

Resolving Complement Anaphora

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Abstract

In a quantified expression, the possibility of referring to the set-theoretical difference of restrictor and scope is known as *complement anaphora* (CA). Existing literature suggests two ways of analyzing this phenomenon - either as confusion with reference to the maximal set, or as genuine complement reference.

This paper will show that resolving an anaphor to the complement set is never a viable option. This will be motivated by adopting a formal semantic approach based on optimality-theoretic constraints. Crucially, CA is licensed only by proportional right monotone decreasing determiners. Since proportional determiners introduce their restrictors into the discourse via an accommodated presupposition, the maximal set will always serve as a better candidate for anaphora resolution than the complement set. Further support of this conclusion stems from an independent maximality effect of CA, which follows naturally from the proposed analysis.

1 Introduction

When associated with different focus patterns, English quantifiers such as *few* may have different reference patterns. Compare, for instance, examples (1) and (2). In (1), the anaphoric pronoun ‘they’ refers to the children who are eating the ice-cream. Contrastingly, in (2), ‘they’ seems to refer to the children who are *not* eating ice-cream (Moxey and Sanford, 1993).

- (1) Few of the children ate their ice-cream.
They ate the strawberry flavour first.
- (2) Few of the children ate their ice-cream.
They threw it around the room instead.

The literature suggests two ways of analyzing reference to the complement set - either as confusion with reference to the maximal set, or as a genuine phenomenon. After presenting data concerning the phenomenon and briefly discussing the problem they give rise to in section 2, section 3 of the paper will go on to present both types of analyses. Section 4 will then suggest to integrate the observations made in the two previous types of analyses to a unified theory. The analysis will be based on Optimality-Theoretic (OT) principles and will use formal semantic principles to define the environments which allow the possibility of referring to the complement set. It will have the same explanatory power as the previous analyses, while being more economical than them.

As a consequence of the analysis, it will be shown that actual reference to the complement set does not exist. For independent reasons, we must introduce the referent of the maximal set into the discourse. Optimality considerations will lead us to prefer to resolve the anaphor to this referent, rather than to a specially introduced, non-salient referent to the complement set. Section 4.2 cites further evidence in support of this conclusion in the form of an independent maximality effect of CA, namely that the pronoun must refer to the *maximal* complement set.

Section 5 contains a discussion of the new analysis, detailing different reasons to consider it preferable to the analyses which were presented in section 3. It also outlines ways to deal with several possible forms of criticism against maximal set analyses.

2 Preliminaries

2.1 On anaphora

Anaphora is the use of a linguistic unit, such as a pronoun, to refer back to another unit previously mentioned in the discourse. The prior mention of the unit is called the *antecedent*. It provides the information necessary for the anaphoric pronoun's interpretation. The anaphor is bound to its antecedent by *coreference*. In the following sequence, the relationship of the pronoun 'it' to the noun phrase 'a dog' is an example of anaphora (Kadmon (2001): 5):

- (3) *A dog* came in. *It* is pretty.

Over the past several decades, several types of theories have been developed in order to deal with anaphora-related phenomena. Much research has been concerned with finding constraints on the occurrence of anaphoric expressions, syntactically and semantically. An example of a syntactic oriented theory is the explanation of facts as in example (4) in terms of the constraints on government and binding (Krahmer (1998): 4, ch.1).

- (4) (a) * Louis₁ likes him₁
 (b) Louis₁ likes himself₁

An example of a semantic theory of anaphoric phenomena has been suggested by Karttunen (1976), who introduced the notion of *discourse referents* (DRs) - entities which represent persons or things in the world. Karttunen notes, for example, that when a DR is introduced under the scope of a logical connective, its life span is generally limited to the scope of that connective. Thus, indefinites in the antecedent of a conditional sentence introduce DRs which may

be taken up by the pronouns in the consequent of the conditional, but not in sentences following it (Krahmer: 5a, ch.1):

- (5) If a princess sees a frog, she kisses it.
 #In fact, it is the prince of Buganda.

2.2 Discourse Representation Theory

First suggested in the early 1980s, standard DRT (Discourse Representation Theory: Kamp (1981); File Change Semantics: Heim (1982)) tries to give a general account for the constraints on anaphoric binding by specifying an accessibility relation between positions in a complex Discourse Representation Structure (DRS). The DRS syntactically represents the body of information gathered in a discourse, and is graphically depicted as a box. Statements, which the discourse participants assert as facts, are entered one after the other into the DRS representing the whole discourse (the "matrix" DRS). The discourse may also contain subparts, with denied or doubtful facts, temporary assumptions, etc. These are represented as separate DRSs, embedded in the matrix DRS and possibly embedded within one another.

In DRT, the basic semantic value of a bit of discourse is not its truth conditional content, but rather the role it would play in extending some existing body of information (and determining the truth conditions of its extension). Definite and indefinite NPs are neither quantificational nor referential. Rather, they function as variables, which can be regarded as DRs. An indefinite introduces a new DR into the discourse, and anaphora is simply variable binding. Using a definite requires the discourse to already contain a suitable DR, to which the attribute of the definite can be attached.

Heim's metaphor is that the body of information gathered in a discourse is much like a collection of file cards. For each indefinite NP, the hearer starts a new card; for each definite NP, the hearer updates existing cards.

Existential quantification takes scope over the entire discourse and (unselectively) binds all the free variables in it. For example, if an entire dis-

course contains only the sentence in (6), it will be true iff **there is** a value for x which verifies the formula: $dog(x) \wedge came\ in(x) \wedge pretty(x)$. This is equivalent to the first-order logic translation of the sentence: $\exists x[dog(x) \wedge came\ in(x) \wedge pretty(x)]$ (Kadmon: 8):

(6) A dog came in, and it is pretty.

x
$dog(x)$ $came-in(x)$ $pretty(x)$

For the treatment of quantification, Kamp and Heim adopt unselective restricted quantification, as proposed in Lewis (1975) for sentences with “adverbs of quantification”. This leads to one of the main advantages of DRT - its ability to deal with donkey sentences. A famous example of such a sentence is (7):

(7) Every farmer who owns a donkey, beats it.

Donkey sentences present a problem to many theories; a systematic translation of sentences such as (7) into first-order logic produces an incorrect representation of the sentence, as in (8), which contains a free occurrence of the variable y in $BEAT(x, y)$.

(8) $\forall x(FARMER(x) \wedge \exists y(DONKEY(y) \wedge OWN(x, y)) \rightarrow BEAT(x, y))$

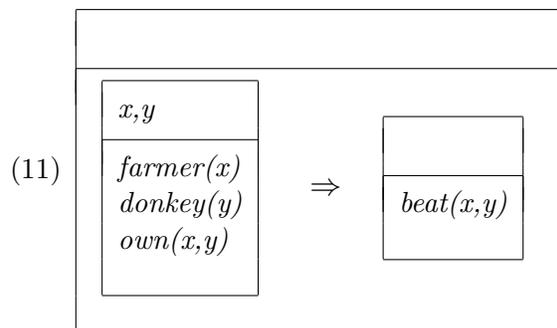
Trying to extend the scope of the existential quantifier as in (9) also does not solve the problem. In this case, the logical translation fails to give correct truth conditions to the donkey sentence: imagine a situation where there is a farmer owning a donkey and a pig, and not beating any of them. The formula will be true in that situation, because for each farmer we need to find at least one object that either is not a donkey owned by this farmer, or is beaten by the farmer. Hence, if this object denotes the pig, the sentence will be true.

(9) $\forall x \exists y(FARMER(x) \wedge DONKEY(y) \wedge OWN(x, y) \rightarrow BEAT(x, y))$

A correct translation of the donkey sentence into first-order logic seems to be (10). Unfortunately, this translation leads to a serious problem of inconsistency. Indefinites must sometimes be interpreted as existential quantifiers, and other times as universal quantifiers, without any apparent regularity.

(10) $\forall x \forall y(FARMER(x) \wedge DONKEY(y) \wedge OWN(x, y) \rightarrow BEAT(x, y))$

The solution that DRT provides for the donkey sentence problem can be roughly outlined as follows: The common semantic function of non-anaphorical noun phrases is the introduction of a new DR, which is in turn available for the binding of anaphoric expressions. Thus, the anaphoric expression simply qualifies one of the preexisting DRs in the discourse. No quantifiers are introduced into the DRS, thus overcoming the scopal and consistency problems that the logical translations had. Sentence (7) will receive the following DRT representation:



2.3 Complement anaphora

2.3.1 The phenomenon

Despite the fact that the study of anaphora-related phenomena has been a fertile field for semantic research for many years, some aspects of anaphora have mostly been neglected. One such aspect is the phenomenon of Complement Anaphora.

A quantified expression of the type $D(A)(B)$ can allow for subsequent anaphoric reference to three sets associated with it: the maximal set A , the reference set $A \cap B$ and, sometimes, the complement set $A \cap \neg B$. The latter case, where an

anaphor relates to the set-theoretical difference of restrictor and scope, is known as *complement anaphora*.

In what follows, the following terminology will be used (adopted from Nouwen, 2003): Given the quantification $D(A)(B)$, where D is a conservative determiner, A is its restrictor and B its nuclear scope, we will call the denotation of A the *maximal set*; the intersection of the denotations of A and B the *reference set*; and the set-theoretical difference between the denotations of A and B the *complement set*. Following are examples for reference to the reference set, the complement set and the maximal set, respectively (Evans (1980): 7, Nouwen: 4,5).

- (12) Few congressmen admire Kennedy, and they are very junior.
- (13) Few congressmen admire Kennedy. They think he's incompetent.
- (14) Few congressmen attend morning meetings, but they all attend the Friday afternoon drinks.

2.3.2 The data

The existence of complement anaphora was first extensively studied in a series of psycholinguistic experiments (Moxey and Sanford, 1993), (Sanford et al., 1994). The experiments were designed to find out what is the functional difference between related determiners such as *a few*, *few*, *very few*, *only a few*, *not many*, etc.¹

In one experiment, subjects were presented with a single quantified statement and were asked to make up a sensible continuation beginning with the plural pronoun *They*. The subjects were also asked to indicate to which of the following five choices the plural pronoun referred to in their continuation: *MPs in general*, *all MPs*, *MPs who went to the meeting*, *MPs who did not go to the meeting* and *none of the above*. Independent judges checked all the utterances and reference indications. In 98% of

¹For a detailed overview of the experiments, see mostly Moxey and Sanford (1993), and also Sanford et al. (1994).

the cases, they agreed with the judgments of the subjects.

- (15) Q of the MPs attended the meeting.
They...

Another experiment tested for intra-sentential complement anaphora, using a structure like (16):

- (16) Q of the MPs attended the meeting,
because they...

The results showed that structures which had one of the determiners *hardly any*, *not many*, *very few* and *few* substituted for Q licensed complement set anaphoric mappings. They did not, however, require them. When reference was made to the complement set, the system was set up to expect a reason why the division is as small as it is.

The determiner *a few* never allowed for pronominal reference to the complement set. In addition, *a few* did not induce the system to expect reasons why the predicate is true of only a small number or proportion, unless this was prompted by a connective.

In the absence of connectives, *only a few* behaved like *a few*, although complement set references were not *ruled out* by it in the way that they were by *a few*. Complement set references were prominent when *only a few* was combined with the connective *because*. Since they did not occur in every instance, it is also clear that they were not *required* by the combination.

Based on these findings, Moxey and Sanford suggest that *few/not many/very few/hardly any*, *a few* and *only a few* induce different strategies of interpretation:

- The statement “Few(/not many/very few/hardly any) X do Y” (a) identifies a small percentage of Xs of which “do Y” is true, (b) puts into focus the set of which Y is false, and (c) sets the system to expect a reason why the division is *as small* as it is;
- On encountering a sentence of the form “A few Xs do Y”, a small proportion of Xs of

which “do Y” is true is identified. Nothing else happens at all, so in a strong sense, *a few* can be thought of as being “a small number”;

- The sentence “only a few X do Y” seems to be a rather weak comment on the small proportion which it identifies. Conceivably, it serves to signal that “X and perhaps less” is the case, such as would seem to fit *few*.

In a separate study, Moxey and Sanford concentrated on complement set reference with proportional numerical expressions. The continuation method and the use of judges was as described for the experiment above. The results showed that complement set continuations were favored following the determiner *less than n%*. The other determiners (*n%*, *only n%* and *more than n%*) showed hardly any continuations containing complement set reference (Nouwen: 11).

- (17) *Less than thirty percent* of the MPs attended the meeting. They were too busy.

Finally, cardinal decreasing quantifiers in partitive constructions also allow complement set reference, as shown below. Out of the partitive construction, these quantifiers resist reference to the complement set (Nouwen: 10,9):

- (18) *Less than thirty of the fifty* MPs attended the meeting. They were too busy.
- (19) *Less than thirty* MPs attended the meeting. #They were too busy.

In contrast to these data, reference to the reference set is always possible, regardless what the antecedent determiner is (Nouwen: 12,13):

- (20) *Most* MPs attended the meeting. They discussed a lot.
- (21) *Few/less than thirty* MPs attended the meeting. Nevertheless, they managed to discuss a lot.

Hebrew sentences containing CA, modeled after the examples presented above, seem to behave similarly to the English examples. Following are three such examples, in which reference to the complement set sounds natural².

- (22) *paxot mi-maxacit me-ha-sarim*
 less of-half of-the-ministers
hiStatfu ba-pgiSa. hem
 participated in-the-meeting. they
hayu asukim miday.
 were busy too.

‘Less than half of the ministers attended the meeting. They were too busy’

- (23) *meatim me-ha-studentim halxu*
 few of-the-students went
la-mesiba. hem halxu bi-mkom ze
 to-the-party. they went in-place it
le-seret.
 to-movie

‘Few of the students went to the party. They went to a movie instead’

- (24) *rak studentim meatim halxu*
 only students few went
la-mesiba, ki haya la-hem
 to-the-party, because existed to-them
mivxan ba-yom Se-le-maxarat.
 exam on-the-day that-to-tomorrow.

‘Only a few of the students went to the party, because they had an exam the following day’

For several other examples in Hebrew and French, and a discussion of their interpretations, see section 3.1.

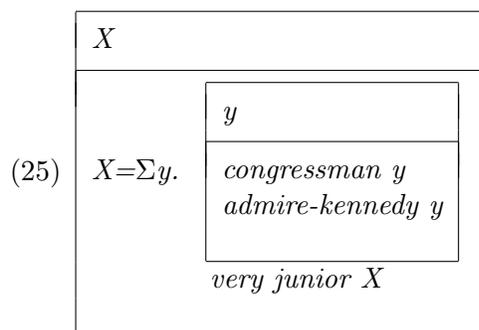
2.3.3 The problem with CA

Reference to the reference set is naturally represented in DRT: in example (12), repeated below,

²It should be mentioned that the examples were only tested on a small number of consultants. The consultants were presented with the sentences, and asked to decide whether they “sound correct” or not. No context was provided for any of the examples. Only sentences which all the consultants agreed were natural-sounding are listed here.

the anaphoric pronoun ‘they’ is interpreted as referring to the largest group satisfying both the restrictor and the scope of the quantificational structure it is linked to. In this example, this is the set of all congressmen who admire Kennedy. In DRT, this observation is realized by creating a sum operation Σ , which collects all the individuals that satisfy certain conditions. The operation creates a plural pronoun, that acts as the referent of that set. (25) gives the DRT representation of (12):

- (12) Few congressmen admire Kennedy,
and they are very junior.



It is more difficult for DRT to explain how it is possible for an anaphoric expression to refer to a discourse referent, which was not formerly introduced into the discourse (i.e., to the complement set). This is an apparent violation of the construction rules of DRT. In the following, we will see how to deal with this problem.

3 Analyzing CA

The literature suggests two ways of dealing with CA. One may make the case that sentences, which contain apparent reference to the complement set, in fact make reference to the maximal set (Following Corblin, 1996, we will call this *pseudo reference* to the complement set). In section 3.1, two strategies, based on this assumption, will be outlined. On the other hand, one may claim that complement set reference cannot be reduced to reference to the maximal set, mistakenly thought to be reference to the complement set. Section 3.2 will detail such an analysis. Most details of this analysis will be adopted in section 4.

3.1 Maximal set analyses

Corblin argues, that accepting the complement set as a potential antecedent for plural reference clashes with an important generalization, which is based on examples such as Partee’s example (26): ‘[A]pparently, subtracting one set from another is not a permissible operation for the formation of pronominal antecedents’ (Kamp and Reyle, 1993, p. 307).

- (26) Eight of the ten balls are in the bag.
#They are under the sofa.

In fact, CA is a case of *pseudo reference* to the complement set. Reference to the restrictor following a quantified structure is in principle always possible. Accordingly, sentences like Kamp and Reyle’s classic example (27) really contain reference to the maximal set.

- (27) Few women from this village came to the feminist rally. No wonder. They don’t like political rallies very much.

This observation is reinforced by the Hebrew translation of sentence (27). Hebrew uses the 3rd person masculine plural pronoun ‘they’ in “unspecified subject constructions”, where English might use ‘one’ (as in: ‘in our village, one does not usually attend political rallies’). Translating (27) into Hebrew using the masculine pronoun in an unspecified subject constructions as in (28 a), or using the feminine pronoun, which agrees with the feminine noun ‘women’ as in (28 b), lead to similar interpretations of the original sentence³.

- (28) (a) *Me’atot mi-nSot ha-kfar*
Few of-woman:PL the-village
ha-ze higi’u
the-this come:PAST-3:PL
la-kenes ha-feministi. Lo
to-the-rally the-feminist. No
pele. Hem lo meod
wonder. They:M not very

³An informal inquiry with several Hebrew speakers indicates that they find both translations of the English sentence acceptable, with a negligible bias toward the unspecified subject construction in (28 a).

ohavim knasim politiyim.
 like:PL:M rally:PL political:PL

- (b) *Me'atot mi-nSot ha-kfar*
 Few of-woman:PL the-village
ha-ze higi'u
 the-this come:PAST-3:PL
la-kenes ha-feministi. Lo
 to-the-rally the-feminist. No
pele. Hen lo meod
 wonder. They:F not very
ohavot knasim politiyim.
 like:PL:F rally:PL political:PL

The only difference between (28 a) and (28 b) lies in the gender of the pronoun *they* (and subsequent verb agreement). Clearly, the referenced set in (28 a) cannot be the complement set. Rather, the sentence seems to make a generalized maximal reference to all the *people* in the village. By correlation, it seems natural to assume that (28 b) makes a reference to the maximal set of *women* in the village.

In a similar fashion, Corblin argues that the French example in (29) cannot possibly contain genuine complement set reference, since the adverbial *a 40% environ* would render the sentence with an explicit reference to this set false.

- (29) *Peu d'électeurs français ont voté*
 Few of-voters French have voted
pour le candidat du parti
 for the candidate of-the party
communiste. Ils ont voté pour
 communist. They have voted for
le candidat de la droite à 40
 the candidate of the right with 40
pour cent environ.
 percent average.

'Few French voters voted for the candidate of the communist party. Approximately 40 percent of the voters voted for the right-wing candidate'

Corblin identifies the complement set licensing determiners as those which demonstrate that the reference set is smaller than expected. Thus,

by referring to the maximal set, we know that its majority will consist of elements not satisfying the nuclear scope. As a consequence, we can confuse a restricted reference to the maximal set with reference to the complement set.

Note that this observation is in line with the conclusions reached by Moxey and Sanford, as outlined in section 2.3.2. In (30), the first sentence declares that the proportion of the MPs that attended the meeting is small. We can therefore generalize the second sentence over the MPs, and explain their (general) absentness (Nouwen: 17).

- (30) Few of the MPs went to the meeting.
 They stayed home instead.

An alternative approach to Corblin's analysis is based on the phenomenon of *collective reference*: The reference in sentence (31) can be sloppy, in the sense that the sentence is considered suitable even to describe situations where not *all* the soldiers were able to cope with the attack (Geurts, 1997).

- (31) The soldiers withstood the attack.

CA is thus an instance of sloppy reference; The plural pronoun refers to the maximal set, which is collectively held responsible for the negation of the nuclear scope in the antecedent sentence.

3.2 Complement set analyses

Nouwen (2003) points out several issues, which are not empirically explained by any of the analyses presented in the previous section. He argues, that complement set reference is caused by logical properties of determiners, not by pragmatic considerations: although sentence (32) could be true even if all the students went to the party, it nonetheless evokes an implicature, that not all the students did so. Rather, it implies that the proportion of students who went to the party is close to 10%. What would exclude analyses based on pseudo reference from using the implied non-empty set of non-party goers as the referent of the pronoun 'they' in the second sentence?

- (32) More than 10% of the students went to the party. #They went to the beach instead.

Nouwen makes two important observations, which will influence the subsequent analysis of CA. First (based on Kibble, 1997), CA is only licensed by proportional determiners, which are monotone decreasing on their second argument. Second, reference to the reference set is the unmarked option, compared with reference to the complement set. Therefore, reference to the complement set should be excluded whenever there exists an easier way of resolving the anaphoric relation. Consider the following examples:

- (33) Few of the students went to the party. I know who they are.
- (34) Few of the 20th century presidents of the USA were elected for two consecutive terms. My history teacher made me learn their names by heart.
- (35) Few of these balls are blue. Can you point them out for me?

These examples are neutral, in that they do not contain any catalysts that would cause preference for resolving the pronoun as referring either to the reference set or to the complement set. Nonetheless, these examples make the case that whenever possible, the reference set is the preferred resolution of an anaphoric pronoun. Complement set reference seems to be a last resort strategy, subject to many constraints. From the example below we can conclude, that complement set reference may be made, when choosing the reference set as the referent of the plural pronoun leads to a contradiction⁴:

- (36) Few of the MPs attended the meeting.
They sent their apologies for being absent.

Nouwen formulates several OT constraints on complement set reference, some of which are

⁴Note that this does not explain why we should exclude the maximal set as a potential referent. This point will be elaborated in section 4.

modeled after an analysis proposed by Hendriks and de Hoop (2001):

- (37) *Forward directionality*: The topic range included by the domain of quantification of a determiner is reduced to the topic range induced by the intersection of the two argument sets of this determiner.
- (38) *Emptiness*: As the antecedent of an expression do not choose a set which is potentially empty, except when this set is the reference set of a quantificational sentence.
- (39) *Avoid contradiction*: prefer reference to the reference set, as long as this does not cause a contradiction with previously introduced assertions in the discourse.

The empty restrictor in the second sentence in (40) needs to be filled in. Forward directionality tells us, that while the first sentence is about some (contextually determined) set of students, we prefer to interpret the next sentence as being about the students who attended the meeting. This means that ideally, the reference set is used as a restrictor for *three* in interpreting the second sentence. Thus, it is interpreted as *three students who attended the meeting spoke* rather than *three students spoke*.

- (40) Ten students attended the meeting.
Three spoke.

Emptiness and Forward directionality account for the fact that in downward proportional cases, reference to both the complement set and reference set is possible, but there is a preference for the latter. CA is not an option for increasing or non-proportional quantifiers.

Avoid contradiction is based on the previously discussed tendency to resolve anaphora to the reference set, when at all possible. Only when this leads to a contradiction, does the last resort strategy of complement set interpretation come into play.

Nouwen argues that Emptiness should be regarded not as a soft constraint, but rather as

part of the generator, the set of hard constraints that dictates which interpretations are in the candidate set. Avoid contradiction is ranked above Forward directionality and below Emptiness, thus explaining examples like (41):

- (41) Most students went to the party. #They went to the beach instead.

Here, Avoid contradiction would direct us to choose the complement set as a possibility of coherently resolving the plural pronoun. However, Emptiness rules this option out, since the complement set could be empty: the first sentence could be true in a situation where all the students went to the party. This leaves us forced to interpret the plural pronoun in the second sentence as referring to the reference set, leading to a contradictory reading, which explains the infelicity of the continuation.

The following table summarizes the effect the three constraints have on available interpretations of anaphoric pronouns⁵. In the table, one can see that Emptiness rules out all the cases where the complement set might be empty, leaving only the proportional downward entailing quantifiers.

		Emp	AvC	FwD
<i>Most (A)(B). They¬B</i>	∅Ref		*	
<i>Most (A)(B). They¬B</i>	Comp	*		*
<i>Most (A)(B). They C</i>	∅Ref			
<i>Most (A)(B). They C</i>	Comp	*		*
<i>Less than half (A)(B). They¬B</i>	Ref		*	
<i>Less than half (A)(B). They¬B</i>	∅Comp			*
<i>Less than half (A)(B). They C</i>	∅Ref			
<i>Less than half (A)(B). They C</i>	Comp			*
<i>Less than ten (A)(B). They¬B</i>	∅Ref		*	
<i>Less than ten (A)(B). They¬B</i>	Comp	*		*
<i>Less than ten (A)(B). They C</i>	∅Ref			
<i>Less than ten (A)(B). They C</i>	Comp	*		*

⁵ *Ref* stands for reference set reference; *Comp.* stands for complement set reference; *Emp*, *AvC* and *FwD* stand for Emptiness, Avoid contradiction and Forward directionality respectively. Predicate C is neutral, in that it does not get a disjoint interpretation with predicate B in sensible models. Contradictory continuations are indicated by predication $\neg B$.

In general, reference set reference is preferred, but this can be overruled in the non-neutral cases, where the predication in the continuation contradicts the predication in the antecedent sentence.

4 A new proposal

The following section proposes a new integrated analysis of complement anaphora. It draws on the semantic nature of the phenomenon, associated earlier with complement set reference analyses, but reaches the conclusion that we are in fact dealing with maximal reference. Though this type of analysis has previously been associated with pragmatically-motivated argumentation, this dichotomy is shown not to stand on firm grounds.

4.1 The analysis

As a first step, it seems advisable to accept Nouwen’s argumentation in favor of the semantic, rather than pragmatic, nature of CA - it is only possible with proportional quantifiers, which are right monotone decreasing. However, adopting Nouwen’s own analysis leads to the opposite conclusion than he reaches.

One of the central stages in Nouwen’s argumentation for complement set reference is the observation that it is a last resort strategy. That is, it will only be used, if no better strategy to resolve the anaphoric pronoun exists. This leads him to formulate the Avoid contradiction constraint. But as Nouwen himself states, ‘it is feasible that proportional quantifiers introduce a referent for their restrictor, since they presuppose this set to be non-empty. This means that in those cases, the maximal set is available independent of a noun phrase anaphoric to it’ (Nouwen, footnote 9, p. 101).

A similar (though more limited) observation was made by Krahmer and van Deemter (1998), who use a *presuppositions-as-anaphors* approach to explain cases of *partial matches* between an anaphor and its antecedent. They suggest that in certain situations, weak NPs can trigger an existence presupposition, when

the determiner is accented (indicated below by small caps).

In sentences such as (42), the weak NP NO/FEW *girls in this class* triggers an existence presupposition. Accommodation yields a presuppositional DRS, which introduces the set of girls into the discourse. This explains why the pronoun ‘they’ in the second sentence succeeds in finding an antecedent, thereby referring to the set of *girls in this class* (Krahmer and van Deemter, 1998).

- (42) If a new teacher is hired, there are
 {NO/FEW} girls in this class who
 immediately have a crush on him. In fact,
 they are primarily interested in the
 Backstreet Boys.

Combining the facts stated above - that CA is only possible with proportional monotone decreasing quantifiers; and that proportional quantifiers independently introduce into the discourse a variable that refers to the maximal set - means that we can always avoid the last resort tactic of complement set reference. The maximal set is always more accessible than the complement set; it is introduced via the restrictor, and need not be specially calculated for the anaphor’s sake. It would therefore always be a better choice for anaphora resolution than introducing a new, non-salient referent into the discourse, and resolving the anaphor to it.

It is worthwhile to note that some analyses that treat CA as real reference to the complement set have recognized the need to introduce a discourse referent that can resolve the problematic pronoun (cf. Devlin, 1997; Kibble, 1997). However, their argumentation for the existence of a such a referent is based on its desirability as an anaphora resolver, not on independent reasoning. As such, it stands on less solid grounds than the presuppositional discourse referent suggested above.

In effect, we can keep the crux of Nouwen’s analysis, including the observations he makes about the semantic nature of the phenomenon and his OT constraints. We do not even have to reformulate the Avoid contradiction constraint;

the only difference is that we would choose maximal set reference, rather than complement set reference, as the last resort tactic.

4.2 Maximality effects

Independently of the question whether CA deals with real or pseudo reference to the complement set, another maximality effect of CA can be pointed out: When referring to the complement set, reference must be made to the *maximal* set. This means, that the continuation of (43) cannot mean that some of the MPs who did not attend the meeting were too busy, and some other non-attending MPs had other excuses (Nouwen: 90):

- (43) Few of the MPs attended the meeting.
 They were too busy.

Nouwen shows that this phenomenon is parallel to other cases of non-salient reference, in which we must use inference in order to calculate the referent of an anaphor. In the subsectional anaphora example below, the two definite descriptions *the boys* and *the girls* both refer to a subset of their (syntactic) antecedent *the children*. The reference here must be maximal.

- (44) The children were having a lot of fun in
 the park. The boys played hide and seek
 and the girls were picking flowers.

The maximality effect causes Nouwen to add a fourth constraint, that addresses the type of knowledge needed in order to refer to a complement anaphor. This can be named the *inferability* constraint: While anaphors referring to the reference set are ordinary pronouns, which have a high degree of salience in the discourse, pronominal complement anaphors are extraordinary pronouns. Their antecedent is not salient and the acceptability of the anaphoric link they contribute is both semantically and pragmatically constrained. The inferability constraint has a last restriction on its use, *Uniqueness*: There must be one clear possible antecedent in the context, not many different candidates.

It seems, that the very fact that even a complement set analysis is in need of a maximality constraint should have caused Nouwen to have second thoughts about his analysis. It is clear that some maximality effect is in play here, which is naturally accommodated within the pseudo reference analysis, but must be specially explained in the complement set analysis.

5 Discussion

Several reasons make the new proposal more appealing than the previous analyses.

First, it renders Nouwen's Inferability constraint and its refinement Uniqueness obsolete. They both emanate directly from the analysis and need not be artificially added. Since the maximal set referent starts its way as a presupposition and is introduced to the discourse through accommodation, it is clear why it is less salient than ordinary anaphoric pronouns. As a presupposition, it is also clear that it must be inferable from the context and coherent with it. The Uniqueness requirement also follows directly from the new proposal: by taking the maximal set as the antecedent, maximality is naturally fulfilled.

Second, choosing the maximal set as the referent of complement anaphors would solve the problem DRT has with complement anaphora. The referent is already introduced into the discourse via the restrictor, and is later free to act as an antecedent that can bind anaphoric expressions. Furthermore, it is in line with Kamp and Reyle's generalization that subtracting one set from another is not a permissible operation for the formation of pronominal antecedents.

Lastly, by suggesting the (somewhat unconventional) use of existing information, the new proposal is more economical than an analysis that would have us add new information to the discourse (namely, calculate a complement set discourse referent in order to manufacture an antecedent that can bind the subsequent anaphoric expression). It explains more data using less calculations.

Several objections can be raised against the different pseudo-reference proposals. Flaws can be found in all such arguments (most argumentation due to Nouwen, see pp. 80-88)

Some suggest, that it is unclear, why speakers should confuse maximal set reference with complement set reference. In Moxey and Sanford's experiments, subjects were explicitly asked to which group they were referring, and were given the choice between the complement set and a generalization of the maximal set. They chose the complement set. However, one can argue that naive language speakers cannot truly understand the question: what does the word 'they' refer to? Their answers cannot be relied on as unbiased data.

Another objection is raised through the use of *instead*. One of the continuations of Moxey and Sanford's experiment is given below:

- (45) Hardly any of the MPs went to the meeting. They were out at the pub or with their secretaries instead.

If this was a case of maximal set reference, then the contrast made would be incomplete. Genuine complement set reference would make the use of *instead* felicitous, since it is implicitly associated with the denial of the antecedent sentence. However, we can think of *instead* as modifying the VP and not the whole sentence, as in (one reading of) example (46). Therefore, the plural pronoun 'they' refers to the maximal set, and there is no explicitly negative property being contrasted (Nouwen: 21).

- (46) Tom went to the cinema, but Bill stayed at home instead.

One further objection raised against Corblin's analysis has to do with the strength of the modifier: Corblin's analysis assumes that complement set licensing determiners report on the smallness of the reference set. However, Moxey and Sanford's studies tell us that there are a few determiners that do license complement anaphora but do not offer a smallness judgment, such as in (47). Corblin's analysis would have

the plural pronoun in the second sentence refer to the maximal set, even though in reality it reports about a minority group within it.

A semantic approach to pseudo-reference can easily explain this fact, since *less than 90%* is a proportional right monotone decreasing determiner. Moreover, one might argue that Corblin's explanation of 'confusion with the complement set' becomes clearest in these circumstances. This is the easiest way explain an apparent contradiction, even though the actual semantic mechanism works somewhat differently.

- (47) Less than 90% of the MPs attended the meeting. They stayed at home instead.

This last criticism is what lead Nouwen to prefer Geurts's analysis, which relies on collective reference as its explanation of maximal set reference, over other maximal set analyses. He finds that it is immune to the last point just raised: even minorities can be responsible for collective reference, as is attested by (48):

- (48) The local residents organized a barbecue.

Imagine a situation where there are a hundred residents and an organizing committee consisting of ten of them. In such a situation, (48) could be truthfully uttered.

In practice, Nouwen finds ways to dismiss all of his critical arguments against maximal set reference analyses (of Geurts's type). He goes on to claim that 'here we stumble on a difficult point in our evaluation. It may well be that the choice between real complement set reference and pseudo reference cannot be made' (Nouwen, p. 86).

It seems that the coincidental fact that all pseudo-reference analyses have been based on pragmatic reasoning caused Nouwen to opt to treat CA as reference to the complement set, since he found that it is based on semantic grounds. However, the fact that a formal semantic approach is required should have been assumed independently of the real/pseudo-reference question, thus avoiding unneeded complications of the theory.

6 Conclusion

This paper discussed the phenomenon of complement anaphora, which describes the difference between examples like (12) and (13):

- (12) Few congressmen admire Kennedy, and they are very junior.
(13) Few congressmen admire Kennedy. They think he's incompetent.

While the theory of anaphora can straightforwardly explain regular anaphora, some development of the theory has to be made in order to accommodate the possibility of complement anaphora. The paper reviewed two such development strategies - one claiming complement anaphora to be a case of pseudo reference to the complement set; and one claiming that complement set reference should be analyzed as a genuine phenomenon.

While the first type of analysis has been formerly based on pragmatic reasoning, the second type has been based on semantic grounds. The paper concluded that a third analysis is required, which combines the semantic reasoning of the complement set reference analysis with a pseudo reference result.

It follows from the new analysis, that genuine reference to the complement set does not exist. It was shown, that the maximal set must be calculated for independent reasons, as it is introduced into the context as a presupposition. For economical reasons, it will always be the preferred candidate for the resolution of an anaphoric pronoun, rather than performing the added work of calculating a new non-salient referent, in the form of the complement set, and resolving the pronoun to it.

This result has a pragmatic effect in constraining the amount and kind of information the brain must calculate when it encounters an unusual anaphor (which does not resolve to the reference set). The new analysis is therefore both more elegant and more economical than previous analyses. It is further motivated by an independent maximality effect, which must be

specially accounted for in complement set reference analyses, but follows naturally from the one proposed in this paper.

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