Presuppositions as Anaphors Revisited*

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Abstract

Van der Sandt's theory of presuppositions-as-anaphors has been argued to be the empirically most adequate theory of presupposition projection on the market. One of the main differences between Van der Sandt's approach and its main competitor, the 'contextual satisfaction' approach, lies in the treatment of the so-called *partial match* phenomenon. In this paper, we show that the distinction between partial and full matches should be a central element of any theory of presupposition projection. However, we also argue that Van der Sandt's own formal theory, as it stands, does not offer an adequate treatment of partial matches. We then propose a modification of his formal theory, which will be argued to be more general, formally more precise, and empirically more adequate than its predecessor.

1 Introduction

Van der Sandt (1992)'s theory of presuppositions has been argued to be the empirically most successful theory on this subject available today (see e.g., Beaver 1997:983). The crux of Van der Sandt's approach is the idea that, in many respects, presuppositions behave as anaphors. A consequence of his *presuppositions-as-anaphors* view is that the notorious *projection problem for presuppositions*[1] can be reduced to the problem of resolving anaphoric pronouns. More concretely, Van der Sandt argues that presuppositions can be handled using the same mechanism which resolves anaphoric pronouns in *Discourse Representation Theory* (DRT, Kamp & Reyle 1993).

The main competitor of Van der Sandt's approach might be dubbed the *contextual satisfaction approach to presuppositions*, which has its roots in the work of Karttunen and Stalnaker, and of which Heim (1983, 1992) and Beaver (1992, 1995) are the modern (i.e., dynamic) hands on the torch. The central idea of this approach is that the presuppositions of a sentence must be entailed by the context

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[1]Langendoen & Savin (1971: 54): "*how [are] the presupposition and assertion of a complex sentence (...) related to the presupposition and assertion of the clauses it contains?*"

of interpretation in order for this context to *admit* the sentence. When Van der Sandt (1992: 349-351) compares his approach to the contextual satisfaction approach, he claims that the difference between the two approaches comes out most clearly when considering what, following Van der Sandt, might be called *the partial match phenomenon*, and of which (1) is one example.

(1) If John has an oriental girlfriend, his girlfriend won't be happy.

The possessive description *his girlfriend* triggers the presupposition that John has a girlfriend. According to Van der Sandt, this example displays a genuine ambiguity between two readings, depending on whether *his girlfriend* refers to *an oriental girlfriend* or not. The two readings may be paraphrased as (2.a) and (2.b).[2]

(2) a. If John has an$_i$ oriental girlfriend, she$_i$ won't be happy.
b. John has a$_j$ girlfriend and if he has an$_i$ oriental girlfriend (as well), she$_j$ won't be happy.

Van der Sandt claims that this is exactly what his theory predicts, while the satisfaction approach *only* gets the first reading; after all having an oriental girlfriend entails having a girlfriend.[3] However, if we apply Van der Sandt's formal theory to examples such as (1), as we will do below, we find that there is a discrepancy between his intuitions about these partial match examples and the predictions made by his formal theory. In this paper we will try to resolve this discrepancy.

2 Van der Sandt: presuppositions as anaphors

But first, let us say something about the approach to presuppositions presented in Van der Sandt (1992). Consider example sentence (3), discussed by Van der Sandt (1992:360/1) and its representation (DRS 1).

(3) If John has a child, his child is happy.

(DRS 1)

$$\begin{array}{|l|}\hline x \\ \hline x = john \\ \begin{array}{|l|}\hline y \\ \hline child(y) \\ poss(x,y) \\ \\ \hline\end{array} \Longrightarrow \begin{array}{|l|}\hline \\ \hline happy(z) \\ \partial \begin{array}{|l|}\hline z \\ \hline child(z) \\ poss(x,z) \\ \hline\end{array} \\ \hline\end{array} \\ \hline\end{array}$$

[2] Van der Sandt (1992:350/1) provides extra evidence for this ambiguity by showing that different continuations can eliminate one of the readings. Thus, continuing (1) with *She has always been rather jealous* (Van der Sandt 1992: 351) eliminates the (2.a) reading in favor for (2.b). Continuing (1) with *But if he has one from France, ...* will eliminate the (2.b) paraphrase.

[3] This is indeed the case for the straightforward conception of the satisfaction approach. However, Zeevat (1992:387) claims that it depends on the *representation* of the presupposition whether it is entailed or not. Zeevat does not make these ideas more precise (nor, to the best of our knowledge, does anyone else).

The consequent of the conditional contains an embedded DRS, representing the presupposition that John has a child, triggered by the possessive definite *his child*. We mark a DRS as presuppositional by prefixing it with a ∂. The ∂ operator is due to Beaver (1992), but in the present paper it is only used to syntactically distinguish presuppositional DRSs from ordinary, assertional ones. Now Van der Sandt's presupposition resolution algorithm is applied to this DRS, and starts looking for a suitable and accessible antecedent for the presupposition (as it would do for an anaphoric pronoun). Obviously, the discourse referent introduced for *a child* (i.e., y) is the ideal candidate. So, the presupposition can indeed be bound. Binding a presupposition goes as follows: the presuppositional DRS is removed from the DRS where it originates (the *source DRS*, for short), and merged with another DRS (henceforth the *target DRS*), namely the DRS which introduces the antecedent to which the presupposition is bound. Furthermore, this target DRS is extended with an equality condition which equates the referent introduced in the presuppositional DRS with the referent of the antecedent. In this way the anaphor is 'absorbed' by the antecedent (Van der Sandt 1992: 349). By binding the presupposition, (DRS 1) is transformed into (DRS 2), and this DRS can be paraphrased as *if John has a child, it is happy.*

(DRS 2)

$$\begin{array}{|l|}\hline x \\ \hline x = john \\ \\ \begin{array}{|l|}\hline y \\ \hline child(y) \\ poss(x,y) \\ \hline \end{array} \quad \Longrightarrow \quad \begin{array}{|l|}\hline \quad \\ \hline happy(y) \\ \\ \hline \end{array} \\ \\ \hline \end{array}$$

A *difference* between presuppositions and pronouns shows up when there is no suitable and accessible antecedent. In that case, a presupposition can be *accommodated*. Consider the following example with its associated DRS:

(4) If John has an oriental girlfriend, his son is happy.

(DRS 3)

$$\begin{array}{|l|}\hline x \\ \hline x = john \\ \\ \begin{array}{|l|}\hline y \\ \hline oriental(y) \\ girlfriend(y) \\ poss(x,y) \\ \\ \\ \hline \end{array} \quad \Longrightarrow \quad \begin{array}{|l|}\hline \quad \\ \hline happy(z) \\ \\ \quad \partial \begin{array}{|l|}\hline z \\ \hline son(z) \\ poss(x,z) \\ \hline \end{array} \\ \\ \hline \end{array} \\ \\ \hline \end{array}$$

Again, the resolution algorithm will look for an accessible and suitable antecedent to bind the presupposition that John has a son. There are two accessible antecedents (John and his oriental girlfriend) but neither can qualify as suitable. Hence we *accommodate* the presuppositional DRS. If certain conditions are met,[4] accommodation takes place in the main DRS (see Van der Sandt 1992: 345 for explanation). Technically, accommodating a presuppositional DRS amounts to removing it from the source-DRS and merging it with the target DRS (which —under normal circumstances— is the main DRS). Thus:

(DRS 4)
$$
\begin{array}{|l|}
\hline
x, z \\
\hline
x = john \\
son(z) \\
poss(x,z) \\
\\
\begin{array}{|l|}\hline y \\ \hline oriental(y) \\ girlfriend(y) \\ poss(x,y) \\ \hline\end{array} \quad \Longrightarrow \quad \begin{array}{|l|}\hline \\ \hline happy(z) \\ \\ \\ \hline\end{array} \\
\\
\hline
\end{array}
$$

This results in a reading which may be paraphrased as *John has a son$_i$ such that if John has an oriental girlfriend, he$_i$ is happy.* As this paraphrase indicates, after accommodating the presupposition the resulting DRS entails that John has a son. In general: accommodating the presupposition in the main DRS yields a 'presupposing' reading (the presupposition is projected). By contrast, from (DRS 2) it does *not* follow that John has a child; the presupposition is not projected and this produces a 'non-presupposing' reading.

It may be that there are *several* ways to resolve a presupposition. This brings us to a last, crucial ingredient of Van der Sandt's theory: the definition of a preference order over permitted interpretations. Van der Sandt defines a preference order based on the following general principles:

DEFINITION 1 (Van der Sandtian preferences)
1. Binding to a suitable antecedent is preferred over accommodation.
2. Accommodation is preferred to occur as far from the source-DRS as possible.
3. Binding is preferred to occur as near the source-DRS as possible.

In most cases, these preference rules order the set of admissible resolutions in such a way that there is *one* most preferred reading. Following Van der Sandt we will speak of a *genuine ambiguity* when there is *no* single most preferred reading. According to Van der Sandt (1992:363) partial match examples display such a genuine ambiguity, and he claims that this is one of the phenomena that his theory can account for, while the satisfaction camp cannot. However, things are somewhat more complicated. So let us now take a closer look at the partial match phenomenon.

[4]Of which the *Consistency* and the *Informativity constraints* are the most important ones. Roughly, the first says that accommodating a presupposition should never lead to an inconsistent DRS. Similarly, the informativity constraint states that accommodating a presupposition should never lead to a situation in which one of the sub-DRSs becomes redundant (is not informative). For more details we refer to Van der Sandt (1992: 367-369).

3 The partial match phenomenon

3.1 The empirical facts: four cases

I. Antecedent is more 'informative' than anaphor Example (1) is a prime example of this category, and we fully share Van der Sandt's intuitions that it displays a genuine ambiguity. The intuitions concerning example (1) might be a bit blurred due to a kind of lexical ambiguity in the word *girlfriend*. This is especially clear in the paraphrase of the presuppositional reading in which the globally accommodated girlfriend is John's companion in life, while the oriental girlfriend in the antecedent is more like a mistress. However, it is not difficult to find examples that do not suffer from this problem, e.g., by looking at plurals.

(5) If John has sons, his children will watch a lot of football.

This sentence displays the same kind of ambiguity as (1). Thus (5) has a presuppositional reading (paraphrasable as *John has children$_i$, and if he has sons, then they$_i$ will watch a lot of football*) and a non-presuppositional reading (*if John has sons$_i$, they$_i$ will watch a lot of football*).[5]

II. Anaphor and antecedent are 'incomparable' Consider:

(6) a. If John has sons, his young children are happy.
  b. If John talks to some partygoers, the children will look at him in a strange way.

These are ambiguous in the same way as the partial match examples discussed so far. Example (6.b) is ambiguous between a presupposing reading (*there are children$_i$ and if John meets some partygoers, they$_i$ look at him in strange way*) and a non-presupposing reading (*if John talks to some partygoers, the children among them will look at him in a strange way*). (6.a) displays a similar ambiguity.

III. Anaphor and antecedent are equally 'informative' The examples in this category tend not to be genuinely ambiguous and hence they should not be categorized as partial matches. Consider:

(7) If Fido sees a cat and a mouse, he'll chase the cat and devour the mouse.

IV. Anaphor is more 'informative' than antecedent Consider (8), which is based on an example from Zeevat (1992).

(8) A man died in a car crash yesterday evening. The 26 year old man that caused the accident was found to have been drinking.

[5] Suppose the interpreter knows that due to some specific genetic peculiarity John and his partner can never have a *girl*. Given such background knowledge, the example (5) should not be classified in category I, but in III (anaphor and antecedent are co-extensive). This indicates that *hearer's* knowledge should be taken into account.

Examples of this kind must also be categorized as partial matches, since they constitute a genuine ambiguity. On the presuppositional reading the presupposition triggered by *the 26 year old man who caused the accident* is accommodated (i.e., the 26 year old man is still alive), and on the non-presupposing reading the presupposition is bound (i.e., he is dead).[6] Both interpretations are roughly equally plausible, as far as we can tell. However, the distribution of such examples is limited: e.g., it is difficult to find conditionals which fall in category IV. Consider:

(9) If John owns a donkey, he will be worried about the purple farmer-eating donkey on the loose. (after Beaver 1995:61)

Here, the presupposing reading seems strongly preferred over the non-presupposing one, which is at best marginal. In other words, this sentence does not seem to be ambiguous in the same way as for instance example (8) is. In Krahmer (1995:165) it is hypothesized that identity anaphora can only *add* information if the antecedent is interpreted specifically. Let us formulate this as follows.[7]

> Informative Anaphors Hypothesis (IAH)
> A potential antecedent with a non-specific interpretation, which is less informative than the anaphor under consideration, does not qualify as a *suitable* antecedent for the anaphor, provided that the relation between anaphor and potential antecedent is one of identity.

Thus: an (indentity) anaphor can only *add* information about its antecedent when the antecedent has a specific interpretation, and this would account for the fact that example (9) does not appear to be a genuine ambiguity. The IAH explicitly excludes non-identity anaphors, because it seems possible for such anaphors to add information about a *subset* of the antecedent.

(11) If Barney owns cows, then he will feel sorry for the mad cows.

This example indeed displays a partial match ambiguity between a non-presupposing reading (paraphrasable as *if Barney owns cows, then he will feel sorry for the mad cows he owns*) and a presupposing one (*there are mad cows*$_i$*, and if Barney owns cows, then he will feel sorry for them*$_i$).

Summarizing, examples of type I, II and IV display a partial match ambiguity. Of course, other factors (such as pronominal take-up in continuations or the IAH) may cause disambiguation. Similarly, intonation is an important factor which may

[6]Again: extra evidence of this can be given in the form of disambiguating continuations. Continuing (8) with *The police took the drunk daredevil into custody* eliminates the non-presuppositional reading, while continuing with *This was confirmed by the pathologist who performed the post-mortem examination* eliminates the presuppositional reading.

[7]There do exist some potential counter-examples to the generalization proposed in the IAH. Consider, for example the following *'politically correct'* usage of the female pronoun.

(10) If the reader has studied example (10), she might come to the conclusion that it constitutes a counterexample to the IAH.

However, we are unsure whether examples such as (10) are real counterexamples to the IAH. For instance, it has been argued by various people that pronouns are essentially devoid of semantic content (e.g., by Van der Sandt 1992), so to what extent can they *add* information?

cause disambiguation. It should be stressed however, that intonation, and in particular accenting/de-accenting, only leads to partial disambiguation. For example, de-accenting the anaphor leads to a preference for binding. When the anaphor is accented however, this will only lead to an elimination of the *identity* reading (cf. Van Deemter 1991, 1992); both the presupposing and the non-presupposing reading remain possible. Thus, when *children* in (6.b) receives a pitch accent, the reading in which all partygoers are children is excluded, but otherwise the example is still ambiguous between the presupposing and the non-presupposing reading.

3.2 Van der Sandt's predictions

I. antecedent is more 'informative' than anaphor Let us reconsider Van der Sandt's own (1) again, and let us construct a DRS for this example.

(DRS 5)

$$\begin{array}{|l|}\hline x \\ \hline x = john \\ \begin{array}{|l|}\hline y\\ \hline oriental(y)\\ girlfriend(y)\\ poss(x,y)\\ \\ \hline\end{array} \Longrightarrow \begin{array}{|l|}\hline \\ \hline \neg \begin{array}{|l|}\hline \\ \hline happy(z)\\ \hline\end{array} \\ \partial \begin{array}{|l|}\hline z\\ \hline girlfriend(z)\\ poss(x,z)\\ \hline\end{array}\\ \hline\end{array}\\ \hline\end{array}$$

If we feed (DRS 5) to Van der Sandt's resolution algorithm, it will first start looking for a discourse referent which is accessible and which satisfies the conditions of being a girlfriend, and standing in the possessive relation with John. But such a referent is easily found: y meets all the conditions. As we saw in section 2, definition 1, binding a presupposition to a suitable antecedent is preferred over accommodating. In the DRS we are currently discussing, it seems that y is a perfectly suitable and accessible antecedent, so it is unclear how Van der Sandt (1992)'s formalism can avoid binding the presupposition, which would make the non-presupposing reading (given in (2.a)) the primary reading of (1) and hence would predict that this example is not truly ambiguous after all. It is conceivable that binding is defined in such a way that y is no longer a suitable antecedent, but then binding is precluded and accommodation is the only option. Consequently, no ambiguity between binding and accommodation is predicted either. Hence, one might say that Van der Sandt's formal theory does not fully implement the intuitions sketched in the first part of Van der Sandt (1992).

II. anaphor and antecedent are 'incomparable' The same problem applies as in category I, and other problems apply in addition. For example, consider (6.b). Here is the Van der Sandtian DRS for this example.

(DRS 6)

$$\begin{array}{|l|}\hline x \\ \hline x = \mathit{john} \\ \begin{array}{|l|}\hline Y \\ \hline \mathit{partygoer}(Y) \\ \mathit{talk}(x,Y) \\ \\ \\ \hline\end{array} \Longrightarrow \begin{array}{|l|}\hline \\ \hline \mathit{look\_at}(Z,x) \\ \partial \begin{array}{|l|}\hline Z \\ \hline \mathit{child}(Z) \\ \hline\end{array} \\ \\ \hline\end{array} \\ \\ \hline\end{array}$$

If we feed (DRS 6) to the algorithm, it will again look for an accessible, suitable antecedent.[8] It is unclear to us whether *some partygoers* is a suitable antecedent for *the children* according to Van der Sandt's algorithm, but it yields undesired results either way. The situation is roughly the same as for (DRS 5): either Y (the partygoers) is *not* a suitable antecedent for Z (the presupposed children). In that case, the presupposition is preferably accommodated and no genuine ambiguity results. If, by contrast, Y (the partygoers) *is* a suitable antecedent for Z (the children), binding is preferred and, as before, no ambiguity results. But in this case, there is an additional problem, which has nothing to do with preferences between interpretations. If the presupposition gets bound, it is 'absorbed by the antecedent', and this results in a reading which may be paraphrased as *if John meets some partygoing children, they'll look at him in a strange way*. This reading seems wrong. Binding should appear *in situ*, that is: the presupposition to be bound should not be merged with the target DRS, but with the source DRS.[9] Summarizing, we think that the binding reading of (6.b) should be *if John talks to some partygoers, the children among them will look at him in a strange way*. The situation in which all the children happen to be partygoers can be viewed as a special case, which is typically marked by the lack of an accent on *children* (see above). Finally, the reader may easily verify that the same problems are encountered for case IV.

[8] We follow the notation for plurals used by Van der Sandt (1992: 370), where he explains how an example similar to our (6.a) should be dealt with. The capitals are discourse referents standing for sets of objects. All predicates in this paper are 'strictly distributive' in the sense of Kamp & Reyle (1993, 407). E.g., $child(X)$ has the intuitive interpretation that all elements of X are children. In Kamp & Reyle (1993) this is denoted as $child^*(X)$. We will omit the $*$ superscript where this can be done without creating confusion.

[9] Consider another example:

(12) If John has children, he'll spoil the little bastards.

We are well-aware of the fact that epithets like *little bastards* have some peculiar properties. Nevertheless, they serve nicely to further illustrate the point about binding mentioned in the main text. If we bind the presupposition triggered by the definite description in Van der Sandt's way, we end up with a reading which may be paraphrased as *if John has children and they are little bastards, then he'll spoil them*. In other words: the children are only spoiled if they are little bastards. In our opinion, the right reading for this example (disregarding the differences between presupposed and asserted material) is something like *if John has children, they'll be little bastards and he'll spoil them*.

4 An alternative

In the previous section (3.1) we argued that an anaphor and an antecedent stand in a *partial match relation* if the two are *not* co-extensive. Moreover, on the partial match interpretation, a sentence is ambiguous between a presupposing and a non-presupposing reading (although we have seen that certain independent factors may cause disambiguation). In other words, we support the *intuition* sketched in Van der Sandt (1992:349-351). However, if we apply the *formal theory* (i.e., the presupposition resolution algorithm) of Van der Sandt (1992) to the partial match examples (as done in 3.2), we encounter two problems: (*i*) the algorithm does *not* generate the required genuine ambiguity in the case of a partial match, and (*ii*) not all the binding readings are correct.

We propose a modified version of Van der Sandt's resolution mechanism. One central ingredient is the use of so-called *context variables*. *Binding* will be viewed as contextually restricted quantification, where the relevant context is provided by the anaphoric antecedent. *Accommodation* will be a contextually restricted variant of the usual accommodation procedure. To arrive at all the different possible (binding or accommodation) interpretations of a given sentence containing a presupposition, we exploit Van der Sandt's resolution mechanism, with its use of unresolved representations. However, we make some modifications to the resolution mechanism as such, taking the notion of partial match into account by paying more attention to properties of potential antecedents. When antecedent and anaphor stand in a partial match relation, the algorithm will generate a real ambiguity. This entails that our modification of the algorithm yields a modified, *partial* preference order between possible interpretations.

4.1 Preliminaries

Van der Sandt (1992) is mostly based on the basic, first-order DRT fragment. The kind of examples we are interested in, and the treatment we have in mind for them, calls for two extensions of this basic DRT fragment.

Plurality and quantification in DRT In the following, we adopt the basic treatment of plurality and quantification outlined in Kamp & Reyle (1993, ch. 4). Kamp & Reyle use an algebraic 'Link-style' interpretation of plurality, in which the domains contain atomic as well as non-atomic entities. Following the convention of Kamp & Reyle (1993), we use boldface lowercaps variables ($\mathbf{x}$, $\mathbf{y}$, $\mathbf{z}$, ...) to range over both individual (or *atomic*) referents *and* plural (*non-atomic*) referents. Lowercase variables ($x, y, z, \ldots$) are used for individual referents, and uppercase variables ($X, Y, Z, \ldots$) for plural referents. This convention entails that general definitions contain boldface referents, and actual examples do not.

We also adopt the treatment of generalized quantifiers in Kamp & Reyle (1993, ch. 4) in terms of *duplex conditions*. In general, a generalized quantifier (which we shall denote as DET) is a relation between two sets of (atomic) entities, say A and B, and this is represented by Kamp & Reyle as a condition consisting of two boxes A' and B', representing A and B respectively, separated by a capsized box which contains the quantifier and the variable it applies to. The quantifier gets its usual interpretation as known from *generalized quantifier theory* (GQT; for technical details on quantifiers in DRT we refer to Kamp & Reyle 1993:425-427). Here are GQT-style definitions of singular and plural *the* (d and d' atomic):

$the^{sg}(A)(B)$ is true with respect to a model M iff
$\exists d \in D : d \in A \ \&\ \forall d' \in D(d' \in A \Rightarrow d' = d) \ \&\ d \in B$

$the^{pl}(A)(B)$ is true with respect to a model M iff
$\exists d \in D : d \in A \ \&\ \forall d' \in D(d' \in A \Rightarrow d' \in B)$

It is worth pointing out that Kamp & Reyle still distinguish *indefinites* from 'truly' quantificational determiners, and we will follow this practice, as we have done so far. Concretely, this means that indefinite NPs of the form DET CN, where DET is either *a(n)*, *some* or empty (in the case of bare plurals) introduce a fresh discourse referent in the current DRS.

Context variables In Westerståhl (1985) the notion of contextually restricted quantification is introduced, motivated by examples such as the following:

(13) The children were having a lot of fun.

Clearly this is not a statement about all the children in the universe. According to Westerståhl, the definite determiner acts as a *context indicator which signals the presence of a context set C* (Westerståhl 1985:60) in such a way that *the children* denotes $C \cap child$, i.e., a contextually restricted subset of the set of all children.

In our revision of the presuppositions-as-anaphors theory, we will use context variables, which we will represent as $C, C', \ldots$ These context sets are just discourse referents (compare Westerståhl 1985:70). Below, we let every NP introduce an ordinary discourse referent and a fresh context set and our modified presupposition resolution algorithm explicitly operates on these context sets. It is worth to emphasize that the use of context sets in this paper merely facilitates the resolution process. Besides introducing contextual variables, we also employ 'contextually restricted' predicates. That is, we use conditions like $man^C(john)$ which have as intuitive interpretation: *john* is a *man* and an element of the context set C.[10]

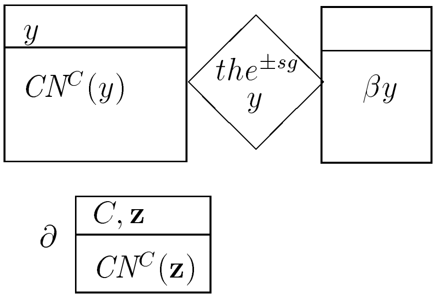
4.2 The presuppositions of definite descriptions

When the DRS construction algorithm encounters a definite description, the [*the* CN] rule is activated. Here *CN* is the representation of CN (in singular form, where CN is a possibly complex common noun phrase), and $\mathbf{z}$ is z or Z depending on the number of the CN. This rule is a variant of CR.NP [Quant = +], Kamp & Reyle (1993: 318, 347). Definite descriptions are generally assumed to trigger an *existence presupposition*. In this rule this is modelled as follows: a definite description presupposes that there is some context set C which has a non-empty intersection with the CN denotation.

[10]Formally, if η is a noun representation: $M \models_f \eta^C(\mathbf{x})$ iff $f(\mathbf{x}) \in I_M(\eta) \cap f(C)$. This clause is a variant of cause (ii:g:i) of definition 4.3.7 of Kamp & Reyle (1993:426).

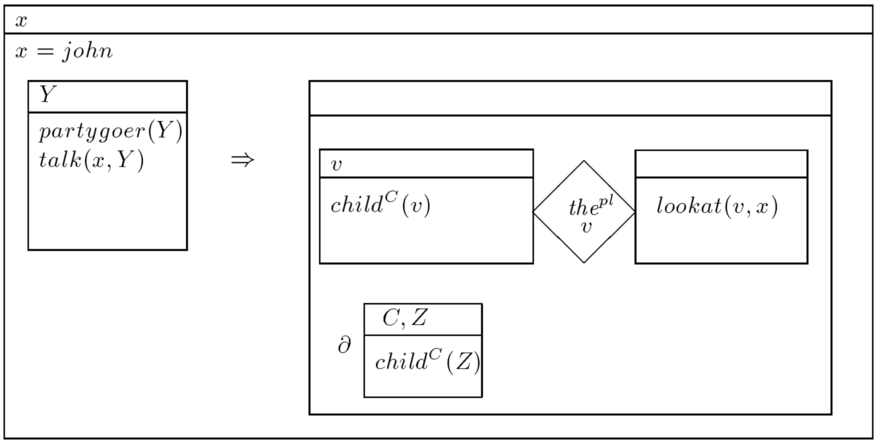
[DET CN] Rule, for DET = *the*

Upon encountering an S of the form $\alpha\beta$ or a VP of the form $\beta\alpha$, with α a definite description (of the form *the* CN[± sg]), replace S or VP with the following presuppositional DRS and duplex condition, where y and $\mathbf{z}$ are fresh discourse referents and C is a fresh context variable.



To illustrate the [*the* CN] rule, consider example (6.b) again. This sentence is represented by (DRS 7). *Some* is indefinite: it introduces a fresh (non-atomic) discourse referent Y. *The children* is handled by our definite descriptions rule: it introduces a presuppositional DRS, with the intuitive interpretation that there is some context set C which contains children, and a duplex condition, which expresses that all children in this context set C look at John in a strange way.

(DRS 7)



4.3 The modified presupposition resolution algorithm

When Van der Sandt's resolution algorithm encounters a presuppositional DRS it will first try to bind this presupposition to an antecedent, and our modified algorithm will do the same. This immediately raises a question: what qualifies as an antecedent? The answer of Van der Sandt (1992) is simple: every suitable discourse referent which is accessible from the DRS containing the presuppositional DRS is a potential antecedent. Van der Sandt (1992) does not specify what makes a referent suitable. In our opinion, the main factor in determining the suitability of a discourse referent is the phrase which lead to the introduction of the referent.

(14) a. Yesterday, an_1 uncle of mine bumped into a_2 man. The_i man fell down.

b. Yesterday, a_2 man bumped into an_1 uncle of mine. The_i man fell down.

We contend that in both (14.a) and (14.b), the definite *the man* is strongly preferred to be coindexed with *a man* (i.e., $i = 2$), even though obviously both 1 and 2 are male persons. This is due to the fact that 1 is introduced as a *man*, while 2 is introduced as an *uncle*.[11] This shows that the resolution algorithm should not only take discourse referents into account, but also properties of the phrase which lead to the introduction of the referent. In particular, we are interested in the possible values which a discourse referent can have according to the denotation of the phrase with which the referent is associated. For this purpose, we will use *value sets*. For the examples in (14) it is the CN which determines the relevant value set. But for other phrases which lead to the introduction of a referent (e.g., proper names) this may be different. Consider the indefinite description *a man with a hat*, and suppose that it triggers the introduction of a discourse referent y. Then the value set of y in a model M and with respect to an assignment f, denoted as $\text{VAL}(y, [\![\, [y, z \mid man(y), hat(z), with(y,z)] \,]\!]_{M,f})$, is given by:[12]

$$\{d \in D \mid d \in I(man) \;\&\; \exists d' \in D : d' \in I(hat) \;\&\; \langle d, d' \rangle \in I(with)\}$$

In words: the value set of y in M is the set of men with a hat in M. Notice that in the case of atomic predicates P, the value set $\text{VAL}(\mathbf{x}, [\![P(\mathbf{x})]\!])$ equals the predicate denotation $[\![P]\!]$.[13] In those cases, we will use the predicate denotation as value set. Below we will consider pairs $\langle \mathbf{x}, \text{VAL}(\mathbf{x}, [\![\Upsilon]\!]) \rangle$ consisting of a discourse referent and a corresponding value set as antecedents. We are now in the position to sketch our modified resolution algorithm. The input of the algorithm is an underspecified

[11] Another illustration of this is the following minimal pair.

(15) If John is looking at some $[_{\text{CN}}$ children], who play basketball, then the children will strive to impress him.

(16) If John is looking at some $[_{\text{CN}}$ children that play basketball], then the children will strive to impress him.

The only difference between the two examples is that in (15) a referent is introduced by *children* while in (16) it is introduced by *children that play basketball*. Now, example (16) is ambiguous and (15) is not. The latter only has a non-presupposing reading; we cannot continue this example with *They know he is a talent scout for Utah Jazz*. Example (16), on the other hand, displays a partial match ambiguity between a presupposing and a non-presupposing reading.

[12] Reference to models and assignment functions is omitted where this can be done without creating confusion.

[13] In general: suppose that a phrase α leads to the introduction of a (atomic or non-atomic) discourse referent $\mathbf{x}$. The value set of $\mathbf{x}$ with respect to Φ (where Φ is the DRS which results from α) and given a model M and an assignment function f is defined as $\text{VAL}(\mathbf{x}, [\![\Phi]\!]_{M,f}) =_{\text{def}} \{d \in D | M \models_{f \cup \langle \mathbf{x}, d \rangle} \Phi\}$ The embedding function f is only needed when Φ is not a *proper* DRS, i.e., when some condition in Φ contains a discourse referent that is not introduced in Φ, that is, if the η phrase contains a pronoun (e.g., *the man that saw him*).

DRS containing at least one unresolved presuppositional DRS. As we have seen, for definite descriptions this presuppositional DRS will be of the form:

(DRS 8) $\partial \begin{array}{|c|}\hline C, \mathbf{y} \\ \hline CN^C(\mathbf{y}) \\ \hline \end{array}$

For each presuppositional DRS there is a list of Potential Antecedents (PA), and as argued above this is a list of accessible discourse referents plus their respective value sets. This list is ordered by *nearness* to the presuppositional DRS, i.e., the first element on the list is the nearest referent and the last element is the one farthest away. In general, this list will appear as follows:[14]

$$\text{PA} = \langle\langle \mathbf{x}_1, \text{VAL}(\mathbf{x}_1, [\![\Upsilon_1]\!])\rangle, \ldots, \langle \mathbf{x}_i, \text{VAL}(\mathbf{x}_i, [\![\Upsilon_i]\!])\rangle, \ldots, \langle \mathbf{x}_n, \text{VAL}(\mathbf{x}_n, [\![\Upsilon_n]\!])\rangle\rangle$$

The modified resolution algorithm is now going to try and bind the presuppositional (DRS 8), triggered by the definite description, to an element of the list of potential antecedents. We use PRES_M to denote the value set of the referent associated with the phrase which triggers the presupposition. In the case of definite descriptions (as in (DRS 8)), $\text{PRES}_M = \text{VAL}(\mathbf{y}, [\![\ [\mathbf{y}|CN(\mathbf{y})]\ ]\!]_M)$. In general, PRES equals $\text{VAL}(\mathbf{y}, [\![\Upsilon]\!])$, where Υ is the DRS representing the phrase which has led to the introduction of $\mathbf{y}$. Similarly, we use ANT^i_M as an abbreviation of $\text{VAL}(\mathbf{x}_i, [\![\Upsilon_i]\!]_M)$, for some $\langle \mathbf{x}_i, \text{VAL}(\mathbf{x}_i, [\![\Upsilon_i]\!]_M)\rangle \in \text{PA}$.[15]

IF $\exists i(\text{PRES}_M = \text{ANT}^i_M$, in all H-models M)
THEN BIND
ELSE IF $\forall i(\text{PRES}_M \cap \text{ANT}^i_M = \emptyset$, in all H-models M)
THEN ACCOMMODATE
ELSE (Partial Match!)
BIND **OR** ACCOMMODATE

In words: the algorithm first checks if there is a potential antecedent with the *same* denotation as the presupposition in all H-models. If it finds one, it is a *full match* and the presupposition will be bound (both the BIND and the ACCOMMODATE operation will be defined below). If the value set of the presupposition is *disjoint* with the value sets of all potential antecedents, the presupposition is accommodated. The other cases are partial matches: there is no antecedent with the same value set as the presupposition, but there *is* an antecedent which matches partially, i.e., has a non-empty intersection with the presupposition in some H-model, then the

[14] Nearness has an obvious formal definition in terms of subordination, see Krahmer & Van Deemter (1997). Instead of a list, PA should be a partial order (because several discourse referents may be introduced at the same level and these are 'equally far away' from the source-DRS), but we will ignore this here.

[15] It has been noted in footnote 5 that the hearer's background knowledge may cause disambiguation. This was illustrated by example (5). It was argued that if the interpreter knows that John and his partner do *not* have *daughters*, this example only has a non-presupposing reading. Therefore, our algorithm will not quantify over all possible models, but rather over all models which are in accordance with the interpreter's knowledge state. For this case, the interpreter's *H-models* (H for hearer) will not include models in which John has daughters. In what follows, specific hearer knowledge will not be taken into account, unless noted otherwise.

presupposition can either be accommodated or bound to this partially matching antecedent. Before we can return to our example, we have to define the notions BIND and ACCOMMODATE. To begin with the former, it follows from the algorithm that we BIND the presuppositional (DRS 8) if an antecedent $\langle \mathbf{x}_i, \text{ANT}^i \rangle \in \text{PA}$ has been found such that ANT^i is either coextensive with the value set PRES (full match), or has a non-empty intersection with it (partial match).

DEFINITION 2 (BIND)
$\langle \mathbf{x}_i, \text{ANT}^i \rangle$ is the nearest antecedent in PA:

1. merge the presuppositional DRS with the source DRS, and
2. add a condition $C = \mathbf{x}_i$ to the source DRS

Binding is *in situ* (the presuppositional DRS is *not* moved to the target DRS, where $\mathbf{x}_i$ was introduced, as in Van der Sandt 1992). Moreover, it generalizes to non-identity anaphors since only the *context set* is equated with a set of objects, as illustrated for example (6.b) below. ACCOMMODATE is defined as follows:

DEFINITION 3 (ACCOMMODATE)
The main DRS is the (initial) target DRS:

1. remove the presuppositional DRS from the source DRS and merge it with the target DRS,
2. add a condition $C = \mathbf{D}$ to the target DRS[16]
3. check whether the result satisfies the Van der Sandt conditions, (consistency, informativity &c). If not, redo 1-3 with a new target DRS: the one immediately subordinated by the old target DRS

The second clause states that the context variable C is equal to the domain of discourse, thereby neutralizing the effect of C. It is worth emphasizing that this is done to keep the differences with Van der Sandt to a minimum: it entails that our ACCOMMODATE is the same operation as Van der Sandt (1992)'s accommodation.[17] Reconsider our example (6.b), and its associated (DRS 7). (DRS 7) is the input for our modified resolution algorithm. The list of potential antecedents for the presuppositional DRS looks as follows:[18] $\langle \langle Y, [\![partygoer]\!] \rangle, \langle x, \{john\} \rangle \rangle$. Let us assume that there is no specific hearer knowledge, then there will be an H-model M such that $[\![partygoer]\!]_M \neq [\![child]\!]_M$. In other words: there is no full match between *some partygoers* and *the children*. However, there will also be an H-model M in which $[\![partygoer]\!]_M \cap [\![child]\!]_M \neq \emptyset$ (after all, children can be partygoers). In other words: the algorithm predicts that this is a partial match, and a genuine ambiguity between a binding and an accommodation reading ensues. (DRS 9) results when we BIND the presuppositional DRS. This DRS can be paraphrased as *If John talks to some$_i$ partygoers, then there are children$_j$ among them$_i$, and all of*

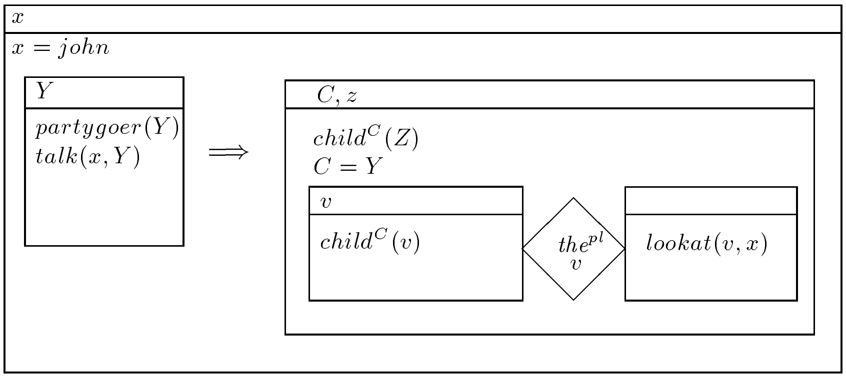
[16] The constant $\mathbf{D}$ refers to the domain of discourse: $[\![\mathbf{D}]\!]_M = I_M(\mathbf{D}) = D_M$.

[17] Krahmer & Van Deemter (1997) explore an alternative definition, where C is not necessarily equated with the entire domain, but rather with a contextually salient group of individuals.

[18] Since, $\text{VAL}(Y, [\![\ [Y|\ partygoer(Y)]\ ]\!])$ is equal to $[\![partygoer]\!]$, and $\text{VAL}(x, [\![\ [x|\ x = john]\ ]\!])$ is equal to $\{john\}$, we opt for the more simple notation.

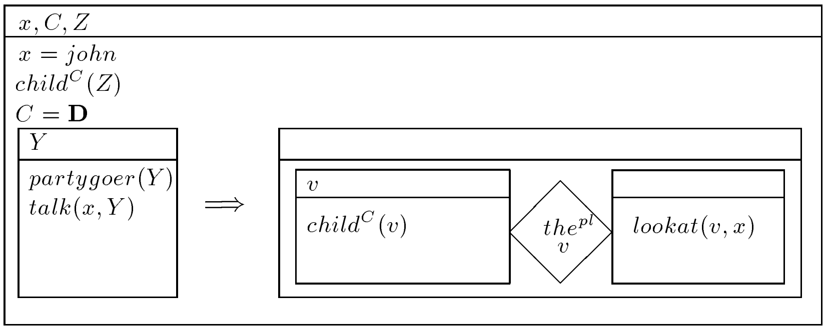
the children among the$_i$ partygoers look at him in a strange way. And, as argued above, this is the correct binding interpretation.

(DRS 9)



The second reading comes about via a global application of ACCOMMODATE:

(DRS 10)



In words: *There are some$_i$ children, and if John talks to some partygoers, all these$_i$ children will look at him in a strange way.*[19] Summarizing, if we feed the representation of example (6.b), (DRS 7), to the modified resolution algorithm, it decides that there is a partial match between the presupposition triggered by *the children* and its antecedent *some partygoers*. The corresponding ambiguity is between (DRS 9) and (DRS 10) for the non-presupposing/binding and presupposing/accommodation interpretation respectively.

5 Concluding remarks

We have seen (section 3.2) that the otherwise empirically successful formal theory of Van der Sandt (1992) does not always make the right predictions in cases where

[19]Under the alternative definition of ACCOMMODATE mentioned in footnote 17 the resulting reading can be paraphrased as *there is a contextually salient group of children, and if John talks to some partygoers, all these children will look at him in a strange way.*

there is a *partial match* between a presupposition and a potential antecedent for this presupposition. We think that the problems with partial matches can be solved by refining and extending Van der Sandt's algorithm, and we have tried to do so. The resulting version of the presuppositions-as-anaphors theory differs from the one of Van der Sandt (1992) mainly in these respects: (1) It contains a precise definition of the 'partial match' phenomenon; (2) we have modified the resolution algorithm in such a way that —in accordance with Van der Sandt's intuitions— partial match sentences come out as genuine ambiguities; and (3) binding is redefined in such a way (*'in situ'*) that non-identity anaphors receive adequate interpretations. In this paper we have opted for a *frog perspective* on presupposition projection, focussing on one kind of presupposition triggers: definite descriptions. However, in Krahmer & Van Deemter (1997) it is shown that there are few impediments to extending the approach described here: a general Noun Phrase presupposition scheme is proposed, applying to *any* NP, and it is shown that the modified resolution algorithm yields the required results in these cases as well.

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