

# Complement Anaphora and Negative Polarity Items

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## 1 Introduction

- (1) a. Complement set anaphora (CA):  
**Few congressmen** admire Kennedy. They think he's incompetent.  
(*they* = the congressmen that don't admire Kennedy)
- b. Negative polarity items (NPI):  
**Few congressmen** have ever admired Kennedy.

## 2 Data

### 2.1 Complement Anaphora

Some quantified NPs can serve as antecedent for a pronoun which refers to the intersection of the restriction and the complement of the scope (the *complement set*), rather than to the intersection of the restriction and the scope of the quantifier (the *reference set*) (Sanford, Moxey and Paterson 1994). Such pronouns are called *complement anaphora* (CA).

- (2) Types of continuations (Nouwen 2003):
- a. Refset anaphor:  
Few congressmen admire Kennedy, and they are very junior.  
*they*: the congressmen that admire Kennedy
- b. Compset anaphor (CA):  
Few congressmen admire Kennedy. They think he's incompetent.  
*they*: the congressmen that don't admire Kennedy
- c. Maxset anaphor:  
Few MPs attend the morning meetings, but they all attend the Friday afternoon drinks.  
*they*: the MPs

CAs:

- always plural
- occur with monotone decreasing proportional quantifiers.

Downward-entailing:

- none of the students; few of my students
  - if  $X \subseteq Y$  and  $\mathbf{NP}(Y)$ , then  $\mathbf{NP}(X)$ .
  - **None of the students** like vegetables.  
⇒ **None of the students** like broccoli.
  - non-monotone: three students  
upward entailing: some students, every student
- (3) a. Some congressmen attended the meeting. They were too busy (# CA)  
b. **Few congressmen** attended the meeting. They were too busy (CA)

Proportional:

- few of the ten students, most of the students, at most 10% of the students
  - **Det(A)** is proportional  
iff **Det(A)(B)** depends on the size of the set A.  
iff the set A is presupposed.
  - cardinal: D(A)(B) only depends on the size of  $A \cap B$   
less than 4
- (4) a. Less than 30 MPs attended the meeting. They were too busy. (#CA)  
b. **Less than 30% of the MPs** attended the meeting. They were too busy. (CA)

### 2.2 Negative Polarity Items

Negative Polarity Items (NPIs) occur only in the scope of monotone decreasing operators (Ladusaw 1980).

- (5) a. Niemand hat jemals etwas von Zafón gelesen.  
Nobody has ever something by Zafón read  
(‘Nobody has ever read anything by Zafón.’)  
(monotone decreasing, cardinal)
- b. Wenige Buchhändler in Barcelona haben jemals von Zafón gehört.  
Few booksellers in Barcelona have ever of Zafón heard.  
(‘Few booksellers in Barcelona have ever head of Zafón.’)  
(monotone decreasing, proportional)

Zwarts (1997) shows that there are NPIs of different strength.

- (6) *auch nur irgendetwas* (anything at all)
- a. **Niemand** hat auch nur irgendetwas von Zafón gelesen.  
Nobody has anything at all by Zafón read  
(‘Nobody has read anything at all by Zafón.’)
- b. \***Wenige Buchhändler** haben auch nur irgendetwas von Zafón gehört.  
Few booksellers have anything at all of Zafón heard.

Strong NPIs require an anti-additive context:

- (7) a.  $f$  is anti-additive iff  $f(A \cup B) \leftrightarrow f(A) \cap f(B)$   
 b. Anti-additive licensors: *none of the N, no N, no one, never*  
 c. No one danced or sang  $\leftarrow$   
 No one danced and no one sang.  
 d. Few students danced or sang  $\nrightarrow$   
 Few students danced and few students sang.
- (8) Strong NPIs from (Zwarts 1997):  
 a. German: *auch nur irgend-* (any- at all), *sonderlich* (especially), *einen Mucks machen* (make a noise), *nennenswert* (worth mentioning)  
 b. English: *lift a finger, any ... at all, until*.  
 c. Dutch: *ook maar iets* (anything at all)
- (9) *sonderlich* (especially):  
 a. **Niemand** fand das Buch sonderlich spannend  
 Nobody found the book particularly exciting  
 b. \***Wenige Leser** fanden das Buch sonderlich spannend.  
 Few readers found the book particularly exciting
- (10) *einen Mucks machen* (to make a noise)  
 a. **Niemand** traute sich, einen Mucks zu machen  
 nobody dared to make a noise  
 b. \***Wenige** traute sich, einen Mucks zu machen  
 Few people dared to make a noise

### 2.3 Strong NPIs in Non-anti-additive Contexts

- Krifka (1995)

(11) **Hardly ANYONE** lifted a finger to help me.

“we perhaps even do not want to rule out combinations like *fewer than three girls did anything at all* by fundamental principles”.

- van der Wouden (1995) observes the occurrence of strong NPIs in negative raising contexts:

(12) *ook maar iets* (anything at all) is a strong NPI in Dutch:

- a. Niemand heeft ook maar iets gezien.  
 no one has anything at all seen  
 ('No one has seen anything at all.')
- b. \***Weinig mensen** hebben ook maar iets gezien.  
 Few people have anything at all seen

*Ook maar iets* (anything at all) in negative raising constructions:

(13) **Weinig mensen** herinneren zich [ook maar iets gezien te hebben]  
 few people remember themselves anything at all seen to have  
 ('Few people remember having seen anything at all.')

If a simply monotone decreasing quantifier is used in a proportional way we can observe an increase in the grammaticality of the use of a strong NPI.

- (14) *sonderlich* (especially)  
 a. \*Höchstens 3 Schüler fanden das Buch sonderlich spannend.  
 At most 3 pupils found this book particularly exciting.  
 b. Höchstens 10% der Schüler fanden das Buch sonderlich spannend.  
 At most 10% of the pupils found this book particularly exciting.
- (15) a. \*Nicht mehr als 3 Schüler haben im Matheunterricht einen Mucks gemacht  
 No more than 3 pupils have during math classes a noise made  
 b. **Nicht mehr als 3 meiner 30 Schüler** haben im Matheunterricht  
 No more than 3 of my 30 pupils have during math classes  
einen Mucks gemacht.  
 a noise made
- (16) a. \*Nicht mehr als 3 Schüler haben auch nur irgendetwas gelernt.  
 No more than 3 pupils have anything at all learnt.  
 b. **Nicht mehr als 10% der Schüler** haben auch nur irgendetwas gelernt.  
 No more than 10% of the pupils have anything at all learnt.

#### Generalization:

- Complement anaphora are licensed by monotone decreasing proportional quantifiers.
- Strong NPIs are licensed by anti-additive operators and by monotone decreasing proportional quantifiers.
- There is a relation between NPI licensing and CA licensing: If a quantified NP can establish an antecedent for a CA, it can also license a strong NPI.

## 3 Previous Approaches

### 3.1 Theories of NPI Licensing

- Entailment-based theories (Zwarts 1997):

– the scope of proportional DE quantifiers is not necessarily anti-additive:

(17) Few of my 10 students danced or sang  
 $\nrightarrow$   
 Few of my 10 students danced and few of my 10 students sang.

– ignore CA

– why does the proportional/cardinal distinction matter?

- Krifka (1995):

– Strong NPIs are licensed in emphatic contexts, i.e. the licenser must be extreme with respect to the alternatives.

(18) **Nicht mehr als 10% meiner Studenten** fanden den Artikel sonderlich  
 No more than 10% of my students found the paper particularly  
 spannend.  
 exciting.

- *no more than 10%* should be extreme in the context.
- Why does the proportional/cardinal distinction matter?
- Is *sonderlich* really emphatic?

- Linebarger (1980), Linebarger (1987):
  - Analyzes NPI licensing by *few* in terms of a *negative implicatum* (NI):
    - Few students** did any homework.
    - NI: Many students **didn't** do any homework.
  - difference strong/weak NPI: strong NPIs only direct licensing.
  - But: the NI is only there under a *proportional reading* of *few*
    - \* weak NPIs are fine with cardinal *few*.
    - \* strong NPIs: for proportional reading: NI valid; but strong NPIs are claimed to be licensed only directly.

### 3.2 Theories of CA

- Sanford, Williams and Fay (2001):
  - DE is necessary for CA
  - The more “negative” the antecedent, the more likely we get a CA interpretation of a pronoun. (*no more than* vs. *at most*)
  - But: ignore proportional vs. cardinal quantifiers don't mention NPIs.
- Kibble (1998)
  - analyzes CAs as e-type pronouns.
  - Some quantifiers introduce both a reference and a complement set, either of which can be used as the antecedent of the pronoun.
  - The semantics of the clause containing the antecedent is the same no matter how it continues.
  - But: a strong NPI prohibits a refset continuation:
 

(19) Nicht viele meiner Schüler fanden das Buch sonderlich spannend.  
not many of my pupils found the book particularly exciting

    - Sie fanden es sogar extrem langweilig. (CA)  
They found it even extremely boring.
    - \*Sie wollten sogar gleich die Fortsetzung lesen. (Refset)  
They wanted even at once the continuation read
- Nouwen (2003)
  - rejects an e-type pronoun approach to CAs.
  - He uses ranked constraints to determine whether a reference or a complement set can be inferred and used as antecedent to a pronoun.
  - with proportional DE quantifiers: The compset can be interfered as discourse referent.
  - However, there is no direct way to link these constraints to a theory of NPI licensing in a way that would allow us to distinguish two cases for *few*.

## 4 Analysis: Lexical Decomposition and Equivalence of Representations

Sketch of the analysis:

- Lexical decomposition of the quantifiers
- The existence presupposition of the restrictor set triggered by proportional allows for a two different logical forms.
- Example:
 

(20) No more than 10% of my students attended the meeting.  
↔ At least 90% of my students did not attend the meeting.
- regular context for a strong NPI!  
“refset” anaphor corresponds to a compset anaphor of the original sentence!

### 4.1 Lexical Decomposition of Downward-entailing Quantifiers

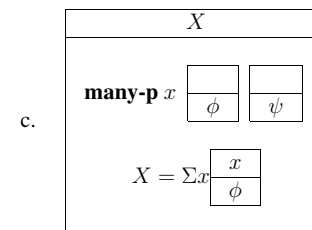
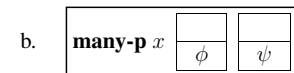
Downward-entailing quantifiers can be decomposed, introducing a negation in the logical form:

- (21) *no*:  $\text{no } x(\phi)(\psi) = \neg \text{some } x(\phi)(\psi)$
- (22) *few*:  $\text{few } x(\phi)(\psi) = \neg \text{many } x(\phi)(\psi)$
- (proportional meaning: **many-p**: a large percentage of the elements in  $\phi$  is in  $\psi$ )
  - (cardinal meaning: **many-c**: a large number of elements is in  $\phi$  and in  $\psi$  at the same time.)

### 4.2 Presupposition of the Restrictor Set

A proportional quantifier presupposes the restrictor set:

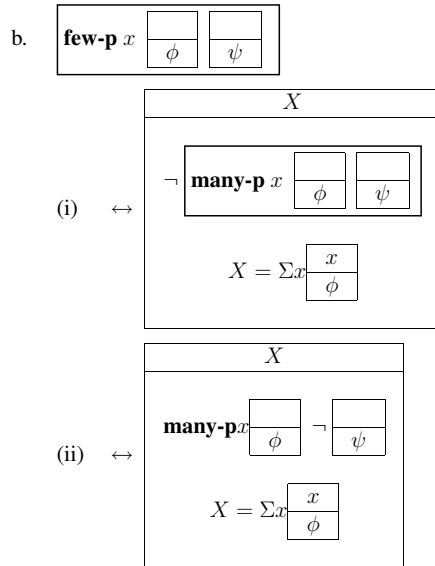
- (23) a. **many-p**  $x(\phi)(\psi)$



For each proportional quantifier  $Q$ :  $\neg Qx(\phi)(\psi)$  is equivalent to  $Q'x(\phi)(\neg\psi)$  for some quantifier  $Q'$ .

- (24) a. No more than 10% of my students attended the class.  
↔ At least 90% of my students did not attend the class.

- b. Few of my students attended the class.  
 $\leftrightarrow$  Many of my students did not attend the class.  
 c. *few*:  $\neg$ **many-p**  $x(\phi)(\psi) = \mathbf{many-p}$   $x(\phi)(\neg\psi)$   
 (25) a. *few*:  $\neg$ **many-p**  $x(\phi)(\psi) = \mathbf{many-p}$   $x(\phi)(\neg\psi)$

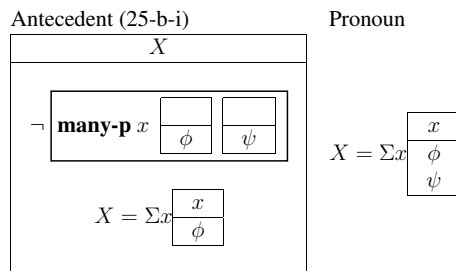


Note that this is not possible for corresponding cardinal quantifiers, because the non-emptiness — let alone the cardinality — of the restrictor set is not given:

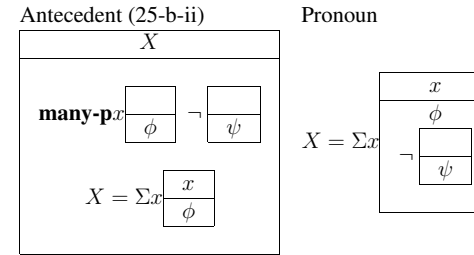
### 4.3 Possible Continuations

The behavior of compset anaphora can be reduced to the dynamics of the quantifier  $Q'$ . The compset anaphora takes as its antecedent all elements in  $\phi \wedge \neg\psi$ :

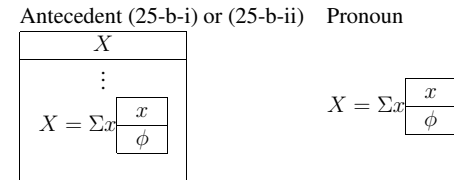
- (26) Refset: Few congressmen admire Kennedy, and they are very junior.



- (27) Compset: Few congressmen admire Kennedy. They think he's incompet.



- (28) Maxset: Few congressmen admire Kennedy, but they all like his wife.



- CA is only possible with downward-entailing quantifiers, because only these introduce a negation into their logical form.
- CA is only possible with proportional quantifiers, because only these guarantee the equivalence of  $Qx(\phi)(\psi)$  and  $Q'x(\phi)(\neg\psi)$  and, thus, allow the lower scope of the negation.

### 4.4 Negative polarity items

- Assumption: strong NPIs are licensed in the immediate scope of negation. I.e.: the semantic contribution of an NPI must be a condition in a DRS  $K$ , such that  $\neg K$  is part of the semantic representation of the utterance.
- Given the decomposed and transformed semantic representations, strong NPIs are licensed in contexts in which CAs can occur.

- (29) a. Nicht mehr als 10% der Schüler haben auch nur irgendetwas gelesen.  
 not more than 10% of the pupils have anything at all read  
 b.  $\leftrightarrow$  At least 90% of the pupils didn't read anything at all.  
 c. **at-least-90%**  $x(\mathbf{pupil}(x))(\neg\exists y(\mathbf{thing}(y) \wedge \mathbf{read}(x, y)))$

### 4.5 Predictions of the theory

If a strong NPI occurs, a refset anaphor is not possible:

- (30) Nicht viele meiner Schüler fanden das Buch sonderlich spannend.  
 not many of my pupils found the book particularly exciting  
 a. Sie fanden es sogar extrem langweilig.  
 They found it even extremely boring.  
 b. \*Sie wollten sogar gleich die Fortsetzung lesen.  
 They wanted even at once the continuation read

- (31) Höchstens ein Drittel der Schüler an unserer Schule kennt auch nur irgendeine Oper von Mozart.  
 At most one third of the pupils at our school knows any at all opera by Mozart.
- Sie kennen nicht mal “die Zauberflöte”.  
They know not even “The Magic Flute”
  - Sie kennen zumindest “die Zauberflöte”.  
They know at least “The Magic Flute”

## 5 An Integration into HPSG?

Integrating DRT into HPSG: (Frank and Reyle 1992), Gert Webelhuth’s recent work. In a first approximation, I will sketch what the theory could look like. In a second step, I will assume an lrnsified version of an encoding of the DRT representation language and get closer to a formalization.

### 5.1 First Approximation

- The logical form of an utterance is a DRS.
- The logical form of a sign is either a DRS or a DRS-condition.
- The preceding context is represented in a *drs*-valued attribute CONTEXT DRS.
- Presuppositions: We assume an attribute CONTEXT PRESUP whose value is a list of *drs*-objects.
- The CONTEXT DRS value of an utterance corresponds to the merge of the CONTENT value, the CONTEXT PRESUP value, and the CONTEXT DRS value of the preceding utterance.  
**Note:** This should be part of a discourse grammar, which is presupposed but not formalized here.
- I will use *Lexical Resource Semantics* (LRS, (Richter and Sailer 2004)) as the means for combinatorial semantics. For the DRS of the preceding context and the list of DRSs in the presuppositions, simple *drs*-objects are assumed.
- Probably, the CONTEXT should be split — in analogy to the local semantics and the operator semantics — into a local context and a non-local context. However, I will stick to the traditional architecture here.
- All I am going to be concerned with is the mapping from  $\neg Qx(\phi)(\psi)$  to  $Q'x(\phi)(\neg\psi)$ .

Formalization as a lexical rule:

$$(32) \left[ \begin{array}{l} \text{SYNS LOC} \left[ \text{CONX} \left[ \text{PRESUP} \langle \dots, \right. \right. \\ \left. \left. X = \Sigma x \left[ \begin{array}{c} x\vec{v} \\ \phi \end{array} \right] \dots \rangle \right] \right] \\ \text{LF} \left[ \text{PARTS} \left[ \text{A} \oplus \langle \neg Qx \left[ \begin{array}{c} \vec{v} \\ \phi \end{array} \right] \left[ \begin{array}{c} \vec{w} \\ \psi \end{array} \right] \rangle \oplus \text{B} \right] \right] \end{array} \right]$$

$$\mapsto \left[ \text{LF} \left[ \text{PARTS} \left[ \text{A} \oplus \langle Q'x \left[ \begin{array}{c} \vec{v} \\ \phi \end{array} \right] \left[ \begin{array}{c} \vec{w} \\ \psi \end{array} \right] \rangle, \neg \left[ \begin{array}{c} \vec{w} \\ \psi \end{array} \right] \rangle \oplus \text{B} \right] \right] \right]$$

- The determiner  $Q'$  depends lexically on the determiner  $Q$ .  
 $Q$  and  $Q'$  are sorts from our HPSG-encoding of DRSs, such that

(33)

PHON	$Q$	$Q'$
few	<i>many</i>	<i>many</i>
at most	<i>more-than</i>	<i>all-but</i>

- Lexical decomposition guarantees that the rule only applies to DE quantifiers.
- The lexical rule does not apply to negative indefinites (*none of NP*, ...): They license strong NPIs directly and, if presuppositional, “complement set reference” corresponds to maximal set reference.
- The lexical rules should leave the syntactic category underspecified. Then, we can also account for CAs in

- (34)
- Not many of my students showed up at yesterday’s meeting. They didn’t put it on their agenda.
  - I doubt that many of my students will show up at today’s meeting. They will be at the Halloween party.

### 5.2 Example

- (35) Sketch of the lexical entry of *few*:

$$\left[ \begin{array}{l} \text{PHON} \langle \textit{few} \rangle \\ \text{SYNS LOC CONT} \left[ \begin{array}{l} \text{MAIN} \left[ \begin{array}{c} \square \textit{many} x K_1 K_2 \end{array} \right] \\ \text{INDEX} x \end{array} \right] \\ \text{LF} \left[ \begin{array}{l} \text{EXCONT} \square \\ \text{INCONT} \square \\ \text{PARTS} \langle x, \square, \rangle \end{array} \right] \end{array} \right]$$

**Note:** There may not be a discourse representant in the universe of the negation.

- (36) Applying the lexical rule to *few*:

$$\left[ \begin{array}{l} \text{PHON} \langle \textit{few} \rangle \\ \text{SYNS LOC} \left[ \begin{array}{l} \text{CONT} \left[ \begin{array}{l} \text{MAIN} \left[ \begin{array}{c} \square \textit{many} x K_1 \left[ \begin{array}{c} \neg K_2 \end{array} \right] \end{array} \right] \\ \text{INDEX} x \end{array} \right] \\ \text{CONX} \left[ \text{PRESUP} \left\langle \begin{array}{c} X \\ X = \Sigma x K_1 \end{array} \right\rangle \right] \end{array} \right] \end{array} \right] \\ \text{LF} \left[ \begin{array}{l} \text{EXCONT} \square \\ \text{INCONT} \square \\ \text{PARTS} \left\langle x, \square, \left[ \begin{array}{c} \neg K_2 \end{array} \right], \neg K_2 \right\rangle \end{array} \right] \end{array} \right]$$

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