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# Complement Anaphora and Negative Polarity Items

Manfred Sailer

Seminar für Englische Philologie

Universität Göttingen

manfred.sailer@phil.uni-goettingen.de

# Introduction
# Complement Anaphora and Negative Polarity Items?

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

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- Negative polarity items (NPI):
  Few congressmen have ever admired K.
- few congressmen is downward-entailing (DE).
  DE contexts are needed for both CA and NPI!



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# Introduction

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  Few congressmen admire Kennedy.
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  *they* = the congressmen that don't admire Kennedy
- Negative polarity items (NPI):
  Few congressmen have ever admired K.
- few congressmen is downward-entailing (DE).
  DE contexts are needed for both CA and NPI!
- More refined generalization and an argument for lexical decomposition of DE expressions.

# Overview

- Introduction
- Data
- Previous Approaches
- Analysis
- Conclusion

# Data on Complement Anaphora

# Possible continuations

Few congressmen admire Kennedy

- , and they are very junior.
  they = the congressmen that admire K. (Refset)
- They think he's incompetent.
  they = the congressmen that don't admire K.
  (Compset)
- , but they all like his wife.
  they = the congressmen (Maxset)

# Occurrence restrictions on CA (Nouwen 2003)

- always plural
- antecedent is a downward-entailing proportional quantifier

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# Occurrence restrictions on CA (Nouwen 2003)



downward-entailing:

- none of the students; few of my students
- if $X \subseteq Y$ and NP($Y$), then NP($X$).
- None of the students like vegetables.
  $\Rightarrow$ None of the students like brocoli.
- non-monotone: three students

  upward entailing: some students, every student
- Some congressmen attended the meeting.
  They were too busy (# CA)
- Few congressmen attended the meeting.
  They were too busy (CA)

# Occurrence restrictions on CA (Nouwen 2003)

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∩B
  less than 4
- Less than 30 MPs attended the meeting. They were too busy. (#CA)
- Less than 30% of the MPs attended the meeting. They were too busy. (CA)



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# Data: Negative Polarity Items

# NPIs in DE contexts (Ladusaw 1980, . . . )

German: *jemals* (*ever*)

- Niemand hat jemals etwas von Zafón gelesen.
  Nobody has ever something by Zafón read
  ‘Nobody has ever read anything by Zafón.’
- Wenige Buchhändler haben jemals von Zafón gehört.
  Few booksellers have ever of Zafón heard.



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# Weak and strong NPIs (Zwarts 1997)

*auch nur irgendetwas* (*anything at all*)

- Niemand hat auch nur irgendetwas von Zafón gelesen.
  Nobody has anything at all by Zafón read
  'Nobody has read anything at all by Zafón.'

- * Wenige Buchhändler haben auch nur irgendwas von
  Few booksellers have anything at all of
  Zafón gehört.
  Zafón heard.



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# Weak and strong NPIs (Zwarts 1997)

Strong NPIs require an anti-additive context:

- $f$ is anti-additive iff $f(A \cup B) \leftrightarrow f(A) \cap f(B)$
- No one danced or sang $\longleftrightarrow$
  No one danced and no one sang.
- Few students danced or sang $\not\longleftrightarrow$
  Few students danced and few students sang.

# Weak and strong NPIs (Zwarts 1997)

*sonderlich* (*particularly*)

- Niemand fand das Buch sonderlich spannend
  Nobody found the book particularly exciting
- * Wenige Leser fanden das Buch sonderlich spannend.
  Few readers found the book particularly exciting

# Weak and strong NPIs (Zwarts 1997)

*einen Mucks machen* (*to make a noise*)

- Niemand traute sich, einen Mucks zu machen
  nobody dared to make a noise
- * Wenige trauten sich, einen Mucks zu machen
  Few people dared to make a noise



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# Strong NPIs in non-anti-additive contexts

Krifka 1995:

- 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”.

# Strong NPIs in non-anti-additive contexts

van der Wouden 1995:
strong NPIs in NegRaising contexts:

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

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# Strong NPIs and proportional DE quantifiers

Proportional DE increase the grammaticality of a strong NPI:

- * Höchstens 3 Schüler fanden das Buch sonderlich
  At most 3 pupils found this book particularly
  spannend.
  exciting.

- Nicht mehr als 10% der Schüler fanden das Buch
  No more than 10% of the pupils found this book
  sonderlich spannend.
  particularly exciting.



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# Strong NPIs and proportional DE quantifiers

Proportional DE increase the grammaticality of a strong NPI:

- * Nicht mehr als 3 Schüler haben im Matheunterricht
  No more than 3 pupils have during math classes
  einen Mucks gemacht
  a noise made

- Nicht mehr als 3 meiner 30 Schüler haben im
  No more than 3 of my 30 pupils have during
  Matheunterricht einen Mucks gemacht.
  math classes a noise made



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# Strong NPIs and proportional DE quantifiers

Proportional DE increase the grammaticality of a strong NPI:

- * Nicht mehr als 3 Schüler haben
  No more than 3 pupils have
  auch nur irgendetwas gelernt.
  anything at all learnt.

- Nicht mehr als 10% der Schüler haben
  No more than 10% of the pupils have
  auch nur irgendetwas gelernt.
  anything at all learnt.



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# Strong NPIs and proportional DE quantifiers

- 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.

# Compatibility with Previous Approaches

# Theories of NPI licensing

Entailment-based theories:

- Zwarts 1997
- the scope of proportional DE quantifiers is not necessarily anti-additive:
  Few of my 10 students danced or sang
  $\not\leftarrow\rightarrow$
  Few of my 10 students danced and few of my 10 students sang.
- ignore CA
- why does the proportional/cardinal distinction matter?



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# Theories of NPI licensing

Krifka 1995:

- Strong NPIs are licensed in emphatic contexts, i.e. the licenser must be extreme with respect to the alternatives.
- Nicht mehr als 10% meiner Studenten fanden den Artikel
  No more than 10% of my students found the paper
  sonderlich spannend.
  particularly exciting.
- *no more than 10%* should be extreme in the context.
- Why does the proportional/cardinal distinction matter?
- Is *sonderlich* really emphatic?



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# Theories of NPI licensing

Linebarger 1980/87:

- 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.

# Theories of CA

Sanford et al. 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.

# Theories of CA

Kibble 1998:

- analyzes CAs as e-type pronouns
- DE quantifiers introduce both a refset and a compset, either of which can be the antecedent.
- No account of the proportional/cardinal distinction.
- Semantics of the clause is the same independent of the continuation.

# Theories of CA

But: a strong NPI prohibits a refset continuation:

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

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# Theories of CA

Nouwen 2003:

- rejects an e-type pronoun approach to CAs.
- 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.
- no link to NPIs.

# 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 quantifier allows for two different logical forms.
- No more than 10% of my students attended the meeting.
  $\rightarrow$ 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!

# Lexical decomposition of DE quantifiers

- DE quantifiers can be decomposed into negation + upward-entailing quantifier.
- *no*: **no** $x(\phi)(\psi) = \neg$**some** $x(\phi)(\psi)$
- *few*: **few**$x(\phi)(\psi) = \neg$**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.)

# Presupposition of the restrictor set

A proportional quantifier presupposes the restrictor set:

**many-p**$x(\phi)(\psi)$

$=$ **many-p** $x$ $\phi$ $\psi$



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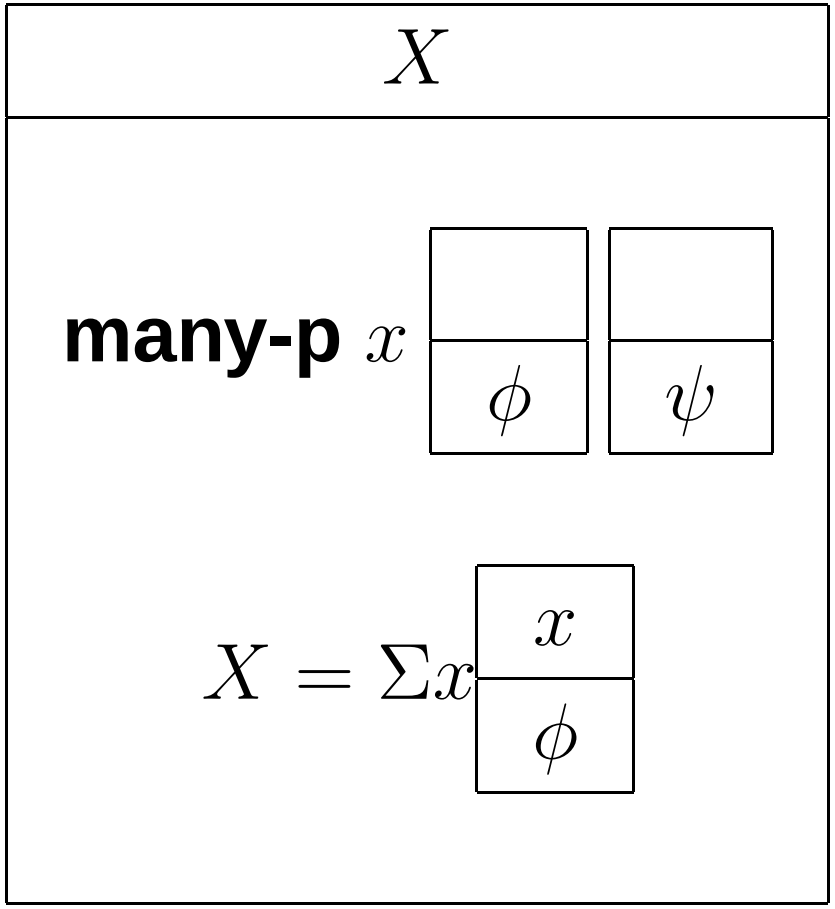
# Presupposition of the restrictor set

A proportional quantifier presupposes the restrictor set:

**many-p**$x(\phi)(\psi)$



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# Equivalences for proportional quantifiers

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

- No more than 10% of my students attended the class.
  $\leftrightarrow$ At least 90% of my students did not attend the class.
- Few of my students attended the class.
  $\leftrightarrow$ Many of my students did not attend the class.
- *few*: $\neg$**many-p** $x(\phi)(\psi) =$ **many-p** $x(\phi)(\neg\psi)$



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# Equivalences for proportional quantifiers

*few*: ¬**many-p** $x(\phi)(\psi)$

= ¬**many-p** $x$ $\begin{array}{|c|c|}\hline & \\ \hline \phi & \psi \\ \hline \end{array}$



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# Equivalences for proportional quantifiers

*few*: $\neg$**many-p** $x(\phi)(\psi)$

$$= \begin{array}{|c|}\hline X \\ \hline \neg \begin{array}{|c|c|}\hline \textbf{many-p}\ x & \begin{array}{|c|}\hline \\ \hline \phi \\ \hline\end{array} & \begin{array}{|c|}\hline \\ \hline \psi \\ \hline\end{array} \\ \hline \end{array} \\ \\ X = \Sigma x \begin{array}{|c|}\hline x \\ \hline \phi \\ \hline\end{array} \\ \\ \hline \end{array}$$

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# Equivalences for proportional quantifiers

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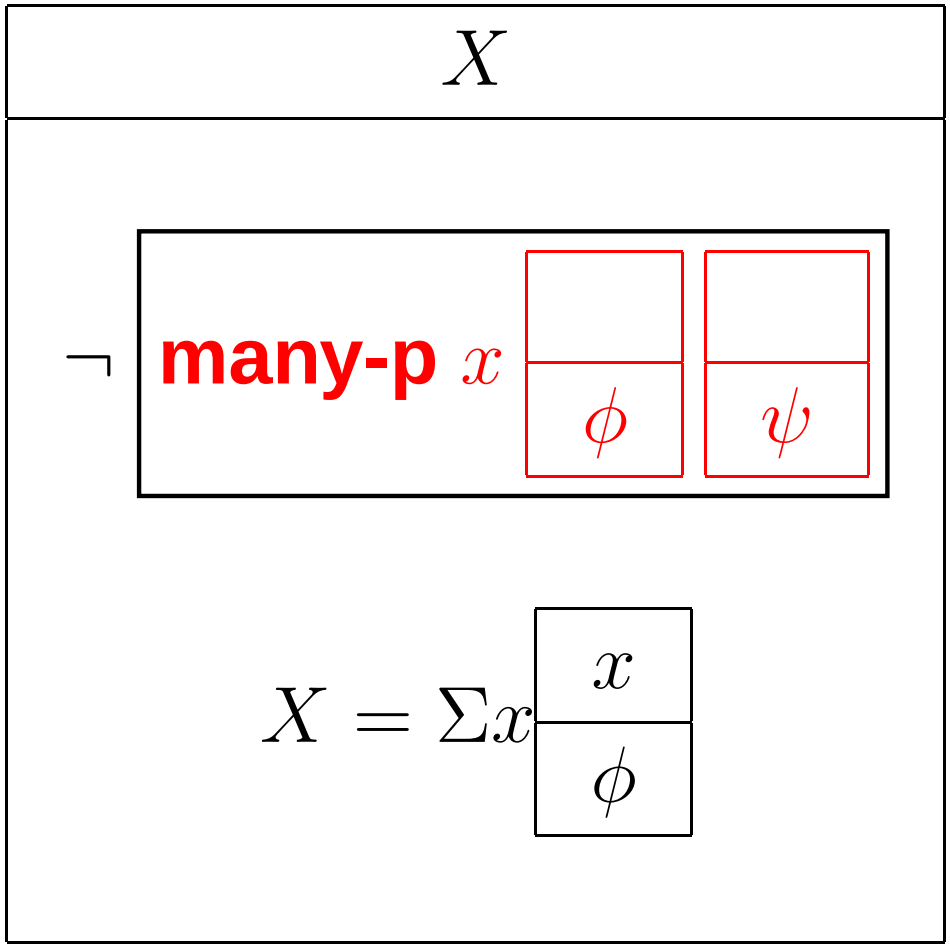
# Possible continuations

Refset: Few congrm. admire K., and they are very junior.

Antecedent representation: $\neg$**many-p**$x(\phi)(\psi)$



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# Possible continuations

Refset: Few congrm. admire K., and they are very junior.

Pronoun referent: $X = \Sigma x$

| $x$ |
|---|
| $\phi$ |
| $\psi$ |



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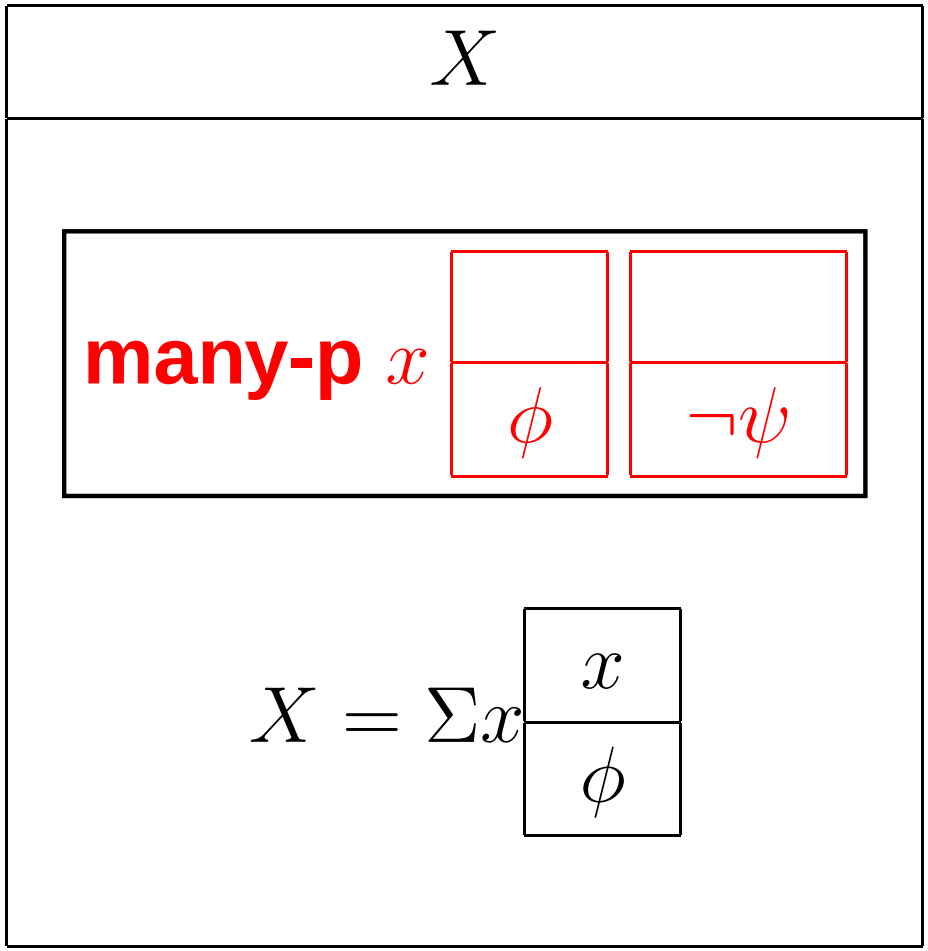
# Possible continuations

Compset: Few congrm. admire K. They think he's incomp.

Antecedent representation: **many-p**$x(\phi)(\neg\psi)$



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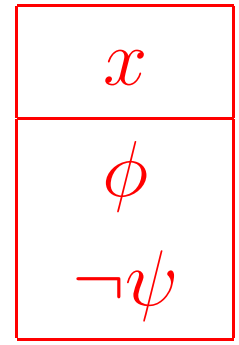
# Possible continuations

Compset: Few congrm. admire K. They think he's incomp.

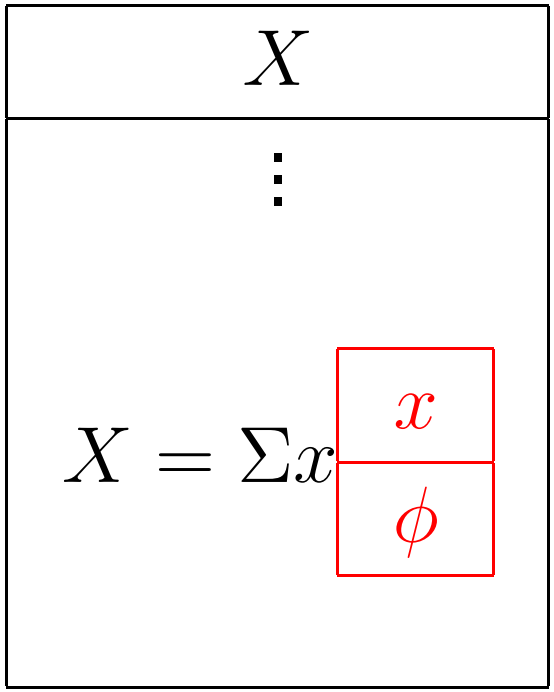
Pronoun referent: $X = \Sigma x$



# Possible continuations

Maxset: Few congrm. admire K., but they all like his wife.

Antecedent: (in both cases)




Pronoun referent: $X = \Sigma x$ $x$ / $\phi$



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# Summary: Complement Anaphora

- 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 $\neg \mathcal{Q}x(\phi)(\psi)$ and $\mathcal{Q}'x(\phi)(\neg\psi)$ and, thus, allow for the lower scope of the negation.

# Strong NPIs

- Assumption: strong NPIs are licensed in the immediate scope of negation.
- Given the decomposed and transformed semantic representations, strong NPIs are licensed in contexts in which CAs can occur.

# Strong NPIs

Nicht mehr als 10% der Schüler haben
not more than 10% of the pupils have

auch nur irgendetwas gelesen.
anything at all read

$\leftrightarrow$ At least 90% of the pupils didn't read anything at all.

**at-least-90%**$x($**pupil**$(x))(\neg\exists y($**thing**$(y)\wedge$**read**$(x,y)))$



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# Strong NPIs

* Nicht mehr als 10 Schüler haben auch nur irgendetwas
  not more than 10 pupils have anything at all

gelesen.
read

$$\neg \textbf{more-than-10} x(\textbf{pupil}(x))(\exists y(\textbf{thing}(y) \wedge \textbf{read}(x, y)))$$

With non-proportional quantifiers the negation cannot be “pushed down”. Therefore, the strong NPI is not in the immediate scope of the negation!



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# Conclusion

# Summary

- With lexical decomposition and equivalences of representations:
- Nothing special has to be assumed for CAs.
- Strong NPIs in apparently non-anti-additive contexts can be reduced to the standard case.

# Open Questions

- Data problem: individual judgments are not clear. Data don’t occur in present corpora (IDS, internet with google)
  Experimental study is under construction (Potsdam and Tübingen)
- What is the status of the equivalence transformation of sem. representation? (different from NI, but what?)

# Thank you!