Abstract

Sentences with crossing coreference (Bach-Peters-sentences) are notoriously difficult to explain in a natural manner. An intriguing parallel with certain properties of log suggests a modification to Discourse Representation Theory which allows a simple and coherent explanation of these, and related, sentences.

The Problem

In English there is one type of sentence that has caused major problems for practically all linguistic theories that have tried to explain it, and none of the explanations put forward is very convincing. The sentences in question are those with crossing coreference, the so-called Bach-Peters-sentences. The standard examples are:

1) The hunter who shot at the lion that chased him
2) Every man who wants it will get the prize he deserves

What is the difficulty with this type of sentence? They contain two noun phrases each of which contains a pronoun that refers to the other noun phrase, and the first pronoun is furthermore a case of “backwards anaphora”, or “cataphora”. These sentences are admittedly rare, but sentences with simple crossing cataphora are quite frequent in real world English (Carden 1982). And Bach-Peters-sentences are nevertheless perfectly regular, and so they should find a natural explanation. Moreover, they are key examples of sentences where cataphora cannot, in principle, be replaced by anaphora (cf. also Mittwoch 1983). This is important because one of the standard approaches to cataphora has been to define it away as stylistic variant of anaphora, which can be “rectified” by a simple transposition. In other words: since we have to find a way to explain cataphora for Bach-Peters-sentences anyway, we can save us the trouble to devise such tricks for the simpler cases.

Are Bach-Peters-Pronouns Descriptive Pronouns?

The non-reducibility of cataphoric to anaphoric pronouns in Bach-Peters-sentences becomes clear if we try to explain them in the traditional manner. It seems that both of the two traditional interpretations of pronouns, the “descriptive” as well as the “deontational” one, fail to capture the intuitive truth conditions of Bach-Peters-sentences. In Transformational Grammar the descriptival approach is taken, and pronouns are always expanded to the surface syntax form of the noun phrase they anaphorically refer to (in other words, pronominalization is an obligatory cyclic rule). But then we get, for the example above, a double infinite embedding of relative clauses:

The hunter who shot at (the lion that chased)
  (the hunter who shot at (the lion that chased ...)))
hit the lion that chased
  (the hunter who shot at (the lion that chased ...)))

This analysis is patently useless. Karttunen shows (Karttunen 1971) that dropping the requirement that pronominalization is a cyclic rule alleviates the problem somewhat, but at a cost: it would make sentence 1 derivable from (at least) two different deep structures, viz. from the deep structure corresponding to the sentences

3) The hunter who shot at the lion that chased him
4) The lion that chased the hunter who shot at it

This would mean that 1 has to be ambiguous between the meanings of 3 and 4. This is what Karttunen assumes, but it is a highly dubious claim as Karttunen himself seems to feel (Karttunen 1971:167 f). Moreover, the structure of 1 could also be derived from a deep structure corresponding to

5) The hunter who shot at the lion hit the lion that chased the hunter

But this sentence is considered by many informants to be simply ungrammatical (Karttunen 1971:179), and it is not acceptable at all make the coreference relations that should obtain between the noun phrases. Finally, the assumption that 1 is three ways ambiguous between 3, 4 and 5 is unacceptable, too. In order to show this, and in order to understand better what these three sentences really mean, we can use a set of data bases (after Karttunen 1971) which either contain, or do not contain, well-defined references for the various definite noun phrases occurring in the example sentences. We will see that 1 is not ambiguous between 3 and 4, but that the three sentences have three distinct meanings which can be derived directly from their syntactic structure. This proves, at the same time, that cataphoric pronouns are irreducible in Bach-Peters-sentences. Let us first consider the definite noun phrase “the hunter who shot at the lion that chased him” (from 3) consisting of an embedding of two definite noun phrases. Since each singular definite noun phrase presupposes that there is a unique referent for it, this phrase can refer to a pair “hunter H - lion L” in the case where lion L is the only lion chasing hunter H, and this hunter H shot at this very lion L in the following data base (Karttunen 1971:166) there is one such pair.

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6) shoots

This rules out that other lions chase the hunter, but leaves open the possibility that the hunter shoots at other lions, that the lion chases other hunters and, in particular, that other hunters shoot at the lion. On the other hand, example 4, “The lion that chased the hunter who shot at it was hit by him”, is not interpretable in the data base given above. Its subject, “the lion that chased the hunter who shot at it”, fails to refer properly: There is only one lion for which there is a hunter we can call “the hunter who shot at it”, viz. lion 2 (the other two lions are both being shot at by more than one hunter), but lion 2 does not chase “the hunter who shot at it” (viz. hunter 3), and so the entire noun phrase fails to refer. A data base where there is a referent for this noun phrase could look like this:

7) The definite noun phrase “the lion that chased the hunter who shot at it” has a well-defined referent in any data base which contains just one configuration of the type:

Example 1 cannot be interpreted in either the first or the second data base. It is interpretable only in a data base which contains at most one configuration like 8 which combines restrictions 6 and 7:
But this is the point where other people disagree. McCawley (McCawley 1980), McCawley's suggestion: Referential indices define the relationship that exists between the different objects talked about in overall sentences should not be cast in terms of First Order Logic, but rather in terms of the for instance, argues (for other reasons), that the semantic representation of sen-
determined by the nonn phrases. A sentence such as "The man killed the sentence, but these objects would be represented independently by referential indices are “identified” by the noun phrases in the sentence, i.e. their values are
descriptions] could be eliminated by a more clever use of variables, especially
respectively. This is a very unattractive way to express this sort of thing, and
But in cases 11 and 12 part of the expression must be repeated, namely the one
The main syntactic difference between the three example sentences is the way in which the different full noun phrases are embedded in each other. In particular,
in the Bach-Peters-sentence there are no embedded full noun phrases; the only embedded noun phrases are pronouns ("who shot at it", "that chased him"). This kind of distinction is lost in McCawley’s original notation, which is the reason why he has to claim that the examples sentences are all synonymous. Dik’s first (and main) modification of McCawley’s notation makes sure that this, crucial, distinction is not lost. The way to achieve this goal is by introducing what might be called (not Dik’s expression) “announced variables” to take the place of McCawley’s referential indices, which are constants. The annotation of a variable indicates how the value of the variable is to be computed. Thus "x2"(to x2= iota z: (lion(Z) A chased(Z,Y))) is an announced variable. This would give us, for 3,

Dik’s Modification of McCawley’s Theory

This approach has been criticized on different counts. First, it is not clear at which point referential indices may begin to be turned into pronouns rather than being replaced by identifying expressions. Second, and more importantly, McCawley’s suggestion allows all these sentences (1, 3, and 4) to be derived from the same semantic representation, which would require that they are all synonymous. Hence all the problems we encountered with the descriptive interpretation of pronouns are back with a vengeance. Does that mean that we have to return to the standard First Order Logic representation with all its unsatisfactory features (repetition of components)? Dik 1973 suggests a modification of McCawley’s approach that takes care of the empirical fact that the three sentences mentioned above are not synonymous.

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An Unexpectedly Simple Solution Suggested by Second-Order Prolog Constructs

As it turns out, the additional interpretation rule that makes the correct interpretation of Bach-Peters-sentences virtually "fall out" is the definition of second-order operators, and the general interpretation rules of Horn Clause Logic, as implemented in standard Prolog. Instead of "\( \exists \)-iota \( X \): (\( Y \) we use "setof(X,Y,Z)"), where the uniqueness requirement is built into the definition of "setof", and singularity is enforced by requiring the result list to consist of exactly one element. Annotated variables on the other hand are "multiplied out" in the relational spirit of Prolog, i.e. instead of "predicate(X,Y,Y=Z)" we write "predicate(X,Y,Y=Z)". Combining these two steps we got, for the expression above,

\[
\text{hit}(\text{TH}, \text{TL}), \\
\text{setof}(\text{Y}, (\text{hunter}(\text{Y}), \\
\text{setof}(\text{L}, (\text{lion}(\text{L}), \text{chased}(\text{L}, \text{Y})), \{\text{X}2\}), \\
\text{hit}(\text{X}2, \text{Y2})), \{\text{X}1\})
\]

or, with a more suggestive choice of variable names and a more efficient ordering of the goals

\[
\text{setof}(\text{H}, (\text{hunter}(\text{H}), \text{shot}(\text{H}, \text{TL})), \{\text{TH}\}), \\
\text{hit}(\text{TL}, \text{TH}).
\]

Now the desired truth conditions come out correctly. We can see this if we treat 18 as a Prolog query: We find, first, a hunter \( \langle \text{TH} \rangle \) which shoots at something \( \langle \text{TL} \rangle \). Then we check whether this entity is identical with the set of exactly one item \( \langle \text{TL} \rangle \) that is chased somewhere \( \langle \text{TH} \rangle \) which must then turn out to be identical with the hunter who is the only such hunter \( \langle \text{TH} \rangle \). Finally we check whether this hunter also hits this lion. The other sentences are represented the same way; 4 and 1 (the Bach-Peters-sentence) give

\[
\text{setof}(\text{L}, (\text{lion}(\text{L}), \text{chased}(\text{L}, \text{TH})), \{\text{TL}\}), \{\text{TH}\}), \\
\text{hit}(\text{TH}, \text{TL}).
\]

Now we get, without any additional stipulations, the three different interpretations for the three example sentences. The sentences are neither collapsed into one single meaning representation (with three synonymous surface sentences), as with McCawley’s approach, nor into two different ones (with two distinct and unambiguous, and one ambiguous, surface sentence), as with Kartmann’s approach. The simple fact that in Bach-Peters-sentences the full definition of the implicit quantifiers is the 

\[
\text{hit}(\text{X}1, \text{X}2), \\
\text{setof}(\text{L}, (\text{lion}(\text{L}), \text{chased}(\text{L}, \text{TH})), \{\text{TL}\}), \{\text{TH}\}), \\
\text{hit}(\text{TH}, \text{TL}),
\]

Now it is clear why we need not repeat any expressions in the representation of the example sentences, and yet the variables all get properly bound: In the example above, the two terms of \( \text{18} \) (i.e. the setof-expression and the expression \( \text{hit}(\text{TH}, \text{TL}) \)) are part of the same clause, and values for variables created in either of them will spread to the other. In particular, the value which the variable \( \text{TL} \) takes during the evaluation of \( \text{hit}(\text{TH}, \text{TL}) \) is still available during the evaluation of the embedded \( \text{setof}(...) \). And in this the Prolog setof-operator differs 

\[\text{plus(times(3,2)))}\]

in a relational language, we must "multiply out" the embedded expression and create auxiliary variables for the intermediate results, e.g. \( \langle X \rangle \) and \( \langle Y \rangle \) in \( \text{times}(3,2,\times(X,Y)) \)

Thus we had to use 20, with auxiliary variables \( \langle \text{TH} \rangle \) and \( \langle \text{TL} \rangle \), instead of a functional representation such as, for instance,

\[\text{hit(set(TH, (Hunter(H), shot(H, L)), ...))}, \\
\text{set(L, (lion(L), chased(L, TH))), ...)}
\]

These "auxiliary" variables are situated on the same level of embedding (by definition: their purpose is to flatten embeddings). Co-occurrence of such variables on the same level of embedding maps, in simple cases, onto concatenation \( \langle `'` \rangle \) in surface structure: Thus the following occurrences of variables \( \langle \text{TL} \rangle \) and \( \langle \text{TH} \rangle \) in 20

\[\text{hit(X1, X2)}, \\
\text{setof}(L, (...), \{\text{TH}\}), \\
\text{setof}(H, (...), \{\text{TH}\}), \\
\text{setof}(L, (...), \{\text{TL}\}), \{\text{TH}\}), \\
\text{hit}(\text{TH}, \text{TL}).
\]

must map onto a pronoun \( \langle \text{The hunter who shot at it} \rangle \). A problem arises when we try to translate 19 back into English.

\[\text{hit(X1, X2)}, \\
\text{setof}(L, (...), \{\text{TH}\}), \\
\text{setof}(H, (...), \{\text{TH}\}), \\
\text{hit}(\text{TH}, \text{TL}).
\]

It is done right to translate these variables from, say, left to right (as in the case of example 19, where the first variable \( \langle \text{TH} \rangle \) is a level-crossing occurrence), it is done right to left. This requires that the surface verb form be passivized but it gives the grammatically correct ordering of full noun phrases and pronouns (i.e. we get the origin

\[\text{hit(X1, X2)}, \\
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Mapping Variables onto Pronouns

If we want to generate surface sentences from these structures, we must distinguish between two uses of variables: First there are those uses which are merely an artefact of the relational way of representing functional application, and, second, there are those that correspond to true anaphoric relations in language. The first use is simple: If we want to represent functional applications such as

\[\text{hit(X1, X2)}, \\
\text{setof}(L, (...), \{\text{TH}\}), \\
\text{setof}(H, (...), \{\text{TH}\}), \\
\text{setof}(L, (...), \{\text{TL}\}), \{\text{TH}\}), \\
\text{hit}(\text{TH}, \text{TL}).
\]

“hit(\text{TH}, \text{TL})” takes during the evaluation of “\text{hit}(\text{TH}, \text{TL})” is still available during the evaluation of the embedded “\text{setof}(\text{L},(\text{lion}(\text{L}),\text{chased}(\text{L}, \text{TH})), \{\text{TL}\})”, and later during the evaluation of “\text{hit}(\text{TH}, \text{TL})”.

Now the desired truth conditions come out correctly. We can see this if we treat 18 as a Prolog query: We find, first, a hunter \( \langle \text{TH} \rangle \) which shoots at something \( \langle \text{TL} \rangle \). Then we check whether this entity is identical with the set of exactly one item \( \langle \text{TL} \rangle \) that is chased somewhere \( \langle \text{TH} \rangle \) which must then turn out to be identical with the hunter who is the only such hunter \( \langle \text{TH} \rangle \). Finally we check whether this hunter also hits this lion. The other sentences are represented the same way; 4 and 1 (the Bach-Peters-sentence) give

\[
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Now we get, without any additional stipulations, the three different interpretations for the three example sentences. The sentences are neither collapsed into one single meaning representation (with three synonymous surface sentences), as with McCawley’s approach, nor into two different ones (with two distinct and unambiguous, and one ambiguous, surface sentence), as with Kartmann’s approach. The simple fact that in Bach-Peters-sentences the full definition of the implicit quantifiers is the
Second-Order Prolog Constructs and Discourse Representation Theory

The painless way in which the correct truth conditions of Bach-Peters-sentences and the related sentences virtually fall out of the standard Prolog interpretation rules and the definition of the second-order set-of-operator is not just a lucky coincidence. It is rather another case of the intriguing parallel between Natural Language and Horn Clause Logic which has become particularly clear in Discourse Representation Theory (DRT). The main hypothesis of DRT is that noun phrases (and articles) have no quantificational force on their own but are implicitly quantified by the context. This allows DRT to explain, with remarkable ease, so-called donkey-sentences, a type of sentence that does not yield to the traditional interpretation of noun phrases as quantified statements. The correspondence between the logic underlying DRT and Horn Clause Logic is, in this respect, almost one-to-one. In DRT, indefinite noun phrases introduce discourse referents which are quantified by the (discourse) context in the same way as variables in Horn Clause Logic are implicitly quantified by the (clause) context.

How do Bach-Peters-sentences fit into DRT? First, we notice the parallel between McCawley’s ideas and DRT: His “referential indices” correspond, in their intended function, to the discourse referents in DRT, and “propositions” correspond to the DRT “conditions” on discourse referents. In the Prolog version of DRT’s modification of McCawley’s ideas, discourse referents correspond to the value of the third argument in a set-of-operator, and the “conditions” of a Discourse Representation Structure (DRS) to the expression(s) in its second argument. All this applies, for the time being, only to definite noun phrases and their representation. If we want to incorporate this into DRT, we must first provide for the possibility to explicitly represent the embedding of noun phrases. This kind of explicit embedding was the main reason why we got the right truth conditions in the Prolog representation of the example sentences. We must, in other words, be allowed to use embedded “conditions” in a DRS. Traditional DRT allows for the embedding of entire DRSs, but not of individual conditions. While a sentence like “If John owns a donkey that dislikes him, he bites it” is traditionally represented as a flat DRS like

| noun phrases | discourse referents |
|-------------|-------------------|
| John        | John (John)       |
| donkey      | donkey (donkey)   |
| owns        | owns (owns)       |
| dislikes    | dislikes (dislikes) |
| bite        | bite (bite)       |

(cf. Kamp 1981, Kamp 1983, Frey 1983, Guenthner 1983, Guenthner 1985, Kolb 1985, Guenthner 1986, Pinkal 1986, Root 1986) this will not do for the sentences with embedded definite noun phrases considered above. We must somehow represent this embedding. And we must, obviously, provide for the interpretation rules to use them. These rules will crucially rely on Prolog’s meta-call facility to implement the double use of embedded sexpressions, as data structures on the one hand and as “executable procedures” (i.e. as provable assertions) on the other.

In traditional DRT mostly indefinite and universal noun phrases (and proper names) are used while the Bach-Peters-sentences considered above contained definite noun phrases. But for some of them there are versions with indefinite noun phrases, too, and all of them have corresponding plural versions. In order to cover all these cases we must introduce, instead of the “conditions” of DRT, generalized set expressions without the totality implication of Prolog’s “setof” (cf. also Webber 1983). We use set(Def,Card,Grd,Var,Int,Ext), where “Def” can take the values “def” (init) or “indef” (init), and “Card” either an explicit number, “plur”, or a quantifying expression (“all”, “some”, etc.). “Grd” gives the gender of the main noun. “Var” (table), “Int” (concat) and “Ext” (concat) correspond to the three arguments of the set-of-operator. The variables “Ext” can now stand for sets as well as for individuals.

Mapping Pronouns onto Variables

So far we have mentioned how pronouns correspond, statically, to certain semantic objects of our modified DRSs (i.e. to the level-crossing occurrences of variables). But it is one of the main goals of DRT to give a unified account of what the procedures that actually perform the resolution of pronouns should look like. This problem is much harder than it seems, i.e. the mapping of level-crossing variables onto pronouns. The central idea used here by DRT is simple (it goes back to Karttunen, together with the term “discoarse referent”): Indefinite noun phrases in “assessive” contexts create discourse referents which “live on”, and which can be accessed by anaphoric expressions from points later in the sentence or discourse. Discourse referents, however, are created by indefinites in universal, conditional, and negative contexts, “die off” when the sentence in which they occur is processed. This idea corresponds closely to Prolog’s concept of variables and Skolem constants (the latter standing for existentially quantified variables): During the interpretation of a program variables remain accessible by name within the clause where they occur. This corresponds to the limited life-span of discourse referents created in universal, conditional, and negative contexts. For Skolem constants in Prolog, however, the scope is the entire program; they “live forever”, in the same way as discourse referents created by indefinites in assessive contexts. And whenever a (definite) pronoun or definite noun phrase is encountered, a suitable antecedent must be located among the discourse referents still “alive”. Its value is then replaced by the value of the discourse referent found. If several pronouns access the same discourse referent, they get, of course, the same value. This is the DRT counterpart of unification.

If we want to have, in our modified notation, discourse referents “float on the surface” of the corresponding DRSs, accessible for later anaphoric reference, we could write, for the indefinite version of 3, viz. “A hunter who shot at a lion that chased him but hit it”.

19a) [TL,Ti]

set (indef1,1, meso, B, (hunter (H)), shot_at (H, TL)),
set (indef1, meso, L, (lion (L)), chased (L, TL)), Ti)

hit (TL, Ti)

But there are fundamental differences between the treatment of variables in Prolog and DRT: During the interpretation of a Prolog program, bindings of a given variable spread throughout a clause to all occurrences of the same name, forwards and backwards. DRT, however, allows only forwards, “anaphoric”, spreading of values. Since a pronoun is processed as soon as it is encountered, it can “look for” anecedents exclusively in the DRSs built up by the preceding discourse. The interpretation procedures of DRT thus implement, implicitly, the syntactic rule that a pronoun can refer anaphorically to a preceding noun phrase that c-commands it. Because this is, at the same time, the only case where anaphora is allowed, these interpretation rules block, correctly, cataphora from the pronoun to the indefinite noun phrase in 3.

23) He said that a boy had taken the book.

But legitimate cases of cataphora, such as those in Bach-Peters-sentences, are blocked by these interpretation rules of DRT; as well. Hence we must weaken the accessibility restrictions for anaphoric pronounal references somewhat, but not too much: If we modelled them on Prolog’s unrestricted variable sharing, 23 would go through in its coreferential reading.

Accessibility rules of DRT not only block certain correct interpretations, they also allow certain blatantly incorrect ones. They would allow, for instance, the sentence above with a definite noun phrase, i.e.

24) He said that the boy had taken the book.

He must say that a donor that dislikes him, he bites it.

to get an interpretation where pronoun and definite noun phrases are coreferential. Why? The correct interpretation of this sentence (no coreference between “he” and “the boy”) requires that the definite noun phrase will be able to find an antecedent among the pre-existing discourse referents. But then the sentence-initial “he” would be equally capable of accessing them, and this would allow the prohibited coreferential, cataphoric, reading of the “he” (i.e. “pseudo-cataphora” via a common antecedent). The same thing holds for “He hit the lion that chased the hunter who shot at it”.

The prohibited reading of this type of sentence can be ruled out on the basis of purely syntactic information. The standard rule about pronouns says that a pronoun cannot be coreferential with an noun phrase if it both precedes and c-commands it. This rules out the cataphoric use of a pronoun if it c-commands its target noun phrase but it allows cases of cataphora such as

25) When he got up, John felt hungry.

(which are reducible to anaphora) as well as Bach-Peters-sentences (which are not), but it blocks the prohibited coreferences in “He hit the lion that chased the hunter who shot at it” and “He said that the boy had taken the book”.

Mittwoch (1983) has shown that these purely syntactic criteria are not sufficiently general to cover all relevant occurrences of cataphora. In many cases, discourse considerations are needed to explain why cataphora is allowed. The pronoun can occur, for instance, in a sentential constituent which is demoted, by explicit discourse subordination markers, to a lower position than warranted by syntax. That is, in

26) I haven’t seen him yet but John is back.

(from Mittwoch 1983) the “but” functions as an overt marker of topicality for the second sentence, denoting the first sentence, and in

27) He may not represent the US at the United Nations anymore, but that does not mean that Andrew Young has slowed his pace.
(from Macleod 1984, quoting from "Time") the "but", together with the modal "may", even manages to make categorapha acceptable from a sentence initial subject position (at least in journalese). The common element of all these examples of categorapha pronouns is that they occur in discourse conditions. In simple names this coincides with sentential conditions (Cf. etc.), and very often with sub-sentential conditions (in particular with postmodifiers of noun phrases, such as restrictive relative clauses, prepositional phrases, or nonfinite clauses). But this is complicated by the fact that the "antecedent" of categapha must be definite if the sentence is specific. Compare:

28) ?? A hunter who shot at it hit a lion that chased him
29) A hunter who shot at it hit the lion that chased him
30) ?? When he was poor a farmer tended to overlook his donkey
31) When he was poor the farmer tended to overlook his donkey

In general (and in many journalese) statements this restriction does not hold. The following sentences are fine although the "antecedent" norm phrases are indefinite:

32) A hunter who shoots at it will hit a lion that chased him
33) If he is poor a farmer will tend to overlook his donkey

What seems to happen here is that, intuitively speaking, the categapha pronoun sets up an "expectation" for a following noun phrase which is specific or non-specific, depending on the specificity of the conditional context in which the pronoun finds itself. The specificity of the personal context is determined (roughly) by the aspect of the verb there: "who shoots" vs. "who was poor", etc. A specific expectation requires a definite noun phrase or a proper name as its "antecedent", while a non-specific one accepts either an indefinite or a definite noun phrase.

**Required Modifications to Discourse Representation Theory**

How could DRT incorporate this kind of information in order to determine more reliably the range of grammatical anaphora and categorapha, while ruling out the illegal coreferential reading in sentences like: "He said that the boy had taken the book"? The following is a list of requirements for an implementation that would take those additional conditions into account: As a traditional DRT, the incoming sentence opens a new IMS, which defines the space where all newly created discourse referents can survive. Noun phrases create set expressions (the "conditions" of standard theory): Indefinite and definite noun phrases give rise to normal set expressions, while pronouns create set expressions of a special type. Indefinite noun phrases give rise, in addition, to discourse referents, which are deposited in the IMS under construction. Traditional DRT has proper names create discourse referents, too. Whether this is the best possible decision is open to debate. It would, in many respects, be more consistent to treat proper names on a par with definite noun phrases. Discourse referents should contain all the information that can become relevant for the resolution of pronoun anaphora, i.e. at least an nouns and references. Definite noun phrases without conditional modifiers, as well as those derived from definite pronouns, are evaluated as soon as they are created, i.e. they try to find their antecedents among the pre-existing discourse referents. Expressions for pronouns whose antecedents have been found are removed, once they have done their duty as value-sharing channels. So far nothing really new.

But now the first modification of standard theory is needed: Definite full noun phrases are not allowed to look for their antecedents inside the IMS still under construction, whereas pronouns may do so. Second, when any definite noun phrase (full noun phrase or pronoun) has found the correct discourse referent, it drags it into the IMS under construction. These two changes make sure that two full noun phrases within the same clause are never interpreted as coreferential. They also block categapha in "He said that a boy had taken the book" (the "he" has dragged the appropriate discourse referent into the IMS, where it is "invisible" to the subsequent "the boy"). And, finally, it brings a discourse referent accessed by a definite noun phrase into focus and makes it the prime candidate for subsequent anaphoric reference by pronouns. The third modification to standard DRT is that discourse pronouns in non-generic contexts require definite noun phrases as antecedents (see examples 28 to 31), discourse referents must also carry information about the definiteness of the noun phrase from which they were derived. Set expressions derived from pronouns will use this information to determine whether a given discourse referent is a possible antecedent. The fourth modification, finally, takes care of categorapha. Whenever an expression denoting a condition (on the discourse, sentence, or sub-sentential level) is encountered, no embedded DRSs are created (as it is done in standard DRT for "if"- and "every"-sentences) and the production of discourse referents goes on, but evaluation of all new set expressions is prevented. In particular, no further attempts at anaphora resolution are made, and all pronouns encountered from now on are stored in the DRS under construction as unvaluated set expressions. It is only when the end of the clause is reached that unvaluated set expressions are processed. Among the set expressions and discourse referents "in suspended animation" within a DRS (for reference (backwards and forwards) is permitted, as long as the conditions outlined above are fulfilled. This allows categorapha to be modelled, while the classical syntactic restrictions (categorapha only from a non-commanding constituent) are subsumed. Lastly, those discourse referents that are allowed to live (from assertive, i.e. non-conditional, contexts, and those that were dragged in from the outside) are released into the universe of discourse referents.

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