditions. While (10) is false if the jets have fired, (11c) is still true if the jets shot as long as the shots were not directed towards the ship. (11c), but not (10), entails that there was a shooting event. (12) would be the intonation for a narrow focus reading where only the verb *geschossen* is focused. This version would only be true if there was no shooting, but some other action which was performed on the ship, so (12) contradicts what has been said before in (11a,b). In this context, there is no plausible other action that the jets possibly performed on the ship, other than shooting. We can also see this problem from a slightly different angle: The three intonation patterns are compatible answers to different possible questions, using the question contextualisation strategy used for (3) above.

- (13) a. What did we not do? (answered by (10))
 b. Where did we not fire at? (answered by (11c))
 c. What did we not do with the ship? (answered by (12))

In order to choose the right reading (and discard the wrong one), the reader has to reconstruct the correct IS of the sentence.⁵ If we want to explain such data, which stem from *written* text, we cannot rely on a given phonological contour since it is not provided. In these example the only possible source for the disambiguation of IS is the surface context.⁶ Independent of the solution we give to the IS disambiguation of (11c), such examples show clearly that there is a genuine need to compute IS (at least partially) on the basis of the surface string of written words. After all, this example is from a real printed news text and there is no reason to assume that the reader cannot successfully disambiguate IS, select the right semantic reading and place pitch accents on the right words. The only possible source for disambiguating information in all of these cases is the context. So a theory of IS must be embedded in a theory of context, what means a theory of discourse structure.

⁵As a matter of fact, my attention became drawn to this example because I first interpreted the sentence in its there-was-no-firing reading, which corresponds to the intonation with stress on the verb, only to notice a split second later, that this reading is incompatible with the given context. Because of this incompatibility a re-interpretation of the sentence is required. This resembles the well-known garden-path phenomenon (cf. Steedman, 2000b, Crain and Steedman, 1985). Both phenomena lead to a wrong interpretation of a segment because *a priori* an eventually wrong interpretation seems to be more likely. I will return to this point in chapter 3, where I will interpret such parsing errors in a similar way to the garden path effect.

⁶This should by no means imply that phonological information can be recovered entirely. Phonology does carry information which is not predictable from the context, as I will show in chapter 4.

Of course, computing the right anaphoric connections is a lot harder than just matching words against already uttered word forms. The two examples from above are quite simple in the way a connection between the background and its antecedent is established: it is simply literal repetition. In (6) the antecedent for *Ausgang* is the same noun (*Ausgang*) and in (11b) the match is between the Verb *geschossen* and *geschossen* in (11a). In many other cases, the semantic co-reference must be established in much more difficult ways. The big problem seems to be that, in comparison to semantically lightweight anaphora like pronouns (which have little descriptive contents) backgrounds may be highly descriptive. This has the consequence that the descriptive contents of a background anaphor and its antecedent may differ. While preserving the anaphoric link, backgrounds may match their antecedent fully but may also show a partial match. Partial matching can be seen in examples like (14) and (15):

- (14) a. Bach wrote many pieces for the viola.
b. He must have LOVED [string instruments]_{background}
(adopted from van Deemter and Odijk, 1997, 1998)
- (15) a. What about the children?
b. [The boys]_{background} are on a SCHOOL trip.

In (14) the *viola* is only one type of *string instruments* (it is a sub-type) and the *boys* are part of the set of *children*. In such examples there is only a partial match between the antecedent description and the descriptive content of the background in that they stand in a part-of relation. It is interesting to note here that in (14) the background is less specific than its antecedent while in (15) it is more descriptive and more specific. In chapter 2 this difference will play a very important role. I will show that it is precisely this extra descriptive content that explains the seemingly different behaviour of links/tails and pronoun-type anaphora. It also has a second effect: since links and tails are more descriptive than pronouns, they have a much higher ability to identify their antecedent, a fact that will have important consequences on the structure of discourse.

Considering these ambiguity problems, the need arises to resolve the question of how a model of discourse is to be constructed in order to give the sufficient information required for IS disambiguation. For the purpose of antecedent resolution it will be necessary to define which kinds of referents may be accessed anaphorically. The discourse model has to provide all the semantic building blocks to allow for the determination of givenness. Referents or individuals are the best known example of primitive units of discourse reference, but we also have to assume that information about events (like the shooting event in (11)), times, places and properties have to enter anaphoric relations and be available in the discourse model when disambiguating the IS of a target sentence. As I will argue below, this will also require some thought about what kind of information cannot be referenced and accessed anaphorically. A second interesting question is in which way this information may be exploited. This means we have to define the mechanism that we need for anaphoric linking. This will include, for example, a treatment of partial matches, such as the match between *boys* and *children* in (15).

1.1.2 Locality constraints

In addition to having the right referential ontology in discourse modelling, discourse must be seen as a structured object itself. A discourse is organised in terms of topics being addressed (van Kuppevelt, 1997, Roberts, 1996). Some arguments depend on others and the structure of discourse has to reflect such dependencies. We know that the sentences from which a text is built cannot be put in a random order just like the words in a sentence can not be randomly sequenced. Sentences have to be organised to form a coherent discourse and the order of sentences discourse is not just a linear one. Different parts of a text form coherent segments and there are boundaries between them when the topic changes. On an intuitive level, we know that texts are organised in paragraphs and a books have chapters. A well-written paragraph addresses one topic, a change between paragraphs often means a change of topic as well. We also expect that chapters group together a piece of discourse which is topically homogeneous. Although chapters and paragraphs are not precisely definable units, it seems reasonable to assume that there are intermediate textual constituents in addition to the top level unit ‘text’ and the low level unit ‘sentence’.

Anaphors related to information structure, like other anaphors, are subject to locality constraints. Pronouns have to be ‘close’ enough to their antecedents in order to be felicitous. If we assume that backgrounds are anaphoric we would expect that they are also subject to locality constraints. For example, we would expect that a nominal referent which is given in the wider context must be realised as part of the focus and not part of the background in case it is separated from its antecedent by too much material. In fact, we can quite easily find such examples: (16) is taken from the NOCANDO corpus.⁷

- (16) he’s extremely pleased that the gift is for him and his pet dog and turtle hm look a bit curious as to what the gift is, and in the distance his pet frog looks extremely pleased that he’s received a gift. He opens up the gift and much to his and his dog’s happy surprise, the gift turns out to be a_ a little frog hm who the dog then hm promptly begins to lick. # And everybody looks happy hm for the arrival of the new little frog except for the_ the_ the larger frog who was already the pet of the boy. ## Ok so_ everybody seems happy with the presence of the_ new frog except for the larger frog and the larger frog, a bit jealous of the_ the younger one hm begins to bite his leg. And <the> big frog is then scolded by the boy, and also feels the anger of the dog and the TURTLE.
(Nocando-Corpus)

⁷In the NOCANDO project at the Department of Translation Studies and Philology of the Universitat Pompeu Fabra a multi-lingual corpus of spoken texts was created on the basis of children’s stories narrated in pictures which themselves contained no text. Speakers were asked to re-tell the story in their own words. The advantage of this data is that it is taken from natural production and that the phonological realisation can be studied. Some of the examples in this dissertation are taken from this corpus.

differ in that indefinites introduce new discourse referents (Karttunen, 1971, cf. also 2.2.1 below), while definite NPs refer to familiar referents. One could easily confuse the concept of familiarity with the notion of anaphoricity. In (16) the *turtle* of the last sentence refers to the same turtle which is mentioned in the first sentence. But this does not imply that the former is also anaphoric to the latter. Familiar definite NPs are not subject to locality constraint as anaphors are and I assume that familiar elements in foci are not anaphoric. Familiarity is not a sufficient condition for a referent to be realised as part of a background. Familiar definite NPs are not necessarily anaphoric, if locality constraints are violated. Even if they are not strictly anaphoric they can appear in a context where the referent can be identified uniquely within the context.⁸ If the target realisation is separated structurally from the antecedent, it may still be realised as a definite NP, but not as a backgrounded one; so it must be marked as a focus.

Nevertheless locality constraints do not seem to depend on linear locality alone. Sometimes the background may be separated from by quite a lot of intervening surface material.

- (18) a. Em refereixo a la sonda espacial Mars Polar, que la NASA va enviar a **Mart**, i que s'ha perdut. [...]
 'I'm referring to the space probe Mars Polar which the NASA sent to Mars and which got lost. [...]'
 (9 sentences making fun of the lost Ship)
- b. Jo, als de la NASA no els entenc. [...] 'I don't understand those people from the NASA. [...]'
 (11 sentences about finding the way to Mars)
- c. Un altre tema és que hi ha molta gent que no té ganes d'anar-hi a **Mart**.
 to'go-there to Mars.
 'It's another topic that there are many people who do not want to GO to Mars.'
 (Andreu Buenafuente, 2001a p. 173, cited by Mayol, 2002)

(18) is a piece of monologue from the stand-up comedian Andreu Buenafuente. In the last sentence the PP *a mart* is linguistically marked as a background (via left-dislocation). The whole segment covered by (18), in total 21 sentences, uses the anecdote about the mars-probe which got lost as a kind of grid into which funny comments and further anecdotes are woven in. First the author compares the mars mission to to a situation where someone parked his car and cannot find it later on (over a span of 3 sentences) then he compares it to a situation where someone has to find her way though the motorway belt of Barcelona (another 3 sentences). At the time (18c) is uttered, the planet Mars has not been mentioned over 4 sentences. The discussion has moved to an entirely different topic (finding one's way around the outskirts of Barcelona). But nevertheless the backgrounded PP can establish an anaphoric con-

⁸cf. Umbach (2002) for a somewhat different perspective on accented and deaccented definites. Shows that there some definite descriptions are anaphoric, while others are not. She argues that the non-anaphoric type of definite NPs make use of the descriptive contents of the NP in order to determine a referent uniquely.

nection to the story which begins in (18a). At the same time, the line of argumentation (which centres around the Mars-probe anecdote) is taken up again. The linguistic marking of *a mart* in (18c) plays an important supporting role in marking the backbone of the monologue storyline.

What examples like these also suggest is that locality is highly dependent on the way a discourse is organised. A linear notion of locality does not explain the effect of seeming non-locality in anaphoric behaviour we observe. Similar effects have been noted for pronouns. (19) is an example from Grosz and Sinder (1986) which illustrates this in a dialogue:

- (19) A: One bolt is stuck. I'm trying to use both the pliers and the wrench to get it unstuck.
E: Don't use pliers. Show me what you are doing.
A: I'm pointing at the bolts.
E: Show me the 1/2" combination wrench, please.
A: OK.
E: Good, now show me the 1/2" box wrench.
A: I already got it loosened.
(Grosz and Sidner, 1986, p. 198)

Here the pronoun *it* in the last line has its surface antecedent in the first line (*bolt*). The ability of the pronoun to refer back to a linguistic surface element which is at a certain distance is related to the structure of the task: once an detail problem (trying to find the right tool) is solved, the focus of attention returns to the main task. I will give more support to this hypothesis in chapter 4. For the moment it is important to keep in mind that locality effects are a problem for a theory of information structure and that we have to account for it. A theory of discourse structure should be able to explain locality effects and also cases in which (surface) locality seems to be violated.

1.1.3 Givenness and strict anaphoricity

The anaphoric resolution which licences backgrounds must in some cases be reconstructed from separate sources. In such cases, not all elements of the background share a unique antecedent which licenses the whole background as a single atomic block, but rather establish anaphoric links to discrete antecedents.

- (20) A: What about the boss? Does he like broccoli?
B: L'amo [L'ODIA]_{focus} el bròquil
The boss [it hates]_{focus} the broccoli
B': The boss HATES broccoli. (Vallduví, 1992)

In the Catalan example (20) there are two NPs marked syntactically as backgrounds. In Catalan neither clitic-bound right-dislocated material nor pre-verbal subjects may be part of the focus (Vallduví, 1992, I will return to this point in section 1.3). So both the subject *l'amo* and the dislocated object *el bròquil* together form the sentence background, which is not a continuous unit. If we search for an antecedent for this discontinuous background we could assume that the second question entails that there

is some relation between the boss and broccoli, such that the boss either likes broccoli or has any other comparable relation to it. This would mean that the background has an antecedent as a whole or, in other words, the context entails the information expressed in the background and it entails that as an informational unit of some sort. The aboutness-effect which affects *the boss*, however, which licenses *the boss* as a sentence topic in (20B), stems from the first question of (20A).

Alternatively we could assume that the antecedent for the *boss* is the referent for the NP *the boss* of the first question in (20a) (or the co-referring pronoun *he* in the second question). This would mean that background elements behave in a similar way as pronouns do, parallel to the slightly altered version of the sentence: *he hates it*. But not always such a single antecedent for a whole block of a sentence's background is available as (21)-(24) show.

- (21) a. What about John? And where is Mary?
b. John drove Mary HOME.
- (22) a. I will throw a party and I'm going to invite Johnny, Laura, Susi, Peppy, Andy, Wendy and Cleopatra.
b. Oh, no. You can't do that. Susi HATES Johnny. (He is her ex-boyfriend.)

From the question (21a) it does not necessarily follow that there is some relation between *John* and *Mary*. The background of the answer (21b), however, is something like '*there is a relation between John and Mary*'. The same realisation pattern could be found in a context '*what did John do with Mary?*', where such a relation (in the wide sense) is asked for, hence given as a unit. But in this example we cannot find such an antecedent for the background. (22) exemplifies the same problem. If there are two given persons we could still argue that it is somehow implicit in the context that those two persons must have some relation. But for the whole group of people invited it is quite difficult to argue that they are all necessarily related. In fact, (22b) asserts rather than anaphorically recovers or presupposes a relation between Susi and Johnny.

Also in (23) the sentence background expresses given information which does not stem from the same source. In this example the background has two antecedents: *Gilles said* and *the x president drinks*.

- (23) Jack said the American President drinks. What did Gilles_i say?
he_i said the [FRENCH]_{focus} President drinks. (Schwarzschild, 1999, p.168)

(24), finally, is an example of a double link construction in Catalan, marked by multiple left-dislocation.

- (24) Context: Monologue about weddings.
[Jo]_{link}, [a les bodes]_{link}, m'hi avorreixo sempre.
[I]_{link}, [at the weddings]_{link}, me'there bore always.
'I'm always bored at weddings.'
(Buenaforiente, 2001b, p. 131)

Both link constituents are linguistically marked by virtue of being syntactically clitic left-dislocated (this is a case of multiple left-dislocation), which is a sound test for top-

ichood in Catalan (more details will follow below in section 1.3.1 and 2.1.3). The antecedents for both of the topics comes from two different sources again. The whole text is about weddings. At the point (24) is uttered the speaker decides to give his personal opinion on the subject. Nothing in the preceding discourse expresses explicitly that the speaker is involved in some way in the topic of the monologue. Of course the speaker is prominent in the discourse and it can be inferred that he has a personal experience with the topic of weddings, but still there is no unique antecedent which would render the background as given en-bloc. We can either assume that different parts of the background are anaphoric to different antecedents or that a unique antecedent has to be created by inference.

Accounts of IS which assume that there is one single background (as the complement to a single focus) have the extra burden of explaining how and appropriate antecedent for the information expressed in this unit is introduced into the discourse model either by entailment (Schwarzschild, 1999) or presupposition accommodation (Geurts and van der Sandt, 2004a). In chapter 3 I will take the alternative approach and argue that backgrounds do not have to be treated a monolithic blocks. Different parts of the background may be anaphoric separately and have separate antecedents. I will also claim that background elements may not differ from other anaphoric elements in the range of semantic types to which they belong. These claims can be summarized as in (25).

- (25) **The strict anaphoricity hypothesis**
- (i) Background elements behave like any other type of anaphora.
 - (ii) Background elements may belong to the same semantic types to which other anaphora belong.

I will show in chapter 3 that the two hypotheses in (25) can be maintained and that these assumption require only a minimum of extra machinery in order to to explain IS resolution.

1.1.4 Anaphors in focus

One apparent problem for the current approach is the fact that anaphoricity is a necessary but not a sufficient condition for backgrounds. Consider the following examples, taken from Schwarzschild (1999).

- (26) Q: Who did John's mother praise?
A: She praised HIM.
(Schwarzschild, 1999, p. 145)

As has often been noted (e.g. Rochemont, 1986), all background material must be given, but not all given material is backgrounded. Such cases are not resolvable only from information about anaphoricity alone, because all strings of words in (26) are apparently anaphoric. There are, however, two observations to be made: First, and as described by Schwarzschild, a recursive notion of anaphoricity (or givenness in his account) may resolve IS in this example: while both *praise* and *him* are given, the VP *praise him* as a whole is not given. The second observations we can make is that there is

an overt context question which asks for the person which is praised. Such examples, which display contrastive foci (in the sense of Rochemont, 1986) are somewhat difficult to explain on the basis of anaphoricity. I will return to this point in chapter 4. I will argue there that questions under discussion (e.g. Roberts 1996) play an important role in determining IS, in that they guarantee discourse coherence.

It is also important to keep in mind that background elements are anaphora with a mission. On the one hand they behave anaphorically and are interpreted with respect to their antecedents. On the other hand they tie the assertion of a sentence to the context. If an otherwise anaphoric element cannot fulfil this function it will not be licensed as a background.

1.2 How does information structure influence discourse structure?

The relation between IS and DS is no one-way street. There are cases where IS gives important clues on how to attach new information in a discourse to the right place in the discourse structure. I will assume that a discourse is structured in recursively organised segments (Grosz and Sidner, 1986, Webber, 2004, Asher & Lascarides, 2003). At each point a new segment has to be added, a decision has to be made as to which node of the discourse tree has to be taken as an attachment point. This decision is crucially dependent to the right frontier constraint (Polanyi and Sha, 1983, cf. also (2.2.1) below), which requires every new discourse segment to the right frontier of the discourse tree. As a result the linear ordering of sentences cannot result in crossing branches of the discourse tree. (27) illustrates this. Here the marked background *de voluntat* (via clitic right dislocation) of the last line picks up an antecedent from the first sentence:

(27) Per fer règim, s'ha de tenir una especial voluntat.

'If you are on a diet you have to have special willpower.'

[

No com el Gallardo, que me'l trobo l'altre dia i li dic: "Com estàs?". I em diu: "Fa tres setmanes que faig règim". Dic: "Ah, sí? I quan has perdut?". Diu: "Tres setmanes". I té raó.

'Not like Gallardo, which I saw the other day. I asked him: "How are you?" And he says: "I've been on a diet for three weeks." And I: "Oh? And how much did you loose?" He: "Three weeks"." And he's right.'

]

Jo tampoc en tinc, [de voluntat]_{tail}. Quan faig règim, ho I neither of-it have, of willpower. When make-I diet, it passo fatal. have-a-time-I terribly.

'I don't have the willpower either. When I'm on a diet I'm having a terrible time.'

(Andreu Buenafuente 2001a, p.103 cited by Mayol, 2002)

What is described in the middle bit of the example, marked by square brackets, is an anecdote which exemplifies the claim made in the first sentence. Since a discourse is organised as a tree, the attachment of a new sentence to a higher attachment point has the effect of closing a discourse segment. The two sentences of the last line closes off the discourse segment which contains the short anecdotic story. I will discuss this example and similar ones in more detail in chapter 4.

I have claimed above that in many cases the information structure of a sentence is recoverable from the context of utterance. In other cases, however, this is not so. In (27) the background is syntactically marked. Even in English, where written texts usually lose phonetic information entirely, authors sometimes feel the need to represent phonological accents by printing some word(s) in bold face, italics or small capitals, as is the case in (28), an example from the front page of a New York Times Magazine (cited by Vallduví, 2002).⁹

(28) Men *are* different.

Evidently, a news headline like this is placed in an out-of-the-blue context. Nevertheless the stress on *are* suggests that there is a cultural context, a discussion of whether men are different from whoever they might be contrasted. If such a context was not assumed, the default stress would fall on the sentence final word *different*. The prominence marking here is highly informative in the sense that we have to accommodate the right context in which this sentence is used.

Certain ways of linguistic marking require a background element to be stand in a partial match relation to their antecedent. (15b) is ambiguous. The *boys* can either be identical to the children or form a subset, such that the group of children contains both boys and girls.

- (15) a. What about the children?
b. The boys are on a school trip.

In the second case (the reading where the boys are a subset of the children), but not in the first, the subject must be marked with a rising accent which marks it as a link. If this accent is present the discourse can continue with some comment on the girls, like *the girls stayed at home*. If there is no rising accent on the subject, such a continuation does not sound natural. In Catalan this contrast is marked syntactically as (29) shows: Contrastive topics (*links* in the present terminology) must occur pre-verbally while non-contrastive background elements are right-dislocated. In Catalan this example is even more self-evident, since *nens* is both the word for boys and children. So the contrastive (29b.) requires a gender-neutral interpretation of the antecedent, including both boys and girls. That means that *nens* in (29a) is equivalent to *children* and cannot be interpreted as *boys*, while in the answer (29b) *nens* necessarily means *boys*.

- (29) a. Que passa amb els nens?

⁹It is actually quite surprising that writers do not feel more often the need to represent phonetic information graphically since phonology often carries information which is not explicit in the text. It is also surprising that most writing systems, like the one of English, do not incorporate a standard representation of accentuation.

- ‘What about the children?’
- b. Els nens se n’han anat d’excursió, les
 The boys/#the children refl have gone to’school-trip, the girls
 nenes són a casa.
 are at home.

In chapter 4 I will return to the role that links play in the construction of discourse structure. I will argue there that the contrastive relation that holds between the two clauses of (29) must be interpreted as a contrast between two discourse segments which are subsumed under the common topic of *children*.

1.3 Information structure and linguistic realisation

1.3.1 The linguistic realisation of information structure

Information structure is linguistically marked differently in different languages. A very common way to mark foci is via sentential stress. In English foci are associated to the main sentence stress in combination with to a H* or H*L pitch accent (Lieberman, 1979, Pierrehumbert, 1980, Selkirk, 1984), as (30) exemplifies.

- (30) a. What did Peter do with the cake?
 b. He ATE the cake.

Phonological marking is quite common among different languages. But also syntax and morphology are possible ways to signal a special informational status of a sentence part. In this dissertation I will rely on data from three languages: English, German and Catalan.

In this section I will present some heuristics which shall help us in determining links, tails and foci. The presentation of the data here is by no means exhaustive.¹⁰ The main goal of this short discussion here is to lay the ground of a more theoretic account develop further on. The emphasis here lies on the distinction between two different elements which are both possible parts of the sentence background: links and tails.

Catalan is a language which marks the distinction between links and tail explicitly by syntactic dislocation operations (Vallduví, 1992, 1994b, 1994a, Mayol, 2002). In (31), for example, the link *l’amo* is pre-verbal and pre-focal (cf. Brunetti, 2008), while the tail is clitic-left dislocated.

- (31) Q: What about the boss? Does he like broccoli?
 A: [L’amo]_{link} [L’ODIA]_{focus} [el bròquil]_{tail}
 [The’boss]_{link} [it-hates]_{focus} [the broccoli]_{tail}

For the moment I will not consider details about the semantic and pragmatic function of links and tail. It is interesting and instructive that Catalan systematically distinguishes between two different parts of the background. Links correspond to sentence

¹⁰For a more complete overview about the realisation of links and tails across languages, see Vallduví and Engdahl (1996b).

topics, in that they display the *aboutness*-effect (Reinhart, 1995). They mark what the sentence is about. Link marking typically occurs in the context of *what-about* questions, like (31Q). As I will illustrate throughout this dissertation, links are usually also contrastive to some other element in the context.

Syntactically, links and tails are marked by left-dislocation or clitic-left-dislocation in the case of sentence objects. This marking by dislocation is most often found in spoken register. Also preverbal subjects are typically links (Vallduví, 1992, Vallduví and Engdahl, 1996b). The sentence focus is represented by the core clause and marked by the main sentence accent. I adopt the standard convention here and represent the focus-identifying accent by using capital letters.

Tails, in contrast, are syntactically realised as right-dislocated elements. In the case of dislocated objects, a co-referential weak pronoun (*l'* in (31)A) is attached to the verb as a clitic. Tails do neither display an *aboutness*-nor a *contrastivity*-effect. Link-realised NPs often act like pronouns, like in our example (31) where *el bròquil*, which could be elided, so the weak pronoun fulfils the same function.

- (32) L'amo l'ODIA
The'boss it'hates
(Catalan)

In English and German the linguistic realisation of links and tails is not as unambiguous as in Catalan. Both English and German use a fall-rise accent (L+H*, Jackendoffs, 1972, B-accent) to mark links. This rising accent is different from the typical focus identifying accent, which is realised as either H* or H*L (Lieberman, 1979, Selkirk, 1984). There are fine-grained phonetic differences between English and German, which will not concern us here. I will use letters in bold-face and italics to mark the link-related accent from now on.

Tails are typically unaccented in both languages. This means that when they occur post-focally they are deaccented, like in (33) and (34).

- (33) [The *boss*]_{link} HATES [broccoli]_{tail}
L+H* H*
- (34) [Der *Chef*]_{link} HASST [Broccoli]_{tail}
L+H* H*
- (German)

Since German is a language with relatively free word order, object-fronting to the pre-field position is frequent.

- (35) Q: Was ist mit Broccoli? Mag der Chef den?
'What about broccoli? Does the Chef like it?'
- A: (Nein,) [*Broccoli*]_{link} HASST [der Chef]_{tail}
(No,) [*broccoli-acc*]_{link} HATES [the boss-nom]_{tail}
(German)

What is especially interesting for the purpose of the present dissertation is the fact that, as noted in connection to example (24), there are constructions with multiple links or

tails. Again, this can be seen best in Catalan:

- (36) a. I a l'amo? Li agraden les verdures?
 'And what about the boss? Does he like vegetables?'
 A: [El bròquil]_{link}, [l'amo]_{link}, l'ODIA.
 [The broccoli]_{link} [The boss]_{link} it'HATES.
 (Catalan)
- (37) a. Q: El bròquil l'agrada, a l'amo?
 'Does the boss like broccoli?'
 A: No, l'ODIA, [el bròquil]_{tail}, [l'amo]_{tail}.
 No, it'HATES, [the boss]_{tail}, [the broccoli]_{tail}.
 (Catalan)

I will return to the theoretical issues related to the tripartite articulation of IS in chapter 2. The most important finding is that there is strong linguistic evidence for the assumption that there are two different possible elements of the sentence background which are licensed in different contexts. As I will show, this has important theoretical implications.

1.4 Concluding remarks

In this section I have presented some of the data and some of the problems I will address in this dissertation. The aim of this discussion was mostly to give a short introduction in the topics which will be discussed in more detail in the rest of this dissertation. I have tried to show that the notion of information structure cannot be separated from the notion of discourse structure without missing important aspects. Information structure and discourse structure constrain each other mutually. Information structure depends on discourse information in that only given information may form part of the background. The accessibility of this given information is subject to locality constraint which are very similar to the constraints which hold for other types of anaphora, like pronouns. The discourse context seems to be the only available source of information which allows to disambiguate the information structure of individual sentences. On the other hand, the structure of discourse is influenced by overt marking of information structure. Most notably, contrastivity effects induced by the overt linguistic marking of a constituent as a link calls for an explanation in terms of discourse structure. Finally I have shown that there is a genuine need to distinguish between two distinct element of the sentence background: links and tails. The distinction between links and tails calls for a more detailed analysis of the notion of background itself, since links and tails behave differently, both in what concerns their linguistic realisation patterns and what concerns the contexts in which they are licensed.

Chapter 2

Orientation: Information Structure and Discourse Structure

This chapter will give a short introduction to the theoretical background of this dissertation. Since it is impossible to give an exhaustive overview of all topics neither in information structure (IS) nor in discourse structure (DS), I will mainly concentrate on the points which are of relevance for the rest of the dissertation. This will be especially the discourse semantics and the pragmatics of information structure and the ‘syntax’ of discourse: the way a discourse is segmented and organised in the form of a tree.

This chapter is organised as follows: I will first delimit the cover term information structure in the sense relevant here section 2.1.1 presents the syntactic basis on which the current proposal rests: Combinatory Categorical Grammar. This syntactic framework provides a way to integrate information structure directly into syntax and make informational primitives, like links and tails, available as syntactic constituents. In 2.1.2.1 I will explain why a givenness approach to IS is necessary and how such an approach can resolve IS on the basis of information from the discourse. Section 2.1.2.2 discusses the relation between IS and presuppositions. I will critically revise two presuppositional approaches and show that presuppositions are a necessary ingredient for a theory of discourse structure, but also that presuppositional rules are best used with care. In 2.1.3 I justify the theoretic decision of using a tripartite model of discourse structure which distinguishes between three informational primitives: links, tails, and foci.

In the second part of this chapter (2.2) I will introduce the structure of discourse. I will distinguish between theories which concentrate on discourse semantics and pragmatics (2.2.1) and approaches to the segmentation and organisation of discourse (2.2.2).

2.1 Information structure

2.1.1 Phonology and syntax

First of all, information structure is to be understood here as a sentence level notion.¹ IS is the structure which causes variation in linguistic realisation that correlates with change in meaning. This change in meaning does, however, usually not alter the propositional content of a sentence. Instead of truth-conditions, information structure affects the conditions of felicity with respect to a given context. IS also determines

¹This is simply a terminological definition. Roberts (1996) understands IS as a discourse notion. Both points of view are possible and justified. In chapter 4 I will argue that sentence level IS has important effects on DS. It is simply important to remember that the term IS here does not refer to the level of discourse.

how information is distributed across a sentence and of how a sentence is divided into different informational units, which relate to the model of context in different ways.

The most visible facet of IS is probably phonology: As we have seen in chapter 1, in languages like German or English a focus is usually marked by pitch accents. Here I use upper case to represent the focus identifying main sentence accent.

- (1) Who likes grog?
The PIRATE likes grog.
- (2) What does the pirate do with the grog?
The pirate DRINKS the grog.

On the other hand, there are languages which clearly use syntactic devices to mark IS. In chapter 1 I also showed that Catalan marks background elements syntactically through dislocation and linearisation.

- (3) Q: Que fa el pirata amb el grog?
'What does the pirate do with the grog?'
- A: El beu, el pirata, el grog.
It drinks, the pirate, the grog.
(Catalan)

IS meaning affects phonology and meaning, both being peripheral devices from a syntactic point of view (for some syntacticians, at least). Rochement (1986), for example, which assumes that focus marking happens as S-Structure within the Y-model of syntax, assumed in Government and Binding Theory. This marking applies at an level of syntax (S-Structure in Government and Binding Theory) which feeds phonological form and logical form separately). Although this involves a considerable amount of non-determinism (multiple focus structures are generated and checked *a posteriori* against PF and LF) it explains why IS affects both phonology and meaning under the (GB dependent) assumption that there is no direct interface between phonology and semantics. Of course the lack of a direct interface between phonology and meaning may be an artefact of GB, but if such an interface is assumed it must be properly defined. In any case, the data from Romance strongly suggests that syntax plays a central role in information partitioning.

Vallduví and Engdahl (1996a) develop an HPSG (Pollard and Sag, 1994) account for information packaging which explains both the data from English and Romance. In this approach phonologic rules for English assign values to features like *focus* and *link* which are attributed to constituents. Phrasal rules manage the right feature percolation for focus projection. This theory extends to Romance (in particular Catalan) data in a natural way. In Catalan, the assignment rules for information structural units depend, however, on syntactic constellations and not on phonology. In either of the two cases, assignment by phonology or syntax, the HPSG signs for words, phrases and sentences contain the same information about IS. Again, syntax is the mediating level which maps linguistic surface realisations to feature values which represent IS in HPSG signs. The advantage that such an HPSG treatment has over a treatment in GB, is that phonology, syntax and IS can be represented at one level, namely the HPSG sign. In this way syntax does not have to feed the levels of phonology and meaning independently.

Another influential syntactic approach is Steedman's (1991, 2000a, 2000b) CCG (Combinatory Categorical Grammar) treatment of IS. This is the approach I will build my analysis on. Steedman's proposal is largely compatible with the proposal developed in chapters 3 and 4 and represents a sound basis for the derivation of sentence information partitioning which will be assumed there. This is why I will provide a short introduction to the relevant fragments of his proposal here.

Steedman assumes a monostratal model of the language processor in which phonology and semantics are computed in parallel to syntax (in what he calls *the syntactic process*). This monostratal approach does not distinguish different levels of derivation (like D-Structure and S-Structure in GB theory), but assumes that syntax, semantics and any other module apply at only one level. Under this assumption Rochemont's problem of a mediating level between phonology and meaning vanishes, since dependencies between different linguistic modules (lexicon, syntax, semantics, phonology) hold on the level of words or small increments while the computation of the sentence applies in parallel. Syntax is still the agglutinating factor in linguistic derivation, but it follows semantic needs.

CCG is a categorial grammar framework and has two peculiarities which distinguishes it from other context-free grammars:² It allows for variable constituency and it makes constituency dependent on information structure and intonation. First of all, it assumes a much wider range of possible constituents. A subject plus a transitive verb, for example, can be combined into a constituent, which in turn may form a sentence in combination with the object. But let us first clarify what *category* and *combination* mean in CCG. Consider the following lexical entry for the intransitive verb *dance*:

$$(4) \text{ dance} := S \backslash NP : \lambda x. \text{dance}' x$$

The intransitive verb (4) belongs to the syntactic type $S \backslash NP$. This means that it can be turned into an S (the target category which is by convention written on the left) if it finds an NP with which it can combine. The directionality of the slash character indicates on which side the argument type must be found. In (4) the backslash requires that an argument of type NP must be found immediately to the left of the predicate *dance*. Now the most basic combinatory rule, the rule of functional application in (5) can apply.

- (5) Functional application
 a. $X/Y : f \quad Y : a \Rightarrow X : f a (>)$
 b. $Y : a \quad X \backslash Y : f \Rightarrow X : f a (<)$

In a sentence like '*Mary dances*' the predicate *dance* is so combined with the subject NP *Mary* to its right in order to form a type S . In addition to the syntactic part, the type of *dance* in (4) has a semantic part which follows the colon. In this case it is a lambda abstract which replaces the only argument of *dance* by a variable. When functional application applies to the sentence *Mary dances* this variable is instantiated to the semantic value of the NP , which is *mary'*. So the result of applying functional application to the two types for *Mary* and *dances* is $S: \text{dance}' \text{mary}'$. The combinatory pattern is as follows:

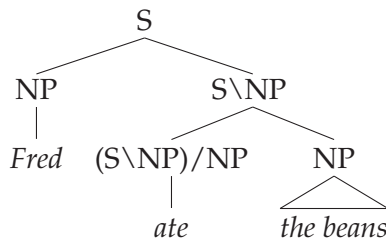
²CCG is mildly context sensitive, but largely comparable to other generative grammars like GB (Government and Binding Theory, Chomsky 1981), but also HPSG (Pollard and Sag, 1994) and LFG (Lexical-Functional Grammar Kaplan and Bresnan, 1982).

$$\frac{\frac{Mary}{NP} \quad \frac{dances}{S \backslash NP}}{S : dance'mary'} <C$$

Let us now turn to the more interesting case of transitive verbs, which may occur within the non-standard constituent constellations i mentioned above. The lexical entry for a transitive verb like *eat* is as in (6)

$$(6) \text{ eat} := (S \backslash NP) / NP : \lambda x. \lambda y. \text{eat}' x y$$

Again, the type for *eat* has a syntactic and a semantic side. Transitive verbs are of type syntactic type $(S/NP) \backslash NP$, which means that they combine with two NPs. Semantically they have two arguments which are lambda-abstracted in the semantic side of the type. In CCG transitive verbs can either combine first with the object and then with the subject (as traditionally assumed), or in the inverse order; first with the (type-raised) subject and then with the object. The first of the two possible derivations implies only recursive functional application, first to the verb and the object and then to the VP (which is of type $S \backslash NP$) and the subject NP. For a sentence like '*Fred ate the beans*' the following tree can be derived in this way:

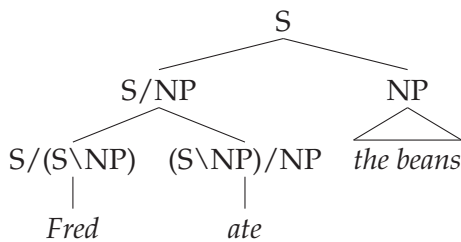


But in CCG categories can be manipulated by other combinators, apart from functional application such as the type-raising and the forward composition rules in (8) and (9) (which are named after birds, following Curry and Feys, 1958: the thrush (T) and the bluebird (B)).

- (7) Subject type raising (>T)
 $NP \Rightarrow_T S / (S \backslash NP)$
- (8) Type raising
 - a. $X : a \Rightarrow_T T / (T \backslash X) : \lambda f. f a (>T)$
 where $T \backslash X$ is a parametrically licensed category for the language
 - b. $X : a \Rightarrow_T T \backslash (T / X) : \lambda f. f a (>T)$
 where $T \backslash X$ is a parametrically licensed category for the language
- (9) forward composition (>B)
 $X / Y : f \quad Y / Z : g \Rightarrow_B X / Z : \lambda x. f(gx)$

An NP may be raised to type $S / (S \backslash NP)$ (a sentence which lacks a verb phrase to be complete), by (7) (which is an instance of (8a)). This means that a subject NP is potentially a full sentence which lacks a VP (of type $S \backslash NP$) to its right. Now, the second way of deriving a parse for the sentence '*Fred ate the beans*' is as follows: First the subject is type-raised to $S / (S \backslash NP)$ and then it combines modulo forward composition with the verb $((S \backslash NP) / NP)$ to type S / NP . The result the non-standard constituent which covers the string '*Fred ate*'. This constituent of type S / NP can then combine with the object

NP. Even if the technical details may be confusing at first sight, the effect is clear: We get a second syntactic derivations, which has the following syntactic tree:



What is this good for? First of all, so called ‘non-constituent’ (also called right-node raising, Ross, 1967) coordination, exemplified by (10) turns out to be a coordination of constituents, after all.

- (10) [Anna married] and [John detests] Manny

For the treatment of IS this combinatory potential is very interesting, since it can derive constituents which corresponds to foci and backgrounds where other frameworks have to assume that information partitioning is orthogonal to constituency, as in (11).

- (11) What does the pirate like?
 [_{S/NP} The pirate likes] [_{NP} GROG].

It has been argued (Lieberman, 1979, Selkirk, 1984) that intonation structure is orthogonal to syntactic constituent structure. In CCG, however, constituent structures can always be isomorphic to intonational phrasing. Nevertheless, even in CCG some constituent structures are possible, which have no sensible semantic interpretation, as example (12) (attributed to Pierrehumbert, 1980). Such examples have been claimed to be phonologically impossible for the same reason, namely the lack of semantic plausibility (Selkirk, 1984).

- (12) *(Harry likes the NUTS) (and bolts APPROACH)

A second peculiarity of the treatment of IS within CCG is that phonology directly influences constituency. Steedman treats tones as carriers of lexical information. Pitch accents mark a word as thematic or rhematic, depending on the accent type: according to this proposal, a L+H* accent in English marks a word and its type with the subscript θ (as thematic) and a H* accents will mark it as ρ (rhematic). The subscript ϕ is applied to phrasal categories which contain θ and ρ . Boundary tones (L, LL%, LH% in English) receive a status similar to words and the meaning they carry is that of a delimiter of a thematic or rhematic constituent. The rule for boundary tones is given in (13). S\$ is a variable which ranges over all categories relevant for IS: S, S/NP and all verbs and type-raised arguments of verbs.³ η' is a variable which ranges over the information types θ (theme) and ρ (rheme).

- (13) L, LL%, LH% := S\$ ϕ \S\$ η' : $\lambda f.\eta'f$

³Although Steedman does not stress this point in any way, it is very interesting that S\$ ranges over types which may also enter anaphoric relations, excluding the ones which are never anaphoric. In chapter 3 I argue that this set is relevant for the determination of possible background elements.

Syntactically a boundary tone converts any type to the right of it, which can be either marked θ (thematic) and ρ (rhematic), into a phrasal type with the subscript ϕ . Once marked as ϕ , this type may combine only with other phrasal types, but not with themes or rhemes that have not combined with a boundary tone yet. This prevents unfinished themes and unfinished rhemes to combine. The semantic side of the type in (13) takes the meaning representation of the argument type and marks this as either thematic or rhematic. The derivation of the sentence (14) (originally discussed by Jackendoff, 1972), for example, would be as shown below.

(14) Q: I know what Harry ate. But what did FRED eat?

A: *Fred* ate the BEANS
 L+H* LH% H* LL%

First the subject *Fred* is marked as thematic by the raising accent. Then the type-raised subject combines with the verb forming a non-standard constituent, which combines then with the boundary tone LH%. Once the boundary tone has combined with the constituent to its left, the informationstructural domain, in this case the theme, is closed and Θ -marked, as can be seen in (15). The layer structure of the inference pattern is the same as the constituent structure:

$$(15) \quad \frac{\frac{\frac{Fred}{L+H^*}}{S_\theta/(S_\theta \backslash NP_\theta)} : \lambda p.p *fred'}{\frac{ate}{(S \backslash NP)/NP} : \lambda x.\lambda y.ate'xy} \quad \frac{LH\%}{S\$_\phi \backslash \$_\eta} : \lambda f.\theta'f}{S_\theta/NP_\theta : \lambda x.ate'x *fred'} > \mathbf{B} \quad \frac{S_\phi/NP_\phi : \theta'(\lambda'x.ate'x *fred')}{S_\phi/NP_\phi : \theta'(\lambda'x.ate'x *fred')} <$$

(Steedman's 2000b (46), p.113)

The semantic result of the derivation is a lambda-abstracted proposition, marked with the theme-marker θ . The syntactic side of the type, however, is already marked with ϕ , which signals that the type contains one or more informationstructurally primitive units. In this particular case the type that represents the whole string in (15) is, rather than forms part of, a theme. The theme could be described as being fully encapsulated within the ϕ -marked constituent. A similar derivation is obtained for the rheme *the beans* LL% in (16), which is semantically again a lambda-abstract. Correspondingly, the syntactic side of the type is marked ϕ . Now, in a final step, theme and rheme combine to a full sentence which is informationally partitioned. The final inference in (16) is a simple reduction to the standard truth-conditional semantics of the sentence.

$$(16) \quad \frac{\frac{\frac{Fred \text{ ate } LH\%}{L+H^*}}{S_\phi/NP_\phi} : \theta'(\lambda'x.ate'x *fred')}{\frac{\frac{the \ BEANS}{H^*}}{NP_\rho} : \lambda p.p(the' *beans')} > \quad \frac{LL\%}{S\$_\phi \backslash \$_\eta} : \lambda f.\rho'f}{\frac{S_\phi/NP_\phi : \theta'(\lambda'x.ate'x *fred')}{NP_\phi : \rho'(\lambda p.p(the' *beans'))} < \quad \frac{S_\phi : \rho' \lambda p.p(the' *beans')(\theta'(\lambda'x.ate'x *fred'))}{S_\phi : ate'(the' *beans') *fred'} <$$

calculus explicitly refrains from making use of other null categories, such as traces or null pronouns. The calculus must be burdened with a heavy load of additional non-determinism. As pointed out in chapter 1, this non-determinism (and the resulting ambiguity) is one of the central problems we encounter in dealing with IS. Nevertheless, Steedman argues that “this nondeterminism can be eliminated for processing purposes by taking advantage of the fact that the unmarked theme is exclusively used when the hearer is assumed to already know the theme.” (p.118) The key to ambiguity resolution is, hence, available information which comes from the *discourse model*.

At this point we have arrived precisely at the issue which is central to this dissertation: the need to explain thematic in terms of “what the hearer is assumed to already know”, in other words, anaphoricity. I assume here that information from the discourse model is needed 1) for the detection of unmarked background elements (where marking may otherwise happen through phonology or other linguistic means, like syntax or morphology) and 2) to determine how far the marked background elements extend in examples like (14)/(17). I continue to assume that Steedman’s calculus is the best syntactic basis we can assume for the realisation of IS. The key advantages are that the basic units of IS - whatever basic set of IS we may assume - can be derived as genuine syntactic constituents and that phonological information can be used directly for the calculus when available. Nevertheless, Steedman’s calculus calls for the integration of discourse information. Only if we know which elements are required by the discourse to be realised as background elements, we can separate them from the sentence focus (Steedman’s rheme). In chapter 3, I will develop a theory of background resolution as anaphora. I will argue there that the process of IS resolution can be subsumed under another principle which Steedman proposes: the *principle of parsimony*.

2.1.2 The semantics and pragmatics of information structure

In this dissertation the main focus will be on the pragmatic felicity conditions on certain IS realisation patterns and the function that background elements have with respect to the discourse environment. I will have little to say about the semantic interpretation of information structure within a sentence. Background anaphora can be seen as anaphoric connectors which tell us in which way we have to relate new information to things that we already know in a discourse. The current approach is built on the concepts of givenness and questions under discussion. As has repeatedly been noted (Schwarzschild, 1999, Roberts, 1996), this class of approaches, like the proposals made by Schwarzschild and Roberts, differ from approaches which build on focus-interpretation as *the* central cornerstone of a theory of IS. In difference to proposals like alternative semantics (Rooth, 1985) or structured meanings (von Stechow, 1989, amongst others) the present proposal does not assume that the sentence focus is inherently bound by a focus-sensitive operator. In contrast, I assume that focus-sensitive particles like *only* or *even* take scope over a sentence focus, once IS resolution has taken place.

2.1.2.1 Givenness

In the long honoured tradition of Halliday (1970), I make the basic assumption that backgrounded material is given, in the sense that it can be anaphorically resolved. Foci, in turn, present new information, i.e. information which is not already given in

the context and which is not anaphorically recoverable. As a starting point I will take the givenness-theory developed in Schwarzschild (1999), which I will revise in many ways in chapter 3.

Schwarzschild argues that the definition of ‘new’ or ‘new information’ can be simply reduced to ‘non-given’. This simplifies Halliday’s definition of ‘new’ considerably, since Halliday identified three cases in which a focused element counts as new: 1) the element which replaces a wh-element in an answer, 2) an element which is “textually and situationally non-derivable” and 3) an element which stands in contrast to some alternative. The three cases are exemplified by (20), which are the examples given by Schwarzschild (p. 141).

- (20) a. Q: Who did John’s mother vote for?
A: She voted for JOHN.
- b. A: Why don’t you make French TOAST.
B: I have forgotten how to MAKE French toast.
- c. John’s mother voted for Bill.
No, she voted for JOHN.

In an attempt to eliminate the category of ‘new information’ (which corresponds to the sentence focus) Schwarzschild argues that this category is simply the complement to the part of the sentence which is marked as ‘given’. As (20) shows, the definition of ‘new’ is highly problematic, while - as he argues - the category ‘given’ can be defined in a uniform way. This makes the sentence focus a kind of ‘default’⁴ category which applies to any non-background part of the sentence. Although Schwarzschild proves quickly that this assumption *alone* is too strong (given material can form part of the sentence focus), this is a desirable step, since one of the categories ‘new’ and ‘given’ seems to be superfluous and the category ‘new’ is less homogeneous than the category ‘given’. Because givenness marking is not sufficient to determine IS, it has to be complemented by a minimality principle concerning F-marking: Only a *minimum* of F-marking (focus marking) is allowed. In particular, given material has to be F-marked in very specific cases discussed below. The formal structure Schwarzschild builds in order to derive givenness is centred around two rules: GIVENness and AvoidF. The rules are as given in (21) and (22). They contain a series of concepts, which need further clarification, so let us go step by step through the definitions and see then how an example derivation works.

- (21) **GIVENness**
If a constituent is not F-marked, it must be GIVEN.
(Schwarzschild, 1999, p. 155)

- (22) **Avoid F**
F-mark as little as possible, without violating GIVENness.
(Schwarzschild, 1999, p. 156)

⁴Schwarzschild does not use the term “default-category”, but I think it describes nicely the way in which we can look at focus in IS resolution: it is the part of the sentence which remains, once all backgrounded parts have been identified. The F-marker applies, thus, by default to non-background material. The focus identifying accent must fall within this part of the sentence and focus-sensitive operators like *only* (Jackendoff, 1972, Rooth, 1985) take scope over it.

First of all, Schwarzschild assumes that any constituent which is not part of the focus (or F(ocus)-marked) must be given, or at least be *presented as given*⁵ by the speaker. GIVENness is captured by the rule in (21). In other words, givenness of a constituent licenses its status as background. At this point it is important to note that *background* and *givenness* are distinct concepts. A background must be given, but not all given material has to be necessarily backgrounded (or excluded from F-marking, according to (22)). The AvoidF constraint ensures that given material will not be marked as part of the focus unless it is absolutely necessary. F-marking is seen here as a process that can apply to any syntactic constituent which contains a focus-marking accent. I skip the details of phonological marking, since they not important for the present purpose. The only important thing here is the basic and uncontroversial assumption that any focus (of whatever size) must be marked by at least one pitch accent.

Turning to the central concept of givenness, for Schwarzschild both a entities of type *e* (individuals) or propositional type expressions can be given. The first type of givenness is quite straightforward: an entity is given if it has a co-referential antecedent. Any other semantic type must be raised to a full, but potentially open, proposition by a mechanism called *existential type shift*, given in (23).

- (23) **Existential Type Shift: ExClo**
- a. If $\omega \in D_t$, then $\text{ExClo}(\omega) = \omega$
 - b. For any conjoinable type $\langle a, b \rangle$:
If $\omega \in \langle a, b \rangle$, then $\text{ExClo}(\omega) = \lambda w \exists u \in D_a[\text{ExClo}(\omega(u)(w))]$
 - c. *t* is a conjoinable type.
If *b* is a conjoinable type, then so is $\langle a, b \rangle$, for any type *a*.
- (Schwarzschild, 1999, p. 152)

In the case a non-propositional type is raised to a proposition, there are two different abstraction operations which must apply, one for focused material within a *given* constituent and another which abstracts away from arguments which are not realised within the target constituent. Schwarzschild combines the two operations in one rule, which is labelled *existential f-closure*, given in (24).

- (24) **Existential-F-Closure** of *U* =_{df} the result of replacing F-marked phrases in *U* with variables and existentially closing the result, modulo existential type-shifting

F-closure is an operation which abstracts away from any F-marked (focalised) constituent, while existential type shift raises any semantic type to type *t* (the type of propositions). If existential type shift applies, all unfilled arguments are replaced by existentially bound variables. An important feature of Schwarzschild's account is that givenness is an instance of *entailment*, but - according to (25b) - only in case existential type-shift applies. Referents of type *e* are given in the same way pronouns are anaphoric: under co-reference. Using the definition of existential type shift and existential F-closure, the term *given* can now be defined as follows:

⁵In chapter 4 i will return to the overt marking of links and tails which presupposes a constituent to be given.

(25) **Definition of GIVEN.** (Informal Version)

An utterance U counts as GIVEN iff it has a salient antecedent A and:

- a. if U is of type e, then A and U corefer.
- b. otherwise: modulo \exists -type shifting, A entails the Existential-F-Closure of U (Schwarzschild, 1999, p. 151)

In order to see how these constraints and rules work, it is probably best to derive two representative example sentences. Let us first apply them to the relatively unproblematic case of (26).

- (26) Q: Who did John's mother praise?
 A: She praised [BILL]_F.

In this example the context, in the form of the question (26Q), allows the subject pronoun of (26A) to be given because it is co-referential with *John's mother*. The sequence *she praised* counts as given because (2.gdefb) applies: the existential F-closure of this sequence is ' $\exists x(\text{she praised } x)$ ' and this F-closure is entailed by the context. The only part of the answer which is not given, is the object *BILL*, since it has no co-referential antecedent. In consequence also the VP '*praised Bill*' cannot count as given, because (26Q) does not entail its existential F-closure ' $\exists x(x \text{ praised Bill})$ '. The same applies to the sentence as a whole. The problematic case is the one of contrastive foci (in the sense of Rochemont, 1986): a focus which is itself anaphoric or contains anaphoric material. Consider (27) (Schwarzschild's (11)/(38))

- (27) Q: Who did John's mother praise?
 A: She praised [HIM]_F.
 (Schwarzschild, 1999, p. 145)

Schwarzschild assumes that the question (27Q) is interpreted as the set of possible answers (which is derived by replacing the wh-element with all possible values it may take) and hence it is equivalent to 'there is an x such that John's mother praised x'. The focus marking on *him* is assumed to be determined by the accent. Now we can iteratively apply GIVENNESS and AvoidF to all of the constituents in (27A): [_S[_{NP} she][_{VP} [_V praised] [_{NP} HIM]_F]] and check every constituent if it is given. At the word level any of the individual words is given. The givenness of the two pronouns *she* and *him* should follow from (25a). The verb *praised*, on the other hand, is not of type e and its givenness must follow from (25b). This condition can also be met, because ' $\exists y \exists x(y \text{ praised } x)$ ' is entailed by (27Q). The problem arises on the next level, when we consider sequence of two or more words (i.e. '*she praised*' and '*praised him*'). Since none of these sequences is of type e, they have to be checked for givenness applying existential type shift, following (25b).

- (28) a. Node V '*praised*' is given, because its existential F-closure $\exists y \exists x(y \text{ praised } x)$ is entailed by its antecedent: 'Johns mother praised x'.
 b. Node VP '*praised [him]_F*' is given with the F-marking on [*him*]_F because (as with the V node) its existential F-closure $\exists y \exists x(y \text{ praised } x)$ is entailed by its antecedent: 'Johns mother praised x'. (*him* is substituted by a variable by virtue of being in focus, cf. (24)).

- c. Node S ‘*she praised [him]_F*’ is given because its existential F-closure $\exists x(\textit{she praised } x)$ is entailed by its antecedent: ‘Johns mother praised *x*’.

Now, why can *him*, as a given word, be F-marked, without violating AvoidF? First of all, Givenness is a necessary, but not a sufficient condition for backgrounding (or lack of F-marking in Schwarzschild’s theory). But givenness must be respected by F-marking. This is captured by the AvoidF constraint (22). The F-marking of (27) is the minimal violation of AvoidF⁶, since only one given constituent must be marked as F. All other F-marking possibilities, including the ones which require a different locus of the focus identifying pitch accent, will result in more violations of AvoidF, some of which are exemplified in (29):

- (29) a. She [praised [HIM]_F]_F. → 1 AvoidF violation: 2 given constituents must be marked +F: VP, in addition to the object NP
 b. [She [praised [HIM]_F]_F]_F. → 2 AvoidF violations: 3 given constituents must be marked +F: VP object NP and S.
 c. [[She]_F [[praised]_F [HIM]_F]_F]_F. → 4 AvoidF violations: 5 given constituents must be marked +F: VP object NP, V, subject NP and S.
 d. She [PRAISED]_F him. → 1 AvoidF violation: V and 1 GIVENness violation of S.
 e. [[SHE]_F praised him. → 1 AvoidF violation: VP. 1 Givenness violation: S.

The interesting cases here are (29d&e): In addition to mark given material as F (which may happen only as a last resort according to AvoidF), also GIVENness is violated. In (29d) the existential F-closure of the S node would be ‘R[*she R-ed John*]’, which is not entailed by the context question. The same applies to (29e), where $\exists y[y \textit{ praised } \textit{John}]$ would have to be entailed, contrary to the context information. (29a-c) present different amounts of AvoidF violations (or more correctly: they violate AvoidF to various degrees) and are ruled out because (27A) is a version that requires less F-marking of given material.

Although the current proposal owes a lot to Schwarzschild’s theory of givenness there is a series of issues which I would like to discuss. They have mainly to do with the use of existential type shift and the assumption that backgrounds are anaphoric under entailment.

First of all, Schwarzschild’s AvoidF has nothing to say about the fact that the problem of focused and given material in sentences like (27) closely resemble problems found for the resolution of ordinary pronouns. Consider (30):

- (30) What did [[John]_j’s brother]_i do? He_{i/*j} praised his beer.

What such examples suggest is that referents embedded within a possessive NP are simply less accessible than non-embedded NPs, probably because they are less salient.

⁶ AvoidF is not absolutely violated if F-marked material is given, only if there is a derivation with less F-marking. For explanatory reasons, however, I find it more intuitive to talk about AvoidF as a defeasible constraint even if this is not a strictly literal interpretation of the AvoidF constraint. In this manner we can count the number of nodes which are given but F-marked.

If this turns out to be true, then such differences in salience should also be taken into account when analyzing (27). A possible alternative explanation for (27) would then be that *him* must be F-marked because an ordinary anaphoric co-reference relation is hard to establish, just as it is the case with the pronoun in (30). Further on, this would also suggest that the resolution of given material, at least material of the semantic type *e*, works more like simple pronoun resolution than Schwarzschild's apparatus suggests.

Another case for which a pronounlike account is surely desirable, is the case of partial matches, like in (31), already mentioned in chapter 1. Here the nominal referent *string instruments* is deaccented and backgrounded by virtue of being partially identical to the *viola*. Although *string instruments* and *the viola* might not be of type *e* (being descriptions of kinds rather than individuals), one would expect that (25a) (the condition for an entity for being 'given') holds for them. But they are not strictly co-referential.

- (31) a) Bach wrote many pieces for the viola.
 b) He must have LOVED [string instruments]_{tail}
 (adopted from 1997, 1998)

So, maybe we should apply existential type shift here, and let *string instruments* be given by virtue of entailment. But this seems to be a rather costly way to resolve the (partial) anaphoric match. I will discuss examples like (31) in more detail in chapter 3.

The distinction between entity type meanings and all other types, which is made in (25) also seems somewhat arbitrary if one considers that other types, apart from entities may be anaphoric, for example verbs, VPs and properties (Webber, 1977 amongst others):

- (32) a. John drank_i a beer and Bill ∅_i a whisky.
 b. John [drank a beer]_i and [so did]_i Bill.
 c. John is angry_i and so_i is his girlfriend.

If types like $\langle e, t \rangle$ (properties of individuals, intransitive verbs and verb phrases) and $\langle e \langle e, t \rangle \rangle$ (transitive verbs) may be anaphoric in the traditional sense, why should they be treated differently from anaphora for *e*-type meanings? What is the argument for making them given qua entailment, instead of using a simpler type of anaphoric association, as we would do for their corresponding pro-form anaphora (*so, did so* etc.)? The only strong reason for using a device like *existential type shift* seems to be the fact that it can apply to so-called non-constituents. Schwarzschild stresses "the need for a theory in which a non-constituent such as *John's mother praise* could count as given." (p. 150) If we compare this to the discussion of CCG in section 2.1.1, this motivation becomes quite questionable. Assuming a framework like CCG, the need to make so called non-constituents available for anaphoric binding does simply not arise; these word strings are available as constituents in CCG. As Steedman (2000b) discusses at length, there are good reasons to treat sentence segments like *John's mother praised* as potential constituents. For example, they can be coordinated, which is a test for constituency:

- (33) [John's mother praised] and [his sister nominated] John.

If non-constituent anaphoricity is indeed the only motivating factor for the assumption

of existential type shift, then we can probably substitute it by some simpler anaphoricity principle which does not depend on entailment between propositions. A potential argument *in favour* of an entailment-between-propositions approach would be if all the information which is necessary to resolve givenness stems from one source, i.e. from one antecedent proposition. Then each background *would* have *exactly one* antecedent. But there are clearly cases where a sentence background has two separate antecedents as in in (34) (Schwarzschild's (55), p.168).

- (34) {Jack said the American President drinks. What did Gilles_i say?}
 He_i said the [FRENCH]_F President drinks.
 (Schwarzschild, 1999, p.168)

In (34) the meaning bit '*the x presidents drinks*' and '*Gilles said that y*' have antecedents in different sentences. This is not an absolute problem, since givenness could be argued to be a recursive notion. Assuming this recursivity Schwarzschild's rules of GIVENNESS and AvoidF work properly and make the right predictions. But once we admit that the given information of a sentence is inferred from multiple sources, we can also argue that the inference can also come from smaller sub-parts of an antecedent propositions which is a more economic solution. The information which licenses givenness can then be built out of multiple antecedent bits. Applying this to (27) we could argue that the question makes available three possible bits of antecedent information: *John's mother* as an entity, *praise* as a verb of type $\langle e, \langle e, t \rangle \rangle$ (a type which licenses gapping as an anaphoric null element) and the property *John's mother praised* of type $\langle e, t \rangle$, which is a property of all individuals that are praised by John's mother. A crucial point here is that the existence of a property does not entail that some exists who has this property. In this example, the existence of the property of being praised by John's mother includes the possibility that it holds for no individual at all.

- (27) Q: Who did John's mother praise?
 A: She praised [HIM]_F.
 (Schwarzschild, 1999, p. 145)

Remember that the subject+verb sequence '*she praised*' is derivable as a constituent in CCG. Instead of claiming that there must be an entailment relation⁷ between the antecedent question and the partially anaphoric answer, we could simply explain the IS of the answer by saying that the property *John's mother praised* in (27Q) is the same property as *she praised* in (27A). The property *John's mother praised* is the most informative antecedent available and we could argue that it is to be preferred over the two separate antecedents which it contains: *John's mother* and *praised* (although also the anaphoricity of *John's mother* and *praised* would explain the givenness status of the sequence backgrounds not being monolithic units, cf. 1.1.3). This solution would predict the same effects as (25), but it seems to be simpler and abolishes the different treatment for entity-type anaphoricity and anaphoricity of all other types.

⁷Enric Vallduví (p.c.) pointed out another problem for the entailment account for givenness, which can be seen in the following example:

- (i.) Q: Who, if anyone, praised John?
 A: [MARRY]_F praised John.

Here the question does not entail that somebody exists, such that he or she praised John.

Of course, the alternative sketched here would divorce question-answer congruence from givenness for the following reason: The question gives us a proposition type meaning and if we make use of smaller bits of meaning (e.g. properties), we can not directly match these smaller meaning bits against a full proposition. The fact that information from the question is picked up in an utterance that follows it does not necessarily entail that the follow up utterance is a congruent answer to the question. But it is not necessarily a disadvantage to explain question-answer congruence separately from (but related to) givenness, as I will argue in chapter 4.

There is a further advantage to eliminating non-constituent (\exists -type shifted) anaphoricity from the definition of givenness. Schwarzschild claims that “we stop short of eliminating F-marking altogether, but this move is strongly suggested” (p.143) Elimination of F-marking is desirable reasons which are related to phonological marking and ‘focus projection’,⁸ which will not concern us here. But an independent argument for eliminating F-marking is the one already mentioned above: foci seem to be a kind of default-category for IS resolution.⁹ Once we identify all backgrounded parts of the sentence, the non-background is the sentence focus by default. If we defined, in turn, the sentence background in terms of foci, a unified explanation becomes next to impossible since foci seem to have at least three different uses (the ones identified by Halliday and exemplified by (20)). Schwarzschild expresses it this way: “Since [...] ‘given’ receives a straightforward interpretation, I suggest that its complement, ‘new’, be eliminated from the theory.” (p.142).

What keeps us from making the final step and eliminate F-marking from IS resolution (and replace it by background-marking) is the same problem as we had before: backgrounds do not seem to correspond to syntactic constituents, which makes their marking difficult. But the availability of non-standard constituents in CCG (e.g. [subject + transitive verb]) gives us one part of the solution. If we assume with Steedman (2000b) that information structure forces ‘*she praised*’ to be a constituent in (27), this constituent can be marked with something like a (hypothetical) feature *+background* (or *+bg* for short). The other part of the solution comes from the assumption that backgrounds are not necessarily open propositions. If we allow a background to be licensed qua givenness from different antecedents, nothing really keeps us from marking multiple constituents as *+bg*. Let me exemplify this last point with another of Schwarzschild’s original examples (Schwarzschild’s (17), p. 148):

- (35) a. If John ate a green apple, he will lose the contest.
 b. Don’t WORRY, he ate a RED apple.

According to (25) the F-closure of *he ate a RED apple*, which is $\exists P[\text{John ate a } P \text{ apple}]$, must be entailed by the antecedent. This seems to come out, since ‘*John ate a green apple*’ entails that ‘*John ate an X apple*’. Since the antecedent is embedded under a conditional, (35a) does not entail that in the world we are talking about John necessarily ate an apple. So far, (25) works and makes the right predictions.

⁸Schwarzschild discusses the focus projection version of Selkirk (1984, 1995), but the arguments extend to other focus projection accounts, as e.g. the one proposed by Rochemont (1986), which is mentioned in chapter 1, and Zubizarreta(1986).

⁹Eliminating F-marking from IS-resolution does not imply that the sentence focus, once identified, plays no role in sentence interpretation. A focus sensitive operator, like *only* or *even* takes scope over the sentence focus. The current approach only eliminates F-marking as a means to identify the focus-background partitioning of a sentence.

However, an alternative account is possible, which does not have to make use of existential F-closure: the antecedent entails that there is a property '*John ate*' which is a property of things that John ate (which is possibly nothing at all). In addition, the context entails that there are things like apples, i.e. the existence of the property of being an apple (although no apple must actually exist in order to make (35a) true). Now we can argue that '*he ate*' is anaphoric to '*John ate*' and, independently, '*apple*' in (35b) is anaphoric to '*apple*' in (35a). Is this alternative explanation justified? I think yes, because we can again find examples where the anaphoricity of the background stems from separate sources:

- (36) Q: a. Jack ate a green apple.
b. What did Gilles_i eat?
A: He ate a RED apple.

Here '*Gilles ate*' from (36Qb) does not entail that '*Gilles ate an P apple*'. The *apple* has an antecedent independent from this proposition. We can even stretch this example a little bit further and use different verbs:

- (37) Q: Jack ate a green apple. And he cooked a banana. What did Gilles_i cook?
A: He cooked a RED apple.
A: #He cooked a red APPLE.

Here eating events and apples are not necessarily coupled any more. And still the accent has to fall on *red*. To express this by means of a metaphor: if a complete sentence background is the birthday cake, givenness gives us only the ingredients, but it will not bake the cake. But the approach in analogy to the ingredients (and not the cake) allows us to mark constituents as *given* and decide later if they are also part of the background (when the ingredients are mixed together). This approach also preserves the insight, which is implicit in (21) and (22), that givenness is not a sufficient condition to make a constituent part of the background. I will come back to that point in both chapter 3 and 4.

In summ: Schwarzschild's account of givenness works fine in many cases. In contrast, the application of existential type shift for some, but not all, semantic types seems to be somewhat unmotivated. Under closer scrutiny, existential type shift does not even seem to be necessary to derive givenness. Once we eliminate it and allow backgrounds to be anaphoric to disjoint sources, givenness looks less and less like something different from other types of anaphoricity. For this reason I will propose a version of givenness in chapter 3 which is not based on existential closure and which reduces givenness to anaphoricity in the strict sense.

2.1.2.2 Backgrounds: presuppositions or anaphora?

Sentence backgrounds are related in interesting, but often not very clear ways to presupposition. The background has even been called *presupposition* by some authors (Chomsky 1971, Jackendoff 1972). In this section I will shortly review two of the newer approaches which make crucial use of *presupposition satisfaction* and *presupposition accommodation* as mechanisms for the computation of IS: Geurts and van der Sandt (2004a, 2004b) and Roberts (1996). I will also show two possible problems that arise

when presupposition is used as the central mechanism for IS resolution. I will argue here that backgrounds cannot be explained only as presuppositions, but I will finally adopt a revised and extended version of Roberts' presuppositional rule for the introduction of abstract context questions. I argue here to carefully distinguish between the anaphoric properties of background elements and the presuppositions they trigger.

Geurts and van der Sandt argue in favour of a null hypothesis which treat background directly as existential presuppositions:

(38) **The Background-Presupposition Rule (BPR)**

Whenever focusing gives rise to a background $\lambda x:\varphi(x)$, there is a presupposition to the effect that $\lambda x:\varphi(x)$ holds of some individual.

(G&vdS, 2004a 2003, p.1 f.)

Geurts and van der Sandt (G&vdS hereafter) argue that the presuppositions triggered by a background behave similarly to other presuppositions, for example the existential presupposition triggered by a possessive. Presuppositions tend to project upward, as can be seen in (39a).

(39) a. If [Fred's wife]_F stole the tarts, then Fred is innocent.

b. If Fred has a wife, then [his wife]_F stole the tarts.

(G&vdS's examples (20)/(21) p. 15)

Here the existence of *John's wife* is presupposed (which entails that John is married). This presupposition holds under any circumstances, even if John's wife didn't steal the tarts. In (39b), in contrast, the presupposition is bound by an antecedent within a conditional. Here the existence of a person that is John's wife (in the conditional consequent) is only presupposed globally in case the condition in the if-clause is met, i.e. if *John has a wife*.

G&vdS embed their theory in van der Sandt's (1992) theory of presuppositions as anaphora. In this article, van der Sandt argues that presuppositions must be bound in a similar way as anaphora must be bound. If presuppositions are not bound by an antecedent, the presupposition must be accommodated. There is an interesting asymmetry between accommodated and bound presuppositions, which can be seen in (39): if the accommodation is triggered within a logical island, such as a conditional, a negation, a quantification or a modality, accommodation will apply preferably outside this logical island. The conditional in (39a) is such a logical island and the existence of John's wife does not seem to be affected by it, because the presupposition has to be accommodated. In (39b) something else happens: the presupposition is bound within the conditional and, hence, trapped within the logical island created by it. In simple words: If the condition '*if Fred has a wife*' is not met, then the consequent '*Fred's wife has stolen the tarts*' will not be sufficient to force *Fred's wife* to come into existence.

According to G&vdS's (38), (39a) triggers a second presupposition (apart from presupposing the existence of John's wife). The sentence background, which has been given rise by focusing *Fred's wife* presupposes that there is some x , such that x stole the tarts. Again, this presupposition must be accommodated, this accommodation is preferred outside the scope of the conditional and the sentence is understood in a way that the tarts were stolen independent from the question of whether or not it was Fred's wife

who committed the tart-stealing crime. But also the presupposition triggered by the BPR (38) may be trapped within a conditional island, namely if the information that the tarts were stolen is given in the conditional antecedent:

- (40) If someone stole the tarts, then [Fred's wife]_F stole the tart.
 (G&vdS's example (21) p. 15)

(40) can not be understood in a way that it was Fred's wife who stole the tarts in a situation where the tarts were not stolen. This shows that - at least in some cases - a background behaves like other presuppositions.

Another approach to IS which makes use of presuppositions is represented by Roberts (1996). Roberts assumes a less powerful presuppositional mechanism, within a framework which makes *questions under discussion* (QUDs) (Ginzburg 1995a, 1995b, 2005, Ginzburg and Sag, 2000) one of its crucial ingredients. Roberts assumes that every utterance answers an underlying question, even if this question has not been explicitly asked (cf. also van Kuppevelt, 1997 for a similar proposal). This corresponds to the intuition that questions are in some way prototypical contexts which disambiguate a sentence IS. This also means that Question-Answer congruence is taken as *the* central mechanism for the resolution of IS. In order to see how this approach works, let us go step by step. According to Roberts a prosodic focus carries the following presupposition:

- (41) **Presupposition of prosodic focus in an utterance** * β
 β is congruent to the question under discussion at the time of utterance
 (Roberts' (28), p. 25)

The definition in (41) crucially depends on the notion of question-answer congruence, so we have to understand first what it takes to make an answer congruent to an underlying question under discussion. For Roberts, both questions and answers are *moves* in a dialogue. Both questions and answers give rise to alternative sets, questions because they contain a *wh*-element, and answers because they contain a focus. Consider (42) as an example:

- (42) Q: Who did Mary invite?
 A: Mary invited [Grace]_F.

The question in (42) triggers an alternative set in the form of {Mary invited Alice, Mary invited Grace, ...}. The full set of alternatives can be derived if we iterate over all persons that Mary could have invited and replace the *wh*-element by each of these persons. Turning to the answer, also (42A) triggers an alternative set. In order to compute this we have to replace the focused element by all possible alternatives to *Grace* (including *Grace* herself), again in an iterative manner. As a result we obtain the same alternative set as for the question (42Q): {Mary invited Alice, Mary invited Grace, ...}. This coincidence of the question alternative set and the focus alternative set of the answer makes the answer congruent to the question. This is formally captured in (43):

- (43) Move β is **congruent** to a question $?_a$ iff its focal alternatives $||\beta||$ are the Q-alternatives determined by $?_a$, i.e. iff $||\beta|| = \text{Q-alt}(a)$.
 (Roberts' (25), p. 24)

Since (41) presupposes Q-A congruence, this presupposition can again be satisfied in two ways: either by satisfaction or by accommodation. (42) is an example of presupposition satisfaction. In most cases, however, utterances are not placed in the context of an overt question. In such cases, the abstract question under discussion must be assumed to be created by accommodation. The sentence ‘[John’s WIFE]_F stole the tarts’ would therefore accommodate an underlying question ‘*who stole the tarts?*’. QUDs play an important role in Roberts’ account of discourse structure and the organisation of discourse segments. I will return to this point in chapter 4. For the moment, it is important to understand that according to Roberts a background (although Roberts does not use this term) triggers a presupposition which is quite different from what G&vdS assume (see (38)). Most importantly, the presupposition triggered by Roberts’ (41) is not existential. It does not require that there is an individual such that the presupposition hold for this individual. The presuppositions which she assumes are much weaker than the presuppositions that G&vdS’s rule (38) introduces.

Having sketched the most important traits of G&vdS’s and Roberts’ presuppositional rules for sentence backgrounds, we can turn to two problems that may arise under a presuppositional approach to IS. First of all, it is well known that words like *nothing* and *nobody* present a problem in this respect when they are focused. Consider (44):

- (44) Who stole the tarts?
 [NOBODY]_F stole the tarts.

A naïve application of G&vdS’s (38) would lead to the presupposition that there is someone who stole the tarts and that the tarts were stolen, which contradicts (44). G&vdS are aware of this problem, and they assume that such cases are instances of polarity focus. So the semantics of (44) is in some way similar to ‘*it is not the case that someone stole the tarts*’¹⁰. Such an assumption is certainly possible, but it requires a special semantic for *nobody* and *nothing*. It is interesting and important to note, that Roberts (41) does not run into this problem, since this rule would only presuppose a question of the form ‘*who did steal the tart?*’. This does not imply that the property of *having stolen the tart* hold for an individual.

A more serious problem for existential presupposition is discussed in some of the replies to G&vdS’s paper, published in the same volume. Schwarzschild (2004) dubbed it the *promiscuous binding problem*. Consider (45), taken from Büring (2004, p. 72, slightly modified)

- (45) a. Muslims believe that Allah is almighty.
 b. But Buddhists do not believe that [BUDDHA]_F is almighty.
 (Büring, 2004, example (10) p. 72)

Here the belief-verb induces an embedded context which should act also as a logical island in that it should not allow presuppositions triggered under this embedding to take wider scope. (45a) implies that that Muslims belief that someone is almighty, not that someone is indeed almighty. So far this is no problem for the BPR, since the presupposition can be accommodated under the belief context. But if we assume that this presupposition is bound, a problem arises: the binder (*‘Allah is almighty’*) for this

¹⁰The reader is referred to G&vdS’s original discussion for details of this account.

presupposition is itself embedded in a belief context (*'muslims believe that x'*). In order to get the binding conditions right, we would have to assume that the presupposition that someone is almighty is accommodated above and outside the two separate belief contexts. So it should follow that (45) requires that somebody be almighty in the world we are talking about. But this is not what (45) means. This forces G&vdS (2004b) to assume in their reply to Schwarzschild's and Büring's (among others') criticism that the binding conditions for such presuppositions are somewhat exceptional in that they can access binders which other types of anaphora can not access. I will return to this problem in chapter 3, where I compare this presupposition to the seeming ability of backgrounds to find their antecedent within an island created by a so-called donkey-sentence (Geach, 1962).

- (46) a. Every farmer combs his donkey.
 b. Also [MARY]_F combs *it/a donkey/her donkey.

In such sentences an anaphoric link from outside the quantificational island created by *every* is blocked. So the pronoun *it* in the follow-up sentence in (46)¹¹ is not licensed, because the quantification over farmers-donkey pairs blocks the anaphoric link. Nevertheless a deaccented (i.e. backgrounded) indefinite is allowed. This seems to be because *a donkey* in (46b) is *given* by virtue of the donkeys mentioned in (46a). I will return to this problem in chapter 3.

For the BPR this should also present a problem, since it would predict that the focus in (46b) gives raise to the background $\lambda x:\text{comb_a_donkey}(x)$ and, in consequence, triggers a presupposition such that there is a donkey that is being combed by x . At first sight this might not appear to be a problem, since the existence of x can be equated to *Marry*, an existing person. The problem here is, that the intended binder is trapped within a logical island in (46a), which blocks all other anaphoric links to the inside of its scope. For example, a pronoun like *it*, could not refer back to *a donkey* in (46a). We can only solve this problem by claiming that the presupposition triggered by the focus in (46b) is different in the accessibility conditions it has to respect when it establishes an anaphoric link to its antecedent. This means that, again, the accessibility and binding conditions for backgrounds must be assumed to be quite different from the ones imposed on other anaphora.

Again, Roberts' weaker presuppositional rule (41), does not run into this problem for (45). It is no problem to accommodate globally that there is a question *'who believes that who is almighty?'*. From such a question it does not follow that there is someone who exists and is almighty. Another possible solution, which is related to Roberts', is the following: Intuitively the two sentences of (45) are - amongst other things - about the property of being almighty. If we assume that there is (exists) a property of *being almighty*, this does not require that this property is actually instantiated by an individual. So global accommodation of the property *being almighty* would not result in the erroneous interpretation that there is an x , such that x is almighty. In the case of (46), (41) presupposes that the sentence addresses the question of *'who combed a donkey?'*. This question is addressed both by (46a) and (46b).

What this discussion shows is that presuppositional rules are necessary, but not un-

¹¹Thanks to Josep Macià for this politically correct version of a donkey sentence, where donkeys are not beaten.

problematic. The more presuppositions are assumed the more powerful a theory becomes. Often presuppositional rules make predictions that are too strong. This is especially the case when one assumes existential presupposition. However, we will probably not want to discard presuppositions completely. Roberts' presupposition of underlying questions which are being addressed does not run into the problems which G&vdS have to solve with extra assumptions. In chapter 3 I will make use of presuppositions in a way not discussed here. These presuppositions are, however, very weak and are closer to Roberts's (41) than G&vdS's(38).

2.1.3 The building blocks of information structure

As I mentioned briefly in chapter 1, I assume a tripartite distinction of information structure primitives here, which follows Vallduví (1992).

(47)

| | | | |
|------------|------|-------|-------------------------|
| Link/Topic | Tail | Focus | tripartite articulation |
| Background | | Focus | focus-background |

The tripartite articulation combines the focus-background (e.g. Jackendoff 1972, Lambrecht, 1994) and the topic-comment (e.g Gundel, 1988, Reinhart, 1995) distinction. Links can be seen as sentence topics in the narrow sense (Büring's 1999, 2003, contrastive topics). Within this articulation, the complement to a link corresponds to the comment of a topic-comment structure (although this unit plays no independent role here). In addition, links and tails together correspond to the sentence background, i.e. they constitute the complement to the sentence focus. The way in which the tripartite link-focus-tail distinction subsumes both focus-background and topic-comment approaches, is exemplified by (48) (taken from Vallduví and Engdahl 1996b).

- (48) What about John? What does he drink?
 a. Focus-background: [*John* drinks]_{bg} [BEER]_{focus}.
 b. Topic-comment: [*John*]_{topic} [drinks BEER]_{comment}
 c. Link-focus-tail: [*John*]_{link} [drinks]_{tail} [BEER]_{focus}
 (Vallduví and Engdahl 1996b, p. 467)

There is strong empirical support for this articulation coming from Romance Languages, especially from Catalan. Let us review some of the Catalan facts here. Catalan dislocates any backgrounded constituents either to the left or to the right. While links are dislocated to the left, tails are dislocated to the right. (49) exemplifies this. Link identifying accents are marked by bold face and italics from here on:

- (49) Q: What about the boss? Does he like broccoli?
 A: [*L'amo*]_{link} [*L'ODIA*]_{focus} [*el bròquil*]_{tail}
 [*The'boss*]_{link} [*it-hates*]_{focus} [*the broccoli*]_{tail}
 B': The **boss** HATES broccoli.
 (Catalan, Vallduví, 2002, examples (3)/(4), p. 5, slightly modified)

The subject *l'amo* is a link and appears before the sentence focus. The object NP *el bròquil*, is clitic right dislocated. Vallduví (2002) assumes that all preverbal subjects,

like the one in this example, are links. This is supported by the fact that subjects in all-focus sentences typically occur post-verbally, as in (50).

- (50) a. [Odia el bròquil l'AMO]_{focus}
 [Hates the broccoli the'BOSS]_{focus}
 b. [Va trucar la MARIA]_{focus}
 [Has called art MARIA]_{focus}
 'MARY called'
 (Catalan)

Strong support for the left-dislocation requirement for links comes also from link-realised objects which must be clitic-left-dislocated. In such cases links are easily identified, first because of the non-canonical preverbal position of the object and, second, because of the clitic pronoun which doubles the preposed object.

- (51) Q: What about Enric? Do you have any news about him?
 A: [De l'Enric]_{link}, no en se res. (CLLD)
 [Of art'Enric]_{link}, not part know anything.
 'I don't know ANYTHING about *Enric*.'
 (Catalan)
- (52) Q: Sé qui es va menjar les patates. Però, qui es va menjar les monjetes ?
 'I know who ate the potatoes. But who ate the beans?'
 A: [Les mongetes]_{link}, se les va menjar en PERE.
 [The beans]_{link} refl them past eat art PETER.
 'PETER ate the *beans*.'
 (Catalan)
- (53) Q: Que passa amb la Maria? Qui es va casar amb ella?
 'What about Mary? Who did marry HER?'
 A: [Amb la Maria]_{link} h'hi va casar en PERE.
 [With art Mary]_{link} refl past marry art PETER.
 'PETER married *Mary*.'
 (Catalan)

In contrast, tails are right-dislocated in Catalan. This clearly sets them apart from links with respect their linguistic realisation. As for their semantics and pragmatics, the difference is more subtle. They require an antecedent like links, but they are not contrastive. While the context in (51)-(53) explicitly singles out an individual and stresses that the answer must be about this particular individual, the contexts which support tails does not mark this aboutness. Links usually receive a contrastive interpretation (cf. Brunetti, 2006, 2008), whereas tails do not, as (54), (56) and (56) show.¹²

¹²(55) and (56) are not the most natural answer, since native speakers strongly prefer null realisation of subjects in contexts which consists of an explicit question. If the tail is to be overtly realised, it must be right dislocated as shown here. (54), in turn, which has no question as its context, is a fully natural realisation pattern.

- (54) a. I molts pares acaben: "Calla, nen, o et posaré el caseta de la Xuxa".
 'And many parents end up saying: "Be quiet, or I will put you in the house of the Xuxa.'"
 b. I els nens muts, tu.
 'And, look, the children are quiet.'
 c. Els fa una por, [la Xuxa...]_{tail}
 them makes a fear, [the Xuxa...]_{tail}
 'They are so AFRAID of the Xuxa.'
 (Catalan, Buenafuente, 2001b, Pàgina 36)
- (55) Q: Amb qui es va casar la Maria?
 'Who did Mary marry?'
 A: Es va casar amb en PERE, [la Maria]_{tail}
 refl past marry with art PETER [art Mary]_{tail}
 'Marry married PETER.'
 (Catalan)
- (56) Q: Que va menjar en Pere?
 'What did Peter eat?'
 A: Es va menjar les MONGETES, [en Pere]_{tail}.
 refl past eat the BEANS, [art Peter]_{tail}
 'Peter ate the BEANS.'
 (Catalan)

In English, as mentioned in 1.3.1, marking is mostly done by means of phonology and the distinction between links and tails is not so clear-cut as in Catalan. Links are marked by an additional non-focal rising accent (L+H* in English, called B-accent by Jackendoff, 1972, cf. also Steedman, 2000b, Büring, 2003). See (14), repeated from 2.1.1, and (57)

- (14) Q: I know what Harry ate. But what did FRED eat?
 A: *Fred* ate the BEANS
 L+H* L% H* LL%
 B-accent A-accent
 (Jackendoff's 1972 example, Phonological marking by Steedman 2000b, p. 111 f.)
- (57) Q: Well, what about Anna ? Who did SHE marry?
 A: *Anna* married MANNY.
 (Steedman, 2000b, p. 98, slightly simplified)

Tails are not phonologically marked by any accent in English. They are simply unaccented or deaccented, when they occur after a focus accent. The similarity of link- and tail-marking in English may lead to the assumption that links and tails are two variants of the same informational primitive, but the Catalan data shows that the distinction is more fundamental as it might appear at first sight. In addition, there are many cases where a link- or tail-marking is mandatory. I will show more evidence for this in chapter 3.

Under the anaphoricity approach taken here, the distinction between focus and background has a straightforward motivation: the focus is the part of the sentence which

has no need to be anaphoric. They are usually non-anaphoric. Both links and tails must nevertheless always be anaphoric. But in addition to the apparent difference in linguistic behaviour, links and tails also behave in quite different ways with respect to the relation they hold to their antecedents. I will show this in detail in chapter 3. The most prominent property of links is that they usually induce a contrastivity effect. Another important difference in behaviour can be observed, when links and tails are not strictly referent-identical to their antecedent. For example, links can refer to a part of a plural antecedent (for example (18)), while tails do not have this ability.

It is important to note that links are *linguistic* units. They mark linguistically what the sentence is about. If the a sentence contains no link, this does not mean that the sentence is not *about* something. Sentences with links are *topic marked constructions* (cf. McNally, 1998). This distinction is important since the term *topic* can possibly be applied to more abstract entities. For examples, null subjects in languages which allow for them (including Catalan) may be argued to *represent* the sentence topic in cases where the sentence is about the same entity as the previous one. (58) is an example from the NOCANDO-corpus. The first sentence is about the frog, and the second sentence as well. But in the second sentence the referent for the frog is realised as a null (or implicit) pronoun, the only overt realisation of which is the 3rd person singular inflection of the verb in combination with the dependent reflexive pronoun.

- (58) a. La granota va decidir que també aniria sopar.
The frog past decide that also would-go-to supper.
'The frog decided that he also would go to have supper.'
- b. Es va ficar dins de la butxaca de l'americana del nen.
reflex past place-3sg inside the pocket of the jacket of-the boy.
'He placed himself inside the pocket of the boy's dinner jacket.'
(Catalan)

Links must, thus, have a special function with respect to the underlying sentence topic. Vallduví assumes an update semantics which operates on a file change semantics model (Heim, 1982, 1983) and assigns to every information primitive a role in the update process. While foci are the carriers of the update potential, links serve to locate and activate the discourse referent which is to be updated, only, of course, in the case this referent is not active already (which would be the case in (58)). In file change semantics discourse referents (in the sense of Karttunen 1971) are represented by file cards which hold the information that has been transmitted about them during the discourse. Vallduví's update process makes direct use of this file-metaphor, since links manipulate the salience status of a discourse referent in that they activate the file card for the referent in question. Links trigger a *LOCATE* function, which locates a file card which is then prepared for manipulation. The focus represents the update potential of the sentence which will be added on the file card with an *ADD* instruction. If the sentence has no overt link the locus of update is the file card for an already prominent referent. Along these lines an account of (58) above would be as follows: a link is not necessary for (58b), because the file card representing the discourse referent for the frog is already active and ready for further update instructions concerning the corresponding card. Links trigger a location function only in case an abstract *topic*, in the

on common features that links (=marked themes) and foci share.¹⁴ A further feature of the two-dimensional approach is that the phonological background is not part of the *syntactic* calculus: there is no requirement for the phonological background to be a constituent. The sentence can, thus, in most cases be neatly split up in two main constituents, representing theme and rheme.

Suggestive as Steedman's account is, it creates a series of puzzles, especially when we apply it to Catalan data: a first observation is that tails (which are clearly marked by right dislocation in Catalan), sometimes correspond to Steedman's unmarked themes, but sometimes form part of the sentence focus. Consider the following examples, taken from Steedman (2000b).

(60) Q: What about the Fred? What did HE do to the beans?

A: [*Fred*]_{Theme} [ATE the beans]_{Rheme}
 L+H* LH% H* LL%
 (Steedman's (64), p. 120)

(61) Q: I know who COOKED the beans. But then, who ATE them?

A: [FRED]_{Theme} [*ate* the beans]_{Theme}
 H*L L+H* LH%
 (Steedman's (65), p. 120)

Here *beans* forms part of the rheme in (60) while in (61) it forms part of the theme. Why should that be so? After all, in both cases the *beans* are given material. Note that even on the basis of question-answer congruence it is hard to justify a different information status, since 'who ate them?' can be changed to 'who ate the beans' in (61) while fully preserving the meaning of the question. In fact, when we translate the sentence to Catalan within the same context, in both cases *les mongetes* are clitic right dislocated tails.

(62) Q: What about Fred? What did HE do to the beans?

A: En Fred se les va MENJAR, [les mongetes]_{tail}.
 art Fred them past EAT, [the beans]_{tail}.

(63) Q: I know who COOKED the beans. But then, who ATE them?

A: Se les va menjar en FRED, [les mongetes]_{tail}.
 Them past eat art FRED, [the beans]_{tail}.

Steedman argues that (60)/(61) "are the only derivations that the rules permit" (p. 120). It is, however, not evident why his rules should not permit derivations like (64) for the context (60Q), for example. Steedman allows such derivations, but only if the object is a marked theme, as in (65).

(64) [Fred]_{Theme} [ATE]_{Rheme} [the beans]_{Theme}

¹⁴Cf. Vallduví and Vilkuña (1998) for a version of the link-focus-tail approach which treats *kontrast* as an independent feature that may affect links and foci. Also Vallduví and Zacharsky 1994 argue that the deaccenting that affects elements like *the musical* in (59) is triggered by an independent anaphoric device.

(65) Q: Well, what about the beans? What did Fred do to THEM?

A: [Fred]_{Theme} [ATE]_{Rheme} [the beans]_{Theme}
 L H*L L+H*LH%

(Steedman's (68), p.121)

Although Steedman does not discuss the syntactic derivation of (65), the problem with such sentence structures is that they require a discontinuous thematic constituent - if we want to maintain the assumption that themes and rhemes can be construed as constituents. This is also the case in (64). The grammar fragment that Steedman develops for the calculus of the theme/rheme partition does not include rules for such discontinuities. In principle this is not a problem without potential solutions. There are ways to calculate discontinuous constituents in categorial grammar, e.g. Moortgart's type constructor Q (Moortgart, 1996) or discontinuous Lambek Calculus (Morrill et al., 2007 2007). A problem for discontinuous calculus is that it is computationally costly¹⁵ and it requires context-dependent rules¹⁶ Catalan link-focus-tail constructions with both left- and right-dislocated material would systematically need such discontinuous calculus. Of course this is not an absolutely decisive argument, but, applying Occam's razor if we have a less costly alternative to discontinuous themes that alternative is preferable, if all other factors are equal.

If we assume that links and tails are informational primitives (in addition to informational foci), the problem becomes somewhat simpler. In Catalan, at least, links and tails seem to constitute independent syntactic units. In the light of (65) and (60Q)/(64) it is likely that links and tails are separate units in English as well. The structure of (65) would be (66), something which is supported by (67), its Catalan translation which displays the typical dislocation marking for links and tails.

(66) (Well, what about the beans? What did Fred do to THEM?)

a. [Fred]_{tail} [ATE]_{focus} [the beans]_{link}
 L H*L L+H*LH%

(67) (Well, what about the beans? What did Fred do to THEM?)

[Les mongetes]_{link}, se les va MENJAR, en [Fred]_{tail}.
 [the beans]_{link}, them past EAT, [art Fred]_{tail}.

This also extends to example (59), with which we started our discussion. The Catalan version would be clearly a link-focus-tail construction and it would even display a double link, as in (68). The *musical* is in the Catalan version, clearly marked as a tail. *Maria* can be either realised as a link ((68a) or be elided ((68b). Finally, *admirar* and *Maria* are realised as separate syntactic units, both marked as links in (68a).

¹⁵I'm thankful to Oriol Valentin to point this out to me.

¹⁶This means that it cannot be described by a context-free grammar (Chomsky 1956, 1963) anymore. We need at least a rule similar to: Theme Rheme → ThemeP, RhemeP, ThemeP. Although it is a well known fact that natural language is not strictly context-free (e.g. Shieber 1985), context-dependent rules seem to correspond to marked constructions in natural language - e.g. serial cross dependencies in Swiss German and Dutch.

- (68) a. [De admirar]_{link}, [la Maria]_{link} admira la dona que el va dirigir,
 [part admire]_{link}, [art Maria]_{link} admires the woman that it past directed,
 [el musical]_{tail}
 [the musical]_{tail}.
- b. [De admirar]_{link}, admira la dona que el va dirigir, [el
 [Of admire]_{link}, admires-3sg the woman that it past directed, [the
 musical]_{tail}
 musical]_{tail}.

Note that *el musical* is not part of the focus, although Steedman assumes precisely that it is part of the rheme (cf. (59)). The tail realisation makes sense since the *musical* is mentioned in the context and should count as given. The tripartite classification used here respects *givenness* of information, while Steedman's account allows for more than a minimal amount of given material within the rheme (cf. section 2.1.1).

Besides all the differences between Steedman's and Vallduví's taxonomy of the sentence's information primitives, it is important to note that CCG (Combinatory Categorical Grammar, cf. section 2.1.1), as a system of syntactic calculus, is not incompatible with our tripartite classification of links, tails and foci. What we have to assume is that 1) all informational sentence units correspond to CCG constituents and 2) these units can combine in a relatively free fashion. So, instead of (60), we can assume (69) with either of the derivations in (70) or (71). I use semantic labels like 'link-focus' and 'focus-tail' as convenient ad-hoc labels, meaning a combination of link and focus or focus and tail. An important detail of these derivations is that they keep links, tails and foci semantically apart until the semantics of the whole proposition is computed. It is only at this final point where labels like link-focus are needed. The syntactic calculus is exactly the same as Steedman's original CCG calculus, the only additional requirement being that all informational primitives must correspond to syntactic constituents. The syntactic label ϕ now marks informationally complex types, which *contain* any unit of type link, tail or focus, or any combination of these types.

- (69) Q: I know who COOKED the beans. But then, who ATE them?
 A: [Fred]_{link} [ATE]_{focus} [the beans]_{tail}
 H*L L+H* LH%

(70)

$$\begin{array}{c}
 \begin{array}{ccc}
 \begin{array}{c} \textit{Fred} \\ L + H^* \end{array} & \begin{array}{c} \text{ATE} \\ H^* \end{array} & \begin{array}{c} \text{the beans} \\ NP_\phi : \\ \textit{tail}(\textit{the_beans}') \end{array} \\
 \hline
 \begin{array}{c} S_\phi / (S_\phi \setminus NP_\phi) \\ : \textit{link}(\lambda p.p\textit{fred}') \end{array} & \begin{array}{c} (S_\phi \setminus NP_\phi) / NP_\phi : \\ \textit{focus}(\lambda x.\lambda y.\textit{ate}'xy) \end{array} & \\
 \hline
 \begin{array}{c} S_\theta / NP_\theta : \\ \textit{link}(\lambda p.p\textit{fred}') \textit{focus}(\lambda x.\lambda y.\textit{ate}'xy) \end{array} & > \mathbf{B} & \\
 \hline
 \begin{array}{c} S_\phi : (\textit{link}(\lambda p.p\textit{fred}') \textit{focus}(\lambda x.\lambda y.\textit{ate}'xy) \textit{tail}(\textit{the_beans}')) \\ \textit{link} - \textit{focus}(\lambda x.\textit{ate}'x\textit{fred}') \textit{tail}(\textit{the_beans}') \\ = \textit{link} - \textit{focus} - \textit{tail}((\textit{ate}'\textit{the_beans}')\textit{fred}') \end{array} & > &
 \end{array}
 \end{array}$$

(71)

$$\begin{array}{c}
 \begin{array}{ccc}
 \begin{array}{c} \textit{Fred} \\ L + H^* \end{array} & \begin{array}{c} \text{ATE} \\ H^* \end{array} & \begin{array}{c} \text{the beans} \\ NP_\phi : \\ \textit{tail}(\textit{the_beans}') \end{array} \\
 \hline
 \begin{array}{c} NP_\phi \\ : \textit{link}(\lambda p.p\textit{fred}') \end{array} & \begin{array}{c} (S_\phi \setminus NP_\phi) / NP_\phi : \\ \textit{focus}(\lambda x.\lambda y.\textit{ate}'xy) \end{array} & \begin{array}{c} NP_\phi : \\ \textit{tail}(\textit{the_beans}') \end{array} \\
 \hline
 \begin{array}{c} NP_\phi \\ : \textit{link}(\lambda p.p\textit{fred}') \end{array} & \begin{array}{c} S_\theta \setminus NP_\theta : \\ \textit{focus}(\lambda x.\lambda y.\textit{ate}'xy) \textit{tail}(\textit{the_beans}') \end{array} & > \\
 \hline
 \begin{array}{c} S_\phi : \\ \textit{link}(\lambda p.p\textit{fred}')(\textit{focus}(\lambda x.\lambda y.\textit{ate}'xy) \textit{tail}(\textit{the_beans}')) \\ = \textit{link}(\lambda p.p\textit{fred}') \textit{focus} - \textit{tail}(\lambda y.\textit{ate}'\textit{the_beans}'y) \\ = \textit{link} - \textit{focus} - \textit{tail}((\textit{ate}'\textit{the_beans}')\textit{fred}') \end{array} & < &
 \end{array}
 \end{array}$$

Note that we have now taken the burden of combining links and tails from syntax. There is no need that the sentence background forms a unique constituent. Also the semantics of the sentence keeps the meaning bits contributed by links and tails separate.

What can we learn from this discussion? Both the tripartite link-focus-tail articulation and the independent theme-rheme | phonological focus-background distinction are operative ways of describing IS; they both do work and properly describe the data. I opt for the tripartite articulation because it naturally explains because links and tails form clearly identifiable constituents in Catalan and why sentence backgrounds are not always syntactic constituents, at least not continuous ones. Steedman could in principle explain these data, but only with the extra burden of discontinuous syntactic calculus.

2.2 The two dimensions of discourse representation

Let us now turn to the structure of discourse. There are different ways of looking at discourse as a linguistic phenomenon. Someone may be interested in the way in which a discourse evolves in order to elaborate an argumentation or in which way rhetorical resources are used in order to support a certain point of view. Other aspects of discourse are the progression of topics, the ways in which different parts of a discoursed are interwoven in order to connect different bits of information transmitted and the organisation of larger topics into smaller topics and information details which are used to give content to a discussion. Depending on to research interests discourse can be seen as a cultural, a rhetorical, an informational, a semantic or a syntactic object.

Here I am concerned only with the formal properties (i.e. semantics/pragmatics and syntax) of discourse that relate to information structure, so I will not have anything to say about rhetorical or content analytical aspects of discourse. As for the mentioned formal properties, the literature on discourse has been mainly concerned with two aspects of representation: On the one hand, there are different models of dynamic semantics (Heim, 1982, 1983, Kamp 1981, Kamp and Reyle, 1993). Such models have mainly focused on the proper representation and existential interpretation of discourse referents in addition to constraints on anaphoric relations. Dynamic semantic theories are largely a response to the problems of intersentential anaphora in older semantic frameworks, which represented existential closure on a sentence level and could not explain the existential binding of co-referring expressions which occurred in different sentences.

On the other hand, there are a number of approaches which have tried to explain the structure of discourse proper, i.e. the way a discourse is segmented in different parts and the logical and rethoric relationships which hold between those segments. We could call this the 'syntax' of discourse, although the term syntax has a slightly different meaning from the syntax of sentences (Polanyi and Scha 1984, Webber et al. 2003). The structure of discourse has repeatedly been assumed to be organised in a kind of tree-structure (Grosz and Sidner, 1986), in a similar fashion in which sentences constituents are organised in phrases and sentences. There have been attempts to write context independent or mildly context sensitive grammars for the construction of discourse structure (e.g. d-trees, Büring, 2003 or LTAG discourse grammar, Webber et al., 2003).

The relation between dynamic semantics and discourse segmentation is not a simple one. Although classically treated as relatively independent aspects of discourse it is clear that discourse reference and discourse segmentation interact in complex and interesting ways. The possible distance between an anaphoric element and its antecedent is, for example, not only dependent on the amount of linguistic material which occurs linearly between the two, but also on the discourse structural relation in which the segments stand to each other (Grosz and Sidner, 1986).

Segmented Discourse Representation Theory (SDRT, Asher 1995, Asher and Lascarides, 2003 2003) is an important attempt to bring together the two traditions and explain (among other things) certain interactions between the formal representation of discourse binding phenomena and the rhetorical relations which different discourse segments enter.

2.2.1 Discourse Representation Theory

In order to understand the meaning of a discourse it is not sufficient to understand the meaning of the all individual sentences that constitute the discourse. One of the key problems is the interpretation of intersentential anaphoric elements like pronouns. A simple sequence like (72) is sufficient to explain in a nutshell the central problem of deriving the right semantic representation of a discourse:

(72) A pirate entered the tavern. He ordered grog.

It is no problem to represent the first sentence as a formula in first order logic (leaving aside the problem of how *the tavern* is resolved as being the one specific tavern the

pirate enters).

(73) $\exists x(\text{pirate}(x) \ \& \ \text{enter}(x, \text{the_tavern}'))$

As simple as the second sentence looks, it is not trivial to give a proper first order logic representation. If we assume that pronouns represent variables of natural language, the non-dynamic interpretation of this sentence would be:

(74) $\text{ordered}(x, \text{grog}')$

But this is certainly not a good representation of the sentence (72) because the variable x is not bound within the formula and the occurrence of x could be resolved to any male referent available within the model against which the sentence is evaluated. The problem is that the existential quantifier in (73) takes sentence wide scope but the pronoun *he* must be resolved on a level above the sentence.

(75) $(\exists x(\text{pirate}(x) \ \& \ \text{enter}(x, \text{the_tavern}')) \ \& \ \text{ordered}(x, \text{grog}'))$

(75) is not a well-formed formula (under the intended interpretation in which *he* refers to *the pirate*) since the second occurrence of x is free: it is outside the sentential scope of the existential quantifier. A naïve approach would be to allow all existential quantifiers to take scope above the sentence level, but the full force of the problem hits us when we take cases into consideration where the existential quantifier takes narrow scope within the scope of another quantifier, a modal embedding or a negation.

(76) Every farmer who owns a donkey combs it. *It is a happy creature.

(77) It is not the case that a pirate entered the tavern. *He was dirty.

(78) A pirate may have entered the tavern. *He was dirty.

(76) is a so called *donkey-sentence* (Geach, 1962). Here the existence of every donkey is tied to each farmer who owns it. So there is no single referential donkey which the intended pronoun *it* could pick out as a good antecedent. (77) and (78) present a similar problem: The existence of a specific pirate within the discourse is tied to an event which did not take place or only *may* have take place (unless the intended reading is one where a specific pirate is already established in the discourse and *a pirate* is understood as *a certain pirate*).

The problem extends to other anaphoric expressions. For the present purpose this is especially important, since I assume that information backgrounds are anaphors. Consider the following example:

(79) One-eyed Pete owns a parrot. Pete LOVES [his pet]_{background}.

Here *his pet* is anaphoric to *parrot*. Any interpretation which fails to treat the two referents as being identical will wrongly claim that there are two animals: one parrot that Pete owns and a pet that he loves. This failure to resolve anaphoric elements does not only result in an incomplete interpretation, it fails to represent the correct meaning of discourse altogether. The NP *his pet* is necessarily backgrounded and the

focus stress falls on the verb *loves*. The justification of the claim that such backgrounds are indeed anaphors will be addressed in chapter 3. Assuming that backgrounds are indeed anaphors, it should be clear why we need a way of dealing with inter-sentential anaphora in order to explain IS with respect to discourse.

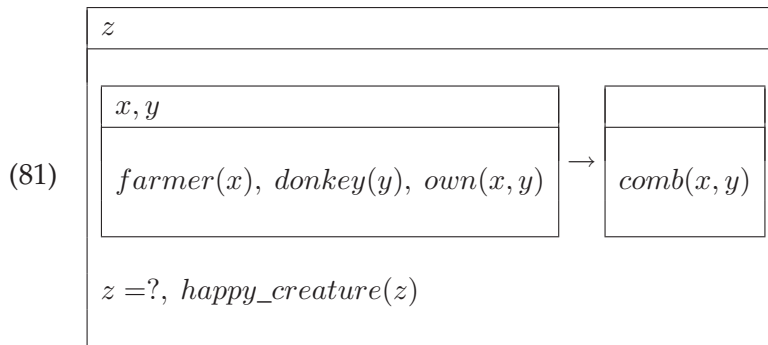
Dynamic semantic frameworks present a way to treat intersentential anaphora and existential interpretation of referents on the level of discourse. I will use Discourse Representation Theory (DRT, Kamp, 1981, Kamp and Reyle, 1993) as the framework in which a theory of IS will be implemented. DRT allows to represent the whole discourse in one single representational structure.

DRT makes use of *discourse representation structures* (DRSs) as a basic unit. Each DRS can be represented as a box with two parts: the top part represents the *universe* of discourse while the lower part represents the *condition set*. In the universe the discourse referents (Karttunen, 1971) must be listed which are used in the *conditions set*, in the form of variables. For a variable, being listed in the universe of discourse has the effect of existentially binding any further occurrence of the variable in the condition set. DRSs can also be embedded recursively. The derivation of (72), a simple case, would be represented as (80). (80a) is the representation of the first sentence in (72). (80b) is the representation of the sequence of the two sentences, but without the resolution of the pronoun. The pronoun projects a discourse referent on its own which looks for a suitable antecedent. This is represented by the condition $z=?$. In a final step the discourse referents for the *pirate* and the pronoun can be equated, since they are co-referential.

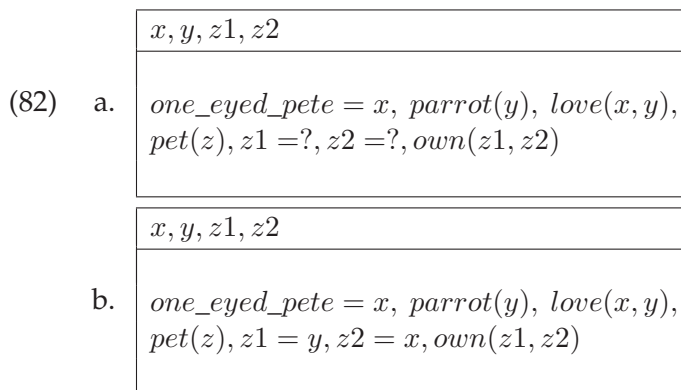
| | | | | |
|---|----|--|-----------|---|
| (80) | a. | <table style="width: 100%; border-collapse: collapse;"> <tr style="border-bottom: 1px solid black;"> <td style="padding: 2px 5px;">x, y, z</td> </tr> <tr> <td style="padding: 2px 5px;">$pirate(x), tavern(y), enter(x, y),$</td> </tr> </table> | x, y, z | $pirate(x), tavern(y), enter(x, y),$ |
| x, y, z | | | | |
| $pirate(x), tavern(y), enter(x, y),$ | | | | |
| | b. | <table style="width: 100%; border-collapse: collapse;"> <tr style="border-bottom: 1px solid black;"> <td style="padding: 2px 5px;">x, y, z</td> </tr> <tr> <td style="padding: 2px 5px;">$pirate(x), tavern(y), enter(x, y),$ $z = ?, order_grog(z)$</td> </tr> </table> | x, y, z | $pirate(x), tavern(y), enter(x, y),$ $z = ?, order_grog(z)$ |
| x, y, z | | | | |
| $pirate(x), tavern(y), enter(x, y),$ $z = ?, order_grog(z)$ | | | | |
| | c. | <table style="width: 100%; border-collapse: collapse;"> <tr style="border-bottom: 1px solid black;"> <td style="padding: 2px 5px;">x, y, z</td> </tr> <tr> <td style="padding: 2px 5px;">$pirate(x), tavern(y), enter(x, y),$ $z = x, order_grog(z)$</td> </tr> </table> | x, y, z | $pirate(x), tavern(y), enter(x, y),$ $z = x, order_grog(z)$ |
| x, y, z | | | | |
| $pirate(x), tavern(y), enter(x, y),$ $z = x, order_grog(z)$ | | | | |

In (80) the binding relations for the pronoun *he* are right. Both the NP *the pirate* and the pronoun *he* project separate discourse referents which are equated by the condition $z=x$. Both z and x are properly bound by the variables listed in the universe of the DRS.

(76)-(78) are represented somewhat differently: logical subordination causes the creation of a subordinated DRS. Conditionals are represented as a relation between two subordinated DRSs. (76) can be represented as (81):



Here the problem is that the variable z cannot be equated to any other discourse referent. In DRT only referents are available for anaphoric relations which occur in an superordinated DRS (i.e. a DRS which contains the DRS in which the target anaphor occurs) or which occur in the DRS that represents the antecedent of a conditional, which is the case in (81): here the pronoun *it* is bound by the NP *a donkey* which is represented in the lefthand DRS. Finally an anaphoric definite NP, like in (79) can be represented just like a pronoun in DRT:



The condition $z1=?$ in (82a) is, again, the anaphoricity condition triggered by the pronoun. What is new in this DRS, is that the possessive NP *his pet* triggers a similar anaphoricity condition: $z2=?$. This can be resolved and $z1$ can be equated to x because *his pet* refers to the same individual as *the parrot*. I will extend the coverage of background anaphors in DRT in section 3.3. The crucial point is that backgrounds can be treated formally like any other type of anaphora. I will show that DRT only has to be extended with few rules to allow a coverage of background anaphors.

A point that is important in DRT is that it crucially rests on the notion of discourse reference. NPs like '*a donkey*' in (76)/(81) is not referential in the traditional sense, since it cannot be identified with one and only one donkey within a model. The way in which DRT overcomes this problem is to introduce a discourse referent (Karttunen, 1971) for such indefinites. These discourse antecedents are bound not within the main DRS, but within a subordinate DRS. So it is this binding within an embedded DRS which explains the cases where a discourse referent is not referential in the traditional sense (cf. also Heim, 1982, 1983 for a formally slightly different, by now classical, account which captures the same insights). Another important point is that, while entities in a model are unique, more than one discourse referent may be co-referential. It is different linguistic realisation that are associated with different discourse referents (Karttunen, 1971). For example, if a pronoun is uttered, this pronoun is not directly associated to

the linguistic expression which represents the antecedent. First of all, a new discourse referent will be associated to the pronoun. In DRT this means that a new variable is created for this. The resolution of pronoun-type anaphors requires the equation of the discourse referents for the pronoun to the discourse referent which represents the antecedent expression (something I will call a surface antecedent) and not the linguistic expression itself. Anaphora resolution is, thus, not a linking of linguistic expressions, but a linking of discourse referents.

When we apply anaphora resolution to IS, it is important that some linguistic realisations of referents, like indefinite noun phrases, typically signal novelty of the referent within the model (Heim, 1982). The referents triggered by such expressions are usually understood as to be not anaphoric. Definite noun phrases, in contrast, appear to signal that their referent is familiar, i.e. it must be identified with a discourse referent which is already given in the context. In 1.1.2, I have, however claimed that co-reference of discourse referents is not necessarily established by an anaphoric relation. There are cases where two instances of the same referent are too distant from each other, so that locality constraints block anaphoric linking and, hence the realisation of the second instance as a pronoun of a background anaphor. For the the problem of locality constraints it is, however, important to consider how distant the linguistic realisations are from each other, that means how far the surface antecedent is from the target anaphor which intends to refer back to the referent triggered by the surface antecedent. Sometimes, however, it is convenient to identify the surface string of words which triggers the introduction of a discourse referent. For instance, this is interesting when we talk about the linear distance between an anaphor and the last linguistic realisation of its antecedent. In such cases I will use the term *surface antecedent*.

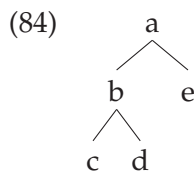
A last point, which shall be stressed, is that, as a consequence of the use of discourse referents, anaphoric linking between two elements is formally represented as a binding relation. In chapter 3 and 4 I will develop a binding theory for links and tails, which also makes use of association of variables as its central ingredient. A prerequisite for doing so is that the linguistic constituents which are to be bound, can be substituted by a properly typed variable.

2.2.2 Segmentation

Discourse is also vertically organised. A discourse consists of discourse segments. Bigger discourse segments are organised in smaller discourse segments. Like the constituents of a sentence the segments of a discourse are recursively structured in a way they form a tree (or a graph which is very close to being a tree, Polanyi and Scha, 1983, 1984, Webber et al, 2003 Webber 2004, 2004). As an example, consider (83) (taken from Asher and Lascarides, 2003 p.8f)

- (83) a. Max had a great evening last night.
b. He had a great meal.
c. He ate salmon.
d. He devoured lots of cheese.
e. Then he won a dancing competition.

If we consider the organisations of 'topics' being addressed we can argue that this short discourse fragment can be organised as follows:



Both the great dinner and the dancing competition form part of the great evening Max had. So the segments (83b-d) and (83e) are an elaboration of (83a). Therefore (84) the corresponding nodes b-d are dominated by node a. The great dinner mentioned in (83b) consisted of salmon and cheese in (83c,d). Again, in the tree structure this is represented by the fact that nodes c and d are dominated by node b. But since the salmon and the cheese are otherwise independent from each other, apart from forming part of the great meal, neither node c dominates node d, nor does d dominate e. They are only connected via node b, which addresses the meal as a whole. This example could, of course, be elaborated further, introducing recursively further segments. We could, for example, elaborate on the cheese and say that the Italian cheese was great and the French cheese was even better, and so on. This is exactly what we expect under the assumption that discourse is recursively organised into segments.¹⁷

There are at least three other aspects that interact with discourse segmentation. The first two of these are intentions and attention (the third being rhetorical relations, cf. below), as argued by Grosz and Sidner (1986, G&S hereafter) in their classical paper on discourse segmentation. Intentions are what drive the production of discourse. The intention for (83) is relatively simple: the description of Max's evening. In order to realise it, the intention has to be broken down into smaller-scale intentions, such as describing the meal and describing the dancing competition. For G&S intentions have the form of instructions. So the intention of the example could be paraphrased as '*convince the reader to believe that Max had a great evening*'. Intentions may be private, which means that they are known only to the speaker/writer, but they are not necessarily reflected in the discourse itself. This makes them a dimension which is often hard to capture. Apart from the intention of convincing the reader/hearer that Max had a fabulous time, the speaker could have a private higher level intention, e.g. to seduce the hearer to do the same as Max did; go out and have a good time. But we will never know if such an intention is present just from the discourse as it is presented.

A concept related to intentions are *questions under discussion* (Roberts 1996, Ginzburg 1995a, 1995b, 2005, Ginzburg and Sag, 2000) within a discourse. Both intentions and questions drive the construction of a discourse. Addressing a question can also be seen as a type of intention: We could argue that one of the intentions of the speaker in (83) is to address a question (besides possibly having other intention). The question which is being addressed could be '*What did John do last night?*'. We could further argue that

¹⁷There is a technical difference between discourse trees and syntactic trees for sentences which might create some confusion. In discourse trees we allow for sentences to act as nodes, while the words of a sentence must always be terminal symbols. This could, however, be easily changed: The following three is equivalent to (84), but it converts all sentences into terminal nodes:



This requires, however, to use c-command relations where we could otherwise simply talk about dominance. For simplicity I will use the former type of trees here.

addressing a question under discussion is always a basic ingredient of an intention behind a sentence within a discourse. Although the relation between *addressing questions* and other intentions is probably not clear in all cases, *questions under discussion* approaches (like Roberts, 1996), seem to implicitly make such an assumption. Roberts assumes that every discourse addresses one (abstract and inherent) question which is then recursively broken down into smaller and less abstract questions. Any discourse, in turn, can be seen as a part of *the big question*: ‘*which is the way things are?*’. Roberts’ approach is, however, more general and directly extends to information structure (which she understands as a property of discourse). I will return to her approach in more detail in chapter 4.

A more easily deducible property of discourse is the structure of attentions, which G&S model as a stack of ‘*focus spaces*’, which is also called the *focus hierarchy*. Since I am mainly interested in IS parsing and intentions are hard to recognize during the parsing process, attentional structure is the most interesting aspect of discourse structure for this purpose. It is very important to keep in mind that what G&S call focus is the focus of attention, which is practically the opposite of what is called focus in most of the literature on IS. In fact, G&S’s focus of attention (a.k.a. AI focus, cognitive focus in some of the relevant literature, e.g. Gundel et al, 1993, Zuo and Zuo 2001) is a concept very close to what we call ‘topic’ here. I hope this will become evident from what follows shortly.

The focus stack¹⁸ works as follows: Each discourse segment is associated to a focus space. A focus space is a record of the entities which are salient in a discourse segment. When a new discourse segment is uttered, a new focus space is pushed on (i.e. placed on top of) the focus stack. All other focus spaces will be covered by the last space which entered the stack and are inaccessible unless the now topmost focus space has been popped off (i.e. removed from the topmost position of) the stack. The first three sentences in example (83) will trigger push-operations which place their corresponding focus spaces on top of the stack. As a result, after (83c) has been processed, the focus space for (83c) will be topmost on the stack, while the focus space for (83a) is the lowest one. When (83d) is processed, the picture changes. Since (83d) is not dominated by (83c), the focus stack for (83c) must be first popped off the stack until the new focus space can be pushed on it. The same happens when (83e) is processed. The information that certain discourse referents were salient within the corresponding segment is lost when a focus space is popped off the stack (unless an auxiliary stack is employed which G&S suggest for some cases which do not concern us here).¹⁹ This loss of information is in principle a good thing, since it liberates memory and ensures that the consumption of memory to keep track of salient referents is dependent on embedding depth and not on the length of the discourse.

¹⁸A stack is a common data structure in computation. It is the direct opposite to a queue. In a queue the first element that enters is also the first that leaves it (which is sometime called “first in first out” or FIFO for short). A stack is similar to a pile of plates, where only the topmost plate can be removed at any time and a new plate can only be placed on top of the pile. So the first element to enter the stack is the last to leave it (LIFO). The two operations on stacks are commonly called “push” and “pop”.

¹⁹Some types of flashback interruptions which make reference to an earlier point of discourse are such cases. Such flashbacks require non-tree graphs and would require some graph-building rules which are beyond context-independence. In most cases it is, however, quite safe to assume that discourse structures are actually representable by trees.

One observation we can make is that the focus stack partly represents the discourse tree. It does not represent the whole tree, but rather the right frontier of it (at any point in the process of computing the discourse structure). The maintenance of the focus stack is dynamic and requires push and/or pop actions for any new discourse segment that is processed. The right frontier of any partially built tree is the place where new discourse segments may be attached to. This follows from the fact that any focus space which corresponds to a segment which is not on the right frontier has been popped off at some point and is not represented there anymore. The focusing process, thus, builds up the discourse tree, but the focus stack is not identical to the tree. Another way of expressing that only the right frontier is accessible for the attachment, is Asher and Lascarides' (2003) *Right Frontier Constraint* (based on earlier works by Asher, e.g. 1995 and others, e.g. Polanyi and Scha, 1984). This constraint operates directly on the discourse tree and avoids the creation of crossing branches (i.e. the building of non-trees). As an example of the right frontier constraint at work, Asher and Lascarides (A&L, hereafter) argue that (83) cannot be continued by (85), where the intended reading is that *it* refers to the salmon.

(85) It was beautifully pink.

Such a continuation would require (85) to be attached to (83c), which would result in a violation of the right frontier constraint. Also G&S's focusing process would disallow such an attachment, since the focus space for (83c) will not be on the focus stack anymore.

Also another important point can be shown through this example: Anaphoric reference is also sensitive to the right frontier. A pronoun can only refer to an antecedent which is salient in some of the discourse segments (the nodes of the tree) which is located on the right frontier of the tree. This does not have to be necessarily a linearly close antecedent. There may be a certain amount of intervening material between the linguistic surface antecedent and the anaphoric element, as (86) shows (from G&S, p.198).

- (86) A: One bolt is stuck. I'm trying to use both the pliers and the wrench to get it unstuck.
E: Don't use pliers. Show me what you are doing.
A: I'm pointing at the bolts.
E: Show me the 1/2" combination wrench, please.
A: OK.
E: Good, now show me the 1/2" box wrench.
A: I already got it loosened.
(Grosz and Sidner, 1986, p. 198)

This example is from a task oriented dialogue. The pronoun *it* in the last line refers to the *bolt* in the first line. All the linguistic material between these two utterances must be treated as a closed segment, once the anaphoric link has been established. The corresponding focus spaces are popped off the focus stack. Once all intermediate focus spaces have been popped, the *bolt* will count as salient enough for anaphoric reference.

A third aspect of discourse structure are rhetorical relations (Mann and Thompson, 1986) which hold between different discourse segments. This work will not be com-

mitted to this dimension, but it certainly plays an important role in the resolution of discourse structure. In example (83), (83b-d) elaborate on what has been said in (83a) while (83c,d) elaborate on (83b). But *elaboration* is only one of many possible rhetorical discourse relations. The relation between (83b) and (83d) is one of temporal precedence, which A&L call *narration*. Rhetorical relations play an important role for the determination of temporal structure, for example. In the pair of sentences in (87) differs in the relation in which the two sentences stand to each other: *narration* vs. *explanation*. As a result the pushing event in (87b) must be interpreted as anterior to the falling event, while (87a) displays the inverse temporal structure.

- (87) a. Max fell. John helped him up.
b. Max fell. John pushed him.

Although rhetorical relations may interplay with IS resolution, I will not investigate their relation in this work. Asher (2004) investigates the role that *discourse topics* play in relations like *contrast* and *narration*, but a full integration of rhetorical relations and in a theory of IS would require a systematic examination of all possible rhetorical relations, a something outside the scope of this dissertation. I am, nevertheless, quite optimistic that we can learn a lot about the interplay between the two structures without having to take rhetorical relations into account. I will, therefore, follow G&S and make use only of two relations between discourse segments: dominance and structural precedence.

The three aspects of discourse structure - attentions, intentions and rhetorical relations - determine in which way a discourse structure is built up. If we had a direct access to the intentional structure, we could argue that this would fully determine the dominance relations between different discourse segments. But if we want to parse discourse, this information is only partially available, since intentions (including *questions under discussion*) are often private to the speaker/writer, so the hearer/listener has to infer many of the intended relations. In practice we have the following parsing problem: when a new segment has to be attached to the right frontier often more than one node of the discourse tree will be available as a possible attachment point and a choice between the different possibilities will have to be made. Now it would be interesting to know which factors help us to make a decision in this respect. A&L assume that this choice is largely guided by the need to make the discourse coherent (in the sense of Sperber and Wilson, 1986b). They propose the following principle of *maximize discourse coherence* (p.21).

(88) **Maximize Discourse Coherence (MDC)**

The logical form of the discourse is always a logical form that's maximal in the partial order of the possible interpretations; i.e. those which are consistent with compositional semantics and monotonic constraints on anaphora resolution.

Asher and Lascarides (2003)

A&L show that a large part of coherence can be explained by discourse relations: Some possible discourse structures capture more rhetorical relations than others (e.g. apart from providing further background information a new segment provides an explanation for a proposition already expressed). What is important for the present purpose is the fact that also anaphora resolution plays a role in the determination of the correct discourse structure. A&L argue that "[a]ll else being equal, the more anaphoric

expression whose antecedent are resolved, the higher the quality of coherence of the interpretation" (p.20). In the case of pronouns, the effect that anaphora resolution has on discourse structure might not be too spectacular. But the more descriptive content an anaphor has, the stronger is its ability to disambiguate the attachment point.

- (89) a. John called his friends and told them that he could not go to the party.
b. They told him that one of the girls wouldn't go either.
c. He/She had a cold.

In (89) the choice between a masculine or a feminine pronoun determines to which of the preceding sentences (89c) will be attached (one segment has a salient masculine and the other a salient feminine referent). The choice of attachment point will also determine whether or not we can naturally continue to speak about *the girls*. If (89c) is attached to (89a), such a further reference is predicted to be blocked by the *right frontier constraint* in follow-up segments. Admittedly, the effect that pronouns have on such choices of attachment points is relatively modest. But in the case of anaphors with more descriptive content, e.g. definite NPs, links or tails, the ability of identifying an antecedent is much stronger. So the discourse segments which may intervene between the anaphoric element and its antecedent may be much bigger than in the case of pronouns. In chapter 4 I will argue that establishing such anaphoric connections sometimes has quite a decisive influence on the way a discourse tree is constructed.

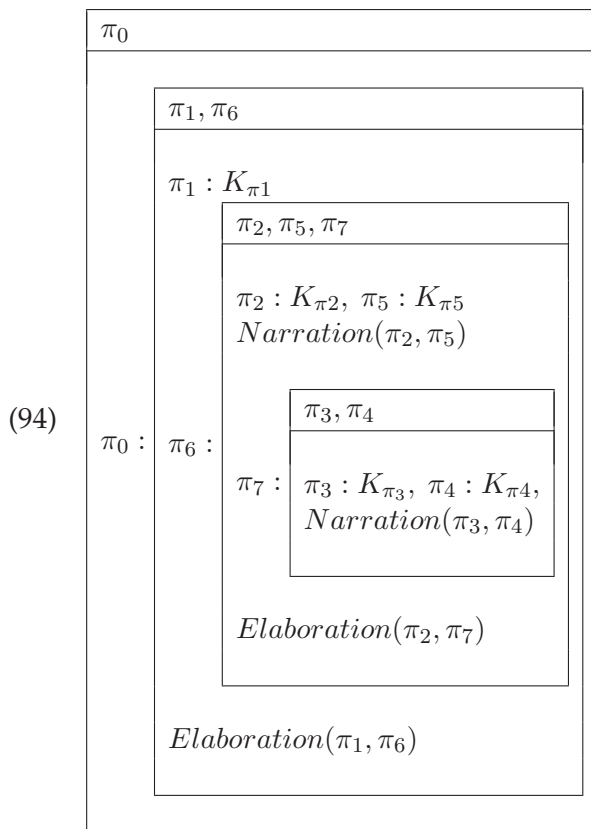
- (90) a. John called Bill and told them that he could not go to the party.
b. He told him that Peter and Mary wouldn't go either.
c. Peter had caught a cold.
d. Mary had taken Peter's car and had an accident with it.

(91) He was not very pleased about that. After all, his car was quite new.

(92) Bill was very not very pleased about that. #After all, his car was quite new.

To conclude this section, I will remark on the way discourse segmentation can be integrated into a discourse semantic model like DRT. A&L use a version of DRT which is called *segmented discourse representation theory* (SDRT) which was developed in earlier work by Asher (especially 1995) and Asher and Lascarides. The most important assumption SDRT makes with respect to discourse segments is that each discourse segment is represented by a DRS (discourse representation structure) and that different DRSs can stand in rhetorical relations to each other. An example for an SDRS (a DRS representing segmentation) is (94), which represents (83), repeated as (93).

- (93) a. Max had a great evening last night. π_1
b. He had a great meal. π_2
c. He ate salmon. π_3
d. He devoured lots of cheese. π_4
e. Then he won a dancing competition. π_5



(Asher and Lascarides, p. 140)

(94) contains the information from the tree (84), in addition to the discourse semantics. Each node K_{π_n} represents what would be the standard DRS for the corresponding sentence π_n . Constraints on Discourse structure like the *right frontier constraint* can be checked on the tree representation (e.g. (84)) or the SDRS (e.g (94)). This approach allows us to represent most of the discourse semantics needed to express anaphoricity of links and tails.

2.3 Concluding remarks

In this chapter I have critically revised earlier wrk which is directly relevant for this dissertation. I have argued that there is a mutual relation between information structure and discourse structure.

A central concept in this dissertation is *givenness*. Following Schwarzschild (1999) I have argued that information structure is related to the discourse context via the information which is *given* within the context. I have, however shown that Schwarzschild's givenness approach must be adapted in some respects. As a syntactic basis for the treatment of information structure within discourse I make use of Steedman's *Combinatory Categorical Grammar* framework, which allows us to model foci, as well as background anaphora as independent syntactic constituents. I have, however, departed from Steedman's proposal in that I adapted Vallduví's tripartite articulation of information structure instead of Steedman's two-dimensiona theme/rheme and phonetic-focus/phonetic-background distinction. Nevertheless I have shown that the tripartite articulation can be properly modelled within the CCG framework. This articu-

lation avoids, in addition, some of the problems which the theme/rheme distinction brings along, because links and tails seem to be systematically realised as syntactic constituents, which renders a discontinuous calculus for link-tail combinations unnecessary.

As for the structure of discourse, I have made the fairly common assumption that discourse is organised in the form of a tree and that the semantics of discourse can be captured by a dynamic semantic framework. I will use *Discourse Representation Theory* in order to formalise some of the insights in chapter 3 and 4. DRT has the additional advantage that it can integrate the tree-structure of discourse in the form of *Segmented Discourse Representation Theory*.

Chapter 3

Givenness as Anaphora Resolution

In this chapter I will adopt a givenness-approach to information structure (IS). I will narrow down the concept of givenness and assume that all background elements are anaphoric in a strict manner. The aim of the chapter is to discuss and solve some of the problems which arise under such a strictly anaphoric approach and model givenness properly as anaphoricity in a dynamic semantic approach like DRT (Discourse Representation Theory, 2.2.1). The anaphoricity approach I endorse here is confronted with a series of problems. I will, nevertheless, argue that these problems can be solved with very few extra assumptions about anaphoricity in general. Many of these difficulties are shared by other types of anaphors, like plural pronouns, pronominal *one* and similar pronouns which do not require a full match with its antecedent. Other difficulties arise because backgrounds are what we could call ‘highly descriptive’ anaphors, which allows them to match their antecedents only partially (cf. section 1.1.3 of chapter 1). A last difficult point is to distinguish between anaphors that are backgrounded and those that appear as part of the sentence focus. In this chapter I will address these problems. The the last of them, anaphors in focus, will be only partially resolved, because this problem is related to the way discourse is structured and for that reason I will postpone part of the discussion to chapter 4.

The strict anaphoric approach I develop here is close to Schwarzschild’s (1999) givenness account (as discussed in 2.1.2.1), but includes additional constraints. Treating backgrounds strictly as anaphors requires that only semantic types which may otherwise enter anaphoric relations can serve as background elements. I will abandon a en-bloc treatment of backgrounds altogether. Rather, I assume that different background elements are anchored separately to the context. This will allow to develop a binding theory for links and tails which depends on properly typed variables.

Schwarzschild’s GIVENness rule discussed in chapter 2, illustrates the unrestricted nature of antecedence relations Schwarzschild’s theory. It builds on existential type shifting, an operation which can turn any complex type into type t (the type of propositions). It does not require the background constituent to correspond to any specific semantic type. The rule, discussed in 2.1.2.1 above, is repeated here:

- (1) **Definition of GIVEN.** (Informal Version) An utterance U counts as GIVEN iff it has a salient antecedent A and:
 - a. if U is type e , then A and U corefer.
 - b. otherwise: modulo \exists -type shifting, A entails the Existential-F-Closure of U (Schwarzschild, 1999, p. 151)

As argued in in section 2.1.2.1, the assumption that all possible abstractions over propositions are also possible backgrounds is not unproblematic. Existential type shift is a rule which has no independent motivation in natural language and it is quite uneconomic, since it requires raising every potential sentence background to type t and

checking of the result against all contextually salient propositions. In a sentence like ‘John ate the [RED]_{focus} apple’, for example, the antecedent of the background must entail that ‘John ate the x apple’ (which is the background). Furthermore, as discussed in 2.1.2.1, some examples require the background to be entailed by different antecedent propositions, which would require a rather complex entailment mechanism.¹

Anaphoricity, in contrast, obeys semantic typing and is quite economic. A nominal referent, an event, a proposition or a fact can be anaphoric, among others. Although it may be difficult to give a complete list of all possible entities which may be referenced anaphorically, we know that there are linguistic things which simply do not appear to license anaphoric relations: determiners, quantifiers, polarity (yes/no) values or random abstractions over propositional units, etc. For example, natural language does not seem to provide anaphors for things like $\lambda X(\text{John ate an } X \text{ apple})$ (which would be the combined property of both being an apple and be eaten by John, plus probably having some relevant color). One reason for this lack of higher type anaphora might be that natural language does not provide variables of a higher order than two, as argued by Chierchia (1984), and functors that operate over second or higher order arguments cannot be abstracted over. This would predict, among other things, that properties (abstractions over individuals e.g. ‘green’ ($\lambda x.\text{green}(x)$) in *John ate a green apple*) can be anaphoric,² but any abstraction over properties (e.g. $\lambda P.(\text{ate}'(\text{john}', \text{apple}')) \& P(\text{apple}'))$ ³ can not. However, this does not mean that there may not be gaps in the paradigm of lexicalised elements which can serve as anaphora for such types. ‘Bill ate a so pear’ may not be a grammatical sentence in English, but the sequence ‘The apple was green and so was the pear’ (with *so* being anaphoric to the property *green*) is fine. Although an in-depth discussion of type-theory is beyond the scope of this work, I consider that the proper typing of background elements contributes a good deal to a theory of information structure under a givenness approach.

My way of approaching the problem will be simpler and empirically oriented: I will consider any string of words π a possible background anaphor if we can reasonably assume that natural language provides anaphoric elements for the *type* that corresponds to π . A background, or rather what is traditionally called the background of a sentence, may be build out of various background-anaphora. I argued in chapter 2 that there are two informational primitives which can be *backgrounded*, so in present terms this means that a background anaphor is a backgrounded constituent which can either be a *link* or a *tail*.

A simple non-typed givenness approach also fails to distinguish between links and tails: I will show in this chapter that links and tails display a quite different anaphoric behaviour and may have antecedents in separate sentences. I will argue that a theory that indiscriminately treats sentence backgrounds as one unit can explain neither the different properties of links and tails nor the combined effects they may have in a

¹The same arguments also extend to propositional approaches which require that a presupposed proposition must be bound by the context, such as Geurts and van der Sandt’s *Background Presupposition Rule*(cf. section 2.1.2.2).

²Chierchia assumes that properties have entity correlates (cf. also McNally, 2008 for a good discussion). If this is true it would predict, in consequence, that we can in principle treat all anaphoricity phenomena in a first-order logic model. However, I have to leave this question for further research.

³There is even a further complication: since the modified NP has to be combined with the verb and then with the subject the combined property of being both an apple and being eaten by John has to be derived from the nested formula $\lambda P.(\text{ate}'(\text{john}', P(\text{apple})))$

sentence. A preliminary illustration is given in the following example (2).

- (2) a. What about the staff members? Do they like broccoli?
 b. [*The boss*]_{link} HATES [vegetables]_{tail}.

Here the antecedents for the link (*the boss*) and the tail (*vegetables*) are given in two separate sentences. Although the context may be argued to entail some open propositional meaning like $\lambda R.R(\text{the_boss}', \text{vegetables}')$ it is not clear how this context should be modelled in order to allow for such an entailment and how this model is derived. I will argue that the separate anaphoric relations for the link and the tail are, in context, easily established. Even if we use an anaphor-resolved version (they=*the staff members*) of the second context question we would get: *'?like'(staff_members', broccoli)'*. In order for this to entail $\lambda R.R(\text{the_boss}', \text{vegetables}')$ we both have to widen and narrow down the context given information (broccoli \leftarrow vegetables & staff members \rightarrow boss). I will show below that an anaphoricty theory for links and tail can make the right predictions about such cases, considering that we widen or narrow only one context element at a time.

Finally, we will have to explain the contrastivity effect which is present in (2), *'The boss'* is to be contrasted against the rest of the *'staff members'* which might either like broccoli or not. The concept of givenness alone does not explain that links must be contrastive to some other element. What we can observe in this example is, however, that there is a very specific anaphoric relation between *'the staff members'* and *'the boss'*, such that *'the boss'* is part of the *'staff'*. I will finally give an account of links in chapter 4 which derives the contrastivity effect from their binding requirements within a structured discourse.

The present proposal is not to be taken to be presuppositional (as e.g. Geurts and van der Sandt, discussed in section 2.1.2.2), although they share important features. The similarity between the two approaches will be shown to result from the fact that presuppositions themselves behave anaphorically. Both presuppositions and backgrounds are anaphorically licensed, but they are nevertheless distinct anaphoric categories, with distinct functions in interpretation.⁴ Existential presuppositions made on the basis of sentence backgrounds are too strong. I will show in section 3.2.1 that an anaphoricty approach to backgrounds can resolve some of the problems which a presuppositional approach has to face, especially the binding out of scope islands.

For the discussion in this chapter I will need to make some methodological assumptions: First of all I will temporarily treat IS resolution as if it were detached from the structure of discourse, before I revise this point of view in chapter 4, where I will embed this theory in a theory of discourse. Throughout this chapter I will assume a simple structure of discourse and I will not take discourse segmentation or discourse relations into account. For the moment, I will treat discourse as if it were flat and linear. The only exception to this flatness are scope islands created by modal subordination, negation, conditionals or quantification, i.e. all the cases of logical subordination which are usually treated in DRT as introducing islands for anaphoric accessibility. As noted

⁴Cf. Bosch (2001) for a review of arguments against interpreting anaphora and presupposition as being identical devices. Bosch argues that there is a very close connection between anaphoricty and presupposition, but they should be seen as two separate mechanisms.

in chapter 2, discourse structure is essential to IS resolution. I will focus on this interdependence in chapter 4.

I will show in which way the distinction between links and tails is crucial for the proper modelling of background givenness. As for foci, they are a default category with respect to anaphoric resolution. A constituent will be focus by default if it is not marked as a part of the background. Only links and tails require anaphoric antecedents. If such an anaphoric link is established, this triggers marking of a constituent as a link or a tail. By definition, foci do not require antecedents and are not inherently anaphoric. Therefore a constituent is focus if and only if it is not anaphoric as a whole, i.e. it is marked as focus by default. Once the background is identified, the focus of a sentence is the complement to that. Of course this 'default' status of foci in IS *resolution* does not carry over to semantic interpretation or to phonological realisation.

As mentioned in 2.2.1, when we talk about anaphoric relations we assume that there is a link between an anaphor and an appropriate antecedent. Often such antecedents are more abstract entities than just surface strings of words. I will assume here that antecedents are discourse referents (Karttunen, 1971), entities which are more abstract than their linguistic representation. Discourse referents can be equated to each other, even if their surface description differs. For example "Stanley Kubrick" and "the director of 2001" refer to the same person, although the surface descriptions are totally different. Both descriptions trigger the introduction of a discourse referent, say x and y which are equated to each other: $x=y$. This means that the discourse referents triggered by such descriptions, not the descriptions themselves, are related to each other. Remember from 2.2.1, that sometimes it is convenient to use the term *surface antecedent* when we refer to the linguistic realisation of the antecedent, rather than the discourse referent which serves as the antecedent.

As noted above there is a problem that arises if one adopts an strict anaphoricity approach. It concerns cases in which anaphoric material, like pronouns, is part of the focus, as in (3) (already discussed in 2.1.2.1).

- (3) a. Who did John's mother praise. She praised [HIM]_F.
b. What did John's mother do? She [PRAISED him]_F.

In this chapter I will only provide half of the answer to the question of how the IS of such sentences is resolved. The part of the answer given here is that, whereas it is true that the anaphoric material is encapsulated within a focus, it is also true that the focus as a unit is not anaphoric entirely. I will outline the argument for such an account in 3.3.3. Nevertheless, such cases cannot be explained without clues that come from discourse structure and for this reason I will postpone the second part of the answer to chapter 4.

In chapter 2 I introduced DRT as a dynamic semantic framework which I will use here to describe IS facts. The strictly anaphoric approach to backgrounds is not fully describable in standard DRT. So I will propose an addition to the theory to be able to discuss the facts as needed. Since one of the basic mechanisms in DRT is the determination of accessibility conditions for anaphora, an approach to IS which relies on this central aspect of DRT is also desirable from a theoretical point of view.

3.1 Givenness, anaphoricity and semantic typing

3.1.1 Background elements ARE anaphors

In a wider sense backgrounds have already been treated as anaphoric elements (Halliday, 1970, Rochemont, 1986). This treatment is sometimes implicit and without a principled analysis of the possible anaphoric relations that may hold between a background and the context that licenses it. Backgrounds are not grammaticalised anaphors like e.g. pronouns, but their interpretation is usually incomplete without information given in the context in which the sentence in question is uttered. A simple example for this effect is the following:

- (4) a. Who saved the world?
b. SUPERman saved the world.

Such simple sentences are relatively unproblematic. The focus of (4b) is ‘*Superman*’, the only element which is not given in the context, while the VP ‘*saved the world*’ is a (in this case literal) repetition of the minimal context illustrated by the wh-question in (4a). The focus is marked phonologically as an accent on ‘*Superman*’. This is the simplest case and the backgrounded NP can even be substituted by the pronoun ‘*it*’ in (4b’) or the VP can be elided or replaced by the pro-VP ‘*did*’ in (4b’’):

- (4) a. Who saved the world?
b’. SUPERman saved it.
b’’. SUPERman (did).

Backgrounds, just like plural pronouns, can also pick up plural referents created by *summation* (Kamp and Reyle: 1993), which is exemplified by (5).

- (5) a. The police was looking for a man called Clyde and his girlfriend Bonnie for a several months.
b. They were travelling trough several states, committing crimes wherever they passed.
c. Finally, they GOT the couple.

When (5c) is uttered, the hearer/reader knows what the backgrounded ‘*couple*’ refers to. Again, if (5c) is uttered without context, a complete interpretation of the sentence is impossible. The pronoun ‘*they*’ is not anchored and tied to a discourse referent. This is what we generally expect in the case of grammaticalised anaphors. The second background constituent, ‘*the couple*’, behaves similarly, although it does not belong to the class of gramaticalised anaphors. ‘*The couple*’ will not be construable as extending to *Bonnie and Clyde* (it would only be so in a world with only one couple).

While definite NPs have often been claimed to be anaphoric (Webber, 1977, Gundel, Hedberg and Zacharsky, 1993, Krahmer and van Deemter, 1998) indefinite NPs, on the other hand, have been characterized as presenting novel referents (Heim, 1982, 1983), or be simply ‘type identifying’ (Gundel et al, 1993). Although indefinites have usually not been included in the list of typically anaphoric elements, I suggest that also they can serve as anaphors if they have a proper antecedent and are realised as part of a

background. As (6) shows indefinites can serve as background elements. Here the indefinite is realised as a tail.

- (6) A: Remember that the doctor recommended you eat apples.
 B: But I just ATE an apple.

The definite/indefinite distinction is thus not parallel to the distinction between anaphoric and non-anaphoric elements. It follows from that, that all types of NPs, including indefinites, must be treated as being *potentially* anaphoric. Although it has often been argued that indefinite NPs introduce novel discourse referents (e.g. Heim, 1983), examples like (3.app) show that the novelty is only partial. But note that in terms of discourse referents, 'an apple' in (6b) indeed introduces a novel discourse referent. This discourse referent must, however, be anaphorically related to the discourse referent for the nominal kind 'apples', introduced in (6). Anaphoricity is a stricter concept than *givenness* of descriptive information.

Simple examples like (4)-(6) suggest a strong parallelism between backgrounds and other anaphoric units. But, as I will show in the next section, a formal treatment faces a series of problems. One of the aims of this chapter is to show that such apparent difficulties can be overcome if a much richer sorting of discourse referents is assumed.

3.1.2 The proper typing of background elements

Following a strict anaphoricity approach, we may first ask what kind of elements may be anaphoric or, in other words, to which semantic types they must belong in order to be able to act as anaphors. There is a wide variety of elements whose discourse referents that can be referred to by a descriptively poor anaphoric element, like nouns and noun phrases (pronouns), verbs (e.g. *do*), verb phrases (*do so*) or properties (*so*). These antecedents belong to different semantic types. The class of anaphoric elements is quite ample and heterogeneous, so it is probably easier to invert the question and state it like this: Which types do never appear to be anaphoric? Two good candidates for this non-anaphoric class of elements are quantifiers and polarity values. There is no empirical evidence that they can be referred to by anaphors in any natural language. In English there are no anaphoric elements which can substitute the hypothetical (made up) anaphor *anaph* in (7) and (8) and take the interpretation of *not* or *all*, respectively. And it is quite doubtful that such elements can be encountered in other languages.⁵

- (7) a. * George did not_i eat the cake and Brat *anaph*_i drink the milk.
 b. * George did not_i eat the cake and *anaph*_i did Brat drink the milk.
 (8) * All_i men are different and *anaph*_i animals are the same.

⁵ This does not affect quantified noun phrases as a unit, which can be referenced by an anaphoric element. In this case it is the whole quantified NP and not the quantifier which serves as a surface antecedent.

(i) What do all men like? All men/they like CARROTS.
 (ii) Q: Are all pirates scum?
 A: [Some pirates]_{link} are scum.

In addition, quantifiers and polarity elements show an interesting asymmetry with respect to their ability to make foci or backgrounds. They do not seem to be able to act as sentence topics (or backgrounds in the wider sense) alone, as the following examples suggest.⁶

- (9) a. Tell me about all members of some set.
 b. # As for all, [all] cats are grey
- (10) a. Tell me about things that are not.
 b. # As for not, the butler is [not] the murderer.

The observation that such elements are not able to serve as topics can be accounted for if our assumption is right and links and tails are indeed anaphoric elements. If quantifiers can never be anaphoric, then they are expected to not be able to serve as topics either. Whatever the reason is for the absence an anaphor that picks up quantifies and polarity items that is also the reason why they can not serve as backgrounds. The reason is related to the fact they are not referential in any sense. A possible theoretical explanation for this inability to refer would be that natural language only supplies variables for first and second order semantic types, as Chierchia (1984) suggests. This is coherent with empirical observations, since there are grammaticalised anaphors for nouns and noun phrases (first order) as well as for properties and verbs (second order). But quantifiers must be of an order higher than two since they can take second order elements - verbs and properties - as their arguments. Also, we can quantify over properties and other second order elements, but not over quantifiers (because this would imply abstraction over quantifiers, which are higher order elements themselves).

In contrast, quantifiers and polarity elements (verum focus, Höhle, 1992, Polarity Focus, Drubig, 2003) can constitute a narrow focus. While topical elements are anaphors (and restricted in type), foci have no need to be anaphoric to anything. So, as a result, we do not expect any restriction on their semantic type, either. If this is right we can naturally explain, among other things, why there are verum foci (11-13, but no verum topics(14).

- (11) a. Some cats are grey.
 b. In fact, ALL cats are grey.
- (12) Q: a. Are men different?
 A: Men ARE different.
 A': Men are NOT different.
- (13) a. Too bad that John did not repair the car.
 b. But John DID repair the car.
- (14) # What about all? [All]_{topic} cats are GREY.

Now, there are examples, like (15), which appear to be acceptable and, if so, are potential counterarguments to the claim that quantifiers cannot serve as topics. The background of this sentence would be something like ' $\lambda P.\lambda x.(all\ x\ P)$ ', something which is not possible in (9). But in cases like (15) we may wonder if the quantifier should not

⁶I'm thankful to Louis McNally who suggested to apply the as-for test in these cases.

be part of the focus at all. Question/answer pairs like this seem to be licit only in clarification contexts (also called metalinguistic accentuation, Horn, 1989) and the accents seem to be merely a repair device to mend misunderstanding in a dialogue.

- (15) Q: All what are what?
 A: All [CATS are GREY]_{focus}.
- (16) I said SUPERnatural, not SUPRAnatural.

The finding that quantifiers cannot serve as topics has an important consequence for any theoretical treatment of backgrounds. If we think of backgrounds as the part of the sentence that stays behind when the focus is abstracted away, we have in principle no guarantee that this remnant corresponds to a semantic type which can be anaphoric. Practically any part of a sentence can be focused and, accordingly, any random remnant can constitute the background. If this is the case, a strictly anaphoric treatment of backgrounds will run into trouble. Fortunately, there is evidence from different sources against an untyped-remnant analysis. A sentence like (17) exemplifies the problem:

- (17) Q: What kind of apple did John eat?
 A: John ate a GREEN apple.
 (adopted from Schwarzschild, 1999)

If the focus in (17) is *green* then the background would be '*John ate an X apple*', which is an abstraction over properties: $\lambda P.(ate('john', apple) \ \& \ P(apple))$. But is this background (*as a whole*) (of type $\langle\langle e,t \rangle, \langle e,t \rangle \rangle, t \rangle$)⁷ a unit which can be anaphoric in any natural way? There is no empirical evidence that natural language has anaphora of such a type. This could be because the unit is too complex for natural language to supply a grammaticalised anaphor for it, or it could be because of an improper semantic type. Backgrounds are, as noted, often treated as a single and monolithic unit, but in principle there is no need to treat them like this. Infact, the inexistence of anaphors for certain semantic types would require that the anaphoric linking for the background in examples like (17) be carried out by different units separately. I will pursue this idea and argue in favour of a non-atomic background which is built up from smaller anaphoric units.

Before we proceed to argue in favour of a split-background solution, let us consider, and refute, a possible alternative approach to the the typing problem. We could argue that '*a GREEN apple*' in (17A) is in fact a focus which projects from the accent on '*GREEN*' to the whole NP. In this way the sentence would be cut into two neat information units where the background could be argued to correspond to a second order type (the property of being eaten by John) which can then be anaphoric. This would be an analysis along the lines of Steedman(2000b, 2000a, also Vallduví and Zacharsky, 1994). Steedman argues in favour of theme-rheme partitions (in his terms) like (18) (= Steedman's, 2000b (64), p. 120, the notation is adapted).

⁷Intuitively the background is a full sentence which lacks a property of the object in order to become complete. The syntactic side of the type is even more complicated because the background is discontinuous. For example (s/(np/np)) will not do, because this would require the adjective to be post-nominal. This is also an instance of the problem of discontinuous backgrounds, discussed in chapter 2, sections 2.1.1 and 2.1.3. See also the discussion of (22)-(25) below.

(18) Q: What about FRED? What did HE do to the beans?

A: [Fred]_{theme} [ATE the beans]_{rtheme}.
 L+H* LH% H* LL%

As shown in chapter 2 (2.1.3), this partition is problematic because, with a context that is similar in that ‘the beans’ are given, ‘the beans’ can also form part of the sentence theme. This happens, for instance, in in Steedman’s 2000b example (65) (p. 120, cf. section 2.1.3):

(19) Q: I know who cooked the beans. But then, who ATE them?

A: [FRED]_{rtheme} [ate the beans]_{theme}
 H*L L+H* LH%

More importantly, (20), the Catalan counterpart of (18), linguistically realizes *the beans* (*les mongetes*) as a tail by clitic right dislocation.

(20) (Fred) les va MENJAR, [les mongetes]_{tail}.
 (Fred) them past EAT, [the beans]_{tail}.
 ‘Fred ATE the beans.’
 (Catalan)

In (21a) the focus falls clearly on the adjective without the noun: the NP ‘*de pomes*’ is a partitive in Catalan and it is either realised as a tail or is elided altogether (which most speakers prefer). (17A) is also possible in a context like ‘*what kinds of coloured fruits did John eat*’, but such a realisation makes ‘*the apple*’ contrastive to other types of fruit. In the corresponding Catalan (21b) the partitive ‘*de pomes*’ is again syntactically divorced from the focused adjective. In analogy, this suggests that (18) is not the right way to divide the sentence and that it is not a way out of the typing problem.

(21) Did John eat a RED apple?
 a. Se’n va menjar una de VERDA, [(de poma)]_{tail}.
 art past eat one of GREEN, [(of apple)]_{tail}.
 ‘He ate a GREEN apple.’
 b. [De pomes]_{link}, se’n Joan va menjar una de verda.
 [Of apples]_{link}, art John past eat one of green.
 (Catalan)

If we build a background out of smaller units, we can then derive all of the background as anaphoric, although it is not anaphoric en-bloc. In order to do so. let us take a closer look at the link/tail distinction. As shown in chapter 2, Catalan may display left- and right dislocation simultaneously, marking the dislocated elements as links and tails, respectively.

(22) [En Pere]_{link}, no l’he VIST, [jo]_{tail}.
 [art Peter]_{link}, not him’have SEEN, [I]_{tail}.
 ‘I haven’t SEEN Peter.’

- (23) [Les mongetes]_{link}, els va MENJAR, [en Pere]_{tail}.
 [The beans]_{link}, them past EATEN, [art Peter]_{tail}.
 ‘Peter ATE the beans.’

I will assume that the encoding of backgrounds in Catalan is a structural reflection of the fact that backgrounds are indeed composed of smaller constituent units that are licensed via anaphoricity separately. Of course, we could posit a semantics-syntax interface in which the discontinuous dislocations of Catalan are regrouped for interpretation via Moortgat’s (1997) Q-operator or Morrill et al.’s (2007) discontinuous Lambek calculus, as mentioned briefly in section 2.1.3) but if we can do without a syntactic discontinuity treatment, we can keep our theory simpler. We can claim, applying Occam’s razor, that, all other things being equal, a simpler theory is to be preferred. Of course, this by itself is not a decisive argument, but I think that it is a good starting point; and there are also other reasons to assume that Catalan links and tails do not have to be cast into one background block.

As shown above, in (2) the whole background both widens and narrows down in order to match its antecedent from ‘*staff members*’ to ‘*the boss*’ (narrowing) and from ‘*broccoli*’ to ‘*vegetables*’ (widening). This is a somewhat uncomfortable fact for the en-bloc analysis of backgrounds, because it has to assume that they can be linked to their antecedent in quite unpredictable ways.

- (2) a. What about the staff members? Do they like broccoli?
 b. [*The boss*]_{link} HATES [vegetables]_{tail}.

In contrast, if we assume that links and tails are both anaphorically independent, then they partially match their respective antecedents, either overspecifying or underspecifying them. This allows to avoid anaphoric links with bidirectional partial matches: If in (2b) the background is formed by two units, each unit partially matches its antecedent in one direction. Each unit can widen the description of their antecedent or narrow it down, but not the two things at the same time. I believe that this is the answer to the problem. In fact, I will show below in section 3.2.2 that the behaviour of links and tails is quite uniform in this respect: only links can narrow down the descriptive content with respect to their antecedent, while tails show the opposite behavior. Treating links and tails as being anaphoric separately is the essential ingredient that allows us to solve both this partial match problem and the syntactic discontinuity problem. If links and tails have separate antecedents (so they are separate informational units) we do not have to burden syntax with a calculus for discontinuous backgrounds, while deriving nicely typed semantic elements as the basic anaphoric units for background licensing.

There is further evidence for the anaphoric independence of links and tails: it is possible for links and tails to have separate antecedents, to begin with. In chapter 2 (section 2.1.2.1) I discussed examples (24) and (25).

- (24) Jack said the American President drinks. What did Gilles_i say?
 He_i said the [FRENCH]_{focus} President drinks.
 (Schwarzschild, 1999, p.168)

- (25) [Jo]_{link}, [a les bodes]_{link}, m'hi avorreixo sempre.
 [I]_{link}, [at the weddings]_{link}, me'there bore always.
 'I'm always bored at weddings.'
 (Catalan, Buenafuente, 2001b, p. 131)

As already noted, the fact that Gilles said something and the supposition that some president drinks in (24) have separate antecedents in two separate sentences. In (25)⁸ there are two separate clitic left dislocated links. The general context is a satirical discussion of weddings. At the point where (25) is uttered, however, there is no previous explicit mention of the speaker in the form of the first person singular pronoun or by other linguistic means. The NP '*bodes*' (*weddings*) has been repeatedly used in the context and is, thus, easily available as an antecedent. Now we could argue that, since the speaker is talking about weddings, he must have a personal attitude towards the matter. Now, one could argue that both the speaker and his attitude towards the subject of the discourse (*weddings*) are salient antecedents throughout the monologue which is about weddings. In such a scenario we need to introduce an abstract antecedent $\lambda R.(R(\text{buenafuente}', \text{weddings}'))$ by inference on the basis of the discourse subject and the discourse situation, which is salient at the time of utterance of (25). Such an abstract referent would be necessary to bind the background of (25) en-bloc.⁹ But this would require some non-trivial inference mechanism which allows the creation of such an abstract antecedent. If such a mechanism is assumed, it must be ensured that it does not overgenerate antecedents. The problems would not be too big, if we only had to take the speaker and his attitude to the discourse matter into account. We could express the antecedent generation for (25) as a simple rule. But things are not that simple. For example, (25) would still be acceptable if we change the first person pronoun '*jo*' to '*my wife*' (*'la meva dona'*), as in (26), or even the proper name *Gallardo* (a person recurrently mentioned in Buenafuente's monologues).

- (26) a. La meva dona, a les bodes, s'hi avorreix sempre.
 art my wife, at the weddings, refl'there bore always.
 'My wife is always bored at weddings.'
 b. En Gallardo, a les bodes, s'hi avorreix sempre.
 art Gallardo, at the weddings, refl'there bore always.
 'Gallardo is always bored at weddings.'

⁸Interestingly, I found a very similar example in an independent conversation.

- (i) a. A mi, les bodes no m'avorreixen (però prefereixo quedar-me estirada al sofà)
 To me, the weddings not me'bore-3pl (but preferr-1sg stay-me stretched out on the sofa)
 'Weddings do not bore me, but I prefer to stretch out on the sofa.'
 (coffee-break discussion)

There seems to be a very fundamental cultural question under discussion whether or not weddings are boring. Such questions can be accommodated, but this accommodation is not unconstrained. In 4.1.1.2 I will argue that these constraints depend, precisely, on the discourse referents which are salient at the time of utterance.

⁹Note that Schwarzschild's version of givenness would require that some proposition in the context entails that '*Buenafuente has an x relation to weddings*'. A similar thing would happen under a *question under discussion* approach (cf. section 2.1.2.2 of chapter 2 and 4.1.1.2 below). Under such an approach the background of the sentence would trigger the presupposition that there is a contextually salient QUD '*what relation does Buenafuente have to weddings?*'. Although QUDs can be created by accommodation, they still have to be coherent to the given context, as mentioned in the last footnote. I will return to the problem of coherence in section 4.1.1.2.

In such cases, it is difficult to argue that there is an abstract antecedent for $\lambda R.(R(\text{my_wife}, \text{weddings}))$ which is introduced by inference. In contrast, it is quite easy to assume that there are separate antecedents for ‘*jo/la meva dona*’ on the one side and ‘*les bodes*’ on the other. In the case of ‘*my wife*’ I will argue in section 4.2.2 that the realisation as a link signals contrastivity and the referent corresponding to this NP is bound by a contrastive set. Also tails have to be independently bound. (27A), where ‘*les bodes*’ is realised as a tail, rather than a link, is utterable in a context which is minimally different from (25).

- (27) Q: A *algú* *li* *agraden* *les bodes*?
 To someone him/her like the weddings?
 ‘Is there someone who likes weddings?’
 (question addressed to several persons)
- A: Jo, *m’hi* *avorreixo*, *a les bodes*.
 I, me’there bore, at the weddings.
 ‘I’m allways bored at weddings.’

In this example the first person pronoun *jo* is realised as a link, indicating that the person who utters (27), in possible contrast to the other discourse participants, is bored by weddings. The NP ‘*les bodes*’ is realised as a tail and does not exhibit such contrastivity effects. For the creation of an en-bloc background in (27A) we would have to built a semantic unit from a discontinuous syntactic constituent and create an appropriate antecedent by non-monotonic inference process which cannot be properly constrained. If we assume, to the contrary, that backgrounds are made from independent units, the different behaviour of the two dislocated elements follows from independent properties of links and tails: Links, but not tails, require a contrastive reading.

There is also an asymmetry between links and tails with respect to their ability to realise ‘accommodated’ elements, such as the first person singular or ‘*my wife*’. Such elements must obligatorily be realised as a link: in contexts like (25): a tail realisation results in infelicity in the case this tail has properly introduced and salient antecedent. Tails are apparently not able to accomodate the status of being salien of their antecedent. This finding speaks also in favour of treating links and tails as separate semantic units.

- (28) # A *les bodes*, *m’hi* *avorreixo*, *jo*.
 At the weddings, me’there bore, I.

A final argument for a typed theory of background anaphoricity comes from considerations regarding cognitive processing. One of the problems we encounter when processing information structure is massive ambiguity. As argued in chapter 1 (1.1.1) and 2 (2.1.2.1), in many cases anaphoric resolution is the only way to discard unintended IS partitioning possibilities which are otherwise derivable from the surface form of a sentence.

- (29) Q: What did the pirate drink?
 A: The pirate drank [GROG]_{focus}.

- (30) Q: What did the pirate do?
 A: The pirate [drank GROG]_{focus}.

(29A)/(30A) in isolation are ambiguous with respect to the extent of their foci. The only thing that disambiguates these examples are the context questions (29Q)/(30Q). As noted, phonetic information is not enough to resolve IS. Examples like this suggest that constituents (including non-standard constituents like '*the pirate drank*' S/NP : λx .drink' (pirate', x) in CCG) must be checked on-line for possible antecedents. For example, the verb '*drank*' (and also the non-standard constituent '*the pirate drank*') is anaphoric in the context of (29), but not in the context of (30). Unlike ordinary anaphora, e.g. pronouns, we often do not know if elements like NPs, VPs or Vs are anaphoric and, as a consequence, part of the background. To determine their anaphoricity we need to find matching antecedent. If anaphoric links are not restricted to certain semantic types, all possible strings have to be checked in order to see whether they have an antecedent. Assuming a limited set of anaphoric types lessens this problem in that it narrows down the search space.

In conclusion, the assumption that different elements of the background are separate anaphoric units gives us a considerable advantage over theories which have to derive complex en-bloc backgrounds from discontinuous constituents and search for suitable antecedents in an unconstrained manner. This allows us to treat background anaphors in the same way as any other anaphora types, without recurring to non-standard mechanisms for anaphors of complex types. The assumption of a non-monolithic background is also supported by the fact that languages like Catalan code links and tails as separate syntactic units. Finally, the different anaphoric behaviour of links and tails can be explained easily if we assume that they are independently anaphoric, while an en-bloc anaphoricity account of backgrounds would have to assume a high amount of non-monotonic inferences in order to derive the a source for givenness.

3.2 Problems for the resolution of anaphoric relations

In this section I would like to describe two problems which we face when we attempt to treat backgrounds as anaphors. The first problem concerns partial matches between background anaphors and their antecedents. Some backgrounds do not correspond to exactly the same referent as their antecedent, although the background and the antecedent referent are related in some way. The second problem is that some background anaphors seem to have antecedents within scope islands, such as donkey sentences, negation or modality. They share this behaviour with *one*-anaphora. As I will argue, none of these problems is limited to background anaphors since for each of the cases other anaphora types can be found that display the same anaphoric properties. On the other hand, background anaphors are subject to locality requirements which they share with pronominal anaphors. They can not access non-local or inaccessible antecedents.

There are two classes of anaphoric elements: A first class which is descriptively light, i.e. pronouns and similar proforms, and a second class of descriptively rich anaphors, like anaphoric definite noun phrases. There is a fundamental difference in anaphora resolution for the two classes. In the first case we know from the lexical entry of the wordform that the element is anaphoric. Whenever we find a pronoun, like in

(31a), the lack of descriptive content makes resolution of the antecedent strictly necessary; otherwise the meaning of the sentence will be incomplete. For descriptively rich anaphors, however, like *'the brothers'* in (31b), the situation is quite different.

- (31) a. [John and Bill]_i cooked pasta. They_i enjoyed a good meal with a bottle of wine.
b. [John and Bill]_i cooked pasta. The brothers_i enjoyed a good meal with a bottle of wine.

Sentences like (31b) are also incomplete in their interpretation if the anaphoric connection is missed, but it is not immediately clear in a given sentence if occurrences of elements like definite descriptions are strictly anaphoric. In order to know whether they are anaphoric, a matching antecedent must be found. If no antecedent is available, they are not anaphoric. Definite NPs can also refer to referents which are uniquely identifiable without having a contextual antecedent, like the *'pope'* in (32) (Umbach, 2002).

- (32) The pope likes pasta.

This ambiguity problem affects background anaphors, as well. In many cases the first parsing problem is to determine if a constituent of an appropriate semantic type is anaphoric or not. Only if it is anaphoric, it may also be a link or a tail. This means that anaphoric resolution does not only imply finding the right antecedent, rather, we have to decide whether they are they are anaphoric to begin with. What helps us in this quest is that links and tails are often linguistically marked (depending on the language). But as I have argued in chapter 1 and 2, this marking is hardly ever sufficient to resolve IS completely. Finally, let us keep in mind that, thanks to their descriptive force, descriptively rich anaphors allow for partial matches with their antecedents. As repeatedly pointed out, this sets descriptive anaphora apart from grammaticalised anaphors.

In the discussion in this chapter, especially in the formal part, I will concentrate on semantic types which are normally expressed by nominal background anaphors: (singular and plural) entities and kinds. The reason for this is that these can be integrated in a standard first order version of DRT without much further theoretical apparatus. This does not imply that background anaphora is of type e or k (kinds) in general. On the contrary, I assume that there are a great variety of background anaphors, as properties, events, facts etc. I will provide some examples of such types of backgrounds and will discuss them informally. Second-order anaphoricity and reference is a non-trivial problem in its own right, so I will not try to integrate a proper formal treatment of such anaphora here, leaving that for further research instead.

3.2.1 Non-identity I: kinds and instances

In this section I will examine the kind-sensitive behaviour of background anaphors. Background elements may not refer to the same individual as their surface antecedent, but rather refer to the same *class* or *kind* (Carlson, 1977). At first sight it might seem to be a minor problem that some backgrounds are not fully co-referential, but as I will

show in 3.2.4 below, this particular point will have further consequences. (33) and its translation in (34)¹⁰ exemplifies the problem:

- (33) a. Pirates are scum.
 b. Nevertheless Mary MARRIED [a pirate]_{bg}.
- (34) Tot i això la Maria es va casar amb un, ([de pirata])_{tail}.
 Nevertheless art Mary refl has married with one, ([part pirate])_{tail}.

In (33) the NP ‘a pirate’ is anaphoric to ‘pirates’ in (33a). Since backgroundness follows from anaphoricity, ‘a pirate’ in (33b) counts as background and is deaccented. There are two things to be noted: the first is that the anaphoric relation is not one of identity. The antecedent is a kind-referring bare plural noun (Carlson, 1977). The specific pirate Mary married is a representative of the kind ‘pirates’. I assume that if an element can be substituted by a pronoun in a given context, then the element is anaphoric. In (33) we can substitute ‘a pirate’ in the second sentence with the anaphoric pronoun *one*, without changing the meaning, as can be seen in (35). This shows the relation between ‘a pirate’ and ‘pirates’ is indeed an anaphoric one.

- (35) Marry MARRIED one.

The second interesting fact about this example is that ‘a pirate’ in (33b) is realised as an indefinite NP. That is interesting, since indefinites are often assumed to be novel (Heim, 1982) and to trigger the introduction of a new discourse referent (Kamp and Reyle, 1993). This seems to be only half true in this case, since this indefinite is anaphorically anchored in the context by virtue of accessing a highly salient kind. Still, the backgrounded NP in (33b) triggers the creation of a new specific discourse referent which represents the pirate that Marry married.

One-anaphora have been analysed as being anaphoric to descriptions (Webber, diss) or to kinds introduced directly or indirectly in the discourse (Kamp and Reyle, 1993). What makes them so interesting is the fact that their antecedent can also be accessed by an identity-anaphor, for example in (36).

- (36) a. Marry wants to marry a pirate.
 b. Also Sue wants to marry one.
 b’ Also Sue wants to marry him.

The choice between *him* in (36b) and *one* in (36b) decides if the surface NP antecedent is assessed as an individual or a class. Webber (1977) notes

“that a single noun phrase may evoke several discourse entities in the listener’s model which are not alternative perspectives in the sense of example 1 above. [...] Both definite and indefinite noun phrases can evoke a discourse entity corresponding to a generic class. This will be evoked **in addition to** the specific individual or a set that it evokes, and **both** entities will be available to pronominal reference.”

¹⁰In example (34) and similar ones, deletion is normally preferred over realisation of the given constituent under right-dislocation. This seems to be related to the closeness of the antecedent. The right-dislocated versions are, however, acceptable and the only realisation patterns if the constituent is to be realised overtly in the given context.

Kamp and Reyle briefly discuss this phenomenon within a larger discussion dedicated to plural referents and assume that a referent corresponding to the kind is introduced by a presuppositional rule, the *Explicit Representation of Genera* rule (Vol. 2, p. 393). It seems to be a property of NPs in general that they make the kind they belong to accessible as antecedents for anaphors. This point will become more important for my argumentation and I will discuss it in more detail below in section 3.3.1.

Cases of kind-anaphoricity are not limited to nominal referents. In (37) the whole VP is backgrounded and deaccented. For this case we can again find a counterpart with a grammaticalised anaphor: *'do so'*.

- (37) a. Marry married a pirate.
b. Also SUE [married a pirate].
b' Also SUE did so.

'Do so' is a grammaticalised anaphor which accesses a class of properties (the property of having married some pirate) denoted by the VP. It is different from *'did (it)'* in (38), which is anaphoric to the specific content of a surface antecedent VP (the property of having married Cut-throat Bob). Whole VPs can serve as the surface antecedent of different kinds of anaphors, including backgrounded VPs with descriptive content. (39) is a Catalan example from a monologue. Here the right dislocated element corresponds to the property of being king.

- (38) a. You must be crazy to marry Cut-throat Bob,
b. but Martha did (it).
(39) No és tan fàcil, ser rei.
Not is so easy, be king.
'It's not so easy, being king.'
(Catalan, Buenafuente 2001b, p. 38, cited by Mayol, 2002)

The kind/representative distinction seems to play an important role in the resolution of background anaphors and this distinction is extendable beyond nominal reference. But with respect to the resolution of pronominal anaphora, we need no further apparatus to handle kind-sensitivity because *one-* and *do so-* anaphora behave in a similar way. *One-*anaphora refer to kinds, a class of individuals, and picks out one representative. In a similar way *do so* refers to a class of events and not to a specific even. It identifies the class and makes another representative of the same class available. If *'John reads a book'* and *'Bill does so, as well'* John and Bill do a similar thing; they perform the same kind of action. But there are still two separate events of the same kind. In section 3.2.4 I will argue that this kind-sensitivity also explains some puzzles about apparent scope island violations.

3.2.2 Non-identity II: part-of relations and association of referents

A second case in which backgrounds match their antecedent only partially occurs when the background anaphor is either more or less specific than its antecedent. Nevertheless, in such cases an anaphoric connection is possible because a substantial part of their descriptive content matches. Van Deemter (1993) and Odijk and van Deemter

(1997) discuss cases in which backgrounds are more specific than their antecedents, like the example in (40), already discussed in 1.1.1 and 2.1.2.1, where the ‘viola’ is a more specific type of ‘string instrument’ and hence the mention of the former kind licenses backgrounding of the latter. There does not seem to exist any grammaticalised anaphor which could replace the NP in (40b); nevertheless the relation between the two object NPs must be described as an anaphoric one. The NP in (40b) is more general than that in (40a) and the latter is subsumed by the former. (40b) is a more than complete answer to (40a). A complete answer would be (40b’).

- (40) a. Bach wrote many pieces for the viola.
 b. He must have LOVED [string instruments]_{tail}.
 b’. He must have LOVED [the viola]_{tail}.
 (adopted from van Deemter and Odijk, 1997)

Clearly we cannot replace ‘viola’ in (40) with ‘moog’ without losing the backgrounding effect in (40b). And if a marking of ‘string instruments’ as background is forced by linguistic means (deaccentuation in English), the discourse would lose its coherence, since (40b) would not longer be a proper continuation for (40a), as (41) shows:

- (41) a. Bach wrote many pieces for the moog synthesizer.
 b. # He must have LOVED string instruments.

In (40) we have seen an anaphoric linking to an antecedent which is more specific. But backgrounds may also be anaphoric to an antecedent which is less specific. This can be observed in example (42), where the background denotes a part of its plural antecedent. I will argue in the next section that this option is specific to links. In (42) the link-realised NP ‘la Maria’ is anaphoric to ‘els teus amics’ (*your friends*) and Mary is part of the friends in question.

- (42) a. Què en saps, dels teus amics?
 ‘Any news about your friends?’
 b. [La Maria]_{link}, la vaig veure fa poc.
 [ART Maria]_{link}, her have-seen ago little.
 ‘Mary, I saw recently.’

Examples (40) and (42) differ in that (40) has to do with different degrees of concept specificity (viola vs. string instruments) and (40) has to do with atomic parts of plural referents (Mary vs. the set of your friends). In order to provide a unified account I will use a part-of relation in both cases: *Mary* is a part of the plural entity of ‘*your friends*’ and the concept ‘*viola*’ is part of the kind of concept named ‘*string instruments*’. I will justify this decision in section 3.3.2 below. The advantage of using a relation like *part-of* is that we can properly define it. A second advantage, which will become evident in section 3.2.3 is that it is directional: *Mary* is part of the friends, but the friends are not part of *Mary*.

Another phenomenon which interferes with the proper identification of backgrounds and their antecedents is bridging reference. I consider bridging to be a separate case from partially matching descriptions, since bridging relates descriptions more freely

and these relations are sometimes very hard to predict. Here I will simply describe of some of the problems which the phenomenon presents for the resolution of IS and sketch a possible solution. I will, however, not try to give a full analysis of the problem.

In many cases bridging relations license backgrounding as in (43). The most natural intonation pattern seems to be one in which the main stress falls on *new* in (43b), which marks *car* as backgrounded. The reason for this seems to be that the *engine* is a part of the *car*.

- (43) a. The engine broke.
b. So, John bought a NEW car.

Anaphoricity is a relation which is necessary for the full and proper interpretation of the example. If we miss to resolve the anaphoric connection, an adequate and complete interpretation is not possible, since we fail to relate the *engine* to the *car*. In other words: without an anaphoric link the two NPs would remain unrelated and the *engine* could be just any engine in the world and the discourse fragment would no longer be coherent. (44) is a Catalan example from a comedy monologue.

- (44) a. La Guàrdia Civil ha posat un milió i mig de multes en nou mesos. Aquesta és la bona notícia, i la millor és que la província de Barcelona encapçala el rànquing de multes! Un aplaudiment!
b. [...] Doncs la Guàrdia Civil ens té molt mimats, als catalans.
[...] Well the Guardia Civil us have very spoiled, the Catalans.
'The Guarida Civil really spoils us Catalans.'
(Catalan, Buenafuente, 2001a, Pàgina 158)

Here '*Catalans*' is a broader concept than the people inhabiting the province of Barcelona, which are evoked by the context. Again, resolving the anaphoric relation is necessary to relate the '*Catalans*' to the people which have been given fines. If there was no relation between the two, the segment would not be coherent, as the reader can verify by changing '*Catalans*' to, say, '*Italians*' (in (45), which maintains the tail realisation).¹¹ In that case the context would simply provide no justification for making the claim that the Guardia Civil has this special relation to Italians.

- (45) # Doncs, la Guàrdia Civil els té molt mimats, als italians.
[...] Well the Guardia Civil them have very spoiled, the Italians.
'The Guardia Civil really spoils those Italians.'

If we find unresolved definite NPs, often conceptual relations have to be associated to an antecedent in order to interpret the text properly (unless the NP represents a unique referent like '*the pope*'). Sometimes this requires complex inferences. Consider the following example (46), where the '*documentary filmmakers*' have to be resolved with identical and anaphoric to the '*authors*'.¹²

¹¹Of course the '*Italians*' could be contrasted with the inhabitants of the Barcelona area, but this would require a link realisation. I will discuss this point in chapter 4 (4.2.2)

¹²The full context is the following:

- (46) (the text is about the tape-recordings of a famous trial against terrorists in Germany)
- a. ... stießen die Autoren Stefan Aust und Helmar Büchel [...] auf Teile der Bänder.
'the authors found ... part of the tapes'.
- b. [...] Nach langwierigen Verhandlungen [...] wurden die Bänder schliesslich [...] an [die *Dokumentarfilmer*] übergeben.
'[...] After long negotiations the tapes were handed [...] to [the documentary filmmakers]' .
(Taggesschau.de, 30.7.2007)

When the reader has to process the NP '*Dokumentarfilmer*' (*documentary filmmakers*) she or he will have to assume that the NP has to refer to a referent which is familiar or unique within the context because it is definite. And, assuming the text to be coherent, the reader will try to find a way to relate the new information in (46b) to the already transmitted information in the context. The surface antecedent appears to be '*Autoren*' (*authors*), but how can this antecedent be resolved? First of all, documentary filmmakers are a specific sort of authors. But there is also some further contextual information which help to anchor the description. The creation of a TV documentary (NDR is a federal TV channel) is mentioned. The anaphoric link between authors and documentary filmmakers can be established because of a conceptual relation, but also the wider context supports this linking. '*Documentary filmmakers*' is conceptually more specific than '*author*'. So we could assume an anaphoric licensing on the basis of a part-of relation. But the anaphoric relation that holds between the two NPs is, in fact, one of identity.

However, not all bridging relations are predictable and there are cases in which no physical or conceptual part-of relation can be construed. Consider (47),¹³ where the

- (i) Mehr als dreißig Jahre lang galten sie als vernichtet:
'For over thirty years it was assumed that they had been destroyed.'
die Tonbandmitschnitte des Stammheim-Verfahrens gegen die RAF-Gründer Andreas Baader, Ulrike Meinhof, Gudrun Ensslin und Jan-Carl Raspe.
'The tape-recordings of the Stammheim trial against the founders of the RAF Andreas Baader, Ulrike Meinhof, Gudrun Ensslin and Jan-Carl Raspe.'
Doch bei den Recherchen zu der zweiteiligen NDR-Dokumentation "Die RAF" stießen __die Autoren Stefan Aust und Helmar Büchel__ in Nebenräumen des Oberlandesgerichtes Stuttgart auf Teile der Bänder.
'But during the research for the documentary film in two parts made by the NDR "the RAF" the Authors Stefan Aust and Helmar Büchel found part of the tapes in storage rooms of the federal superior court of the Land in Stuttgart'
Nach langwierigen Verhandlungen mit dem Oberlandesgericht und der Bundesanwaltschaft in Karlsruhe, die zunächst auf einer Vernichtung der Tondokumente bestanden hatten, wurden die Bänder schließlich in Kopie über das Staatsarchiv Ludwigsburg an die __Dokumentarfilmer__ herausgegeben.
'After long negotiations with the superior court of the Land and the federal court of the land in Karlsruhe, which first insisted in a destruction of the tapes, a copy of the tapes was handed to the [documentary filmmakers].'

¹³I am thankful to Peter Bosch for pointing this out to me. In order to capture bridging relations as part-of relations along the lines of (40) to (42), we would have to assume a dynamic ontology where nodes like *chicken coop* can have the *smell* as its part, but only in contexts where the coop is old. Similarly in a commercial transaction context, as below, a car would have a conceptual sub-part which is its price, while in other context it does not have such a sub-part.

smell of the chicken-coop is marked as a link (with a rising accent in (47) and is anaphoric to the chicken-coop of (47a). Without the mention of the coop in the context the *smell* would not be fully interpretable. But we cannot assume that the smell is an integral part of the coop. For example, if we change the context to something like ‘*They built granny’s brand new chicken coop*’ the *smell* will not be supported as a part of the coop anymore. The reason for that appears to be that old chicken coops are associated with bad smell, but new ones are not.

- (47) a. Letzte Woche haben wir Omas HÜNERSTALL abgerissen
 Last week have we Granny’s CHICKEN COOP tore-down
 ‘Last week we tore down Granny’s chicken coop.’
 b. Der *Gestank* war unerträglich. (rising accent on *Gestank*)
 The *smell* was unbearable.
 ‘The smell was unbearable.’

The same happens in (48). The link is here marked by a rising accent and by the fronting of the object PP. The *price* can be construed ontologically as a part of the car (as a sales object). However this is only true in contexts where a price is relevant, for example in a commercial transaction context. If the car is mentioned in e.g. a breakdown or a repair situation, the price of the car will not be available as a conceptual part of the car. (48b) would not be possible in a context like ‘*Otto’s car broke down*’ and the price mentioned would refer the price of the repair in a context like ‘*Otto had to repair his car*’.

- (48) a. Otto hat gestern sein Auto verkauft.
 Otto has yesterday his car sold.
 ‘Otto sold his car yesterday’.
 b. Über den *Preis* mussten sie lange verhandeln.
 About the *price* had-to they long negotiate.
 ‘They had to negotiate a long time over the price’.

The moral of such examples is that bridging cases go beyond simple part-of relations. However, the fact that such relations cannot be predicted on the basis of a surface antecedent does not mean that we cannot determine whether a bridging relation can hold in a given context or situation. I will not try to develop a theory of bridging here, but since bridging often plays a role in the anaphoric resolution of NPs and other background anaphors I will assume that, apart from the additional problems they present, they can be treated in essentially the same way as we treat other background anaphors, as implying a part-of relation. This part-of relation may not be predictable from a static ontology (which would express that the price is part of the car and the smell part of the chicken coop), but it is construable. More importantly, there is always an inferrable directionality of this relation between anaphor and its antecedent. If we have a given car we can infer that the engine is physical part of it and the price of the car may be a conceptual part of the car if we think of it as a sales-object, but the reverse will under no circumstances be true: a car will never be part its price, just like a car will never be part of its engine. In order to give form to this observation I will formulate the following descriptive rule, which is meant to be a simple hack:

- (49) **The bridging hack rule**
Bridging relations give rise to part-of relations.

(49) is a simple way to extend the current proposal to bridging cases. It does not explain bridging phenomena, but it preserves directionality of part-of relations. As I will argue in section 3.2.3 this directionality is crucial for the resolution of IS.

3.2.3 The anaphoric behaviour of links and tails

In the last section I have shown that being-part-of is a possible relation that may hold between a background anaphor and its antecedent. In this section I will take a closer look at this relation and investigate the different constraints that hold for links and tails as different kinds of background anaphors. Reconsider example (40) from above. Here the focus accents falls on the verb and the following NP is deaccented without any further phonological marking. Therefore the object NP is a tail. This classification is supported by the fact that the Catalan counterpart of the sentence (given in (50)) displays a right dislocation which syntactically marks it as a tail. The anaphoric relation can be described as ‘string_instruments’ \geq viola’ since the kind of ‘*violas*’ is part of the kind ‘*string instruments*’. The same happens to cases where the background anaphor denotes a physical superset of the antecedent as in (51)/(52). Here Maria (the antecedent) must be part of the friends (realised as the tail NP).

- (40) a. Bach wrote many pieces for the viola.
b. He must have LOVED [string instruments]_{tail}
(adopted from van Deemter and Odijk, 1997)
- (50) Li devien agradar molt, [els instruments de corda]_{tail}.
Him must-have pleased much, [the instruments of string]_{tail}.
‘He must have LOVED string instruments.’
- (51) A: Any news about Mary?
B: I haven’t MET [any friends]_{tail} (recently).
- (52) A: Què en saps de la Maria?
What know-you about art Maria?
‘Any news about Maria?’
B: No n’he vist cap, d’amics.
Not of-them’have seen non, of-them’friends.
‘I haven’t SEEN any friends.’

The difference between the two examples is that one part-of relation holds between physical objects (or sets) and the other holds between kinds as conceptual classes. But what they have in common is the directionality of the part-of relation: tail_referent \geq antecedent referent. In this case, the background anaphor is more general than its antecedent. In addition, we can find the inverse case, where the background anaphor is more specific than its antecedent. (42) is an example for that:

- (42) A: Què en saps, dels teus amics?
‘Any news about about your friends?’

- B: [La Maria]_{link}, la vaig veure fa poc.
 [ART Maria]_{link}, her have seen ago little.
 ‘Mary, I have seen recently.’

(42) is a link-focus construction, in contrast to (40)/(51), which are focus-tail constructions. In fact (42) is the mirror-image of (52). Links may be more specific than their antecedent, while tails may be more general. This generalisation seems to be true for the other examples, as well. Unless they are bound under identity (as I will show in 4.1.2), links can never be turned into tails (and vice versa), in the same context and without altering felicity conditions. (53) illustrates this.¹⁴

- (53) A: Any news about Maria?
 B: # [De amics]_{link}, no n’he vist cap, ultimament.
 [Of friends]_{link}, not of-them’have-I seen any, recently.
- (54) A: Any news about your friends?
 B: # La vaig veure fa poc, [la Maria]_{tail}.
 Her PAST-I seen ago little, [ART Maria]_{tail}.

We can observe here that links are not allowed to be more general than their antecedents while tails may not be more specific. If the match between a background anaphor and its antecedent is partial and the direction of the partial correspondence is known this determines whether the referent must be realised as a link or as a tail. Or vice versa: If a constituent is overtly marked as a link, we can guide the resolution of the antecedent by the knowledge that it has to be either equal or more general.

Remember that (2) was problematic with respect to this directionality, since, assuming a monolithic notion of backgrounds, the background here is both more specific and more general than its antecedent.

- (2) a. What about the staff members? Do they like broccoli?
 b. [*The boss*]_{link} HATES [*vegetables*]_{tail}.

In this example the background appeared to both widen and narrow down its antecedent. The link ‘*the boss*’ narrows down its antecedent ‘*the staff members*’, while the tail ‘*vegetables*’ makes a generalisation with regard to its antecedent ‘*broccoli*’. Under the assumption that links and tails are anaphoric *separately* this example is consistent with our findings. The seemingly strange behaviour of the background in this example with respect to its antecedent is no mystery anymore. It simply follows from the directionality of the different part-of relations imposed by links and tails.

The difference between physical or conceptual part-of relations is not important for the realisation of links and tails. In example (40) we saw that a kind can be anaphoric to another (more specific) kind. A tail realisation is obligatory in (40b). But we can also reverse *this* example: (55) has the reverse anaphoric relation of the original (40) and

¹⁴As Valldvúi (p.c.) notes examples like (53)/(54) are marginally acceptable, but they would require the cohesion of a higher order QUD (question under discussion, cf. 4.3) into the context, that that *d’amics* matches a suitable antecedent. This would, however, alter the context itself, since it would require a different context - in the form of a QUD - by accommodation.

accordingly *'the viola'* must be realised as a link. The tail realisation we saw in (40) is blocked. The English version (55A) requires a rising accent on *'the viola'*. The Catalan version is even clearer: only the link realisation (55A') is possible (the tail realisation (55A'') is infelicitous).

(55) Q: Which relationship did Bach have to string instruments?

A: He surely LOVED [the viola]_{link}
 H* L+H*

A': [La viola]_{link}, li devia agradar molt.
 [The viola]_{link}, him-cl must-have pleased much.
 'The viola, he must have loved.'

A'' # Li devia agradar molt, [la viola]_{tail}.
 Him-cl must-have pleased much, [the viola]_{tail}.

There are also cases where conceptual and physical part-of relations show a certain degree of interference. In (46) above the *'documentary filmers'* were identical to the *'authors'*. A *'documentary filmer'* is, however, only one of different kinds of *'authors'*. If the conceptual relation were decisive in this case, we would expect a link-realisation, required by the \leq -relation. But there is no reason why we should think that the NP *'Dokumentarfilmer'* is realized as a link, rather than a tail. The NP is not left dislocated and the example should be pronounced without a rising accent. But note that the sentence is about the authors as individuals; there is no anaphoric relation between the two kinds *'author'* and *'documentary filmer'*. As a result, the link-realisation (which would correspond to a binding of kinds under part-of) is not required. This strongly suggests that part-of-relations hold between referents (in this case the referents for the individual), and not between descriptions of those referents. In the case of the *'viola'* and the *'string instruments'* the case is somewhat different. The corresponding sentences are about the *kinds* and not about *individuals*.

The link/tail distinction and the different part-of relations also carry over to bridging cases: if we reverse examples like (43) the anaphoric NP has to be realised as a link if it is more specific than its antecedent or if it is a physical part of it.

(56) John's fixed his car.
 a. *The engine* had to be entirely REPLACED.
 b. # The engine had to be entirely REPLACED.
 (without rising accent on *engine*)

(57) En Joan va fer reparar el seu cotxe.
 art John past made fix the his car.
 'John had his car fixed.'
 a. El motor, el van haver de canviar tot.
 the engine, it past had to change all.
 'They had to replace the engine entirely.'
 b. # El van haver de canviar tot, el motor.
 it past had to change all, the engine.

The limiting case of the two part-of relations ' \leq ' and ' \geq ' is identity ('='). Independent of the directionality, identity will be licensed as any of the two part-of relations as they

are defined by now. If the referent for the background is identical to its antecedent, accordingly both a link and a tail realisation is predicted to be possible. But the meaning is not entirely the same: the difference between a link- and a tail-realisation of *Enric* in (59)/(58) is that the link realisation induces a contrastivity effect for *Enric*.

- (58) Què en saps de l'Enric?
Any news about Enric?
- a. No en sé res, [de l'Enric]_{tail}. (CLRD)
no cl know nothing, [of art Enric]_{tail}.
 - b. [De l'Enric]_{link}, no en sé res. (CLLD)
[Of art Enric]_{link} no cl know nothing.
'I haven't heard anything about Enric.'
- (59) Any news about Enric?
- a. I haven't heard ANYTHING about Enric
 - b. I haven't heard ANYTHING about *Enric*. (rising accent on *Enric*)
 - c. About *Enric* I haven't heard ANYTHING.

Considering these findings (but leaving aside contrastivity for the moment), we can formulate a preliminary principle of anaphoricity for backgrounds as in (60). Note that the links and tails stand in nearly complementary distribution. Only the identity case supports both a link and a tail realisation.

- (60) **Anaphoricty of Backgrounds**
1. Links must stand in a \leq -relation to their antecedent.
 2. Tails must stand in a \geq -relation to their antecedent.

The distribution of links and tails seems to be only nearly complementary. But under closer scrutiny it becomes clear that (58a) and (58b) (and their English counterparts in (59)) do not mean exactly the same. The link-construction introduces a contrastivity effect. When (58b) is uttered the hearer would usually wait for a continuation which contrasts *Enric* with someone else, who B might have seen or heard of. A possible continuation would be one in which B has seen *Enric's* sister, *Enric's* wife, one of *Enric's* colleagues or any other person which might be relevant in the context. Although the truth conditions for the two sentences do not change, the realisation of a link or a tail is meaningful. The choice of realisation tells something about how the context must be for the sentence to be felicitous. Although the surface context for (58a) and (58b) is the same, I will argue in chapter 4 that the two versions of the sentence presuppose different underlying *structures* of the context. The anaphoricity principle (60) does not capture this contrastivity effect. I will ultimately argue that links are never identity anaphora (cf. [Hendriks and Dekker: 1996](#))¹⁵ and that they have to be bound by the set of contrastive elements to which they belong. The non-identity analysis is also supported by examples like (61).

¹⁵Hendriks and Dekker (1996) assume that links are non-monotone anaphors, which signal non-identity. In chapter 4 I derive this result on the basis of discourse structure. While Hendriks and Dekker claim that links have no location function (as proposed by Vallduví, 1992) I assume that they have a location function with respect to discourse structure.

- (61) Ten guys were playing basketball in the rain.
 a. The fathers were having FUN.
 b. *The fathers* were having FUN. (rising accent on *fathers*)
 (Hendriks and Dekker, 1996, p.353)

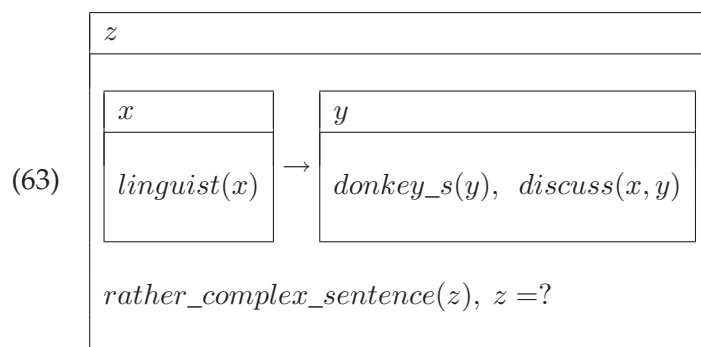
The presence or absence of the rising accent on '*fathers*' changes the interpretation, as Hendriks and Dekker observe: in the first case the '*fathers*' may be equal to the '*ten guys*' (if the subject is realised as a tail, i.e. without any further accent). If the subject is marked with a rising accent, an identity reading is blocked: the fathers have to be either part of the ten guys or they are the fathers of the ten guys. Also a more detailed discussion of the non-identity requirement for links will be given in chapter 4.

3.2.4 Escape from donkey islands

There is a further problem for an analysis of backgrounds as anaphors. Backgrounds seem to be able to access their antecedents in cases where grammaticalised anaphors are not licensed for structural reasons. Consider the following cases in which the antecedent is trapped within a scope island, created by a quantifier or an operator:

- (62) a. Every **linguist** discussed a donkey sentence. # It is a rather complex sentence.
 b. John did not eat a candy bar. # It was delicious.
 c. Dana may have married a pirate. # He is a drunk.
 d. If John drinks a beer than he enjoys it. # It is ice-cold.

Under the predominant narrow scope reading (where there is a donkey sentence for each linguist, the candy bar is not a specific one which John did not eat, etc.) none of the pronouns from above are felicitous. The strong quantifier *every* in (62a), the negation in (62b), the modal in (62c) and the conditional in (62d) create scope islands. Whatever discourse referent is created within such an island is not accessible from the outside. An intuitive explanation of this is that modality or negation select for a set of possible worlds which are either probable, improbable or non-existing (i.e. an empty set). If something is created and exists only within this hypothetical world, it does not follow that it also exists in the set of worlds which are compatible with what we are talking about in the discourse. A standard DRT treatment of the examples in (62) assumes that these islands are represented by an embedded *discourse representation structure* (DRS) which block access to pronominalisation from outside. Since each DRS, including the main DRS, existentially binds all variables which are part of the universe of this DRS, both quantificational and non-quantificational indefinites can be explained in the same way. An occurrence of an indefinite is properly bound in DRT if the variable for its referent occurs in an accessible DRS. In quantificational cases of indefinites this is the representation of their quantification potential: The existential quantifier can enter into scope relations with other quantifiers, as exemplified by the donkey sentences in (62). On the other hand there are seemingly non-quantificational indefinites which simply introduce new referents in the main DRS, which ultimately represents "the world we are talking about". So, if a discourse referent is created in the universe of the main DRS, this is equivalent to the referent being existential within the discourse. Turning to donkey sentences, (62a) can be represented as follows in DRT:



The failure to establish an anaphoric connection between the pronoun *it* and its intended antecedent *donkey sentence* can be explained by accessibility conditions which operate on DRSs: An antecedent referent is accessible if it is listed in the universe of a DRS which contains the DRS containing the anaphor. It is also accessible if the anaphor occurs in a conditional consequent and antecedent occurs in the corresponding conditional antecedent. In (63) neither of these conditions holds for the antecedent with respect to the anaphoric z . This is why the anaphoricity condition $z=?$ cannot be resolved.

Now consider the following parallel sentences with backgrounds that have their antecedent within an non-accessible DRS and which nevertheless are acceptable:

- (64)
- a. Every linguist discusses a donkey sentence. Linguists LOVE [donkey sentences]_{tail}.
 - b. John did not eat a candy bar. His doctor told him to AVOID [candy bars]_{tail}.
 - c. Dana may have married a pirate. Her sister HATES [pirates]_{tail}.
 - d. If John drinks a beer then he enjoys it. John is CRAZY about [beer]_{tail}.
- (65)
- a. Every linguist discussed a donkey sentence. Also one computer scientist EXAMINED [a donkey sentence]_{tail}.
 - b. John did not eat a candy bar. But for his son he BOUGHT [a candy bar]_{tail}.
 - c. Dana may have married a pirate. Her sister DIVORCED [a pirate]_{tail}.
 - d. If John drinks a beer then he enjoys it. Right now, he ORDERED [a beer]_{tail}.

At first sight, this might seem to contradict an anaphora-analysis of backgrounds. The backgrounds access their antecedents, which are within a scope island. But although backgrounds do not pattern with pronouns that require identity to their antecedent, there are other undisputable anaphors which do not respect islands either, namely *one* and similar anaphors, which I have already mentioned in section 3.2.1 above.

- (66)
- a. Every linguist discussed a donkey sentence. Also one computer scientist discussed *one*.
 - b. John did not eat a candy bar. His doctor told him to avoid *them*.
 - c. Dana may have married a pirate. *They* are fierce fighters, but lousy cooks.
 - d. If John drinks a beer then he enjoys it. He thinks that *it* is the best drink in the world.

The problem here does not seem to be that backgrounds do not pattern with other anaphors; rather there seem to be different types of anaphors and only some of them

respect scope islands. The difficulty is to explain how the anaphoric link is established. Note that even the pronoun *it* in (66d) is acceptable in certain contexts, but its interpretation is different from the intended meaning of *it* in (62d). In the former case the pronoun refers to beer in general, while in the latter case the pronoun targets an identity interpretation. The latter is blocked by the island introduced by the conditional *if*.

What seems to make the examples in (64) and (66) acceptable is the kind-referring reading. We have to conclude from that that kinds are often more accessible as antecedents than individuals. But at first sight DRT accessibility conditions do not really shed much light on this asymmetry between individuals and kinds: The surface antecedent ('*donkey sentence*', '*candy bar*', '*pirate*', '*a beer*' in (66a-d)) both represent the kind and the individual. Since this surface antecedent is within a scope island, the anaphoric access to the kind should violate the accessibility constraints, something which they do not appear to do. There are two possible ways to explain this; either we resign ourselves and accept that *one*-anaphora is not subject to accessibility restrictions – so they may be bound across island boundaries – or we assume that kind-sensitive anaphors like *one* and the backgrounds in (64) are anaphoric not to the surface antecedents (the NPs), but to abstract kind referents outside the scope island which serves as an antecedent. I will show that the second option is a viable solution and accounts for the facts at hand.

The intuitive idea is the following: Consider (64a). When every linguist discusses a donkey sentence then this presupposes that there are things like donkey sentences. And the existence of donkey sentences in general, (the existence of a class of '*donkey sentences*'), is independent of the individual donkey sentences the linguists discuss (Carlson, 1977). The class can even be void. Even if there is no linguist in the context (which would not make (64a) untrue) and no linguist discusses a donkey sentence there is still an existing class of donkey sentences. We can take this even a step further: everybody knows that dragons do not exist in our world. Although dragons do not exist, we have a notion of what a dragon is. In other words, we need a class of dragons in order to be able to claim that none of them exists and that the set of extensions of the class '*dragons*' is empty. Although at first sight this might be a trivial presupposition, I will show below that this is the key to the solution of the problem.

Although the present proposal does *not* treat backgrounds themselves as presupposition triggers in themselves I will follow the lines of Van der Sandt's (1992) treatment of presuppositions as anaphora. Before I return to the problem of background anaphors and *one*-pronouns, I will shortly present the key ideas of this approach, which is especially interesting for the present purpose, since it is cast in DRT. Van der Sandt assumes that presuppositions are anaphoric, only that they are a special kind of anaphor. As anaphors, they follow the same formal rules on accessibility as other anaphoric elements. This point of view allows Van der Sandt to explain a series of empirical findings, and it also provides a clearer view on how presupposition phenomena affect the coherence of discourse. Consider the following example:

- (67) a. John has a wife.
b. John's wife is a singer.

The possessive in (67b) is an element which carries a presupposition, namely: '*there is an existing person x such that x is the wife of John*' (cf. 2.1.2.2). This presupposition will be satisfied by the fact that (67a) has already introduced the indefinite '*a wife*' into the

context, which stands in a (grammatical) possessive relation to John. In this sense ‘wife’ in (67b) is anaphoric to ‘a wife’ in (67a). Even if we change (67a) to ‘John is married’ this would bind the presupposition in (67b). Also definite NPs carry a existential presupposition for their referents and even pronouns arguably carry the presupposition that they refer back to an existing antecedent (Beaver, 1997, Kadmon, 2001):

- (68) a. A pirate entered the bar.
 b. The pirate ordered grog.

The definite NP ‘the pirate’ in (68b) triggers the presupposition that there is an existential referent in the context which can be described as a pirate. As a matter of fact, the full NP can be replaced by a pronoun, but this possibility depends on the amount of intervening material between antecedent and anaphor, as well as well as the number of possible matching antecedents for the pronoun. The exact difference of the ways in which definite NPs and pronouns behave is beyond the scope of this chapter (cf. Gundel, 1988, Prince, 1985, 1986). In cases like (68) they can apparently fulfil the same function. Van der Sandt casts this analysis into DRT, and (67) and (68) will be roughly represented as follows:

- (69) a.

| |
|---------------------|
| x, y, z |
| $john(x), wife(z)$ |
| $wife(y), z = y$ |
| $has(x, y)of(y, x)$ |
| $singer(z)$ |
- b.

| |
|------------------------|
| x, y |
| $pirate(x), pirate(y)$ |
| $enter(x), x = y$ |
| $order_beer(y)$ |

There are, however, cases in which a presupposition will not find a proper antecedent. For example (67b) could be uttered out of the blue and would still be acceptable:

- (70) a. John’s wife is a singer
- b.

| |
|---|
| x, y |
| $john(x), wife(z), of(z, x), singer(z)$ |

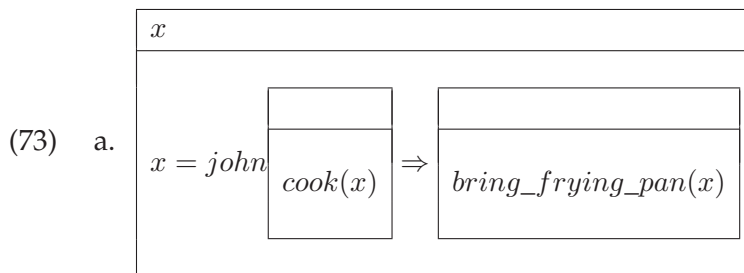
In such cases van der Sandt assumes that the antecedent is introduced via accommodation. An interesting observation about accommodated antecedents is that they may be either introduced in the same DRS in which the presupposition is introduced, or in a DRS which contains the former. This explains why referents introduced via presupposition accommodation may escape from scope island which usually block the anaphoric link between an antecedent and an intended anaphor:

- (71) a. Every linguists discussed John's theory. It is extremely interesting.
 b. Every linguist saw the dog. It's a stupid animal.

Note that the examples in (71) resemble the examples in (64) above. The difference between the two types of sentences is that in (71) the anaphors are plain pronouns, while the ones in (64) are backgrounds. What they have in common is that the anaphoric link between antecedent and anaphor is still possible, although the antecedent should be inaccessible from outside the scope island.

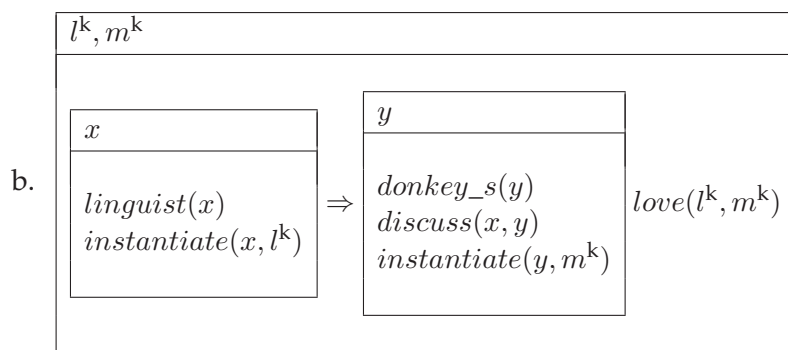
Accommodation is not an unconstrained process, however. There are cases of accommodation into an intermediate DRS. For example the existence of the frying pan in (72) does not seem to be guaranteed in any case. If John is a cook than he has a frying pan, but if he is not a cook we do not know if he owns a pan, and (72) does not seem to require that. In the case John does not own a frying pan, the pan's referent will be accommodated into the universe of the DRS which represents the antecedent condition of the conditional. This seems to be the preferred option, since owning a frying pan seems to be dependent on being a cook.

- (72) If John is a cook, he will bring his frying pan.



The solution that I propose here for cases like (64) takes advantage of presupposition projection. It is an adaption of Kamp's (Kamp , 1981, Kamp and Reyle, 1993) *Explicit Representation of Genera Rule*. The details of this rule will be discussed in the next section. Expressed informally, this rule treats kinds just as other existentially presupposed referents. In case a kind is already given and accessible in the context an anaphoric reference from without the island will not violate the accessibility conditions because the kind referent was already available before the island was created. In case there is no already existing kind as a possible antecedent, accommodation of the kind will be triggered. In this case accommodation may introduce the referent for the kind in the main DRS and again it will be accessible from there for further anaphoric reference. (Kind referring referents are marked with a superscript k here, which will be defined in 3.3.1)

- (74) a. Every linguist discusses a donkey sentence. Linguists LOVE [donkey sentences].



In the light of this analysis, reconsider the examples in (66) above, repeated here.

- (66) c Marry may have married a pirate. *They* are fierce fighters, but lousy cooks.

The pronoun *they* in (66c) refers to no specific identifiable or delimitable set of pirates, rather to the whole class of pirates, i.e. the kind ‘*pirates*’. It does not even seem to be necessary for each and every single pirate to be a fierce fighter and a lousy cook, as long as there is a generalization that can be made about what properties pirates have in general. If there is a reasonably acceptable cook in each thousand pirates, the second part of (66c) will not be false (Carlson, 1977). We are not forced to examine each pirate and decide if he is or not a lousy cook in order to make a statement such as (66c).

An important feature of this analysis is that it can be carried over to non-nominal referents such as propositions and properties, as can be seen in (37) and (75).

- (37) a Marry married a pirate.
 b Also SUE [married a pirate].
 b’ Also SUE did (so).
- (75) A: It is possible that pirates are scum.
 B: I don’t CARE [whether pirates are scum]_{tail}.

This analysis also solves the promiscuous binding problem, described in chapter 2, section 2.1.2.2 (Geurts and van der Sandt, 2004b, Buring, 2004, Schwarzschild, 2004).

- (76) a. (Muslims think Allah is almighty.)
 b. But Buddhists don’t think Buddha_F is almighty
 (Buring, 2003)

The problem in this case is that, assuming that backgrounds trigger an existential presupposition, the binding relations would make a reading necessary in which it is presupposed that someone is almighty. Under the present analysis this problem does not arise, because the propositions (‘*Buddha is almighty*’) embedded under the believe contexts (‘*Bhuddists believe x*’) only presupposes that there is a property of being almighty. This property does not have to be instantiated by any individual. This is parallel to the distinction between individuals and kinds. In order to make a kind available for further reference, there is no need for an existing individual that represents that kind (we can talk about *dragons* and *unicorns* without there having to be such). This presupposition of the property can, thus be accomodated in the main DRS and this will

not trigger the existence of an individual that is actually almighty. The present analysis correctly predicts that the the two contrasted sentences are about the property of being almighty and not about almighty individuals. This current proposal does *not* treat backgrounds themselves as presuppositions, as in Geurts and van der Sandt (2004a, 2004b). The only point where the present proposal makes use of presupposition is for the introduction of kinds and abstract properties as available antecedents.

3.3 Background resolution in DRT

In this section I will summarise the results of the chapter so far and give them a formalised treatment in DRT. I will first consider cases in which backgrounds are sufficiently marked by linguistic means. In this case the problem will be to relate them to a suitable antecedent within the discourse context. As shown above, in many cases, IS can not be sufficiently resolved and stays ambiguous. For such cases there is an additional problem: we have to identify the elements in a sentence which are anaphoric, in order to obtain the correct focus-background partition. This problem will be address in 3.3.3.

3.3.1 Anaphoricity conditions

In dealing with the anaphoricity conditions for backgrounds, we need to to account for three configurations: 1) some anaphora may be licensed by virtue of standing in a kind-representative relation, 2) some anaphors may be licensed by virtue of a underspecification or a part-whole relation, and 3) the kind-representative and underspecification relations may interact, as I will show below.

If we encounter any new linguistically marked link or tail, their surface realisation tells us that this constituent is anaphoric. Depending on the realisation as a link or a tail we also know in which way the background has to relate to the antecedent, according to the anaphoricity conditions in (60), developed in 3.2.3.

(60) **Anaphoricity of Backgrounds**

1. Links must stand in a \leq -relation to their antecedent.
2. Tails must stand in a \geq -relation to their antecedent.

In order to implement this in DRT I propose that an identifiable link α which specifies a discourse referent x_α introduces an unresolved condition $x_\alpha \leq ?$ into the DRS. In turn, a tail β with discourse referent x_β will introduce a condition $x_\beta \geq ?$. These unresolved conditions are resolved just like the unresolved conditions introduced by plain pronouns: Among the list of accessible and matching antecedents, the most suitable will be picked out and the question mark will be replaced with the variable corresponding to the resolved antecedent.

(77) **Introduction of anaphoric conditions**

- a. If α is a linguistically marked link and x_α , introduce a condition $x_\alpha \leq ?$ into the same DRS into which the other conditions for α are introduced.
- b. If x_β is a linguistically marked tail, introduce a condition $x_\beta \geq ?$ into the same DRS into which the other conditions for β are introduced.

According to the rule in (77), the DRSs for (40) and (55), repeated here, will be as in (78) and (79), respectively.

- (40) a. Bach wrote many pieces for the viola.
 b. He must have LOVED [string instruments]_{tail}
 (adopted from van Deemter and Odijk, 1997)
- (55) Q: Which relationship did Bach have to string instruments?
 A: He certainly LIKED [the viola]_{link}
 H* L+H*

(78)

| |
|--|
| $x, y, z1^k, z2^k$ |
| $x = \text{bach}, \text{viola}(z1^k), \text{write_many_pieces_for}(x, z1^k)$ $y = ?, \text{string_instruments}(z2^k),$ $z2^k \leq ?, \text{love}(y, z2^k)$ |

(79)

| |
|---|
| $x, y, z1^k, z2^k$ |
| $x = \text{bach}, \text{string_instruments}(z1^k), \text{relation}(x, z1^k)$ $y = ?, \text{viola}(z2^k)$ $z2^k \geq ?, \text{like}(y, z2^k)$ |

These two DRSs represent include the unresolved anaphoricity conditions, both for the pronouns and the link/tail. In (78)/(79) I have made use of the superscript k in order to mark the type *kind* of the referent. The following definition spells this out for nominal referents:

- (80) **typed reference**
 Any referent in the universe of a DRS must be typed. Nominal referents must be of type k (kind) or i (individual).
 N: e, k.

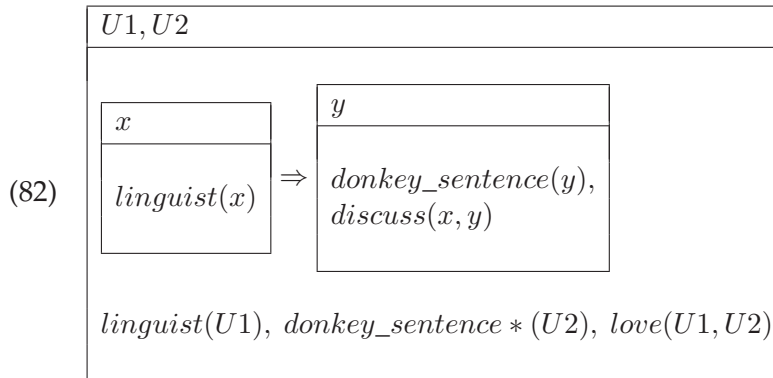
In (40)/(55) the kinds are introduced directly because the NPs '*string instruments*' and '*viola*' denote kinds. In cases like (36) and (64), repeated below, the kind corresponding to the individual has to be introduced indirectly.

- (36) a. Marry wants to marry a pirate.
 b. Also Sue wants to marry one.
 b' Also Sue wants to marry him.
- (64) a. Every linguist discusses a donkey sentence. Linguists LOVE [donkey sentences]_{tail}.

I follow Kamp and Reyle in postulating a presupposition rule for the introduction of kinds. Their rule is given in (81). According to their genera-representation rule the representation of (64) would be the DRS in (82)

- (81) **Explicit Representation of Genera** (Kamp and Reyle, 1993, page 393)
 Triggering configurations $\gamma \in \text{Con}_K$: Suppose γ is of the form $\beta(x)$, where β is of category N.

Operations: Introduce into the universe of the main DRS K a new non-individual discourse referent U while introducing into Con_K the condition $\beta^*(x)$



K&R do not assume differently typed referents for nominal individuals and kinds. Their (81) introduces a complex condition $\beta(x)$ into the main DRS, as well as a non-singular referent U. Because of (80) we will have to say something about the relation between individuals and the kinds they represent and adopt the rule for kind introduction. One advantage of a typed approach is that kinds are treated differently from genuine plurals (which denote sets of individuals instead of kinds), while (81) would treat them alike.

In order to capture the relation between an individual and the kind it instantiates, we need definition (83).

- (83) **Relation between individuals and kinds**

If an individual i realises a kind k , the relation $instantiate(i,k)$ holds.

Now we can declare the following rule for the introduction of kinds via presupposition accommodation.

- (84) **Kind presupposition (declarative version)**

Let i be an individual and k a kind which i instantiates. Then the existence of k is presupposed and this presupposition must be satisfied either by anaphoric binding or by accommodation.

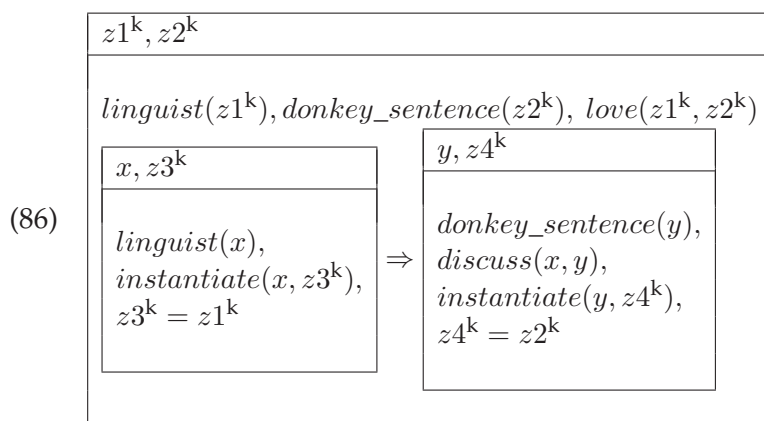
Since we have declared the instantiation-relation in (83), we can now cast (84) into the DRT-rule (85):

- (85) **Kind presupposition (DRT version)**

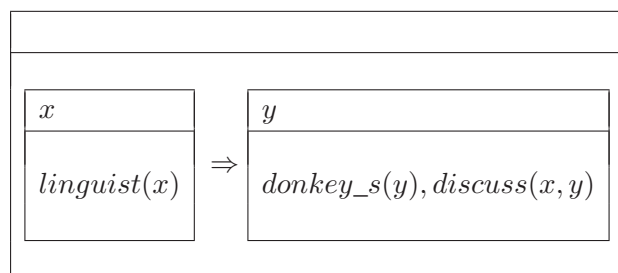
- a. If γ is an N and denotes a individual x , and there is a property P, such that $P(x)$ introduce a condition $instantiate(x, y^k)$, where y^k is the kind that x instantiates, and the additional condition $P(y^k)$. Introduce the presuppositional condition $y^k=?$.
- b. resolve $y^k=?$ either
 - i. by finding a suitable antecedent y^{ik} for y^k in the context, such that $P(y^{ik})$
 - or

- ii. by accommodating a suitable antecedent for k , introducing a new referent y^k and the condition $P(y^k)$ into the main DRS.

Since we are using a standard first order version of DRT here, in the case of accommodation we simply copy the property P from the originating DRS to the main DRS (which might be the same DRS, actually). What this does not represent, is the intuition that the property P itself is anaphoric and should be abstracted over. This would, however, force us to use a higher order version of DRT, which we want to avoid for technical reasons.¹⁶ The DRS in (82), once adapted to the typed-referent approach, looks like (86):

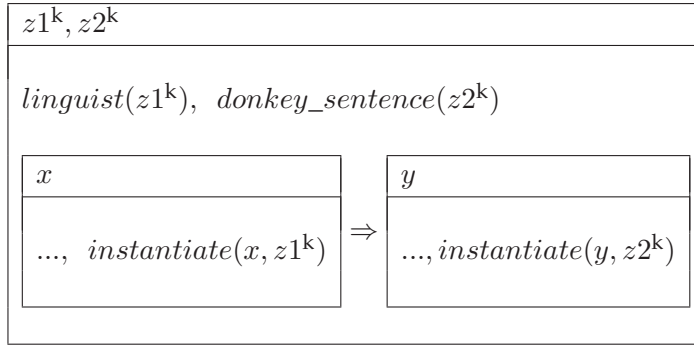


The derivation is as follows: We start out from the standard DRT representation for ‘every linguist discussed a donkey sentence’, which is the following DRS:



Since the noun ‘*linguist*’ denotes a bound individual under the scope of the universal quantifier and the condition $linguist(x)$ (which represents the property of being a linguist) holds, it will trigger rule (85). This rule introduces the conditions $instantiate(x, z3^k)$ and $z3^k=?$. Now the rule tries to find a suitable antecedent for the kind *linguists*, respecting the standard accessibility conditions in DRT (which would block reference for an ordinary pronoun in donkey-sentences). Since no such suitable antecedent can be found it must be accommodated, introducing the new discourse referent $z1^k$ and the condition $linguist(z1^k)$ into the main DRS. Now $z3^k$ can be resolved to $z1^k$. The same will happen to the noun *donkey_sentence*. After the question marks have been resolved, they can be eliminated and the DRS can be reduced to:

¹⁶Kamp and Reyle demonstrate that first order DRT is equivalent to first order logic. To the best of my knowledge there is no such prove for a version of DRT which uses higher order variables for reference.



Now the introduction of the condition $love(z1^k, z2^k)$ does not violate any accessibility condition.

We still have to define the anaphoric conditions which are introduced into the DRS by links and tail. I will again only give the rules for nominal referents. Let us first define the rule for kind sensitive anaphoricity:

- (87) **Definition: $=^k$**
 if x is an individual and y^k is a kind then $x =^k y^k \equiv instantiate(x, y^k)$.

This rule says that an individual which belongs to a kind it can be matched to a kind referent given in the context. This allows for the type-changing behaviour of the anaphoric relation. Let us next define the anaphoric relations which require a partial match:

- (88) **Definition: $\geq^{(k)}$ (polymorphic)**
 either $\geq^{(k)}$ hold between an individual and a kind: if x is an individual and z^k is a kind then $x \geq^{(k)} z^k \equiv (\exists y^k (instantiate(x, y^k) \& y^k \geq z^k))$
 or $\geq^{(k)}$ holds between two members of the same type: if x and y are of type τ : $x^\tau \geq^{(k)} y^\tau \equiv x^\tau \geq y^\tau$, where τ ranges over types e and k .
- (89) **Definition: $\leq^{(k)}$ (polymorphic)**
 either $\leq^{(k)}$ hold between an individual and a kind: if x is an individual and z^k is a kind then $x \leq^{(k)} z^k \equiv (\exists y^k (instantiate(x, y^k) \& y^k \leq z^k))$
 or $\leq^{(k)}$ holds between two members of the same type: if x and y are of type τ : $x^\tau \leq^{(k)} y^\tau \equiv x^\tau \leq y^\tau$, where τ ranges over types e and k .

(88) and (89) are polymorphic definitions. They can hold either between referents for individuals or between a referent for an individual and a referent for a kind. This combines the part-of relation with the kind sensitive behaviour of (87). We can now also recast the anaphoricity conditions in (60) into the the DRT-rules (90) and (91)

- (90) **Anaphoricity of tails**
 If γ is an N, γ denotes a discourse referent x and γ is realised as a tail then introduce the condition $x \geq^{(k)}$?.
- (91) **Anaphoricity of links**
 If γ is an N, γ denotes a discourse referent x and γ is realised as a tail then introduce the condition $x \leq^{(k)}$?.

Finally, we can give the following DRT-rule for *one*-anaphora:

(92) **Anaphoricity of pronominal *one***

The anaphoric N *one* introduces a new individual discourse referent x and the condition $x =^k ?$.

This rule makes use of the kind-sensitive anaphoricity definition (87). The advantage of this is that we can now formally treat one-anaphora and kind-sensitive background anaphora alike.

3.3.2 Model theory

Kamp and Reyle (1993) argue against ZF (Zermelo-Frankel) set theory as a basis for the treatment of plurals. They substitute ZF set by the algebraic treatment of plural individuals proposed by Link (1983). Link organises plural referents and atomic individuals in a lattice structure. K&R provide a formal demonstration for the claim that for the treatment of plural referents the two models predict the same effects, but show (following largely Link's argumentation) that a lattice treatment of plurals overcomes the following conceptual problems which are inherent in ZF set theory:

First of all, ZF predicts a difference between individuals and singleton sets. But there is no evidence that natural language treats them differently. Assuming a set theoretical representation, the '*three linguists*' denotes a set of three linguists, while '*the linguist*' denotes either a singleton set or the individual which is member of this singleton set. Linguistically, plural referents do not seem to behave differently from singular referents (for example pronominalisation) This means that a treatment of the former as sets and the latter as individuals is not motivated. In addition, treating singular referents as denoting singleton sets is also counter-intuitive. Another of Link's (1983) arguments is that ZF set theory does not allow a satisfactory treatment of mass nouns. They do not denote sets and they are conceptually (in the way natural language treats them) not divisible into atomic parts (although they physically may be, e.g. the individual grains of sand).

A further argument could be added to the list: a set theoretical treatment of nominal referents would require us to treat kinds as denoting the set of their subkinds.

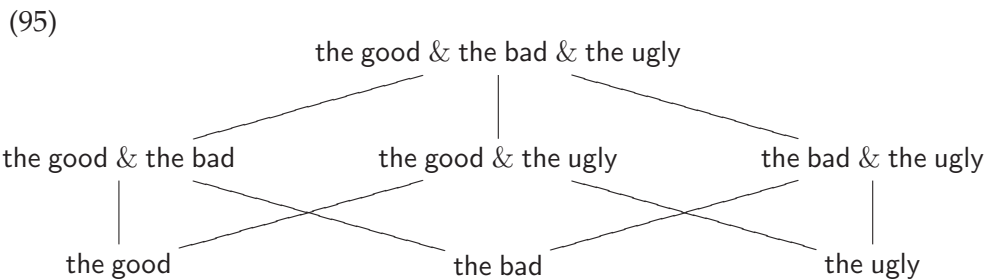
- (93) Dogs have four legs.
Some are large, others are hairy.

The NP '*dogs*' here is a bare plural and kind-denoting (Carlson, 1977). '*Some*' and '*others*' refer anaphorically to the kind '*dogs*', but these anaphors by themselves denote a set of dogs sub-kinds (breeds), namely all the kinds of dogs which are large, e.g. Dalmatians or those big black dogs which look like calves. Compare that to cases where *some* refers anaphorically to a collection of individuals:

- (94) There is a group of students outside. Some eat ice-cream.

A set-theoretical approach would treat the '*students*' as a set and *some* picks out a subset of the contextually given '*students*'. By analogy if '*the students*' denotes a set of students, '*dogs*' should denote the different breeds of dogs (there are over 800 recognized breeds). This is not false, but does not seem to correspond to our intuitions.

K&R adopt a Link-style treatment of plurals for these reasons. They assume that plural referents are organised in a lattice, where the individuals are atomic elements.



K&R assume an upper semilattice (i.e. a join-semilattice) which has the following properties (general properties of partially ordered sets):

- 1) Reflexivity (everything is part of itself),
- 2) Transitivity (a part of a part of an e is still part of e),
- 3) Antisymmetry (if a is part of b and b is part a then a=b),

In addition to these general properties, they assume a bounded semilattice for their purpose:

- 4) Least Upper Bound: there is a supremum entity

Finally, they assume that the semilattice needed to represent plural referents is complete and atomic:

(i) completeness: a upper seminlattice $\langle \mathcal{A}, \subseteq \rangle$ is complete if there is a $\bigoplus \mathcal{B}$ for each $\mathcal{B} \subseteq \mathcal{A}$, where $\bigoplus \mathcal{B}$ is a subset of \mathcal{A} and has an existing supremum b.

In contrast to K&R I distinguish two nomial types for the present proposal: individuals and kinds. I assume that there are two domains, I and K, which are organised as two complete join-semilattices which are homomorphic to each other. We can define the following homomorphism:

(96) The homomorphism of I and K is a function $f: I \rightarrow K$ such that: $f(x \& y) = f(x) \& f(y)$

The homomorphism will ensure that, for example, all individuals which are dogs are mapped to the kind 'dog', and all poodle dogs are mapped to the kind 'poodle dog'. Furthermore, as a consequence of the lattice structure all individual poodle dogs will be part of the set of dogs while the kind 'poodle dog' is part of the kind 'dog'.

The homomorphism maps elements from the domain of individuals into the domain of kinds, but not vice versa. This means that for each individual it is guaranteed that there is a kind onto which it maps. But the reverse is not true. There may be kinds with no corresponding individuals, a fact that is welcome for the our needs, since there are kinds, e.g. 'dragons', which we can talk about although there are possibly no existing members of that kind.

3.3.3 How (most) backgrounds can be recovered from written texts

Let us now turn to the problem of deciding whether a constituent is anaphoric. Background anaphors are identical in form to their non-anaphoric counterparts. A definite noun phrase, like *'the pirate'* for example, can be either anaphoric or not, depending on the context in which it is uttered. The same holds for any other constituent which has the potential to be anaphoric, like verbs and verb phrases. In chapter 2 I also discussed (3a), an example given by Schwarzschild (1999). The problem with such examples is that they require given material to occur in focus.

- (3) a. Who did John's mother praise. She praised HIM.

As for the second problem, Schwarzschild's answer to the problem is to make givenness a necessary, but not a sufficient condition for a sequence of words to be backgrounded (or be exempt from F-marking in his account). His principle of GIVENness (which requires backgrounds to be given) is complemented by an economy principle which prevents excessive F-marking: AvoidF (cf. section 2.1.2.1, repeated here as (97)). If we mark none of the given words as F in situations like (3a), this would result in a focusless sentence. For Schwarzschild the problem is essentially phonological: if there is no focus in the sentence this would imply that the sentence would receive no phonological main accent.

- (97) **Avoid F**
F-mark as little as possible, without violating GIVENness.
(Schwarzschild, 1999, p. 156)

But there are also semantic reasons which seem to disallow sentences without focus. For example, Vallduví (1992) argues that focus represents the update-potential of the sentence (in dynamic semantics), and a focusless sentence would thus have no such update-potential. For this reason, all sentences must have a focus.

I assume here that Schwarzschild's solution of minimal focus marking is essentially right.¹⁷ There are, however, two points to make with respect to AvoidF: 1) So far, we have tried to eliminate F-marking as a formal ingredient in IS resolution (as suggested by Schwarzschild himself). Nevertheless, AvoidF still requires F-marking as a mechanism. A rule which makes reference only to background marking would therefore be preferable. The locus of the main sentence accent would then be predicted by a purely phonological rule. And 2), although AvoidF correctly predicts that marking a constituent as background if possible is better than not marking it, it would be preferable to derive such a minimality principle for focus from a more fundamental principle. AvoidF describes the behaviour of foci, but it does not explain why focus marking must be minimal. While it is desirable preserves his insights in essence, but avoids the two mentioned problem, in that it eliminates F-marking from IS resolution and makes minimality of focus marking follow from a more general principle of parsimony.

I propose here that minimizing foci (or maximizing backgrounds) is simply a part of a general parsing strategy that resolves ambiguities locally whenever this is possible.

¹⁷I have, however, argued in chapter 2 that his notion of givenness (implying resolution qua existential type shifting) should be replaced by strict anaphoricity.

Steedman (2000b) proposes a mechanism which implements such a parsing strategy and informally names it *the oracle*. He notes that “since the earliest stage of inquiry, it has been clear that human parsing phenomena are extremely sensitive to the influence of semantics and especially referential context” (p. 238). But although Steedman discusses information structure in depth, he develops no IS account based on the oracle. But such a step seems only natural and will be proposed here.

In order to understand Steedman’s concept of the oracle, it is important to know that one of Steedman’s main goals is to develop a parsing algorithm which is both efficient and psychologically plausible. He stresses, in particular, that human language processing is to be understood as an incremental process: sentences are parsed from left to right and at each point of the process a partial semantic representation is available. Such an assumption is well motivated and founded on psycholinguistic research. The garden path phenomenon (Bever, 1970, Crain and Steedman, 1985), exemplified by (98) is one of the best known examples which supports this hypothesis:

(98) The horse raced past the barn fell.

(98) is a sentence which is very hard to parse for humans. The reason for that is that the sentence is complete and plausible without the last word ‘*fell*’. When spoken aloud, the hearer is let down a *garden path* into a wrong syntactic derivation. She usually realises that only when the word ‘*fell*’ has to be incorporated into a seemingly complete sentence. As interesting as garden paths are, it is equally interesting that many times human parsers are not let down a garden path even if a sentence potentially represents one.

- (99) a. The doctor sent for the patient arrived.
b. The flowers sent for the patient arrived.

While (99a) may lead a hearer down the garden path, the syntactically parallel (99b), in turn, has no perceived garden path. This can be explained by the fact that the verb ‘*send*’ selects for an subject which may act as an agent and ‘*flowers*’ cannot fulfil this role; *flowers* cannot send for anyone or anything. In this case the ambiguity is resolved as soon as the leftmost string ‘*the flowers sent*’ has been processed and the potential garden path can be eliminated. Although non-determinism is possible in and necessary for natural language parsing, the oracle minimizes this non-determinism and makes it as local as possible. In (99a), no disambiguating lexical semantic information is available, since ‘*the doctor*’ is a possible agent of the verb ‘*send*’. Hence, the garden path can not be eliminated at the same point as in (99b).

Steedman (based on earlier joint works, especially Crain and Steedman, 1985) argues that also contextual information helps the parser to avoid garden paths. If (98) is uttered in a context where several horses are mentioned (=given) and one is known to have raced past the barn, the garden path is not perceived any more. This also is the case in (99b). If it is clear from the context, that there is a doctor which has been sent for, the garden path can be eliminated after the verb and the preposition has been processed and before the PP ‘*for the patient*’ can be interpreted as a goal argument.

In order to make this explicit, Steedman adopts Crain and Steedman’s (1985) principle of parsimony (100):

(100) **The principle of parsimony (Steedman, 2000b)**

The analysis whose interpretation carries fewest unsatisfied but accommodatable presuppositions or consistent entailments will be preferred.

(p. 242)

The principle of parsimony in the form of (100) is very general and should probably be made more specific in order to explain the different cases in which it applies, but it expresses the need for economy in the parsing process. It can be applied to IS resolution if we assume that background anaphors carry a minimal presupposition: they presuppose that they can be resolved to an antecedent. If a constituent does not have a matching antecedent in the context, we could in principle accommodate an abstract antecedent. I will show in the next chapter that there are cases where such an accommodation is necessary, namely in cases where a constituent is linguistically marked as a link or a tail but has no overt antecedent in the context. In such cases material counts as given because it is linguistically presented *as if* it were given. But if there are no strong reasons to assume that an accommodation is strictly necessary, the principle of parsimony rules out an anaphoric interpretation of this constituent (i.e. background marking) and the constituent will be interpreted as focus. This is a type of default-marking: unless a constituent *K* is resolved as background (by givenness or by linguistic marking) *K* must be focus. On the other hand, the oracle keeps track of available salient antecedent and tries to resolve as much material as possible as being anaphoric. Steedman argues that also this is covered by the principle of parsimony: If (98) is uttered in a context with various given horses, the principle of parsimony predicts that an interpretation which identifies the *horse (which) raised past the barn* with a previously mentioned horse, this interpretation is to be preferred over an interpretation which accommodates the existence of a previously not mentioned horse.

The apparent need for incremental parsing in order to explain garden paths (and eliminate them whenever possible) is easily met by CCG: Since CCG can make any leftmost string of a sentence available as a constituent which corresponds to a type which also has a partial semantics. For example the string '*the horse raised*' may have be a constituent of type S/NP. At this point the oracle can check if there is a unique horse in the context.

In order to see how this works in the case of IS resolution let us first consider an unproblematic case:

(101) Q: What did Fred eat?

A: Fred ate the BEANS.

If we parse the sentence incrementally, we will first check the proper name '*Fred*'. Fred is mentioned in the context question and may hence count as given. The same is true for the verb '*ate*', which is anaphoric to '*did eat*' in the context question. Next, we can check if the (potential) constituent '*Fred ate*' is anaphoric. This is also true because the context question makes this property (the property of being eaten by Fred) available as given information. Now we come to the critical point. Neither '*the beans*,' '*ate the beans*' nor '*Fred ate the beans*' is possibly anaphoric. We can deduce from this that '*Fred ate*' as a constituent is a background anaphor, but '*the beans*' is not. This also affects constituency. The givenness resolution of this sentence allows us to recover the boundary between focus and background, which is also a syntactic boundary (cf. section 2.1.1).

Remember from chapter 2 that in the case of so-called *unmarked themes* this boundary cannot be detected on the basis of phonology, which leads Steedman to assume that there is an abstract (an not audible) tone which marks this boundary. Remember also that CCG makes strings as ‘Fred ate’ available as syntactic constituents (section 2.1.1). The final parse of this example would hence be [Fred ate]_{focus} [the beans]_{background}. In the next example, givenness resolution will result in a different syntactic constituency. The individual steps of the incremental parsing process are given in (103):

- (102) Q: Who ate the beans?
A: Fred ate the beans.
- (103) 1. Fred: ‘Fred’ is not given and will be focus by default → partial parse: [Fred]_{focus}
2. Fred ate: ‘ate’ is given but ‘Fred ate’ is not given. ‘ate’ is preferrably background → partial parse: [Fred]_{focus} [ate]_{background}
3. Fred ate the beans: ‘the beans’ is given, as well as ‘ate the beans’. The VP can form a background constituent → parse: [Fred]_{focus} [ate [the beans]]_{background}

An interesting case is the following, where the background is not a constituent. As I have argued above, it is not plausible to require a background to be a syntactically continuous unit. So parsing this sentence is not a problem:

- (104) Q: What did Fred do to the beans?
A: Fred ate the beans.
- (105) 1. Fred: ‘Fred’ is given → partial parse: [Fred]_{background}
2. Fred ate: ‘ate’ is not given → partial parse: [Fred]_{background} [ate]_{focus}
3. Fred ate the beans: ‘the beans’ is given → parse: [Fred]_{background} [[ate]_{focus} [the beans]_{background}]

Furthermore, the type of anaphoric relation will let us deduce which kind of background anaphor we have at hand: If the target referent is only part of the antecedent referent this predicts that it is a link. Remember that the label *background* used so far underspecifies for *link* and *tail*.

- (2) a. What about the staff members? Do they like broccoli?
b. [**The boss**]_{link} HATES [vegetables]_{tail}.
- (106) 1. The boss: ‘the boss’ is anaphoric because he is part of the staff → partial parse: [the boss]_{link}
2. The boss hates: ‘hates’ is not given. → partial parse: [the boss]_{link} [hates]_{focus}
.3 The boss hates broccoli: ‘broccoli’ is anaphoric, but more general than its antecedent → parse: [the boss]_{link} [hates]_{focus} [broccoli]_{tail}

Now, how does that work in the case of (3a)? How can we deal with foci which actually contain anaphoric material? Applying the parsing process under the principle of parsimony will lead us down the garden path, but not for very long:

- (3) a. Who did John’s mother praise? She praised HIM
- (107) 1. She: ‘she’ is given → partial parse: [she]_{background}

2. She praised: '*praised*' is given, as well as '*she praised*' → partial parse: [she praised]_{background}
3. She praised him: '*him*' is given, but neither '*praised him*' nor '*She praised him*' is given. → parse: [she praised]_{background} [him]_{background}

The crucial point is reached at (1073). The parse is consistent with the principle of parsimony, but it fails to mark a sentence element as focus. Under the assumption that there are no focusless sentences, we must conclude that this parse is wrong, so the parser has to backtrack and find a parse which does not conflict with the requirement that all sentences must have at least one focus. This parsing problem can be resolved locally, simply by marking '*him*' as focus, rather than as background, and the resulting parse is as follows:

(108) [she praised]_{background} [him]_{focus}

The parsing process here resembles the one proposed by Schwarzschild, and discussed in chapter 2 (section 2.1.2.1). It also preserves the essence of Schwarzschild's givenness approach in that it takes *givenness* resolution and not F-marking as the central mechanism of IS resolution. There are, however, a number of differences: 1) Although I continue to use the term *given* the version of *givenness* used here is a typed and strictly anaphoric one. 2) Semantic types which are not appropriate for anaphoric relations, will not be checked for possible antecedents. This applies, for example, in cases like (17) and (24) above. 3) If different backgrounds anaphors within a sentence have disjoint anaphoric referents, they will also be treated as separate syntactic units. 4) There is no need for a rule like *existential type shift* any more, since CCG makes all possibly anaphoric strings available as syntactic constituents. And 5) in the present account F-marking is made superfluous for IS resolution. *Focus* is simply a default category for material which is neither *given* by anaphoric resolution or marked as *given* by linguistic means (like deaccenting or dislocation).

The final step of the derivation (107) is interesting, because at this point the anaphoric pronoun *him* is incorporated in the parse. The focus-marking of this pronoun (or rather: its exclusion from the sentence background) happens only as a last resort, in harmony with the principle of parsimony: If we do not mark *him* as focus, the sentence will result in an illegal all-background sentence. So far, however, this does not guarantee that it is actually the object pronoun which has to be focused, and not the rest of the sentence. Consider the following example:

- (109) A: I know that Sue praised Mary's father. But who praise Sue's father?
 B: SUE [praised him]_{background}.
 B': #[Sue praised]_{background} HIM.

Here we could have arrived at exactly the same parse as in (107). The key problem is that '*Sue praised*' (i.e. '*Sue praised*' in the first sentence) has a potential antecedent, although precisely this anaphoric connection is not intended. A parse like (107) would have run down a garden path, resulting in the inappropriate IS (109B'). But what tells us that (109B') is not appropriate? I think this is one of the key questions which can eventually provide the right solution to the problem of contrastive foci under an givenness approach. Although (109B') does not violate givenness constraints, it is not an

appropriate answer to the question in (107A2). Question-answer congruence requires a certain IS of the answer, independent of any other constraint that givenness may impose. I think it is extremely important to keep the two concepts of givenness and question-answer congruence separate (cf. section 2.1.2.1). Note that AvoidF would not have failed in the case of (109), since the amount of F-marked (or at present: non-background marked) material is still minimal. But there are cases where both AvoidF and the parsing algorithm proposed here would fail. Consider (110):

(110) Q: I know that Sue praised Mary's father and gave him a present. But what did Mary do to him?

A: Mary only [gave him a PRESENT]_{focus}.

In this example, again, all of the words in the answer are given, but the focus has to be assumed to be the whole VP 'gave him a present' for two reasons: 1) it is the element which the context question asks for, and 2) it is the constituent which associates with the focus sensitive *only* and represents the set of focus alternatives (Jackendoff, 1972, Rooth, 1985). I take this as evidence which supports the claim that question-answer congruence must be respected when sentence backgrounds are resolved.

At the beginning of this chapter I promised to give only half an answer to the question of how contrastive foci may be resolved. This is what we have arrived at: half of the answer. The second half is postponed to the next chapter, where I will argue that question-answer congruence is a constraint imposed by the structure of discourse and violation of this congruence can render an otherwise possible parse inappropriate.

3.4 Concluding remarks

In this chapter I have argued in favour of a strict anaphoric treatment of background elements. I have shown that *givenness* in information structure does not require more theoretical apparatus than other types of anaphora-resolution. The only additional assumption we have to make is that sentence backgrounds are not monolithic blocks or atomic units. They are built out of smaller pieces which are anaphoric separately: units which are linguistically realised as links and tails. Sentences may have multiple links or multiple tails or any combination of these two units, but each sentence has only one background. A sentence background is built out of these smaller units. Both links and tails are units which must be semantically typed; they may not be complex. But since a sentence background is built out of one or more of these smaller atomic units, it is itself a unit which is unconstrained in complexity.

I have further shown that the binding conditions for links and tails are different. Both links and tails may be bound under a part-of relation, but while links must be more specific than their antecedents, tails may be equal to or more general to their antecedent. So far, there is a certain overlap between the binding conditions for links and tails: they may seemingly both be bound under identity of referents. In the next chapter I will slightly revise this point of view and argue that the contrastivity effect induced by a link-realisation is coupled with a part-of condition which makes the link-referent part of a bigger referential unit.

Finally, I have argued that although anaphoricity is the main ingredient of IS reso-

lution, there is some evidence that it cannot explain all of the facts at hand. I will, therefore, complement the givenness approach with a theory of discourse structure and I will show that an integration of the anaphoricity approach in a theory of discourse structure can account for the cases for which the anaphoricity approach alone gives no satisfactory answer.

Chapter 4

Givenness, Saliency and Discourse Structure

In this chapter I want to change the perspective from which we look at information structure. In the last chapter I have analysed in which ways information structure depends on discourse context. We have seen that givenness can be expressed as anaphoricity in a rather strict sense. But this picture is not complete for two reasons: 1) So far, the structure of context has been treated as flat and linear. But this is not a correct model of how a discourse is organised. As I have argued in chapter 2, discourse forms a syntactic tree. Sentences are grouped together in segments. Multi-sentence segments are grouped together in bigger segments and so on, until they are finally subsumed under a top-level node which we could call “the whole discourse”. The structure of discourse is a syntactic one, although it corresponds to a level above the sentence. 2) Another oversimplification I made in chapter 3 was to assume that givenness makes information structure (IS) follow from anaphoric resolution (and the surface of context) alone. From the examples considered there one could assume that, given a discourse context and given a sentence which is to be uttered in this context, we can always compute the right information partitioning within this sentence. Reality is, however, more complex. Often a speaker presents information in ways that cannot be fully determined from context. A good example are out-of-the blue sentences. One could expect that, having no previous context, a sentence must have necessarily the broadest possible focus and, hence, contain no background. But many examples can be found where an overt link is realised, or even an overt link-focus-tail construction, out of the blue in a null context. This means that a speaker can *present* information as *given*, although the context does not provide the corresponding information explicitly. In the analysis developed in this chapter, overt IS marking is a way in which information structure determines discourse structure (DS), rather than only being dependent on it. The interaction between IS and DS is hence bi-directional: a structured context will determine a reconstructable informational partitioning of a sentence. If this expectable IS marking is overridden by extra linguistic means (for example by unexpected extra accents in English or German), this extra marking will have extra meaning which affects the structure of discourse more than the truth conditions of the sentence.¹ Consider the following examples.

- (1) Men *ARE* different.
- (2) Sai? [A mio *fratello*]_{link} gli hanno rubato la moto.
you-know? [to my brother]_{link} to-him they-have stolen the motorbike.

¹I assume that the truth conditions are affected indirectly in the cases where such truth-conditional effects can be observed: Focus sensitive elements, like *even* and *only* take scope over a focus with *is*, in a first step, determined by contextual information. These changes in meaning are certainly related to information structure, but I do not assume them to be the basis of IS resolution (cf. also Schwarzschild, 1999, Roberts, 1996).

‘Did you know? My brother got his motorbike stolen’
(Italian, Brunetti 2006)

- (3) Weist Du was? [Meinem *Bruder*]_{link} haben sie das MOTORAD geklaut.
Know you what? [To-my *brother*]_{link} have they the motorbike stolen.
(German)
- (4) Saps que? [El meu germà]_{linke} li van robar la moto.
You-know what? [art my brother]_{link} him past-they steal the motorbike.
(Catalan)

(1) is an example from an isolated headline on the cover of the New York Times Magazine (Vallduví, 2002) The letters in italics signaling the main sentence stress.² A headline constitutes a type of out-of-the blue context, so we would *expect* that none of the elements counts as given. This would mean that the sentence should be all-focus. Nevertheless a focus accent on the verb ‘*are*’ is marked typographically. The non-expected focus marking of the copula verb must have a special meaning if it is unpredictable from the (null) context. Intuitively, we would assume that this sentence with this special marking can only be uttered in a context where someone was asking or doubting whether men are really different or not. So what happens here, is that the corresponding context is evoked indirectly. We could say that the necessary context, which we have to assume in order to correctly interpret (1), is evoked by the unexpected intonation pattern.

Also the linguistic marking of links is interesting. Brunetti (2006, 2008) discusses a series of examples, where link realisation of certain constituents are unexpected within a given context, similar to the ones in (2) to (7).³ (2) can be uttered in an out the blue context, where we could expect an all-focus sentence. Nevertheless *fratello* is marked as a link,⁴ with a rising accent, and by occurring sentence initially (in a noncanonical slot). The same is true for the German version of this sentence, (3), where the direct object *mein Bruder* occurs in the German pre-field and receives the link-identifying accent. What this example suggests is that *fratello/Bruder* is the sentence topic (the link) and the sentence is about this referent. Again, this linguistic IS marking is not determined by the explicit context. The Catalan version of the same sentence, (4), displays link-marking through clitic-left dislocation. What such examples show, is that there is no way of directly fully determining IS from the explicit context.

Finally, there are examples where the explicit contexts would lead to preference for a tail realisation, but the speaker marks a constituent as a link:

- (5) Q: Irgend was neues von Enric?
‘Any news about Enric?’
A: [Den *Enric*]_{link} hab ich NICHT gesehen.
[art *Enric*]_{link} have I not seen.
(German)

²In the original example only italics are used to represent this accent typographically. Here I stick to the convention and represent focus accents by upper case.

³(2) is one of Brunetti’s examples. In order to illustrate the effect in German and Catalan, the rest of the examples are adapted versions of (7), but represent the same effects.

⁴Judgments on Italian data are Brunetti’s. These judgments are coherent with the same examples in Catalan and German.

- (6) Q: Què en saps de l'Enric?
 'Any news about Enric?'
- A: [L'Enric]_{link}, no l'he vist.
 [art'Enric]_{link}, not him'have-I seen.
 (Catalan)
- (7) I haven't SEEN [*Enric*]_{link}.

In the German (5) and the corresponding Catalan (6) the proper name '*Enric*' in the answer is coreferential with '*Enric*' in the context question. According to what was said in chapter 3, we could add a tail for '*Enric*', since tails can act as identity anaphors.⁵ As Brunetti notes, the link realisation evokes an alternative set. The link-marked referent becomes contrastive, although the contrastive set may not be specified. Native speakers of Catalan have strong intuitions about this contrastive effect in (6). The German (5) displays a right dislocation of the NP '*den Enric*'. A sharp rising accent on the preposed object is needed in order to achieve the same contrastivity effect in this example, but if this sharp rising accent is present, the contrastive reading is obligatory. In the English version of the sentence (7) there is a rising accent on '*Enric*', which is optional, but if it is present the sentence becomes again contrastive. What (7)-(5) show is that sometimes a constituent can be presented by the speaker as a link, although a tail realisation is possible (and probably more expected) within the same context. This link-marking adds further meaning to the sentence. I will argue in section 4.2.2 that this contrastivity effect is best explained as the effect of an operation on discourse structure. I will argue that this additional information determines DS in a way the hearer can infer the correct discourse relations and, with that, understand the discourse in a maximally coherent way.

What these examples show, is that givenness on the basis of anaphoric linking to explicit surface antecedents is not a necessary condition for a constituent to appear as part of a background. Linguistic encoding may override antecedent resolved givenness. The linguistic marking of a constituent as link or a focus may give extra information about how we have assumed the context to be. If an incoherence between context-resolved IS (the IS realisation expected in a certain context) and linguistic IS realisation occurs, we can either take the discourse to be incoherent or assume that the unpredictable IS marking adds *additional* meaning to the discourse. Discourse incoherences are possible, but given general Gricean principles they are expected to occur only as performance error. And, as a specific case of this phenomenon, link-marking can override simple anaphoric binding under identity and force a contrastive reading.

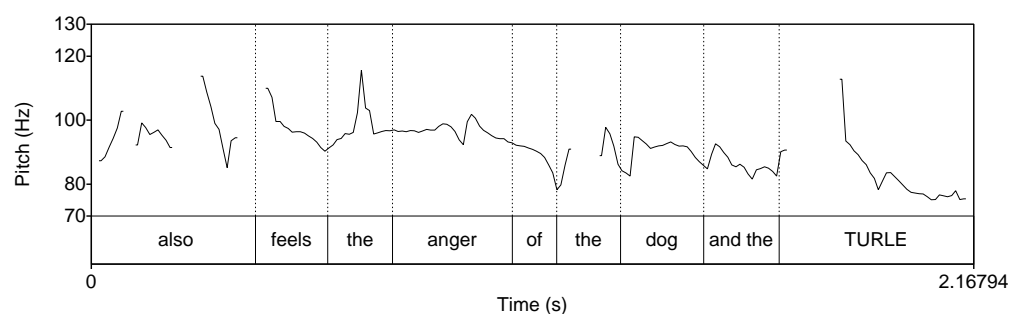
So, contrary to the idealisation made earlier in chapter 1 and 2, givenness is not a necessary condition for background realisation. Nevertheless the realisation of a constituent as a link or a tail may present a referent *as if* it were given. Remember that it was also argued above, that givenness is not a sufficient condition, either. The argument was based on examples like (8):

- (8) Q: Who did John's mother praise?
 A: She praised HIM/JOHN.

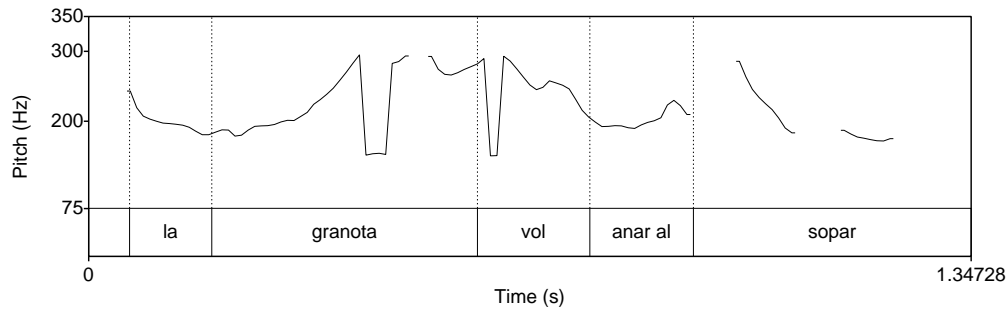
⁵I use the term *identity anaphor* in a somewhat sloppy sense here. Actually the anaphor is not identical to its antecedent, but the referents for the anaphor and its antecedent can be equated.

Focus marked given material also occurs in a different kind of examples, illustrated by (9) and (10). Here a referent which is given in the wider context is linguistically realised again. However, the previous the previous instance of the referent is not sufficiently 'close' to its antecedent. Then the target constituent will be realised within a focus, rather than within the background:

- (9) he's extremely pleased that the gift is for him and his pet dog and turtle hm look a bit curious as to what the gift is, and in the distance his pet frog looks extremely pleased that he's received a gift. He opens up the gift and much to his and his dog's happy surprise, the gift turns out to be a_ a little frog hm who the dog then hm promptly begins to lick. # And everybody looks happy hm for the arrival of the new little frog except for the_ the_ the larger frog who was already the pet of the boy. ## Ok so_ everybody seems happy with the presence of the_ new frog except for the larger frog and the larger frog, a bit jealous of the_ the younger one hm begins to bite his leg. And <the> big frog is then scolded by the boy, and also feels the anger of the dog and the TURTLE.
(Nocando-Corpus)



- (10) a. Avui el_ el nen té un sopar en un restaurant amb tota la seva familia.
'Today the boy is having supper in a restaurant with his whole family.'
b. i el gos, la granota i la tortuga s'han de quedar a casa.
'and the dog, the frog and the turtle have to stay at home'
c. i estan molt tristos,
'and they are very sad.'
d. però la tortuga vol anar al sopar - -
H*L%
but the turtle wants-to go to-the supper - -
e. ai!, la granota vol anar al sopar.
H*L%
oh, the frog wants-to go to-the supper.
(Nocando-Corpus)



(9) and (10) show that a given referent can occur within the sentence focus if it is not mentioned recently enough. As shown in 1.1.2, both ‘the turtle’ in the last sentence of (9) and ‘la granota’ in (10e) are linguistically marked as focus, although they have a co-referring antecedent in a relatively local context. This shows that, while it is true that referents with antecedents that are ‘distant’ in context may be realised as foci, it is not necessarily the case that referents with ‘close’ antecedents (in the previous sentence, for instance) must be expressed as tails. For an obligatory tail realisation the referent must not only be given, but also be *salient*, and presence in the previous two or three sentences does not guarantee salience. That means that we need a notion of salience within our theory of IS resolution. Nevertheless, salience itself is not easy to define. As we have seen in these examples, a simple baseline approach where salience depends on linear distance between an anaphor and its antecedent does not work: simply counting the words or sentences is not enough. In (10) the speaker chooses a focus realisation for ‘sopar’, although a potential antecedent for ‘sopar’ is linearly relatively close (I will return to this problem below in section 4.3). In contrast, there are cases where linguistically realised tail is separated from its antecedent by a considerable amount of intervening material as (11) (repeated from 1.2) shows:

- (11) Per fer règim, s’ha de tenir una especial voluntat.
 ‘If you are on a diet you have to have special willpower.’
 [
 No com el Gallardo, que me’l trobo l’altre dia i li dic: “Com estàs?”. I em diu: “Fa tres setmanes que faig règim”. Dic: “Ah, sí? I quan has perdut?”. Diu: “Tres setmanes”. I té raó.
 ‘Not like Gallardo, which I saw the other day. I asked him: “How are you?” And he says: “I’ve been on a diet for three weeks.” And I: “Oh? And how much did you loose?” He: “Three weeks”.’ And he’s right.’
]
 Jo tampoc en tinc, [de voluntat]_{tail}. Quan faig règim, ho
 I neither of-it have, of willpower. When make-I diet, it
 passo fatal.
 have-a-time-I terribly.
 ‘I don’t have the willpower either. When I’m on a diet I’m having a terrible time.’
 (Andreu Buenafuente 2001a, p.103 cited by Mayol, 2002)

In (11) clitic right dislocated (and therefore tail-marked) partitive NP ‘de voluntat’ is anaphoric to ‘voluntat’ in the first sentence. There are 10 intervening sentences (42

words) and the anaphoric link still holds; a tail realisation of '*voluntat*' is still licenced. What seems to be the case here, however, is that the intervening material must constitute a closed discourse segment. In this example the narrative bit about the particular person *Gallardo* is closed, before we use a tail to pick up the concept '*voluntat*' again. I will discuss such examples in more detail below in section 4.2.1. The proposal I will sketch there is that the ability of a referent to be picked up anaphorically by a background constituent depends on structural closeness, which can be defined in terms of DS.

To summarize so far: information structure (IS) and discourse structure (DS) interact in interesting ways in order to build up a coherent discourse. This interaction works in both directions and the two structure mutually constrain each other. DS determines if an antecedent is close and salient enough to allow anaphoric access. On the other side, IS gives important clues about how we have to assume the context to be in order to support a certain sentence with a certain IS realisation. Accordingly, the question of how DS and IS interact can be broken down into two questions:

- 1) How can we predict which elements are given and salient? And most importantly, how can we explain salience on the basis of discourse structure?
- 2) How does linguistic IS encoding influence the building of DS?

In order to tackle the first question we will need a theory of salience. If a given antecedent is to be picked up by a matching anaphor it must be salient. A pronoun, for example, cannot refer back to an NP which was realised two paragraphs above its target realisation point. We know from pronoun type anaphora that salience is a very important factor (Grosz and Sidner, 1986, Pause, 1991). Most pronouns have their antecedent within a very limited range. The more the distance grows the less likely it is that an anaphoric connection can be established. In order for an element to be anaphoric it must *both* have an antecedent (i.e. be *given*) and its antecedent must be *salient*. Anaphoricity is a stricter concept than givenness. A given referent may be anaphorically inaccessible if it is not salient enough. The degree of salience of a referent apparently fades away as discourse goes on. Anaphoricity is a relation which respects locality restrictions. These locality restrictions must be defined in terms of a sufficiently rich structure that represents discourse. I will present such a theory of discourse salience in section 4.2.2.

An answer to question 2 will also require a theory of DS. Overt IS marking often tells us how we have to assume a discourse context to be. But how such implicit contexts get invoked has still to be explained. The theory which I present in 4.2.2 also allows contexts to be derived as questions under discussion (in a sense related to Roberts, 1996). Such questions will there be treated as derived, rather than primitive units.

4.1 How does discourse structure influence information structure?

In this section I will investigate in which ways DS determines IS. In the chapter 3 I argued that background elements act in a way similar to other anaphors. Examples like (9) and (10) suggest that they are also subject to locality restrictions. If they are separated from their antecedent from too much intervening material they cannot be

anaphoric.

As I have argued in chapter 3(3.1.2), background anaphors belong to what could be called *descriptive anaphors* which sets them apart from semantically light anaphora (e.g. pronouns). Pronouns have little or no descriptive content on their own. For this reason they will not be able to be realised if an anaphoric connection to their antecedent is not allowed because of locality restrictions. But descriptive anaphors, like full NPs, are different. Definite NPs can act as anaphors, but they have no obligation to do so. If a definite NP is anaphoric, it is backgrounded. If it is separated from its antecedent and locality restrictions do not allow an anaphoric connection, it will still be able to be realised as a definite NP, but not as a background one. In this case, it is unbound and must form part of the focus. Determining whether or not they are anaphoric is necessary to resolve IS. The definite NP ‘*the turtle*’ in (9) is given, since there is a corresponding referent in the wider context. On the other hand, the surface antecedent is not local enough to let the NP count as being anaphoric. Therefore it has to be part of the (larger) focus and is marked by a H* accent. Examples like (11) show that locality effects must depend on discourse segmentation.

The fact that links and tails are descriptive anaphors also gives them a further advantage over semantically light anaphors: they are able to disambiguate their antecedent much more efficiently, in cases where there are multiple potential antecedents. Consider the following examples:⁶

- (12) a. Nois: quan arribau al cuartel i un senyor us digui “soy tu **sargento**”, no li feu dos petons, com va fer un que venia amb mi, que era de Coma-ruga, que era molt carinyós.
 ‘Boys, if you arrive at the barracks and a man tells you: “I’m your seargeant”, don’t give him two kisses [on the cheek], as a guy did who got there with me. He was from Coma-Ruga, and he was very affectionate.’
- b. Ell va fotre dos petons, i el **sargento** li va fotre dos ventallots, només arribar, ja.
 ‘He kissed him twice, and the seargent slapped him twice having just arrived.’
- c. “Es que yo soy de Coma-ruga”.
 “‘It’s because I’m from Coma-ruga” ’
- d. “Pues yo soy de Pozuelo de Alarcón, gilipollas”.
 “‘And I’m from Pozuelo de Alarcón, dickhead.”’
- e. No destaquen per ser molt carinyosos, [els **sargentos**]_{tail}.
 Not exceded-they in be very affectionate, [the sergeants]_{tail}.
 ‘Sergeants are typically not very affectionate.’
 (Andreu Buenafuente, 2001a ,p.125, cited by Mayol, 2002)
- (13) a. Em refereixo a la sonda espacial Mars Polar, que la NASA va enviar a **Mart**, i que s’ha perdut. [...]
 ‘I’m referring to the space probe Mars Polar which the NASA sent to Mars and which got lost. [...]

⁶(12) is an example with bilingual intersentential codeswitching. The main text is in Catalan, but the direct speech is in Spanish. As a matter of fact, this makes fun of certain stereotypes concerning the sociolinguistic situation of Catalans in the Spanish army.

(9 sentences making fun of the lost Ship)

- b. Jo, als de la NASA no els entenc. [...] 'I don't understand those NASA people. [...]'

(11 sentences about finding the way to Mars)

- c. Un altre tema és que hi ha molta gent que no té ganes
A different story is that there are many people which not have desire

d'anar-hi a **Mart**.

to'go-there to Mars.

'It's another topic that there are many people who do not want to GO to Mars.'

(Andreu Buenafuente, 2001a p. 173, cited by Mayol, 2002)

(12) is a case of token-type link. In both (12) and (13) there is a tail-marked right-dislocated referent, '*els sargentos*' and '*a mart*' respectively. First of all, these examples exemplify again that a tail can be separated from its antecedent by a large amount of material. Even more interesting is the fact that they seem to delimit the discourse segment which separates them from their antecedent. In order to see this, consider the following: they have an antecedent which is at a distance of more than one sentence and there are other nominal description which occur in between and could serve as possible antecedents. Now, since these tails are anaphors, they will pick out the most salient *matching* antecedent. And since they are anaphors with descriptive content, the choice they make among competing antecedents is more selective than that of a pronoun-type anaphor. Let us compare the behaviour of descriptive and non-descriptive anaphors in such contexts. First of all, these tails cannot be replaced by pronouns or null pronouns. To test this we can change the last sentence of (12) and (13) and eliminate the descriptive content of the tail. Since Catalan is a null-subject language we could simply delete the tail in (12e) and the resulting sentence is still grammatical. In (13c) the tail can also be deleted because the clitic pronoun *-hi* (*there*) is sufficient to keep the sentence grammatical. But although the resulting sentences are grammatical, they are no longer felicitous within the given context:

- (12) e'. # No destaquen per ser molt carinyosos.

Not exceded-they in be very affectionate.

'They are typically not very affectionate.'

- (13) c'. # Un altre tema és que hi ha molta gent que no té ganes

An other topic is if there is many people who not have interest

d'anar-hi.

to'go-there.

'A different story is if there are many people who want to go there.'

The altered (12e'), which lacks the dislocated constituent, could be read either in a way that the people of Pozuelo, the ones of Coma-Ruga or sergeants are not affectionate. The tail NP disambiguates between the three possibilities.⁷ This seems to be the reason

⁷This is reminiscent of the what Ziv and Grosz (1993) say about right-dislocation in English. According to Ziv and Grosz, right-dislocation is used to refer to entities "available" in the discourse situation but not explicitly mentioned or to entities that have been textually evoked but have lost "activation" because the previous mention is not recent enough (a third use of right-dislocation concerns textually-evoked entities as well, but in cases where the right-dislocated NP adds some new attributive meaning).

why it can't be deleted or substituted by a plain pronoun. The same goes for (13). 'Anar-hi' in (13c) can either refer to NASA or to Mars. Again the tail disambiguates the sentence. But there is more going on than only disambiguation. Once the referent for Mars is picked up in (13c) also a direct relationship is established between the discourse segments represented by (13a) and (13c), bridging - so to say - over (13b).⁸ (12e) makes a statement about the nominal kind 'sergeant' which was addressed in the whole discourse segment (12a-e). (12a) is about sergeants in general (i.e. the kind 'sergeants') or a certain type of situation which features a representative of the kind 'sergeant'. (12b-c) tells a little story about a specific sergeant. This story is ended and (12b-c) is a coherent and complete discourse segment. Then (12e) goes back to talk about *sergeants* in general. Now it is reasonable to assume that the final remark in (12e) signals the end of the anecdote and closes the corresponding discourse segment.

The same is true for (13). When (13c) has been uttered, the discussion about the Mars mission seems to have ended. The use of the tail seems to serve as a rhetoric means to close the topic. The continuing sentence brings a change of topic within the monologue:

- (13) d. Els que no volem anar a Mart es queden a *La Cosa Nostra*, però això és un altre tema.
 'The ones who do not want to go to mars stay here in *La Cosa Nostra* [name of the TV show], but that's another topic.'

What we can infer from these examples is that the intervening material between a tail and its antecedent must constitute a unit of its own and at the time the tail picks up its antecedent they intermediate segment is closed. This will also exclude crossing dependencies into an already closed discourse segment. Such crossing dependencies would be of the type [antecedent1, antecedent2, tail1, tail2] and this would violate the tree-structure of discourse. This prediction seems to be correct. The following continuations are not felicitous:

- (12) f. # Son molt carinyosos, els de Coma-Ruga.
 Are very affectionate the-ones from Coma-Ruga.
 'People from Coma-Ruga are very affectionate'.
 (13) d. # És curiosa, la NASA.
 Is curious, the NASA.
 'The NASA is curious'
 (14) d. # No s'ho ha passat bé, el tio. (tio=Gallardo)
 not him-it has passed-time good, the guy.
 'He didn't have a good time, this guy.'

Although we still have to work out the technical details of the accessibility conditions within a structured discourse, these examples show that the structure of discourse does constrain the use of tails. Tails have more power to access antecedents than non-descriptive anaphors, but their distribution still has to respect the structure of

⁸I use the word bridging in a purely metaphorical sense which is **not** to be confused with bridging anaphors, mentioned in 3.2.2

discourse. While pronouns can only access antecedents which are already maximally salient (and have no rivaling alternative antecedents occurring in between), tails seem to be able to signal that an antecedent has to be treated as being salient. This is an instance of presupposition: they presuppose that their antecedent is salient. The effect of ‘closing-off’ a discourse segment appears to be related to that ability. Tails require that the discourse segment to which they belong is attached to a discourse segment in which their antecedent is salient. This can be any discourse segment on the right frontier of the discourse tree, which provides a salient matching antecedent. In this way, the presupposition of tails to have a salient antecedent is satisfied. In section 4.2.1 I will develop a theory which relates salience discourse segmentation, but first we have to consider possible explanations for salience phenomena. In the next section I will do this. I will explore the issue of how we can measure salience and what the factors are that influence the degree of salience.

4.1.1 Salience

4.1.1.1 Cognitive salience hierarchies

Salience concerns the cognitive status of a discourse referent. In the literature many terms inherently suggests a close link between linguistic realisation and the cognitive status of the referents we are talking about. The term *aboutness* (Reinhart, 1995), for example, suggest such a tie. While we are talking about a referent this referent must have a special cognitive status. It must be prominent in a cognitive sense. If the referent for a topic it is not *a priori* prominent it’s being marked as a topic makes it so. Also Vallduví’s (1992) theory of information packaging (cf.2.1.3) is inherently cognitive. He assumes that the different focus background articulations trigger different update instructions. Discourse referents in his model are represented as files in a file-change-semantics framework (Heim 1982, 1983). For Vallduví, links trigger a *LOCATE* function, which locates a file card which is then prepared for manipulation. The focus represents the update potential of the sentence which will be added on the file care with an *ADD* instruction. If the sentence has no overt link the locus of update is the file card for an already prominent referent. Zuo and Zuo (2001) take this idea even a step further and assume that the discourse model represented by the discourse file is just the top-most (and most salient) part of the knowledge store, the tip of the iceberg, so to speak (in what they call an iceberg model).

A empirically quite well funded theory of cognitive status is presented in Gundel, Hedberg and Zacharski (1993, 2006, GHZ hereafter).⁹ They propose a givenness hierarchy based on crosslinguistic observations about the possible realisations of referents as noun phrases. The central question they ask is why some nominal referents can be realised as pronouns, while others must be realised as definite noun phrases or as NPs of the form ‘*this/that* N’. They propose the hierarchy of givenness in (15).

⁹I will use this term only as a convenient gloss in order to distinguish cognitive focus from linguistic focus, but this does not imply any theoretical commitment

- (15) in focus > activated > familiar > uniquely identifiable > referential¹⁰ > type identifiable

GHZ use the term *focus* in the sense of *cognitive focus*, i.e. focus of attention. This use is, of course, not to be confused with the term *focus* in IS theory. In fact, GHZ suggest a relation between c-focus and topichood (where topic is to be understood as “what the speaker intends a sentence to primarily about”, p.279, fn.10).

Their claim is that the different cognitive statuses correspond to different linguistic realisation possibilities, e.g. in NPs: it > this > this N > the N > a N. For example the use of a pronoun requires the corresponding referent to be in c-focus. And in order to use a definite NP, like ‘*the dog*’, its referent must at least be uniquely identifiable. The scale of statuses is downward entailing, so a definite NP may refer to a referent in c-focus but not vice versa: A pronoun may never refer to something which is *not* in c-focus and a definite NP must may not have a status below being uniquely identifiable.

- (16) in focus > activated > familiar > uniquely identifiable >
it > that/this/this N > that N > the N >
referential > type identifiable
indefinite *that N* > a N

As I said above, we need a theory of salience. This theory must be able to account for the following phenomena:

- 1) Given referents may be required to be realised as foci, apparently because they are not salient enough, as (9) shows.
- 2) Sometimes referents which are very distant from their antecedent are allowed to be realised as a tail, as (11) shows.
- 3) Links usually require a salient antecedent, as I have argued in the last chapter. But there are also cases where an appropriate antecedent can be accomodated into the context (cf. (2)).

The notion of salience which can explain these phenomena is cognitive in nature. First of all, *aboutness* seems to be closely linked to the status of being in c-focus. GHZ stress that point, when they say “The entities in focus at a given point in the discourse will be that partially-ordered subset of activated entities which are likely to be continued as topics of subsequent utterances” (p.279). They also assume that topichood directly puts a referent into the set of c-focused elements for the next utterance. This set also includes what they call ‘higher-order topics’, i.e. still relevant possible topics to which the discourse might return. Applying GZH’s hierachy of cognitive statuses to IS, it is immediatly evidident that referent which are very low in the hierarchy must be realised as foci. Backgrounds, in turn, must realise a referent which has a relatively high status, being at least familiar. An interesting question is if GHZ’s hierarchy can also account for the difference between links and tails. In principle the cognitive status of

¹⁰The term *referential* as used by GHZ is also totally different from the use of the same term in this dissertation. They assume that a referential NP is something like *this N* in colloquial English

(i) I couldn’t sleep last night. This dog next door kept me awake.

In the present work I assume that a referential object is simply one which projects a discourse referent.

a referent follows from the structural closeness of its antecedent within the discourse. But structural closeness is something we still have to define.

GHZ's hierarchy of cognitive salience is more finely grained than Heim's (1982, 1983) novelty/familiarity condition for indefinite and definite NPs. For the treatment of IS the availability of finer distinctions is a crucial advantage. We know that the definite vs. indefinite distinction is relevant with respect to IS partitioning (even if we cannot relate indefiniteness and novelty exactly one to one): Indefinites can be used as backgrounds only in very specific cases. Definite NPs can freely occur within both focus and background constituents. But the difference between link NPs and tail NPs is not captured by the familiarity distinction; both links and tails must be familiar. Since the statuses *in-focus* and *activated* both entail the status of being *familiar*, we could hypothesise that a reason for the different realisations of background NPs may be in relation to those cognitive statuses.

Now let us try to apply GHZ's hierarchy to IS. But let us first make two additional assumptions:

1) Anaphoric element, including links and tails, require a cognitive status above *uniquely identifiable*. Anaphoric relations are understood as relations which are subject to binding within a local domain. That means that they must respect locality constraints in discourse and accessibility conditions in DRT. *Uniquely identifiable* referents do not seem to be subject to such restrictions. GHZ's example of such a referent is given in (17). Here 'that dog' does not require an antecedent.

(17) I couldn't sleep last night. The dog (next door) kept me awake.

2) Definite NPs may be *uniquely identifiable*, but if they serve as an anaphor (a link or a tail) they must have the status of *familiar* or higher. (a similar distinction between *unique* and *salient* definite NP is proposed in Umbach, 2002).

As a first approach, we could assume that the link-tail distinction is related to different salience statuses. We could hypothesize that tails have a need to refer to something which is activated, while links can pick up some referent that is familiar, but not necessarily activated (Ziv and Grosz, 1993). In Vallduví's account links have a location function in that they locate and activate a file card, while tails give instructions as how to manipulate an already activated file card. The fact that links can indeed pick up a less than maximally salient antecedent can be seen in examples like (18), an Italian example from the Nocando-Corpus which is discussed in Brunetti (2006):

- (18) a. Ok dunque **il bambino** si prepara per andare a.. Ø è
 Ok so the boy is getting ready to go to.. (he) is
 davanti allo specchio
 in front of the mirror
- b. e Ø si prepara Ø si mette la cravatta per andare al
 and (he) is getting ready (he) puts on the tie to go to the
 ristorante [...]
 restaurant
- c. e **i suoi amici** lo guardano tristi perché sanno che
 and his friends look at him sad because (they) know that

non andranno con lui.
(they) won't go with him

- d. Allora poi [**il bambino**]_{link} saluta il cane e la tartaruga
so then the boy says hello to the dog and the turtle
(Italian, Brunetti, 2006)

The link '*bambino*' in the last sentence of this example picks up a referent which has not been mentioned in the directly preceding sentence. A seemingly natural interpretation of that would be to claim that at the time of utterance of (18b) the referent for '*il bambino*' / '*the boy*' is familiar, but not activated. Following GHZ, the "topic of the preceding sentence" belongs to the set of referents in c-focus, one of the things a linguistically marked sentence's topic (a link) seems to do, is to bring referents into c-focus (cf also Vallduví's locating function of links). So, the link could be argued to pick up a referent which is not activated and make it the topic of the current sentence. On the other hand, links must refer to something which is at least *familiar* (in GHZ's sense), otherwise they cannot be anaphoric in a strict sense (i.e. bound by the referent of its antecedent). For the following sentence in the discourse this referent will then be in c-focus. This set of assumptions would explain the shifting function of links (Brunetti, 2006, 2008), their ability to shift the focus of attention from one referent to another. For cases like (2), where a link occurs in an out-of-the-blue context, we have to assume that referent, together with its saliency status, can be created via accommodation.

In contrast, tails act more like run-of-the-mill anaphors. They do not have a location function, nor seem to be able to shift the discourse topic. In some cases they can be substituted by a pronoun or be elided (i.e. replaced by a null pronoun). So we could argue that their antecedent must at least have GHZ's status of being *activated* under the assumption that tails need more salient antecedent than links. The following examples seem to support that assumption.

- (19) Q: Què en saps de l'Enric?
'Any news about Enric?'
A: No en sé res, [de l'Enric]_{tail}.
no cl know nothing, [of art'Enric]_{tail}.
'I don't know ANYTHING about Enric.'
A': No en sé res.
no cl know nothing.
'I don't know ANYTHING about him'.
- (20) Q: Q: Irgend was neues von Enric?
'Any news about Enric?'
A: Ich weiss NIX von Enric/von ihn.
I know nothing about Enric/about him.

In (19A) the referent for *Enric* is realised as a tail by clitic right dislocation. '*De l'Enric*' can be elided, as in (20A'). The elided version is in fact preferable, a fact which comes as no surprise, since in GHZ's hierarchy referents c-focused can be realised by pronouns or elisions. The clitic pronoun *en* in (20A') is then the only overt reflex of the referent for *Enric*. In the German version *Enric* can be substituted by the personal pronoun *ihn*. Also in English pronominalisation would be possible. This shows that, at least in

such simple cases, tails pattern with pronouns and seem to require a maximally salient antecedent.

But this point of view appears to be too simplistic. We could hope to possibly give a similar analysis to example (21).

(21) Q: What about the boss? Does he like broccoli?

A: [L'amo]_{link} [L'ODIA]_{focus} [el bròquil]_{tail}
 [The boss]_{link} [it-hates]_{focus} [the broccoli]_{tail}
 (Catalan)

A': The boss HATES broccoli.

At the time the answer is uttered in (21A) we would expect that broccoli is the most salient antecedent because of linear closeness and for that reason it can be realised as a tail while the referent for 'the boss' is more distant, hence less salient, and therefore must be realised as a link. But unfortunately the reverse realisation as link and tail (as in (22)) is also possible when the surface antecedent for the link is closer than the antecedent for the tail. In such cases a contrastivity effect is introduced, putting 'broccoli' in contrast to some different but comparable referent, such as the other vegetables in (22)Q).

(22) Q: Does the boss like vegetables? What about broccoli?

A: [El bròquil]_{link} [L'ODIA]_{focus} [L'amo]_{tail}.
 [art broccoli]_{link} [it'hates]_{focus} [the'boss]_{tail}.
 'Broccoli, the boss hates.'
 (Catalan)

Examples like this do not shed too much light on the difference of saliency between links and tails. An alternative explanation would be to relate the link/tail asymmetry to the contrastivity effect which can be observed for whatever element is realised as a link. In (21) 'the boss' is contrastive while in (22) it is the 'broccoli'. Nevertheless, such alternations do not really speak against the cognitive givenness hierarchy either. Since both the link and the tail are definite NPs, they are only required to have at least the status of *identifiable* and - as a stronger requirement - *familiar* by virtue of being background anaphors. It could still be the case that a tail requires a more salient antecedent than a link. Tails would then need to have a higher saliency status than being *familiar*. They would need to be *activated* and fall into the same class as NPs of the form *that N*, only without the morphologic marking of the determiner *that*. We could argue that the tail realisation and the determiner *that* both signal the cognitive status of *activation* (Ziv and Grosz, 1993). This seems possible, the only problem is that it is hard to test such a hypothesis systematically in practice since *that* adds some additional meaning component which a tail not necessarily shares. We cannot simply change 'the boss' into 'that boss' since 'the boss' requires a unique person who is the boss, while 'that boss' may allow alternative bosses in the discourse. The problem seems to be that we have to keep apart the semantic and the pragmatic effects of *the* and *this*, which complicates the problem considerably. In any case it is extremely difficult to find really hard evidence for the assumption that the link/tail distinction is related to cognitive saliency.

Another challenge for the salience hierarchy application to IS are examples like (11). I argued above that the tail in example (11) picks up an antecedent which is linearly separated by a considerable amount of intervening material. I also suggested that this locality effect has to be explained by the tree-structure of discourse and that the tail, in turn, helps to infer this syntactic structure of the discourse. GHZ do not consider the vertical structure of discourse and they do not assume that sometimes finding the correct antecedent has important effects on discourse segmentation. Again, this does not speak against cognitive salience, but it calls for an integration of the cognitive salience account into the structure of discourse. In (11) the referent for '*voluntas*' seems to become available again for anaphoric reference because a discourse segment has ended. In fact, Grosz and Sidner (1986) argue that attentional states (which make antecedents available for further pronominal reference, cf. section 2.2.2) is not exactly the same as the cognitive states, but it has to be seen as a necessary part of the latter: "First, the attentional state component is not equivalent to cognitive state, only to one of its components. Cognitive state is a richer structure, one that includes at least the knowledge, beliefs, desires and intentions of an agent, as well as the cognitive correlates of the attentional state [...]." (p. 180)

There is a gap in GHZ's hierarchy: they do not treat *one*-anaphora, which is deliberately anaphoric to only the type. Also VP-anaphors like '*do so*' (in contrast to '*do it*') belong to this class. Such elements refer to something which is type-identifiable, but they are pronominal at the same time. Since I assume that background elements share important properties with such anaphoric elements, I consider that a short discussion of this problem is necessary here: anaphoric *one* seem to access highly salient antecedents, such as normal pronouns. Consider the following example:

(23) John likes beer. He's drinking one.

'*Beer*' is a type, nevertheless it can be picked up by the anaphor *one*. *One* seem to live a double life as *in-focus* and *type identifiable* anaphor and seems to be a missing species in the paradigm. In any case, the status of type-identifiability does not fit entirely in the hierarchy. A possible way to save the hierarchy would be to assume that there are two kinds of type-identifiability, one for *one*-anaphora and one for indefinite descriptions. But this would be a mere stipulation and lacks support from independent observations. Note that in (23) we could substitute *one* with '*a beer*'. On the other hand, in the syntactically parallel (24), with an individual-referring instead of a kind- (or type-) referring antecedent, the pronoun *it* is perfectly correct, showing that such constellations give rise to a status of 'in c-focus':

(24) John likes his beer. He's drinking it.

To make a long history short, cognitive salience is a very attractive concept when we want to explain IS realisation options, but the concept is not without problems. It is very hard to predict if an antecedent referent must fall into one category or another, especially if we consider the link/tail distinction. The predictors for the salience status in a discourse situation are sparse, especially in the case of referents which are neither maximally salient nor not salient enough as to licence pronouns. On the other hand, in many cases it is precisely the linguistic realisation of those referents which lets us infer the cognitive status or their antecedents. Links seem to *make* their antecedent referents maximally salient. Tails appear to presuppose contexts in which their antecedent is

at least activated. A theory of saliency within discourse structure will probably shed as much light on cognitive saliency as cognitive saliency can help understand IS. I will argue below that tails indeed require an activated antecedent, but also that the saliency of the antecedent depends crucially on the structure and segmentation of the discourse. But in order to solve this problem we first have to examine DS in more detail. We certainly need a cognitive notion of saliency, but at least the link/tail distinction does not seem to depend in a decisive way on the cognitive status of its antecedent.

4.1.1.2 Discourse topics and questions under discussion

A possible way to model saliency is to make it dependent on *discourse topics*: the topic of each discourse segment. We can assume that pieces of discourse can only be grouped together into a segment if they are all 'about' the same topic. If we know what a discourse segment is about then we will also (paratally) know which elements are salient within this discourse segment. Such discourse topics can also be seen as *questions* which are being addressed within each particular discourse segment.

Before we take a closer look at the notion of discourse topic, we have to keep in mind that the term "topic" is highly inconsistent in the way it is used in the literature (McNally 1998). It can either refer to an element within a sentence or to an abstract entity within a discourse. At the sentence level, the term *topic* corresponds sometimes to the non-focused part of the sentence, while other authors assume that the topic is not strictly complementary to the sentence focus (i.e. there is material that is neither focus nor topic). If topic is taken to be a discourse notion, a *discourse topic* applies to a discourse segment or even a discourse as a whole (van Kuppevelt, 1997, Asher, 2004). I have tried to avoid the inconsistency of the term (sentence) topic, by using Vallduví's terms *link* and *tail*, to distinguish sentence topics in the narrow sense and other background material. But since this chapter deals with the structure and segmentation of discourse, we will also have to concern ourselves with the term *discourse topic*.

While *sentence topics* can be seen as a referential unit (like *links*) the term *discourse topic* is usually applied in the literature to a propositional unit (van Kuppevelt, 1997) or a question which is under discussion (Roberts, 1996, 2006, Brüing, 2003, Cooper et al., 2000). I do not subscribe entirely to this point of view. There are no reasons which force us to believe that discourse topics cannot be referential units (along the same lines as links are referential units). In fact, if we assume that both links and discourse topics are referential units, this might help us tie the organisation of information at the sentence level and at the discourse level in a much tighter way. We can assume that sentence topics are bound by abstract discourse topics. But in order to bind them, they have to be bindable, i.e. we must be able to abstract over them and refer to them with variables. In contrast, thinking of discourse topics as propositional type units - or questions - elegantly explains a sentence's information partition with respect to context questions. After all, one of the most widely used test for a sentence's IS is placing this sentence in a question context. I will argue below that we need both kinds of discourse units, which could both be called *discourse topics*: referential and propositional ones. The distinction closely resembles the distinction between links (as referential units) and sentence backgrounds, which I discussed in section 3.1.2 of the last chapter. In order to avoid the ambiguous term *discourse topic* I will rather follow Roberts, Ginzburg (1995a, 2005) and Ginzburg and Sag (2000) in using the term *question under discussion* (QUD)

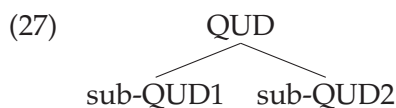
for propositional units; the ones which serve as an abstract context which determines a sentence IS. (25) is an example:

- (25) Fred ate the BEANS.
 QUD: What did Fred eat? | $? \lambda x. \text{ate}(\text{fred}', x)$.

Two sentences can be subsumed under the same QUD. In such cases both sentences together answer the QUD.

- (26) Fred ate the BEANS. Bill ate the PIZZA.
 QUD: What did Bill and Fred eat? | $? \lambda x. \text{ate}(\text{bill_and_fred}', x)$

A QUD can be split up into several smaller parts; sub-QUDs. The QUD of (25), for example, is a sub-QUD of (26). The way in which a bigger QUD is broken down into smaller sub-QUD is called a *strategy* of enquiry. A strategy is a way in which a complex question is broken down into smaller, less complex questions. The answers to the smaller questions all contribute then to the answer of the bigger question.



Any QUD will always be part of a bigger QUD and there is a maximal QUD, which Roberts calls *the big question*: ‘What is the way things are?’. The processing of QUDs can be modelled by using a stack (in a way that resembles Grosz and Sidner’s (1986) focus stack (cf. 2.2.2)¹¹, as far as discourse segmentation is concerned): Whenever a QUD Q_1 is split up into several sub-QUDs $\langle Q_2, \dots, Q_n \rangle$, Q_2 will be pushed on a stack of QUDs, on top of Q_1 . The sub-QUDs are addressed in sequence (following the *strategy* of enquiry). Once Q_2 has been answered it will be popped from the stack. If Q_2 fully answers Q_1 , Q_1 will be popped from the stack as well, if not the next sub-QUD of QUD1 (in the sequence given by the strategy) will be pushed on the stack and so on. Once all sub-QUDs have been answered (the higher-level) QUD will be popped from the stack as well. Given the stack of QUDs and the strategy, a tree-structure of discourse is derived in a similar way Grosz and Sidner’s focussing proces results in a tree (cf. 2.2.2). Every node of the tree can associated with a QUD. Each QUD is a sub-QUD of all the nodes which dominate it.

QUDs result from moves in a communicative game (Carlson, 1983), of which they are only a part. If communication is seen as a *cooperative* game, there are three different types of moves: set-up moves, which establish a question that is to be answered, and payoff moves which answer these questions. In addition, there are acceptance moves for both set-ups and pay-offs: Both types of moves must be accepted in order to enter the common ground as questions which have to be answered or accepted answers to questions.

For Roberts (and building on works by von Stechow 1989, among others), the denotation of a question is the set of alternative which results from replacing the Wh-elements with variables.

¹¹But note that the QUD-stack models intentions while Grosz and Sidner’s focus stack models attentions

(28) **Interpretation of a Question?** α :

$|\text{?}\alpha| = \text{Q-alt}(\alpha)$

(Roberts, 1996, p.8)

Following Rooth (1985, 1992) and von Stechow (1989), she also assumes that foci introduce alternative sets (Q-alt); but unlike Rooth and von Stechow she also assumes that Wh-elements have to be abstracted over when the focus alternative set is computed. This allows her to interpret questions and assertions in the same way.

(29) **Focus alternative sets** (Revised definition)

The focus alternative set corresponding to a constituent β , $\|\beta\|$, is the set of all interpretations obtained by replacing all the F-marked (focused) and *wh*-constituents in β with variables, and then interpreting the result relative to each member of the set of all assignment functions which vary at most in the values they assign to those variables.

(Roberts, 1996, p.8)

The abstraction over foci and *wh*-elements at the same time is important since the *strategy* of inquiry may break a bigger question down into sub-questions. So a question '*who ate what?*' can be broken down (under one of the possible strategies) into '*what did Fred eat?*', '*what did Bill eat?*' and so on. The focus meaning of the sub-questions together will then be equal to the denotation of the bigger question '*who ate what?*', namely the set of all possible pairs of *x* and *y*, such that *x* ate *y*.

A prosodic focus presupposes (cf. 2.1.2.2) that there is a question under discussion to which it is congruent. That means, that whenever there is no overt question under discussion it can be accommodated (cf. also Cooper et al., 2000).

(30) **Presupposition of prosodic focus in an utterance** $\ast\beta$:

β is congruent to the question under discussion at the time of utterance.

(Roberts, 1996, p.8)

For example, if (31) is uttered, the focus alternative set can be computed as the set of all *x*, such that Fred ate *x*. If there is no overt context question, the presupposition of this phonological focus is that there is a QUD which is being addressed and this QUD is '*What did Fred eat?*'.

(31) Fred ate the [BEANS]_F.

One interesting feature of this focus presupposition is that it does not require that the focus alternative set is non-empty (as mentioned in 2.1.2.2). So the answer '*Fred ate NOTHING*' does not presuppose that there is something that John ate (which is a classical problem for focus presupposition approaches). The only presupposition that the focus triggers is that there is a question of '*What did John eat?*'. Hence, any utterance, whether question or assertion, must be congruent with the question which is being addressed, either narrowing it down as part of a strategy, or answering it completely.

Both the strategy of interrogation and question-answer congruence follow ultimately from a Gricean Relevance (in a sense closely related to Sperber and Wilson's 1986b)

- (32) A move m is **Relevant** to the question under discussion q , i.e. to $last(QUD(m))$, iff m either introduces a partial answer to q (m is an assertion) or is part of a strategy to answer q (m is a question).
(Roberts 1996, p.16)

But what about *salience*. Under Roberts approach salience is defined through the question which is being addressed. Under this point of view, a new move must be relevant with respect to a *question under discussion* (QUD). A backgrounded constituent must bound by the QUD. As can be seen from (33), Roberts does not distinguish between givenness and salience, a distinction I want to maintain here explicitly (although this is mainly a matter of terminological definitions).

- (33) **Definition of GIVEN:**
An utterance U counts as *GIVEN* iff it has a salient [possibly accommodated] antecedent A and
a. if U is type e , then A and U corefer;
b. otherwise: modulo \exists -type shifting, A [contextually] entails the Existential F-Closure of U .
(Roberts 2006)

(33) extends to salience when she says the following: “I take the expression *old* to be synonymous with *given by the question under discussion*, and *new* (in the sense relevant here) to mean ‘*not given by the question under discussion*’” (p.23). This means that in order to be salient the antecedent must be part of the QUD from which it can be inferred. The relation between *givenness* and salience is more precise in the definition of givenness in Roberts (1996).

Observe that this definition makes use of Scharzschild’s operation of *existential type shift* in cases where the given referent is not of type e . As I have argued in section 3.1.2 of the last chapter (cf. also section 2.1.2.1) that is probably better to avoid abstractions which do not result in types which can be argued to be referential. Since I will develop a binding theory for discourse topics below, this point is quite important.

The big advantage of Roberts’ theory of QUDs is that it treats sentence level IS within a general theory of discourse structure. Roberts uses the term information structure to refer to a discourse- rather than a sentence-level notion (a terminological definition we will not adopt here). For this reason it is an attractive point of departure for a theory which tries to explain the interaction between IS and DS. Büring (2003,) show that the QUD-based approach can be extended in a way that *links* (his contrastive topics) have a clear function within a *strategy* of answering a QUD.

A central part of Roberts’ definition of salience depends on the notion of question under discussion. This is quite an accurate description in the case a QUD can be actually inferred from the context or a general discourse plan. A potential problem with such a definition in terms of QUDs is that a QUD can not always be inferred on the basis of the *preceding* discourse. Roberts notes that “... we also require, in many examples, fairly rich information about the structure of the preceding discourse in order to determine what the question under discussion actually is...” (p.27) This follows from the fact that QUDs model intentions. Intentions are, however, ofent private information of the speaker (as pointed out by Grosz and Sidner, 1986, 2.2.2) The problem becomes most apparent when we look at relatively unconstrained text genres, like narrations or news

texts. In dialogue the interlocutors have to negotiate the topic of the conversation more or less explicitly and there are many overt questions which make the strategy explicit. In other text genres, strategies are much harder to detect. In many cases the QUD must be accommodated from the utterance itself, employing the presuppositional rule (30). If we want to maintain the idea that texts are generally driven by questions which are being addressed, we have to find a way to deal with the problem of accommodated QUDs. We have to find a precise way of reconstructing the question and relate the reconstructed QUD to the previous discourse. Consider the following example from van Kuppevelt (1997), discussed in Umbach (2006).

- (34) a. Today the workers of the Philips computer division went on strike.
 b. (why?) (Van Kuppevelt's implicit question)
 c. They are worried about the managers' new economy plans.

The QUD to which (34c) is relevant to cannot simply be 'why?' since then the backgrounded *they* would not be bound by it. Umbach argues that there is a reconstructed question (*retrospective Quaestio*) which is more detailed: '*What about the workers? What did they do?*' Probably we could argue that the QUD could be something like '*why did the workers go on strike?*', but then we would have to explain how the question, which is asking for an explanation, can be constructed to begin with. A fact does not simply entail that we have to ask for a cause-effect relation. Of course this is a coherent way of continuing (34a), but it is not the only one. Having a strike may imply directly that there is a reason for going on a strike. But it may also imply other things, for example an elaboration on the action the workers take in order to pressure the employer or a simple spatiotemporal location:

- (35) a. The workers went on strike.
 b. They blocked all access roads to the factory.
 b'. That was on Friday.

In this case we can reconstruct a question like *what did they do (to make their position clear)?* Any QUD will depend on information given by the continuation so it can be reconstructed a posteriori. The problem in such cases is now that the question under discussion is reconstructed, at least partially, from its answer and also determines relevance and saliency with respect to it. This introduces a certain circularity. Sometimes an overt QUD fails to bind a background element altogether, as in (36), another example given by Umbach:

- (36) A: (Bello hat gestern meine chinesische Vase umgerissen.)
 'Bello has ran over my Chinese vase yesterday'
 B: Wie ist das passiert?
 'How did that happen?'
 A2: Bello_{Topic} hat die Vase vermutlich ÜBERSEHEN.
 Bello has the vase probably overlooked.
 'Bello has probably overlooked the vase.'

Here the overt question does not contain any mention of neither *Bello* nor *the vase*.

Nevertheless *Bello* is the topic (a link in our terminology) of the sentence. Umbach's reconstructed question is as follows:

(37) What about Bello? What did he do with the vase?

There is apparently a mismatch between the overt question and the reconstructed (=accommodated) one. Both the overt question in (36) and (34b) have an additional meaning element which the reconstructed questions lack: they hint at a certain discourse relation (Asher, 1995, Asher and Lascarides, 2003), if we take *cause* to be as such.

There is a further important detail, we should observe in (37): This reconstructed - or accommodated - question gives '*Bello*' a different status which the rest of the immediate QUD for (36A2) does not have: It requires the answer to be *about* Bello, i.e. it requires '*Bello*' to be the sentence topic. This suggests that QUDs are not monolithic blocks as well: within the QUD there is an element which binds the topic (link) of the answer.

Despite the finding that QUDs *alone* can probably not explain all phenomena related to IS, the notion of QUDs is nevertheless a useful one. We shall not dismiss it, although I will complement it below. Umbach gives two reasons why QUDs are attractive: First, we can plausibly assume that a speaker has a QUD in mind whenever he utters a new discourse increment. Secondly, the QUD approach explains congruence on the basis of discourse structure. What we will have to keep separate are overt QUDs and reconstructed questions. In many cases the overt QUD does not coincide with the reconstructed QUD, as in (36). In many other cases there is no overt QUD at all and we have to infer how the reconstructed QUD can be made relevant to and coherent with the preceding discourse, as in (34).

On the one hand, it is clear that in relatively free text-types, such as narration, news texts or argumentative monologues, a question which is being addressed is highly dependent on what the overt answer is. On the other hand, the options to continue a discourse from a given point on are not totally free either. Take (34) as an example. Once (34a) has been uttered, we can continue the discourse in various ways and each possible continuation is arguably associated with a different QUD. We can ask why they went on strike, how they did it, where the factory was located and so on. But there is clearly an infinite set of questions which do not seem to be adequate within the same context (unless we change the topic radically). For example, in this context we cannot raise the question of whether Bello, the dog from (36), did not notice the vase. This would result in an incoherent discourse. In fact, the principle of relevance which Roberts adapts to explain question-answer congruence (and prosodic focus in English) must also hold between a reconstructed QUD and the context into which this question is placed. The problem boils down to explaining the *coherence* of a *strategy* in addition to Q-A congruence.

One of the constraining factors for the construction of abstract QUDs seem to be rhetoric discourse relations (Mann and Thompson 1986, Asher, 1995, 2004, Asher and Lascarides, 2003). Questions like '*why* (*did the Philips workers go on strike*)' seem to depend on the type of discourse relation in which the answer (in this case (34c)) stands to the discourse segment it is attached to. The question '*why?*' would require a relation of *explanation*, while the question '*what did that cause*' would require a relation of *consequence*. A second factor is the availability of salient discourse referents in the context.

The reason why the English translation of (36b) cannot continue (34a) is evidently related to the fact that neither *Bello* nor the *vase* is part of the Philips factory context. QUDs can not contain non-given referents. Again, this is a condition which usually holds between a question and an answer in Roberts' account (the Q-A congruence required by (30)). Since there is a finite set of possible discourse relations and the set of contextually given referents is also limited, this lets us conclude that there is also a limited set of possible questions which might be asked at any given point of a discourse. Any follow-up question which is outside the range of this set will violate the *coherence of the strategy* and ultimately ensures the coherence of the text.

In order to capture the idea that at each point of the discourse there is only a limited set of possible moves, let us stipulate a set of possible QUDs, resulting from the possible setup (question) moves. Let us call this set the predictive QUD set, and define it for the present purpose as follows:

(38) *predictive QUD set (pQUDs) / coherence of the inquiry strategy*

At any given point Δ of a discourse, there is a set of setup-moves Σ which result in a set Ω of predictable questions under discussion. Ω is constrained by:

- a. rhetoric relations: For each $i \in \Sigma$ there is a rhetoric relation that holds between Δ and the QUD resulting from i .
- b. the set of available given and salient discourse referents at Δ .

Of course, (38) is a crude way to hack the intuitive notion of *coherence* within the *strategy* into a definition. For the present purpose this definition will simply make the intuitive idea explicit. There are many aspects of QUDs which I do not have much to say about. One would like to have an algorithm which may compute a pQUD set on the basis of given discourse information. This appears to be difficult, but not impossible. A second problem is that the computation of a pQUD set at every point in a discourse does not seem to be plausible with respect to processing effort. In order to guarantee the coherence of the inquiry strategy it is probably enough of an accommodatable QUD can be determined to form part of a coherent strategy or not.

Let us now consider *salience* in such contexts. If we assume that for an answer only elements in the question are salient enough to be backgrounded, this will leave us without immediate predictor of salience in sequences like (34a,c). Claiming that '*the workers/they*' are salient because they are part of the question they answer seems to lead to circular inference, since the actual question which is addressed has to be accommodated on the basis of the focus alternative set associated to (34c). And there are two things which will *not* save us here: 1) The prosodic focus does not disambiguate the focus-background partitioning of the sentence. Even if we knew (presupposing that the sentence is spoken, and not only written) that the nuclear accent falls on *plans* this would not determine extent of the sentence focus. The focus can project from the nuclear accent over just any part of the sentence which contains it. If there was an overt context question '*what were the workers worried about?*' the focus would, for example, not extend to the whole VP, but have the same intonation. And 2) the set of possible QUDs (the pQUDs of (38)) at the point (34a) has been uttered will contain possible questions which do not address the workers, such as '*what did Philips do?*'. So we are definitely trapped in a circularity deadlock if we assume that salience is only dependent on the question being addressed. In such cases we would probably prefer to recur to a cognitive notion of salience, because the *workers* are recently mentioned and their

referent is picked up by the pronoun *they*. This means that 1) we should not built the definition of salience on the notion of questions under discussion directly and 2) in many cases it is in fact cognitive salience that will tell us something about which QUD must must be accomodated. This will be the basis on which a QUD can be accommo- dated into the discourse. On the other hand, I will argue below that QUDs are still a highly useful notion when we want to model the structure of discourse, because they represent the (possibly privat) *intentions* which drive the moves within a discourse.

4.1.1.3 A structural explication of salience

Another factor that influences the salience of discourse referents is the structure of discourse itself. In the case of pronoun resolution this is a well-known phenomenon (Grosz and Sidner 1986, Pause 1991). The resolution of pronouns depends in many cases on structural closeness rather than on string distance. Consider the following example, taken from Pause (1991):

- (39) 1. **Achim** wollte seiner Mutter etwas ganz besonderes Schenken.
 'Achim wanted to give a very special present to his mother.'
 2. Er hatte einen kostbaren Ring aus Platin mit einem großen Rubin gekauft.
 'He bought a precious ring made of platinum with a large ruby.'
 3. Rund um den Edelstein waren in mehreren Ringen kleine glitzernde Dia-
 manten angeordnet.
 'Around the ruby there was a circle of little diamonds.'
 4. Sie sollte sehen wie dankbar **er** ihr war.
 'She should see how grateful he was.' (Pause 1991)

In this example the third person masculine singular pronoun *er* refers back to *Achim* in the first sentence, which is picked up by a pronoun in the second sentence, but not mentioned in sentence 3. In addition, in sentence 2 two new masculine singular referents, '*ein kostbarer Ring*' (a precious ring) and '*einem grossen Rubin*' (a large ruby), are introduced. In the third sentence the referent of '*Achim*' is not picked up, but there is a further mention of the ruby (realised as '*Edelstein*'). Now, in the last sentence the pronoun *er*, marked for gender and number, has three possible matching antecedents: Achim, the ring and the ruby, all being masculine singular referents. Both the ring and the ruby are in linear order much closer to this pronoun. The ruby was even the subject of the directly preceding sentence. Nevertheless, the pronoun refers to Achim. A plausible explanation is the following: Sentence 3 is about the ruby. It is an elaboration on this stone introduced in sentence 2. But after sentence 3 had been uttered the elaboration is finished and sentence 4 continues the 'earlier' discourse and can be attached to the discourse segment represented by sentence 2. A decisive factor for the choice of the antecedent is the fact that rubies cannot be thankful. The discourse segment 3 is popped of the stack of discourse segments (Grosz and Sidner', 1986, cf. 2.2.2) and all the salient referents mentioned in 2 are available again.

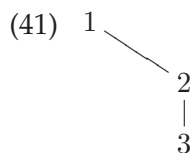
The associated structure of the example would be as follows:

- (40) 1. Achim wanted to give a very special present to his mother.
 2. [
 He bought a precious ruby ring made of platinum.

3. [Around the ruby there was a circle of little diamonds.]
-]
4. She should see how grateful he was

Such examples motivated a series of theories about pronoun and anaphora resolution in dependence of discourse structure. Grosz and Sidner (1986), for example, assume a stack structure on which new discourse segments may be pushed and from which, in turn, such segments may be popped. In example (39) this would mean that at the time of utterance of segment 4, the segments 3 and 2 must be popped from the discourse stack.

Asher and Lascarides (2001) make use of a *right frontier constraint* (Polanyi and Scha, 1983, 1984) which requires each new discourse segment to be attached to the right frontier, assuming that the structure of discourse forms a tree. We could depict the discourse in (39) as the following tree:



According to the right frontier constraint, segment 4 can now be attached to node 1, 2 or 3. Correspondingly, the discourse referents which were salient after uttering the corresponding segment will become salient again.

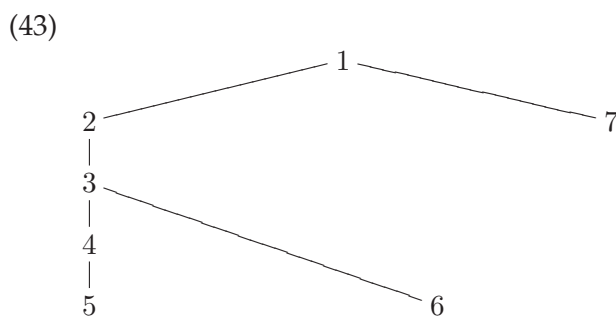
Note that after segment/sentence 3 has been added, further material could be introduced which would not destroy the anaphoric linking between the pronoun and its antecedent, as long as this material addresses the ring or the ruby. For example we could go on describing the ruby, saying that it had a special glimmer and that the ring was ornamented with the name of Achim's mother and so on. In this case all the material would be attached to a discourse segment which is not higher than segment 2. So at the point sentence 4 is uttered segment 2 is still on the right frontier and available at an attachment point.

Let us now consider backgrounds and their accessibility conditions. We would expect to find similar effects, since backgrounds are anaphoric. And indeed we can find examples like (11) repeated here as (42) (segmented into sentences):

- (42)
1. Per fer règim, s'ha de tenir una especial voluntat.
'If you are on a diet you have to have special willpower.'
 -]
 2. No com el Gallardo, que me'l trobo l'altre dia i li dic: "Com estàs?".
'Not like Gallardo, which I saw the other day. I asked him: "How are you?"'
 3. I em diu: "Fa tres setmanes que faig règim".
'And he says: "I've been on a diet for three weeks."'
 4. Dic: "Ah, sí? I quan has perdut?".
'And I: "Oh? And how much did you lose?"'
 5. Diu: "Tres setmanes".
'He: "Three weeks".'

6. I té raó.
 ‘And he's right.’
]
7. Jo tampoc en tinc, [de voluntat]_{tail}.
 ‘I don't have the willpower either.’
8. Quan faig règim, ho passo fatal.
 ‘When I'm on a diet I'm having a terrible time.’
 (Andreu Buenafuente 2001a, p.103 cited by Mayol, 2002)

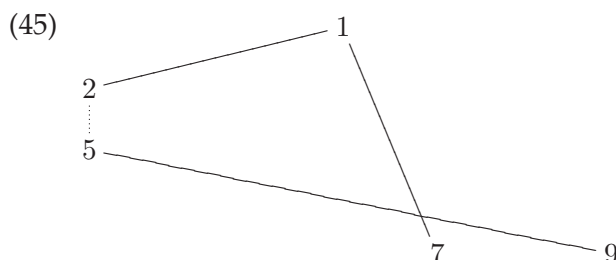
The structure of (42) can be assumed as being roughly as follows:



Now a continuation which tries to anaphorically access an antecedent in segment 2-6 should not be possible anymore, since this would result in an ill-formed discourse tree. It would violate the right-frontier constraint. And indeed we find that a continuation like the following is not felicitous:

- (44) 9. # Van ser una perdua de temps, aquestes tres setmanes.
 ‘These three weeks have been a waste of time.’

A continuation like this is excluded since segment 9 would have to be attached to node 5 in (43). Only in this way the referent of ‘tres setmanes’ would be accessible for a tail realisation. But this would result in an ill-formed tree structure because the branch that connects segments 5 and 9 would have to cross the branch between 1 and 7.



Of course the assumption that discourse is always structured as a tree is an idealisation, but a highly useful one. We can surely find afterthoughts in discourse, like “by the way, he didn’t eat any chocolate during this three weeks.’ The tree-structure of a discourse might be violated in such cases, but I consider this more of a repair strategy than the paradigmatic case. Often such tree-violations are marked by explicit expressions like ‘by the way’, stressed coordinative conjunctions (AND, BUT) and other

discourse markers. I take this to reflect more local imperfections of human communication than a general linguistic principle.¹²

The same phenomenon of seemingly non-local anaphoric dependencies can be observed in sentences with link : links can pick up a higher discourse segment, which is linearly distant:

- (18) a. Ok dunque **il bambino** si prepara per andare a.. Ø è
 Ok so the boy is getting ready to go to.. (he) is
 davanti allo specchio
 in front of the mirror
- b. e Ø si prepara Ø si mette la cravatta per andare al
 and (he) is getting ready (he) puts on the tie to go to the
 ristorante [...]
 restaurant
- c. e **i suoi amici** lo guardano tristi perché sanno che
 and his friends look at him sad because (they) know that
 non andranno con lui.
 (they) won't go with him
- d. Allora poi [**il bambino**]_{link} saluta il cane e la tartaruga
 so then the boy says hello to the dog and the turtle
 (Italian, Brunetti, 2006)

But links seem to be able to do things that tails cannot do: They can switch - or shift - the discourse topic from one referent to another. In (18) the topic of the narration switches first from the boy to his friends (*'i suoi amici'*) and then to the boy (*'il bambino'*) again. I will postpone the discussion to section 4.1.2.2 (Brunetti, 2006, 2008); links are treated there as anaphors with a mission. Apart from their status of being anaphoric, they have an effect on DS.

4.1.1.4 Synthesis

In this section I have argued that saliency is a necessary ingredient of any theory which aims to explain IS within discourse context. Saliency is surely cognitive in nature, but it is also constrained by structural factors. We need to define these structural constraints on saliency, based on discourse segmentation. QUDs are an attractive way of modelling the progression and congruence of a discourse, but QUDs do not seem to be able to determine saliency alone, either. If there is an overt QUD, such as a direct context question which is answered, background elements are correctly predicted to necessarily form part of the QUD. But in many cases QUDs must be accommodated

¹²In fact, any *questions under discussion*-approach (Ginzburg, 1995a, 2005 Roberts, 1996) has to cope with the same problem, since even a loosely connected collection of overt questions within a dialogue can be treated either as a stack, a queue or simply a set:

- (i) When did you commit the murder? Why? Have you been drunk at the time?
 (ii) (Quiz-show context:) In which year was Rome founded? Who was the founder? And which famous myth is associated with the founding of Rome?

Ginzburg theory meets this problem by employing an open stack, a stack that allows for partial ordering.

and reconstructed. In other cases the answers do not fully match an overt question. If a QUD must be reconstructed from the answer, the notion of saliency becomes circular. We would then have to assume that in the worst case that background elements must be treated as having a salient antecedent, i.e. form part of the QUD. Saliency hence becomes part of the reconstruction process as well as part of the determination of saliency. So we have to assume that there are also other factors at work apart from QUDs. For this reason I will adopt a cognitive concept of saliency, which is crucially dependent on discourse segmentation. Cognitive saliency does, however, not seem to explain the link/tail asymmetry.

4.1.2 Links, tails and discourse structure

4.1.2.1 Links vs. tails: different accessibility conditions

In chapter 3 I argued that links and tails have different accessibility conditions. Tails must be upward-monotonic anaphors. The antecedent may be overspecified. Links, on the other hand, can be non-monotonically anaphoric (Dekker and Hendriks, 1996) in that they pick out a referent which is part of a given referent. This is reflected in (46), developed in 3.2.3 and repeated here:

- (46) **Anaphoricty of Backgrounds** (to be revised)
1. Links must stand in a \leq -relation to their antecedent.
 2. Tails must stand in a \geq -relation to their antecedent.

(46) was motivated by alternations like (48) vs. 4.4.inst) the following, where the directionality of the anaphoric part-of condition determines the realisation of the anaphor either as a link or a tail. If the antecedent is more general than the background anaphor, a link realisation (47A/A') is required, while a tail realisation (47A'') is blocked. In the reverse case (48), where the antecedent is more specific than the background NP, the realisation pattern is reversed: a link realisation is blocked and the tail-realisation obligatory.

- (47) a. Q: Which relationship did Bach have to string instruments?

A: He surely LIKED [the viola]_{link}
 H* L+H*

A': [La viola]_{link}, segur que li va agradar.
 [The viola]_{link}, sure that him-cl past he-liked.
 'The viola, he surely liked.'

A'': # Segur que li va agradar, [la viola]_{tail}.
 Sure that him-cl he-liked, [the viola]_{tail}.

(Catalan)

- (48) Q: Which relationship did Bach have to the viola?

A: He surely LIKED [string instruments]_{tail}
 H*

A': # [Els instruments de corda]_{link}, segur que, li van agradar.
 [The string instruments]_{link}, sure that him-cl past he-liked.
 'String instruments, he surely liked.'

(Catalan)

A'': Segur que li van agradar, [els instruments de corda]_{tail}.
 Sure that him-cl he-liked, [the string instruments]_{tail}.
 (Catalan)

In section 4.1.1.1 I have argued that examples (21)/(21) is problematic for a purely cognitive saliency approach, since the cognitive status of the antecedent referent does not seem to follow from closeness of the respective surface antecedent (which would justify to assume a different cognitive status). The link/tail does not seem to have a straightforward explanation in terms of cognitive saliency. There are even cases like (49) where the realisation pattern of links and tails are reversible within the same context.

(21) Q: What about the boss? Does he like broccoli?

A: [L'amo]_{link} [L'ODIA]_{focus} [el bròquil]_{tail}.
 [The boss]_{link} [it-hates]_{focus} [the broccoli]_{tail}.
 (Catalan)

(22) Q: Does the boss like vegetables? What about broccoli?

B: [El bròquil]_{link} [L'ODIA]_{focus} [L'amo]_{tail}.
 [art broccoli]_{link} [it'hates]_{focus} [the'boss]_{tail}.
 'Broccoli, the boss hates.'
 (Catalan)

(49) Q: Does the boss like broccoli?

A: [L'amo]_{link} [L'ODIA]_{focus} [el bròquil]_{tail}.
 [The boss]_{link} [it-hates]_{focus} [the broccoli]_{tail}.
 (Catalan)

B': [El bròquil]_{link} [L'ODIA]_{focus} [L'amo]_{tail}.
 [art broccoli]_{link} [it'hates]_{focus} [the'boss]_{tail}.
 'Broccoli, the boss hates.'
 (Catalan)

In (49), the NP *'l'amo'* (*the boss*) is preferably realised as a link, but it may also be realised as a tail. The two versions are equivalent in their truth conditions and differ in that the (22) displays a contrastivity effect which evokes alternatives for *'bròquil'*. The cognitive statuses for *'l'amo'* and *'bròquil'*, which follow from the context, do not exclude one of the possible realisations. In other words, we have no cognitive predictor for the choice of the realisation pattern. The contrast between the two patterns is also observable in the German version (50), where the object *'Broccoli'* may occur in the preverbal topic position. What such examples suggest is that there is more to the link/tail distinction than only a difference in the saliency status of their antecedent.

(50) Q: Was ist mit dem Chef? Mag der Broccoli?

A: Nee, der Chef mag keinen Broccoli.
 No, the boss likes no broccoli.

A': Nee, Broccoli mag der Chef nicht.
 No, broccoli likes the boss not.
 (German)

As it stands, (46) does not say anything about a preference of one realisation pattern over the other in (21)/(22), either. Since both ‘*the boss*’ and ‘*the broccoli*’ have referent-identical antecedents (more precisely: they have referents which can be equated to the referents of their antecedents), (46) allows both a link and a tail realisation of any of the two NPs. In fact, we can even get a double tail and even a double link realisation, although the last one would be infrequent.

- (51) a. [L’ODIA]_{focus}[el bròquil]_{tail} [L’amo]_{tail}
 b. [L’amo]_{link}[el bròquil]_{link}[L’ODIA]_{focus}
 (Catalan)

In such examples the exact IS realisation is hence impossible to predict from the context. The difference in meaning of the two realisation possibilities is that links have a contrastive interpretation: (21) strongly suggests that there are other persons which are comparable to the boss and who might actually like broccoli. (22), in contrast, implies that the boss might like other vegetables or other types of food. Tail realisation lacks a contrastivity effect. Another property of links is that they often seem to shift the discourse topic (Brunetti, 2008): (18) shows a shift of the topic of narration first from ‘*il bambino*’ (*the boy*) to ‘*i suoi amici*’ (*his friends*) and then back to ‘*il bambino*’. Actually, we could also claim in some way, that the *boy* stands in some sense in contrast to his friends within the discourse segment represented by (18). I will pursue this latter possibility of interpretation below.

4.1.2.2 A binding theory for discourse topics

As seen in the discussion so far, links have some properties that tails do not have. In chapter 3 (section 3.3.1) I claimed that links must stand in a special part-of relation to their antecedent. The referent they represent must be either equal to or part of their antecedent referent. When they are more specific than their antecedent, they represent new information, but this information is only partly novel.¹³ Consider (52), where both ‘*Hunde*’ und ‘*Katzen*’ receive a rising, link-identifying accent in German.

- (52) Q: Magst du Tiere_i?
 ‘Do you like animals?’
 A1: [**Katzen**]_{link} sind ja ganz SÜSS.
 [**cats**]_{link} are prt quite CUTE .
 ‘Cats are certainly quite cute.’
 A2: (Aber) [**Hunde**]_n sind SCHRECKLICH.
 (But) [**dogs**]_{link} are HORRIBLE.
 ‘Dogs are horrible.’
 (German)
- (53) Q: Do you like animals?
 A1: [**cats**]_{link} are quite CUTE.
 A2: (But) [**dogs**]_{link} are HORRIBLE.

¹³cf. Vilkkuna (1995) for a similar claim. Vilkkuna argues that links represent ‘given+new’ information

- (54) Q: T'agraden els animals?
 A1: [Els gatets]_{link} són banstant bufons.
 A2: (Però) [els gossos]_{link} són horribles.
 (Catalan)

The kinds 'Katzen' and 'Hunde' are part of the kind 'Tiere'. In a slightly more formal way: $[[cats]] \leq [[animals]]$ & $[[dogs]] \leq [[animals]]$. Interestingly, such non-identity links share properties with both tails and foci: there are *given* like tails, but they are also *novel* like foci. They present partially new information in that they are more specific. And both links and foci are contrastive (Büring 1999, *inter alia*). I will model contrastive sets for links as abstract discourse referents (possibly plural or kind denoting, as discussed in section 3.2.1 and 3.2.2), which serve as the binder of a linguistically realised link. I will not extend this treatment to the contrastive set of foci.¹⁴

The binding conditions of the two links are noteworthy: they are both anaphoric to *Tiere*. Both $[[cats]]$ and $[[dogs]]$ are bound by $[[animals]]$, and they stand in contrast to each other. Actually, the binder of both $[[cats]]$ and $[[dogs]]$ is what correspond to the contrastive 'set' of the topic (Büring, 1999). The term *set* is somewhat problematic in this examples: $[[animals]]$ here is not a set but a kind, but since a kind has arguably a set as its extension (cf. section 3.3.2), we will assume that what we have at hand here is the contrastive set for the two links: both of the two links, which contrast with each other, are both bound by the referent which represents their contrastive 'set'.

If we examine example (52)/(53)/(54) under a QUD-approach, we could argue that there is a top question 'do you like animals?' which is then broken down into the sub QUDs 'what about cats?' and 'what about dogs?'. But I will built my analysis on a unit smaller than QUDs: discourse topics. In a similar way in which links have been treated as bound by referential units in 3.1.2, discourse topic is to be understood here as a referential unit, not an open proposition (like e.g. in van Kuppevelt, 1997). What I understand here as a referential unit is a properly typed unit that can serve as antecedent. This class of referential units includes more than just existential nominal referents, but also indefinites bound within a quantificational domain, events and event-like entities, kinds and properties (among others). In order to avoid unnecessary terminological confusion I will make the referential nature of discourse topics here explicit notationally and abbreviate them with a superscript as ^rd-topics.

As argued in section 3.1.2 of chapter 3, all background elements of a sentence must correspond to a referential type. A sentence background can be built from more than one anaphoric element. Some empirical evidence for this claim comes from languages like Catalan, which dislocate links and tails separately and may even realise multiple links and tails like in (51). If such elements constitute separate syntactic units it is also plausible to treat them as separate semantic units. A consequence of this assumption is that we expect the following: linguistic elements which do not correspond to a referential semantic type cannot serve as links or tails either: as noted, polarity values and quantifiers were such elements. Foci are not subject to such a restriction. It follows that we can have phenomena like verum focus (a focalised polarity value), but not verum

¹⁴See Umbach (2003) for a theory which derives contrastive sets for foci anaphorically. A unified account of the anaphoric behaviour for contrastive sets for both links and foci is certainly a desideratum, but I have to leave it for further research.

topics. Also if abstraction operations like *existential type shift* or *existential F-closure* (cf. section 2.1.2.1) yield a semantic type which is not referential, the result will neither be able to serve as a background anaphor nor as a ^rd-topic (because natural language does not provide variables for such types). If such types cannot be represented by a variable, they cannot enter binding relations either. Given the anaphoric basis of my approach to discourse topics (^rd-topics) and sentence topics here, we have to assume that discourse topics are appropriately typed. There is nothing in questions under discussion which guarantees proper typing; for this reason, I will assume that in addition to QUDs, ^rd-topics are a necessary primitive concept in discourse.

The approach I will take here is in a certain sense similar to Roberts' (1996) QUD account, although it builds on ^rd-topics as smaller units and tries to derive questions under discussion from those smaller referential units. Hence, QUDs are treated here as a *derived* notion. The arguments for assuming a referential version of discourse topics resemble the arguments I gave in section 3.1.2 for assuming referentially typed background anaphora. Reconsider, for example, (55):

- (55) Q: What about the staff members? Do they like broccoli?
 A: [*The boss*]_{link} HATES [*vegetables*]_{tail}.

As argued in chapter 3, a hypothetical monolithic background of the form $\lambda R.R(\text{the_boss'}, \text{vegetables}')$ both widens and narrows down its antecedent since the *boss* is part of the *staff* and *vegetables* is a super-kind of *broccoli*. I believe that the argument extends to QUDs. Assuming Roberts' account, the interrogation strategy would break down the overt question (55Q) to '*does the boss and do the other staff members like broccoli?*'. But the question (55A) actually addresses is '*does the boss like vegetables?*'. What I will do here is treat QUDs as derived from smaller units. In the basis of (46), which expresses the relation between links and their antecedents, we can assume that links signal also that a current QUD is narrowed down (cf. Büring 2003 where the strategy of enquiry is made explicit with the use of contrastive topics). In other words, the \leq -relation that tholds between links and their antecedents coerces an update of QUD, from QUD(staff) to QUD(the_boss), where $\text{QUD}(\text{the_boss}) \leq \text{QUD}(\text{staff})$. QUDs are, hence, not primitive units. An important difference between Roberts' QUD-account and the present proposal is that the referential discourse-topics and sentence-topics (^rd-topics and links) can actually be treated as bound elements. QUDs are still a necessary concept, in a similar way as sentence backgrounds are necessary for the semantic interpretation of IS. But they are not elements which enter binding relations.¹⁵

Let us see how this works for our example (52)-(54). I assume that there is a top-level ^rd-topic *animals* associated to (52Q), which is then broken down into *cats* and *dogs*. *Animals*, *cats* and *dogs* are part of the corresponding QUDs, in fact the most prominent part. What advantages does this bring? First of all, we do not have to find an explanation for why a sub-QUD of the form '*what about cats?*' (whatever formal representation that may have, perhaps: ' $? \lambda P.P(\text{cats})$ ') has to follow from a yes/no question '*do you like animals?*' (something like ' $? \text{like}(\text{you}', \text{animals})$ '). It is not trivial to break down QUDs: our top level QUD could be broken down into the potential sub-QUDs '*Do you like dogs?*' '*who likes animals?*' instead of '*what about cats?*'. This would lead

¹⁵This gives rise to the question of how backgrounds as a construct are related to QUDs. Cooper, Engdahl et al. (2000) assume a direct correspondence.

to exponential growth. If we assume that the formation of sub-QUDs is a process of nonmonotonic inference process, nothings saves us from inferring QUDs like ‘*What do you like?*’ ($?x.like(you',x)$), ‘*Who likes what?*’ ($?x.\lambda y.like'(x,y)$), ‘*Do you like anything?*’ ($? \exists x(like'(you',x))$), ‘*Who does anything?*’ ($? \lambda x.\lambda P.P(x)$), ‘*Why does someone like animals?*’ and so on. (56a,b) are two fairly acceptable continuations of (53Q).

- (56) a. I like DOGS.
 b. *My brother* likes DOGS.

They are only two of many possible continuations and they would need the accommodation of a question which is rather different from the overt context question. But of course, not all possible questions can be accommodated in a given context. (57) is not a possible continuation of (53Q), since it would require the accommodation of a question ‘*which relation is there between Bello and the vase?*’.

- (57) Bello has probably not SEEN the vase.

The problem here is to delimit the set of questions which can be possibly accommodated without violating the coherence of the enquiry strategy.

Let us now return to the notion of ^rd-topics. The treatment of ^rd-topics are not unproblematic (especially in the bridging cases discussed in section 3.2.2), but they are a lot easier to handle than QUDs. Furthermore, we can assume that any underlying QUD will at least contain one ^rd-topic. The QUD ‘*do you like animals?*’ contains *animals* and ‘*what about cats?*’ contains *cats*. We do not run into QUD-widening problems either, because both *cats* and *dogs* narrow down the concept of *animals*, independently of whether the QUD is narrowed or not. (56b) makes ‘*my brother*’ contrastive and changes the ^rd-topic.¹⁶

There is another advantage to the use of ^rd-topics: We can distinguish more prominent material within the QUD from less prominent material and capture the aboutness effect for links. Reconsider (21)/(22) (repeated here as the slightly changed (58) and (59)). Both of the answers would require the same underlying QUD: ‘*Whats the attitude of the boss towards broccoli?*’.

- (58) Q: What about the boss? Does he like broccoli?
 A: [L'amo]_{link} [L'ODIA]_{focus}[el bròquil]_{tail}
 [The boss]_{link}[it-hates]_{focus} [the broccoli]_{tail}
 (Catalan)
- (59) Q: What about broccoli? Does the boss like it?
 A: [El bròquil]_{link} [L'ODIA]_{focus} [L'amo]_{tail}.
 [art broccoli]_{link} [it'hates]_{focus} [the'boss]_{tail}.
 ‘Broccoli, the boss hates.’
 (Catalan)

¹⁶The realisation of a referent as a tail, in turn, is a way of answering a question completely (or even over-answer it, like *vegetables* in (55), which is more general than *broccoli*). From the proposition that *the boss hates vegetables* we can monotonically infer *the boss hates broccoli*. This widening of the question is only allowed under a tail-realisation, it would not be possible for a link-realisation.

But the choice of a realisation pattern in (58)/(59) is surely significant. The QUD singles out the focus in that *odia* fills the gap in the QUD, but that is the end of the story. We cannot account for the difference between links and tails. The QUD says nothing about the contrastivity of *bròquil* in (59). The notion of ^rd-topic, in contrast, *can* distinguish between links and tails if we assume that links, but not tails, must be bound by a higher-level ^rd-topic in a way that the link is part of the higher ^rd-topic. In analogy to (53), where the kinds *dogs* and *cats* are bound by the kind *animals*, we could argue that in (58) the boss must form part of a bigger group *x*, such that some members of the group do like broccoli and others do not. We could then further assume that the *boss* is bound by *x* under a part-of relation, such that $[[\text{boss}]] \leq x$. Therefore, let us hypothesise that there is a binding requirement for links, such that links must be bound by an explicit or inferable antecedent which is a ^rd-topic.

(60) **The binding requirement for links**

A linguistically realised link λ must be properly bound by a ^rd-topic δ , such that $\lambda \leq \delta$.

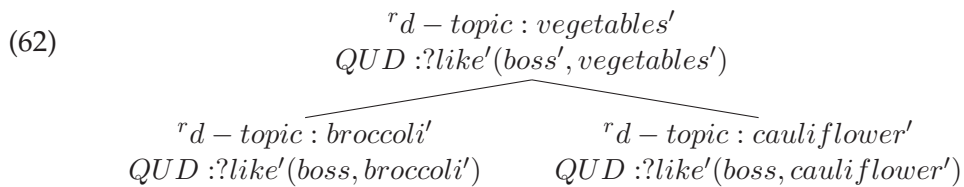
Let us now turn to tails. The tail antecedent must also appear in the underlying QUD. The anaphoricity conditions for tails are different, however: They may equate to or underspecify their antecedent and they do not need to be bound by a ^rd-topic. Let us discuss how that would work in the case of (58): The two questions of (58Q) can be merged into one QUD: ‘Does the boss like broccoli?’ This is the question which (58A) answers. There is nothing new, so far. (58A) in isolation requires *l’amo* and *el bròquil* to be anaphoric because of the link- and tail-realisation of the verbal arguments. In addition, *l’amo*, as a link, must be bound by a ^rd-topic under requirement (60). So, we can infer four things: first, we require that the QUD which is presupposed by the answer (under (30)) must contain *l’amo* and *el bròquil*; second, both referents must be anaphorically bound by some available antecedent; and third, there must be a binder *x* of the link which is a ^rd-topic and, fourth, the condition $x \geq \text{boss}$ must hold. Since *l’amo* and *el bròquil* are backgrounded we can accommodate a QUD ‘what is the relation between the boss and the kind broccoli?’ ($? \lambda P.P(\text{boss}', \text{broccoli}')$). This QUD is compatible with the requirements: the QUD presupposed by the answer (58A) is coherent with the overt QUD (58Q) and we get the desired positive result: ‘ $? \lambda P.P(\text{boss}', \text{broccoli}')$ ’ is entailed by ‘ $? \text{like}'(\text{boss}', \text{broccoli}')$ ’. Turning to (59), the situation is largely similar, but some important details change: The presupposed (and accommodated) QUD for (59A) is still ‘ $? \lambda P.P(\text{boss}', \text{broccoli}')$ ’, but the ^rd-topic *x* must be such that $x \geq \text{broccoli}$. So far, the immediate effect for (58)/(59) is not very spectacular; we only derive the contrastivity effect in the latter case, resulting from the link realisation of *bròccoli*. However, let us continue the discourse with sentence (61):

- (61) La coliflor, però, sí que li agrada.
The cauliflower, but, yes that him pleases.
‘But he LIKES cauliflower.’
(Catalan)

(61) is a natural continuation for (59), but not for (58). Why? *La coliflor* is a left dislocated element, hence a link. We can infer that the underlying (accommodated) QUD is ‘ $? \lambda P.P(\text{boss}', \text{cauliflower}')$ ’ (since the clitic pronoun *li* can only be resolved as being anaphoric to *l’amo* (the boss)). The link *la coliflor* must be anaphoric to the ^rd-topic *x*

and $x \geq \text{cauliflower}'$ must hold. But since the sentence must be subsumed under the same QUD and ${}^r d\text{-topic}$ as (59B), and this requires that $x \geq \text{broccoli}'$, we arrive at the conclusion that $x \geq \text{broccoli}' \ \& \ x \geq \text{cauliflower}'$. This condition can be satisfied, e.g. by $x = \text{vegetables}'$. In turn (58) would lead to $x \geq \text{the_boss}' \ \& \ x \geq \text{cauliflower}'$, which contradicts real world knowledge (unless there is a known class of things which include both *cauliflower* and *the boss*).

There is still one more point which deserves attention: The sequence (59)/(61) as a unit requires an accommodated QUD $'\lambda P.P(\text{boss}', \text{vegetable}')$ which is a widening of the overt QUD (58Q) $'?like'(\text{boss}', \text{broccoli}')$. Since the different types of vegetables are marked as links, which must be bound by a ${}^r d\text{-topic}$, we also have to widen the ${}^r d\text{-topic}$ *broccoli'* of (59) to *vegetables'* which covers both ${}^r d\text{-topics}$ *broccoli'* and *cauliflower'* (the ${}^r d\text{-topic}$ in (61)). In section 4.2.2 I will argue that this topic-widening has an important effect on the structure of discourse. The resulting structure is (62).



The two answers together amount to the answer to the top-level QUD ($'?like'(\text{boss}', \text{vegetables}')$) in (62). I will postpone a discussion of how this is possible to section 4.2.2. For the moment it is important to point out that there is *at least one* mechanism which allows us to widen QUDs.

When we compare the behaviour of links and tails, we can observe the following: Tails do not present partly new information; they must be entirely given, but they can be less specific than their antecedent. Consider (63):

- (63) a. Bach wrote a lot of pieces for the viola.
 b. He must have LOVED [string instruments]_{tail}.

After (63a) has been uttered, but before (63b) is uttered, it is hard to determine which question is going to be addressed. Let us say that within the set of possible follow-up question there is one like the following: *'what about Bach and what about the viola?'* Another of the possibilities is *'what relation is there between Bach and the viola?'* ($'\lambda R.R(\text{bach}', \text{viola}')$). The accommodated QUD triggered by (63b) is: $'\lambda R.R(\text{bach}', \text{string_instruments}')$; the accommodated QUD for largely matches the context (and any question we could expect to be addressed on the basis of the context) since there is a part-of relation between the *viola* and the class of *string instruments*. We can also observe that the accommodated QUD is more general than the context given: The QUD of (63b) has widened with respect to the context-given information. This case is different from the case of llinks discussed above with respect to (58) and (61), since no contrastivity effect can be observed. In addition, any answer to a question that fully answers a question about *string instruments* will also fully answer a question about the kind *'viola'*. Hence we do not contrast the *viola* with any other types of string instruments.

- (63) a. Bach wrote a lot of pieces for the viola.
 b. He must have LOVED [string instruments]_{tail}.
 c. # In contrast, he didn't like the violin.

A continuation like (63c) is not possible. Once (63b) has been uttered, the underlying answer is complete. Any statement about 'string instruments' will extend to the 'violin' as well as the 'viola'. On the structural side, the tail realisation does neither require nor allow 'string instruments' to be contrasted with anything else. The following tree structure is well formed, since any answer to '?λR(R.(bach', string_instruments'))' entails an answer to '?λR(R.(bach', viola'))'.

- (64)
- $$\begin{array}{c}
 {}^r d - \text{topic} : \text{bach}' \\
 \text{QUD} : ?\lambda R(R(\text{bach}', \text{viola}')) \\
 | \\
 {}^r d - \text{topic} : \text{bach}' \\
 \text{QUD} : ?\lambda R(R(\text{bach}', \text{string_instruments}'))
 \end{array}$$

There is an important difference between (62) and (64): In the former the two subordinate QUDs together give an answer to the superordinate QUD. In the latter, the superordinate QUD has only one daughter and the QUD of this daughter over-answers the superordinate QUD, which entails a full answer. In (64) there is no widening of the ^rd-topic, although the subordinate QUD has widened. Comparing (62) and (64) should we come to the conclusion that we should carefully keep separate the two means of widening a QUD:

- (65) 1) Links are able to widen a QUD by widening the ^rd-topic (implying an effect on discourse structure).
 2) Tails are able to widen a QUD without widening the ^rd-topic (implying no change of discourse structure).

Below, I will discuss what the difference means for the structure of discourse. So far, we can at least say that we have narrowed down the possibilities of QUD widening, which is a good step forward. We are now able to say under which conditions a QUD introduced via presupposition accommodation might be more general than and overtly given QUD, and distinguish between two cases. Finally, how do these findings apply to (34) above (partially repeated here)?

- (34) a. Today the workers of the Philips computer division went on strike.
 b. ...
 c. They are worried about the managers' new economy plans.

It is very hard for the hearer/reader to predict what QUD is going to be addressed next on the basis of (34a). We could argue that there is a set of possible follow-up questions (pQUDs, the predictive QUD set) which can be created on the basis of the discourse situation (something I have tried to define in (38)). What the question is, can only be determined when the answer is already given and it is known which QUD (34c) presupposes. This QUD must be congruent with the given context, i.e. it would have to be a member of the set of pQUDs. Depending on the accentuation pattern ('worried'

may be accented or not) the accommodated QUD should be either ‘*what are the workers worried about*’ or ‘*what about the workers? why are they negative?*’. The state of being worried/being negative about something might be inferred from the fact that they go on strike. The creation of a set of possible QUDs via inference is to the computation of a very large number of QUDs which are not addressed in the continuation. This seems to be computationally implausible. The ^rd-topic approach is leaner and can avoid this problem. The only thing we have to say about (34c) is that the ^rd-topic is the workers, which is bound by the topic of (34a).

In summary: I have shown in this section that links hold a very close relation to the structure of discourse. A link must be bound by its contrastive set and this contrastive set must form part of the discourse representation in the form of a referentially typed discourse topic. Links are ‘anaphors with a mission’ in that they serve to ensure discourse coherence. If the contrastive set is not available as an antecedent, a suitable (possibly underspecified) antecedent must be accommodated. I have argued that *questions under discussion* are a derived notion. It is ^rd-topics, not QUDs (which are complex units) which enter binding relations.

4.2 How does information structure influence discourse structure?

So far, I have tried to pin down the right accessibility conditions for referents to be realised as a link or a tail. But examples like (59) suggest that there is something else going on, some effect that the linguistic realisation must have on the structure of discourse itself. In such cases the ^rd-topic is widened. I have already suggested that the overtly asked context question might have to be widened to derive a QUD which covers a contrastive answer like in (66).

- (66) Q: Does the boss like broccoli?
A: The boss HATES *broccoli*, but he LIKES *cauliflower*.

In this section I will generalise this approach. On the one hand, the explicit linguistic marking of IS may override the IS which could be *expected* to be realised on the basis of a given context. In such cases new information will be *accommodated* into the context: such accommodations tell us how we have to assume the discourse context to be, although this context may not have been created overtly. On the other hand, the contrastivity effect triggered by a linguistic link-marking may require the introduction of additional discourse segments, which would not be created without this link-marking.

4.2.1 Interaction of overt IS marking and predicted IS

The linguistic realisation of IS gives important clues on how a discourse graph is to be built up (cf. 1.2, 2.2.2), it helps to determine the right structure of a discourse. In this section I will discuss three types of cases where such an influence can be seen. In the first type of cases, the right-frontier constraint discussed in 2.2.2 (Polanyi and Scha, 1983, 1984, Asher and Lascarides, 2003) predicts that a new discourse segment will only be attached to an available node on the right frontier. Once the new segment has been attached, all nodes which are on the left below that attachment point will

become unavailable for further attachment of new discourse segments. Informally we can describe that process as a discourse bracket being closed. The following example (67) illustrates that point.

- (67) 1. Sí senyor, ens trobem a les portes de la primavera.
 ‘Yes sir, we are at the gates of spring-time.’
 2. No ho noteu?
 ‘Don’t you feel it?’
 3. Jo ja ho he notat.
 ‘I have noted it.’
 4. La gent pel carrer, amb menys roba...
 ‘The people on the street wear less clothing...’
 5. Ja en parlarem un altre dia, d’aquest tema, [de la
 Still about-that talk-we-fut an other day, about’t that topic, [about the
 roba que cau]_{tail}.
 clothing that falls]_{tail}.
 ‘Well, let’s talke about that some other day, about the clothing that falls.’
 (Catalan)
 (Andreu Buenafuente, 2001a, p. 106 cited by Mayol, 2002)

Here the tail in sentence 5 refers back to the noun ‘*roba*’ (*clothing*) in sentence 4. Informally, the rhetorical effect of the tail has is to strengthen the assertion made in the same sentence, namely not to talk any more about the *clothing*. Now the listener can expect the speaker to go on talking about the springtime. In fact, the monologue goes on as follows:

- (68) La primavera és la estació de l’amor, les flors, el pol·len, les al·lèrgies, els grans
 ...
 ‘Springtime is the season of love, of flowers, of pollen, allergies, the big ...”

Another example for the same phenomenon is (69):

- (69) 1. Mantenir viva una planta no és fàcil. Jo tenia un amic que els bitxos se'ls hi menjaven totes.
 ‘It’s not easy to keep a plant alive. I had a friend whose plants were all eaten by bugs.’
 [
 2. Quan no era el pulgó, eren les erugues. Quan matava les erugues, li sortia la cochinilla, un nom lleig, també... Un nom d’insecte guarro. I la mosca blanca.
 ‘When there were no plant lice then there were caterpillars. When he killed the caterpillars, suckling pig appeared, which also have an ugly name.’
]
 3. Al principi estava preocupat, el tio, però al final els hi va acabar agafant carinyo i tot, [als bitxos]_{tail}.

“He was first worried, the guy, but then he finally started to like them all, those bugs.”

(Catalan)

(Andreu Buenafuente, 2001, p.129, cited by Mayol, 2002)

Tails function in a way comparable to pronouns in that they can only access antecedents on the right frontier of the discourse tree. Example (39), above show the same effect. Full NPs which serve as tails can identify their antecedent in a very precise way and they can refer back to an antecedent which would be too distant for a pronoun.¹⁷ This inability of pronouns to single out the right antecedent does not arise because of the *right frontier constraint*, but rather because of the referential ambiguity caused by intervening potential antecedents. In the case of pronoun ‘being distant’ means that the amount of intervening and competing (potentially matching) antecedents is too high. ‘*Els bitxos*’ (bugs) in (69) cannot be substituted by a pronoun, apparently because a personal pronoun would leave too much ambiguity with respect to the antecedent: it could also refer to the plant lice or the caterpillars, etc. When a tail picks up an antecedent, it has to attach to a discourse segment in which the antecedent is salient. By doing so, it also closes a discourse segment. In terms of Grosz and Sidner’s focus stacks this would correspond to popping off all focus spaces from the stack which do not provide the necessary antecedent: all popped-off focus spaces (and the corresponding discourse segments) then become unavailable for further reference. This effect is sometimes used as a rhetorical strategy to end a segment. (67) is a nice example of that, because it shows the segment that is closed, which is the clothing which is falling in spring, is really a matter which is postponed to *another day*, hence not further addressed in the ongoing discourse. When this segment is closed, the speaker goes on to talk about spring time in (68), but not about the *clothing* any more.

A second interesting phenomenon can be observed if we compare the difference between links and tails in cases where they are seemingly referent-identical to their antecedent. Consider the following minimal pair of sentences, which only differ in the way the noun ‘*Enric*’ is realised:

(70) Q: Was gibts neues von Enric?

‘any news about Enric?’

a. Ich weiss nichts neues [von Enric]_{tail}. (deaccented object)

I know nothing new [of Enric]_{tail}.

b. [Von Enric]_{link} link weiss ich nichts neues, aber (fronted object)

[Of Enric]_{link} know I nothing new, but ...

(German)

(71) Q: Què en saps de l’Enric?

‘Any news about Enric?’

a. No en sé res, [de l’Enric]_{tail}. (CLRD)

no cl know nothing, [of art Enric]_{tail}.

¹⁷This is reminiscent of the form-function correlation observed by Givón (1983) in his work on topicality. The referent of right-dislocations is less ‘topical’ than the referent of pronouns. One of the factors affecting topicality is “potential interference”.

- b. [De l'Enric]_{link}, no en sé res. Però ... (CLLD)
 [Of art Enric]_{link} no cl know nothing. But ...
 (Catalan)

The tail case is quite straightforward: (70a) and (71a) directly address the context question. The QUD presupposed by the answer coincides with the overt context question. But the b-cases are different. The link realisation of 'Enric' signals contrastivity or, in other words, that the ^rd-topic 'Enric' must be part of a higher level ^rd-topic which contains 'Enric' plus (at least) some other comparable member. So, although there must be an accommodated higher-level QUD 'What about Enric and other comparable persons?', it cannot be subsumed under the QUD 'what about Enric?'. Now, how does the structure of discourse have to look like to get all the binding conditions correct? I will return to this question in the next section.

The third type of unpredictable IS realisations are out-of-the-blue backgrounds. We usually take it for granted that backgrounds correspond to given referents in the sense that those must have an available linguistic or non-linguistic antecedent. But sometimes this is simply not true. Recall example (1) (repeated here as (72)), found on the cover of an issue of the New York Times Magazine

- (72) Men ARE different.

It is received wisdom that all out-of-the-blue examples are all-focus realisations. But in (72) the explicit focus accent marking of 'are' overrides the expected all-focus reading. What this example suggests is that in certain cases the linguistic marking evokes a context indirectly which is not given overtly. One might think that such an examples can only occur if there is a culturally implicit debate going on whether or not men are different. But we can think of absolutely non-grounded examples, cases in which there is no cultural antecedent whatsoever (unless you are familiar with a particular adventure game classic).

- (73) Guybrush Threepwood really DID defeat the hideous ghost pirate.

This example requires a context where there is a person with the name Guybrush Threepwood and a hideous ghost pirate and a certain uncertainty about whether Guybrush defeated the latter. One way of casting this into a theory is to assume that (73) presupposes that there is a QUD '?defeat'(guybrush', ghost_pirate)'' and this QUD is accommodated into the discourse situation. This means that an utterance with a specific IS marking can entirely create a discourse context the form of a QUD from scratch.

A similar case is represented in (2), where 'a mio fratello' is a left dislocated link. This NP has no antecedent in the discourse, nevertheless it is presented as link. Hence 'mio fratello' is presented as given and an appropriate antecedent must be accommodated. Out of the blue topics can act as scene-setters (Brunetti, 2008, to appear):

- (2) Sai? [A mio fratello]_{link} gli hanno rubato la moto.
 you-know? [to my brother]_{link} to-him they-have stolen the motorbike.
 'Did you know? My brother got his motorbike stolen'
 (Italian, Brunetti 2006)

The effect is also observable in the following example from an oral news flash. Here ‘New York’ and ‘Gebäude’ (*building*) are marked as links with the non-canonical sentence initial position and the sharp rising accent:

- (74) a. Vor wenigen Sekunden hat uns diese Nachricht erreicht:
 ‘a few seconds ago we received this news:’
- b. [Aus New *York*]_{link} wird eine grosse EXPLOSION gemeldet.
 [From New *York*]_{link} is-pass a big explosion reported.
 ‘There is a report from New York of a big explosion.’
- c. [Ein *Gebäude*]_{link} soll in Manhattan EINGestürzt sein.
 [A *building*]_{link} should in Manhattan broke-down is-pass.
 ‘A building has allegedly broke down.’
 (German, Tagesschau, July 18th, 2007)

The possibility of out-of-the-blue links suggests that overt IS marking may override the expected DS in a null context. In an intuitive sense, the non-predictable link sets the topic for the conversation. It presupposes a question which is addressed, but the link also presupposes a referential unit, a ^rd-topic. The second part of (2) could be paraphrased as: ‘presupposing that we are talking about my brother, they stole his car’. Since the presupposition is not met by the context, we have to accommodate it. Another possible way of looking at the problem is to assume that a zero-context implies the maximal ^rd-topic ‘everything we could possibly talk about’. And it is trivially true that ‘my brother’ is part of ‘everything we could possibly talk about’. This top-level ^rd-topic is similar to Robert’s *big question* (the top-level QUD discussed in section 4.1.1.2): ‘what is the way things are?’. The difference between the top-level ^rd-topic and the *big question* is that the former is a referential unit while the latter is a propositional one. I assume that we need both concepts, but that the referential ^rd-topic is a primitive, while the QUD is derived. (72) is hard to explain unless we admit a question-like abstract entity which dominates a discourse segment, but without ^rd-topics we cannot build a properly typed theory of background anaphoricity. The context of (72) can be paraphrased as follows: ‘out of all possible things in the world we could talk about we talk about men, and concerning men the question is whether they are really different’.

Examples as the one discussed in this section strongly suggest that there is a two-way interplay between IS and DS. While DS influences IS via constraints on saliency, IS guides us in choosing the right DS when we build a representation of discourse segmentation.

4.2.2 Links vs. tails: the induction of different discourse segmentations

In the previous section I have argued that examples like (59) or (71) widen the domain of the ^rd-topic they are bound by. We have also seen that widening the ^rd-topic is one of two modes of widening the QUD which corresponds to a discourse segment. In this section I will investigate in which ways a this has to be related to DS and I will develop a series of principles which allow to build a discourse graph, representing a coherent discourse, where all ^rd-topics are properly bound and the QUD can be inferred from ^rd-topics via the use of linguistically realised links. Material used in the linguistic tails complete the information which must be present in a QUD.

Usually ^rd-topics narrow down their antecedent when they occur lower in the discourse-graph. This is what we see in (53).

- (53) Q: Do you like animals?
 A1: [*cats*]_{link} are quite CUTE.
 A2: (But) [*dogs*]_{link} are HORRIBLE.

I assume that this is the default case and this assumption is coherent with Roberts' (1996) theory of QUDs. She assumes that every coherent discourse has a top-level QUD which is then broken down into smaller sub-QUDs and the answering of the sub-QUDs eventually leads to the answer of the top-level QUD. The underlying idea is that a big piece of information is built out of smaller pieces of information. What this means in the case of (53) is quite straightforward: I assume here that both '*dogs*' and '*cats*' are bound by '*animals*', which implies a \geq -relation holds between binder and bindee (i.e. antecedent and anaphor), such that $binder \geq bindee$. If we allowed for the reverse binding case ($binder \leq bindee$) we could argue that '*animals*' is bound by '*cats*', but in this case '*dogs*' would also have to be bound by '*cats*', which is clearly wrong since it is not the case that '*dogs* \leq *cats*'.

I further assume that each basic discourse segment (i.e. utterance) has a corresponding ^rd-topic. The binding relations of ^rd-topics can be formulated as follows:

(75) **Principle of proper ^rd-topic binding**

^rd-topics must be properly bound.

If Σ_1 and Σ_2 are discourse segments, δ_1 and δ_2 are the ^rd-topics of Σ_1 and Σ_2 and Σ_2 dominates Σ_1 , then the relation between δ_1 and δ_2 must be such that $\delta_2 \leq \delta_1$.

Tails are different. They are not contrastive and they do not split a given referent into smaller pieces. They seem to act more like ordinary pronouns and may generalise over their antecedent. We have seen in examples like (70)/(71, repeated below) that there are cases where both a link and a tail realisation of a referent is possible. This may happen if the target constituent (in this case '*Enric*') and the antecedent refer to the same entity. But evidently the meaning of (71a) and (71b) is not the same. Although the truth conditions are not different, they require different (abstract) contexts beyond the simple context question. They also differ in the way they allow the discourse to be continued. (71b) can naturally be followed by (76), but (71a) can not.

- (71) Q: Què en saps de l'Enric?
 'Any news about Enric?'
 a. No en sé res, [de l'Enric]_{tail}. (CLRD)
 no cl know nothing, [of art Enric]_{tail}.
 b. [De l'Enric]_{link}, no en sé res. Però ... (CLLD)
 [Of art Enric]_{link} no cl know nothing. But ...
 (Catalan)
 (76) c. però la seva germana, s'í que l'he vist.
 but art his sister, yes that she'have-I seen.
 'But I DID see his *sister*.'

Until now, we have nothing in our binding theory for discourse topics which would explain the difference between links and tails. (46), repeated here, allows referent identical anaphors to be realised in either way.

(46) **Anaphoricty of Backgrounds** (1st version)

1. Links must stand in a \leq -relation to their antecedent.
2. Tails must stand in a \geq -relation to their antecedent.

In order to explain the difference in the behaviour of links and tails, I assume that links and tails have to be bound in different ways. I have already argued that links are intimately related to ^rd-topics. But tails do not seem to require such strict binding. They seem to access any matching given and salient antecedent, similar to pronoun-type anaphora. Let us express this hypothesis in the following way, as binding principles for links and tail.

(77) **Principle of link binding** (1st version)

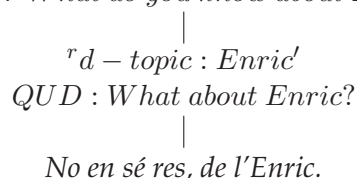
A link α must be bound by the ^rd-topic δ of the immediately dominating discourse node within which they are realised, such that $\alpha \leq \delta$.

(78) **Principle of tail binding**

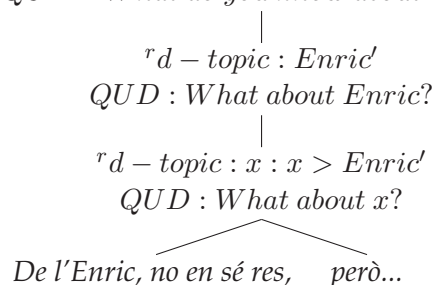
A tail β must be bound by an accessible and activated antecedent γ such that $\beta \geq \gamma$.

Let us see how this applies to (71). The tail case (71a) is easy to explain: The tail 'Enric' must simply be bound by an available antecedent, which in this case can be found in the overt context question. (71b), on the other hand, is more problematic because of the contrastive link. I will tentatively assume that it has the structure given in (79b).

- (79) a. QUD : *What do you know about Enric?*

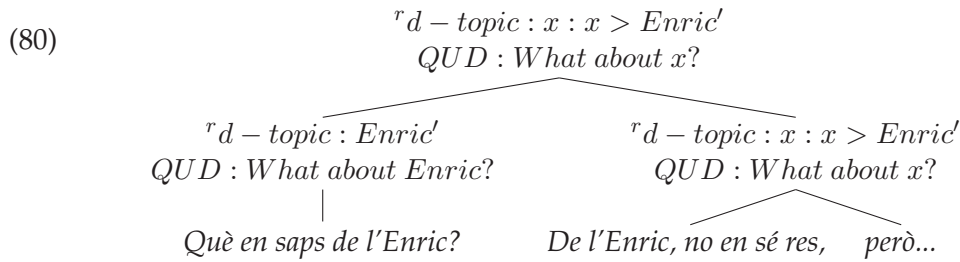


- b. (1st version) QUD : *What do you know about Enric?*

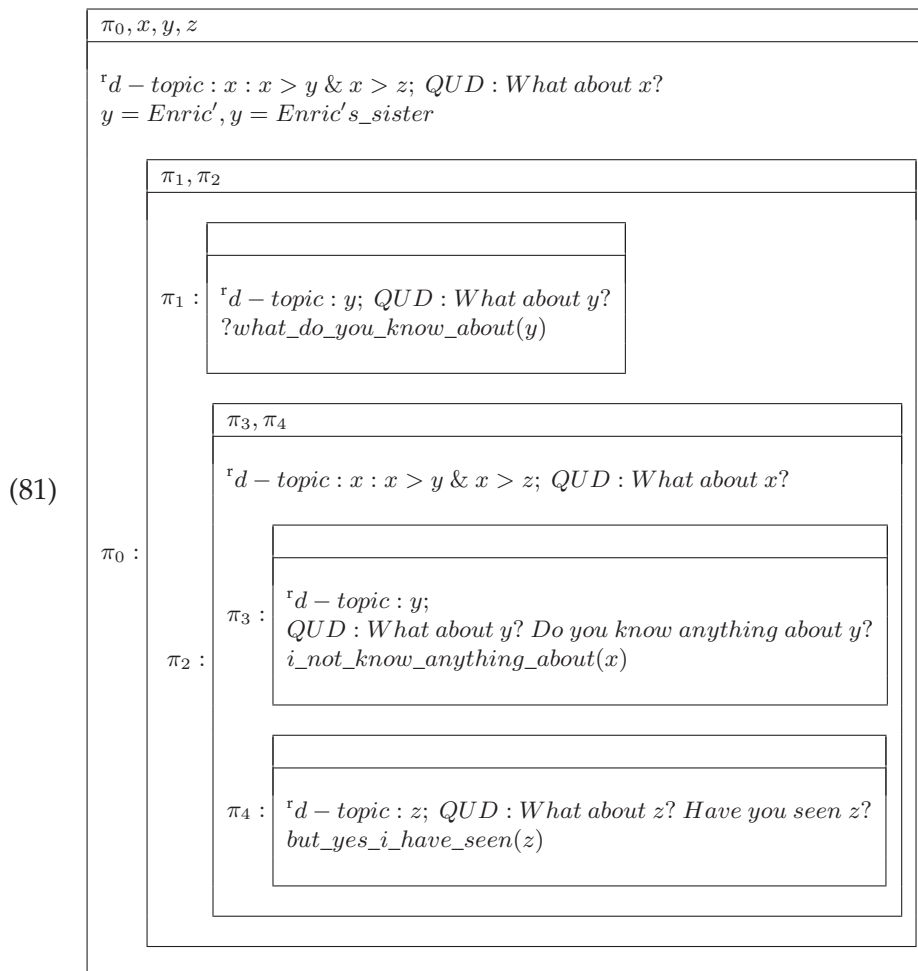


The key to the understanding of (71b) is to assume that at the moment of utterance, the ground is already prepared for a continuation like (76). In structural terms this means that the link realisation of 'Enric' signals that 'Enric' is part of a larger referent x (representing its contrast set). Although we may not be able to specify the exact nature of this larger referent x , we already know that a condition ' $x > \text{Enric}$ ' holds, i.e.

x is underspecified and may be further specified as any set of which 'Enric' is a part of. The contrastivity of Enric in (79b) is explained by the ^rd-topic x which both binds 'Enric' and any other referent y, such that y might stand in contrast to 'Enric' and y is the ^rd-topic of the next sentence. But, (79b) still violates (75), since the overt contrast question must have Enric' as its ^rd-topic, which is more specific than x. Considering the binding relations (lower ^rd-topic ≥ higher ^rd-topic) and the assumption that each (non-top-level) ^rd-topic must be bound (by a higher ^rd-topic), the structure of (71b) should rather be:



This discourse structure can also be expressed in a *segmented discourse representation structure*, visually more complex:



Let us consider the tree in (80): first of all, the contrastivity effect rules out that the link is identical to its binder x. Although on the surface it looks as if Enric' in (71b)/(80b)

is bound under an identity condition to its *surface linguistic* antecedent 'Enric' in the context question, under this analysis the identity condition disappears, requiring all links to be bound under a $>$ -condition. In this way we derive the contrastivity effect from the structure of the discourse. We must reformulate the principle of link binding as follows:

(82) **Principle of link binding** (2nd version)

A link α must be bound by the r d-topic δ of the immediately dominating discourse node within which they are realised, such that $\alpha > \delta$.

Isobar, (46) must now be changed to (83), since links are now not longer allowed to be bound under identity.

(83) **Anaphoricity of Backgrounds** (2nd and final version)

1. Links must stand in a $<<$ -relation to their antecedent. The antecedent must be an abstract r d-topic.
2. Tails must stand in a \geq -relation to their antecedent. The antecedent must be an abstract r d-topic.

The reformulated principle in (82) has a nice effect on the distinction between links and tails: they are now in complementary distribution. The impression that there are cases where both a tail and a link realisation result in the same interpretation is merely an illusion, since the contrastive binding of topics directly influences the structuring of the discourse.

So far we have used the terms *segment*, *node* and r d-topic in a rather informal sense. We shall now define them in a more formal way. I will assume that each discourse segment is represented by exactly one node in the discourse graph, that the graph is a representation of discourse segmentation and that each node in the discourse graph has a r d-topic associated to it.

(84) **Correspondence between nodes and segments / coherence of segments**

For any coherent discourse segment Σ there is a unique node X such that X dominates all nodes of Σ and X dominates only nodes within Σ .

(85) **Def: r d-topic:**

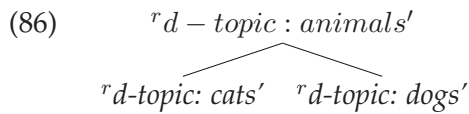
Each node X in the discourse graph has a r d-topic δ associated to it. δ must be of a referential type.

From (84) and (75) follows that: For each r d-topic δ of the list of r d-topics $\{\delta_1, \delta_2, \dots, \delta_n\}$ corresponding to each node Y_m of the list of daughter nodes $\{Y_1, Y_2, \dots, Y_n\}$ which are dominated by node X with the r d-topic δ_X : $\delta \leq \delta_X$. In other words, the r d-topic of a daughter node must be bound by the r d-topic of its mother-node under \leq .

(75) also makes the right predictions for cases like (53). Here *cats'* and *dogs'* are bound by *animals'*. The discourse segment is about *animals'* and not about, say, *dogs'*. The corresponding discourse tree is partially represented by (86).

(53) Q: Do you like animals?

- A1: [*cats*]_{link} are quite CUTE.
 A2: (But) [*dogs*]_{link} are HORRIBLE.



As a result of the necessity of ^rd-topics to be properly bound, we also need a rule which allows us to derive discourse trees like (79a), (80) and (86). There are two modes of incorporating a new discourse segment: Discourse attachment (structure preserving) vs. discourse adjunction (structure extending).

(87) **Principle of ^rd-topic attachment**

A new discourse segment Σ_1 with a ^rd-topic δ_1 may be attached to a node X representing a segment Σ_2 with a ^rd-topic δ_2 if $\delta_1 \geq \delta_2$.

(88) **Principle of ^rd-topic adjunction**

A new discourse segment Σ_1 with a ^rd-topic δ_1 may be adjoined above a node X_2 with a ^rd-topic δ_2 and below the node X_3 with a ^rd-topic δ_3 which immediately dominates X_2 iff $\delta_1 \geq \delta_2, \delta_3 \geq \delta_2$ and $\neg(\delta_1 \geq \delta_3)$.

(87) both explains the structure of (79a) and (86). Note that we have not eliminated binding under identity from the principle of ^rd-topic binding (75). Only the linguistic realisation of a referent as a link signals that anaphoric binding cannot apply under identity and requires a narrowing down of the ^rd-topic. If the ^rd-topic is not narrowed down, a link-realisation is neither necessary nor felicitous. Then the ^rd-topic will be realised by any other anaphoric element: a null pronoun, a pronoun or a tail, as in (71b). (88) creates discourse structures like (80). Both (87) and (88) respect (75).

Finally, we can derive QUD from links and tails as smaller units. (89) affects the binding between QUDs and ^rd-topics (which, in turn, may bind links), while (90) defines the the relation between QUDs and other salient material, including material which tails presuppose to be salient.

(89) **Relation between QUDs and ^rd-topics**

Any ^rd-topic δ of a node X must be part of the (possibly accommodated) QUD Q associated to X.

(90) **Relation between QUDs and activated referents (speculative)**

Any activated referent α of a node X must be part of the (possibly accomodated) QUD Q associated to X.

There is still one problem with the definition of (77): it seems to be too strong. As a consequence of (77) we would expect that no change of topic is possible throughout the whole discourse. This binding principle predicts an uncontrolled compositionality of ^rd-topics: If a node X_1 with ^rd-topic δ_1 dominates X_2, \dots, X_n , with the ^rd-topics $\delta_2, \dots, \delta_n$, then δ_1 is the join of $\delta_2 \dots \delta_n$ such that: $\delta_1 > \delta_2, \dots, \delta_1 > \delta_n$. In simple words this means that any referent which is the ^rd-topic of any part of the discourse would end up forming part of the topmost ^rd-topic, since the ^rd-topic would then be the join of all things we have been talking about throughout the discourse. This is counterintuitive and it is contradictory since referents of different types, e.g. individuals, kinds and properties,

may be ^rd-topics. But referents of different types cannot be combined in a join. If one discourse segment has *John*' as ^rd-topic and the next segment has *string instruments*' (a kind) as its ^rd-topic, there is no possible ^rd-topic which combines the two since there is no possible join of *string instrument*' (a kind) and *John*' (an individual).

There are also clear cases where the topic of a sentence is not bound by the ^rd-topic of the previous sentence (or any other segment it attaches to). One such case is what Asher (2004) calls the discourse relation of *background* (which in no case should be confounded with the term *background* in IS). Consider the following sequence.

- (91) Q: Who ordered what for lunch?
 A: a. John ordered couscous.
 b. Mary ordered broccoli curry.
 c. It is very good today.

The overt QUD of (91) is (91Q). Since John contrasts with Mary the common ^rd-topic of (91a,b) is the join of *john*' and *mary*'. Both sentences are subsumed under (91Q). (91c) should be attached to (91b), because *it* refers to the *curry*. But its ^rd-topic cannot be the same for the two sentences, since (91c) is not about *Mary*. The ^rd-topics shifts between (91b) and (91c) and the ^rd-topics of (91c) is not bound by the ^rd-topics of (91b), it is rather bound by another element of (91b), namely the *broccoli curry*. Asher, who assumes a propositional notion discourse topic, assumes on the basis of such examples, that some discourse relations, like the so called *background* relation in this case, license such topic shifts. I remain agnostic with respect to the role of discourse relations. We could also argue that topic shift, like the one observable in (91b,c), may lead us to infer that (91c) presents background information. The question of topic changes is very interesting, but I must leave it for further research, noting simply that such changes do not seem to be totally unpredicatable.

4.3 Contrastive foci and questions under discussion

One of the difficulties for any theory which explains IS on the basis of anaphoricity or givenness is the fact that sometimes an anaphoric element may be in focus. Consider (92) again, discussed by Schwarzschild, (1999).

- (92) Q: Who did John's mother praise?
 A: She praised JOHN.
 A': She praised HIM.

Here *John* is in focus, although it is given from the context question. Schwarzschild's explanation for this case is that the VP *praise John* is not given as a whole, although *praise* and *John* are given. If we think about this example in terms of *questions under discussion*, we could also argue for a slightly different explanation. (92A) with the phonological marking of *John* as focused presupposes that there is a question '*who did she (=John's mother) praise?*', which is actually the question given in (92Q). Now suppose we find this example in its written form and we do not know which word must be accented. Under the assumption that the sentence must have one main accent, and that this sentence must have a focus, we could go on trying all possible accentuation

patterns. *'She PRAISED John'* does not seem to fit into the context, since this version would presuppose a QUD *'what did she do to John?'* and there seems to be no way to make this question coherent with the over context question. The same is true for the same sentence with accent on *she*.

The problem becomes bigger in the next example, which I already discussed at the end of chapter 3:

- (93) A1: I know that Sue praised Mary's father.
 A2: But who praised Sue's Father?
 B: SUE [praised him]_{background}.
 B': #[Sue praised]_{background} HIM.

The problem here is that both *'Sue praised'* and *'him'* have an antecedent in the local context and should both count as given. I have argued in 3.3.3 that such examples lead the reader down the garden path, since on the basis of givenness a focusless parse can be derived which violates the requirement that all sentences have foci. In this concrete example the reader would notice that he has been lead down the garden path only when she arrives at the end of the sentence and has to re-parse the whole sentence in order to assign the right sentence focus to the first word. Remember also from 3.3.3 that it is possible to construct examples like (94), where more than a minimal amount of material must be assumed to be in focus, and which hence are not resolvable with Schwarzschild's AvoidF requirement. The choice of where to place the sentence focus seem not be solvable on the basis of givenness alone.

- (94) Q: I know that Sue praised Mary's father and gave him a present. But what did Mary do to him?
 A: Mary only [gave him a PRESENT]_{focus}.

With *questions under discussion* we have a further instrument which helps us to resolve IS. Although I have argued above that a definition of salience on the basis of QUDs leads to circularity, QUDs seriously constrain IS realisation patterns. In particular, if a QUD has to be introduced into the context via presupposition accommodation (by virtue of Roberts' rule (30)), such an accommodated QUD may not violate the coherence of the inquiry strategy. Consider what that would mean in the case of (93): (93B) would give raise to the presupposition of a QUD *'who praised him/Sues father?'*, which is actually the same as the overt context question (93A2). This means that the enquiry strategy is coherent. In contrast, (93B') would lead to an incoherent inquiry strategy: Applying Robert's (30) (93B') presupposes that there is a QUD *'What happened to Sue's father?'*, which is not congruent to any other QUD which was implicitly or explicitly given in the context.

Another classical example of contrastive foci is the following:

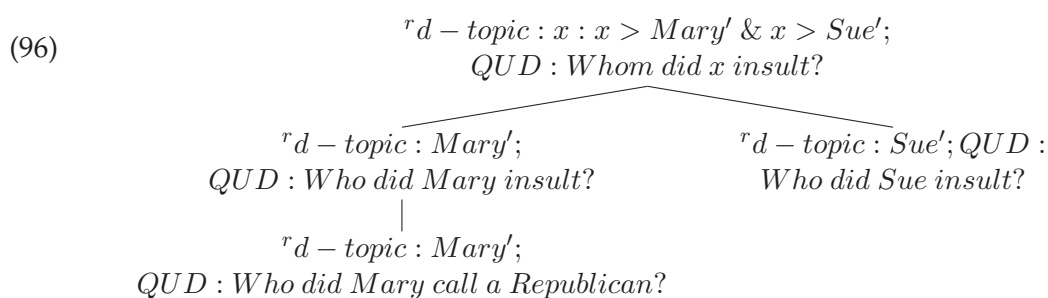
- (95) a. Mary called Sue a republican,
 b. and then she insulted her.

In this case the use of a referential version of discourse topic has the advantage of explaining the contrast relation between Mary and Sue. Let us see how the model

developed here applies to (95). First suppose we encounter this example in its written form, i.e. without any phonological marking. If we fail to capture the connection between calling someone a republican and insulting someone - under the intention that one calls someone a republican in order to insult her or him - then both of the pronouns can be taken as background anaphors. In this case only *insult* is left as a possible sentence focus and the focus accent would have to be realised on it. This IS correspond to the reading where Mary first calls Sue a republican (without intentions to insult her) and then insults Sue. Then the intonation pattern must be as follows:

(95) b' and then she INSUTED her.

The other reading is derived in the following way. If we capture the intention that [[call someone a republican]] = [[insult someone]], the verb '*insult*' will count as given. But since all three words of the sentence are given, we cannot place a main sentence accent by default on the basis of givenness. What is even worse is that the whole sequence would be given since '*she insulted her*' would be given as a whole through the antecedent '*Mary called Sue a republican*'. The way out of this dilemma is equating the subject pronoun *she* to the second available female singular antecedent, *Sue*. This variable assignment avoids the whole sequence in (95b) to be given (which would result in a focusless sentence). Doing so, we make the referent which was object in (95a) the subject of (95b). So signal the shift of the topic, *she* will be marked as a link, by means of a B-accent. *Sue*' is, by this marking as a link, also the ^rd-topic of the discourse segment which corresponds to (95b), which stands in contrast to the ^rd-topic of (95a), which is *Mary*'. We can now also derive a common ^rd-topic *x* for the two conjuncts (95a,b), such that *Mary*' < *x* and *Sue*' < *x*. The corresponding sub-QUD for the two conjuncts have to be inferred as '*Who did Mary insult?*' and '*Who did Sue insult?*'. This results in the discourse tree (96), with the phonologic realisation in (95):



(95) b' and then *she* insulted HER.

Finally, there are cases where a *given* constituent is realised as a focus because locality/salience rules out a background realisation. Under the current approach it would be nice if we could explain this also on the basis of DS. (10) above was such an example:

- (10) a. Avui el_ el nen té un sopar amb un restaurant amb tota la seva família.
 'Today the boy is having supper in a restaurant with his whole family.'
 b. i el gos, la granota i la tortuga s'han de quedar a casa.
 'and the dog, the frog and the turtle have to stay at home'
 c. i estan molt tristos,
 'and they are very sad.'

influences the salience of an antecedent referent. On the other hand, the linguistic realisation of information structure determines in important ways how a discourse tree is built. The realisation of a referent as a tail can determine the attachment point of a new discourse segment to an already established discourse tree. Once the attachment has taken place, the right frontier constraint blocks reference to antecedents in closed off discourse segments. The linguistic marking of a constituent as a link requires its referent to be contrastive to some other element. I have argued that the the referent for the link and the referent for any other referent which is contrasted to it must all be bound by a discourse topic represents the contrastive set. This discourse topic corresponds to a discourse segment which dominates all of the lower discourse segments in which the contrasting referents occur. This has an important effect on how the discourse itself is structured: if no discourse referent is given which can serve as a discourse topic for the whole segment - the segment that spans over the contrasted elements - this referent has to be created via accommodation. In parallel the tree structure of discourse has to be adjusted accordingly.

In addition to referential discourse topics, I assume that each discourse segment is associated to a question under discussion. The discourse topic and all other background elements must form part of this QUD. QUD are, however, a derived and not a primitive type of units. For that reason, it is allowed to be semantically complex, while referential discourse topics must be properly typed.

Chapter 5

Conclusions

In this dissertation I have argued that sentence backgrounds are anaphoric in a quite literal sense. The assumption that backgrounds are anaphoric elements seems to be one of the simplest hypothesis which can be made regarding information structure. According to this approach, information structure depends on discourse structure in the same ways as other anaphora types depend on it. Information structure has, in turn, important effects on the structure of discourse. The linguistic realisation of constituents as links and tails gives important clues to the parser on how a discourse must be segmented. The approach followed in this dissertation has the advantage that it builds on anaphoricity as a well-studied phenomenon and has to assume only a minimum amount of additional theoretical apparatus. Information structure can be explained largely along the lines of other anaphora phenomena. The main difference between background anaphors and pronoun-type anaphors is that the former may be highly descriptive. This high degree of descriptivity has two important consequences: first, it allows for background anaphors to match their antecedents only partially and, second, it gives background anaphors the ability to identify their antecedent from a larger set of competing antecedents, which, in turn, allows them to establish anaphoric links which are linearly more distant than pronoun type anaphors could do. I have argued that the additional apparatus which is needed to explain information structure in terms of anaphoricity follows precisely from this higher amount of descriptive content.

The account of information structure developed here can be integrated naturally in a theory of discourse structure. Information structure and discourse structure mutually constrain each other. The ability of a background anaphor to access its antecedent is affected to a large degree by the *right frontier constraint*, i.e. ultimately by the tree-structure of discourse. I have also shown that linguistically realised *links* play a more prominent role with respect to discourse structure in that they are bound by the topic of the discourse segment which dominates them. Their contrastive behaviour and the fact that they usually need to be more specific than their antecedent can be shown to follow from the organisation of discourse.

Since it is built on anaphoricity as a central ingredient, this approach raises, however, a series of issues, which are summarized here:

- 1) Sentence backgrounds can be arbitrarily complex (1.1.3), while other anaphora is restricted to certain semantic types, like entities, events or properties. How can we account for this asymmetry? And why can backgrounds be arbitrarily complex?
- 2) In certain cases anaphoric material can form part of the sentence focus (1.1.4). If the sentence background is defined as being anaphoric and the sentence focus is defined as the complement to the sentence background: how can we explain the anaphoricity of focal elements?
- 3) Often the referents realised by elements of the sentence background cannot be directly equated to the referent expressed by their surface antecedent (using a '='-relati-

on). In some cases the background element and the antecedent stand in a part-of relation (' \leq ' or ' \geq '), in other cases the background anaphor refers to an individual which belongs to a given *kind*. How can we explain these partial matches between background anaphors (links and tails) and their antecedents?

4) I have shown that a target referent may in some cases be realised as a background element while in other cases it must be realised as part of the focus. The focus realisation may be required even in the case a matching antecedent is given in the wider - but not in the immediate - context. So, how can we determine the cases in which such a focus realisation is necessary? And how does the distinct anaphoric behaviour of links and tails relate to the structure of discourse?

5) There are cases where the realisation of a discourse referent as a linguistic link (a sentence topic) strongly suggests that this referent is to be contrasted with another referent. I have shown that this contrastive relation requires a special discourse configuration, expressed in terms of a tree-structure. How can we explain the organisation of discourse with respect to these contrasted referents?

In order to address these questions I have made use of the following interrelated pieces of theoretical apparatus:

A) *The strict-anaphoricity hypothesis*: In section 3.1 I have argued that background elements are not different from other types of anaphora: semantically they must be properly typed and cannot be arbitrarily complex.

B) *The link/tail distinction* also helps to shed light on the resolution of information structure: sentence backgrounds are divided into two informationally atomic units which are realised as links or as tails, respectively. Links and tails behave differently with respect to how they relate to their antecedent (3.2.3). Links and tails also behave differently with respect to the structure of discourse (4.1.2), in that links require a contrastive relation between two discourse segments, while tails do not require this special discourse configuration.

C) *The typing constraint* on background anaphora and discourse topics: All atomic elements which play a role in the resolution of information structure must correspond to a closed set of semantic types, which includes entities, kinds, properties. There may be further types which must be included in this set, but none of these elements may be arbitrarily complex. This constraint holds for links and tails (3.1.2), as well as for discourse topics in the narrow sense (which I called here referential discourse topics or ^rd-topics, 4.1.2.2).

D) *Non-atomic or complex topical units*: Other units of information structure, like sentence backgrounds or *questions under discussion* are non-atomic units (3.1.2, 4.1.1.2), which do *not* need to be properly typed. But such elements must be derived from atomic element. Neither sentence backgrounds nor QUDs are monolithic blocks and they do not behave like monolithic blocks with respect to their antecedents.

E) *Part-of relations*: In 3.2 and 3.3 I argued that part-of relations play an important role in the resolution of links and tails. These part-of relations can be modelled within an algebraic model of the different domains of reference (3.3.2). Specifically an individual may form part of a set (which is technically treated as a referent for a plural individual) or a sub-kind can form part of a kind.

F) The organisation of a discourse is driven by *questions under discussion* (QUDs, 4.1.1.2) in the sense of Roberts (1996). Higher level questions are broken down into more detailed questions. The way more general questions are broken down into more specific questions is called a *strategy*. I have assumed here that the *strategy of interrogation* is highly non-deterministic, i.e. from the point of view of the parser, it is very hard to predict how a strategy evolves.

G) The *coherence constraint on the strategy of interrogation*: Although the strategy of interrogation is non-deterministic it is possible to determine whether a strategy is coherent or not. The coherence of a strategy is constrained by the discourse relations which hold between discourse segments and the set of given and salient discourse referent.

H) Following Roberts (1996) I assume that every utterance in a sentence presupposes that it answers a question which is being addressed (a QUD). Such QUDs must often be accommodated. But the accommodation of a QUD is constrained, in turn, by the coherence of the interrogation strategy: QUDs which violate the coherence of interrogation cannot be accommodated.

I) *referential discourse topics* (^rd-topics): Apart from the QUD associated to a discourse segment, each segment also has a referentially typed discourse topic which may enter binding relations. ^rd-topics are atomic units. A QUD corresponding to a discourse segment must also contain the corresponding ^rd-topic.

J) *The oracle* (Steedman, 2000b): The principle of parsimony (3.3.3) requires that each constituent within a sentence is interpreted as being anaphoric whenever possible. This has the effect of maximizing the coherence of discourse. The minimality of focus marking, which is assumed by Schwarzschild(1999) can be reinterpreted as maximality of givenness-marking. Parsimony applies the number of different referents which have to be assumed to exist within a discourse: whenever two discourse referents can be equated, it is more parsimonious to do so and less costly to assume that they are unrelated.

Let us turn now to the answer of the questions listed above:

1) The problem of arbitrarily complex backgrounds can be solved by the assumption that backgrounds are neither atomic units nor monolithic blocks (D). They are built out of smaller units which are constraint in type: links and tails (B). Both links and tails are subject to the strict *anaphoricity hypothesis* (A) and the *typing constraint* (C).

2) In order to explain anaphoric material in focus I have used a double strategy: First, according to the principle of parsimony, the *oracle* (G) will resolve anaphoric relations wherever possible. Whenever an anaphoric relation can be established, the marking of the corresponding constituent as part of the background is strongly preferred (J). The marking of an anaphoric element as focus may be required in order to avoid a sentence IS which contains no focus. In many cases, this results in the right resolution of the information structure of a sentence. But just as the garden path effect may lead to an easily processable, but wrong syntactic interpretation, this marking of elements as backgrounded, on the basis of anaphoricity may lead to an inadequate IS resolution. Such a conflict may arise when the information structure, which has been derived by simple application of anaphora resolution, conflicts with the coherence of the *strategy of interrogation* (H). This means that the wrongly derived IS of a sentence would require the accommodation of a QUD (F,H) which is not coherent with the *strategy of interro-*

gation pursued up to the given point in discourse. If such a conflict arises a different information structure of the relevant sentence has to be found.

3) Partial matches between background anaphora and their antecedents are not hard to explain because background anaphora may have a rich descriptive content, in contrast to pronoun-type anaphora. The descriptive content of a link or a tail allows it to match an antecedent even if the match is only partial (E, 3.3.1). The link/tail distinction (B) corresponds to the directionality of such part-of relations: links must be more specific than their antecedent (the referent for the link must be part of the referent for the antecedent), while tails may be equated to their antecedent or be more general than that. The fact that the referents of links must be part of their antecedent referent also plays an important role in determining the right discourse structure. The antecedent referent for links must represent the contrastive set, against which the link is contrasted. If two elements are contrasted against each other, they must occur within two separate discourse segments which are subordinate under one and only one higher discourse segment which has the contrastive set as its discourse topic (I, 4.2.2).

4) The realisation of referents as foci which are given in the wider but not the immediate context can be explained on the basis of salience, which, in turn, depends on the structure of discourse. If a referent is given in the wider discourse context but is not salient within the discourse segment in which it is to be realised, a link- or a tail-realisation is blocked and the referent must be realised as a part of the focus by default. On the other hand, background anaphora have more descriptive content than pronoun-type anaphora. For this reason they may refer further back than pronouns. But this '*further back*' may only mean that the higher distance may be measured in depth of embedding within a discourse tree. The constraints that discourse structure imposes on anaphoric relations are, however, the same for background anaphora and pronoun-type anaphora. In particular, anaphors may only find an antecedent which is salient within a node which is located on the right frontier of the discourse tree. If this fails, the referent must be realised as a focus.

5) Finally, the question of how links differ from tails can be answered as follows: link-realisation is coupled with a function in discourse structure (4.2.2). Links, but not tails, must be bound by a discourse topic. Tails must only be bound by the *question under discussion* which is being addressed within the discourse segment. The different behaviour of links and tails with respect to the part-of relations they can enter can be explained along these lines. Links (as linguistic units) mark that their referent (a discourse semantic unit) is to be related to their antecedent referent under a part-of relation, in that the link referent is part of the antecedent referent. This can be explained because the antecedent represents the contrastive set for the link, which is necessarily a referent which represents a 'superset'. Tails, on the other hand, never induce any contrastivity effect. They behave like ordinary anaphors. They may be either identical to their antecedent, or be more general. If they are more general, this will cause an over-answering of the question which is being addressed in discourse, but this over-answering monotonically entails a complete answer of the QUD, hence tails are licensed in such circumstances.

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