ACS Syntax and Semantics of Natural Language

Lecture 4: Cross-Serial Dependencies in Dutch

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Cross-Serial Dependencies Example 1

. . . omdat ik Cecilia de nijlpaarden zag voeren.

. . . because I_1 Cecilia_2 the hippopotamses_3 saw_1 $\text{feed}_{2,3}$.

“. . . because I saw Cecilia feed the hippopotamses.”

- The Dutch construction is illustrated by the subordinate clauses above and on the next slide
- The co-indexing indicates the dependencies between the verbs and NPs represented in the semantics
- The dependencies *cross* rather than *nest* (as they do in the English translation)

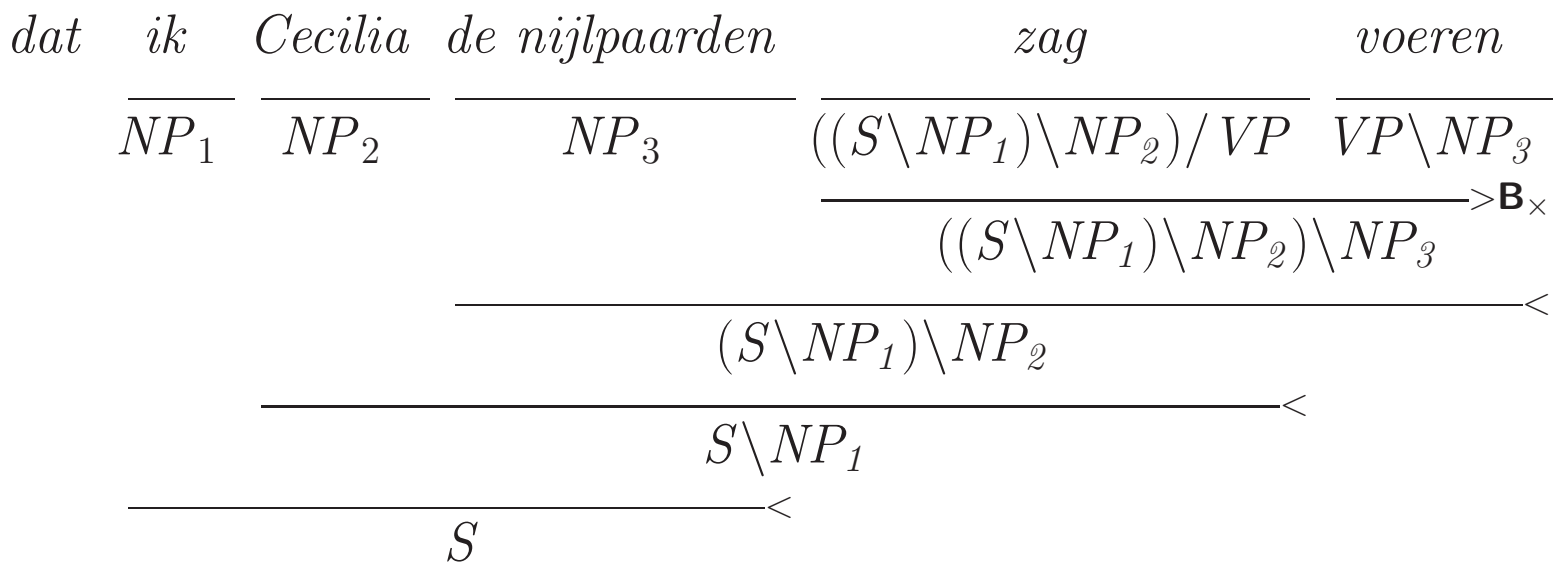
Cross-Serial Dependencies Example 2

. . . omdat ik Cecilia Henk de nijlpaarden zag helpen voeren.

. . . because I$_1$ Cecilia$_2$ Henk$_3$ the hippopotamses$_4$ saw$_1$ help$_2$ feed$_{3,4}$.

“. . . because I saw Cecilia help Henk feed the hippopotamses.”

CCG Derivation 1



Another Combinatory Rule

- Forward-Crossed Composition:

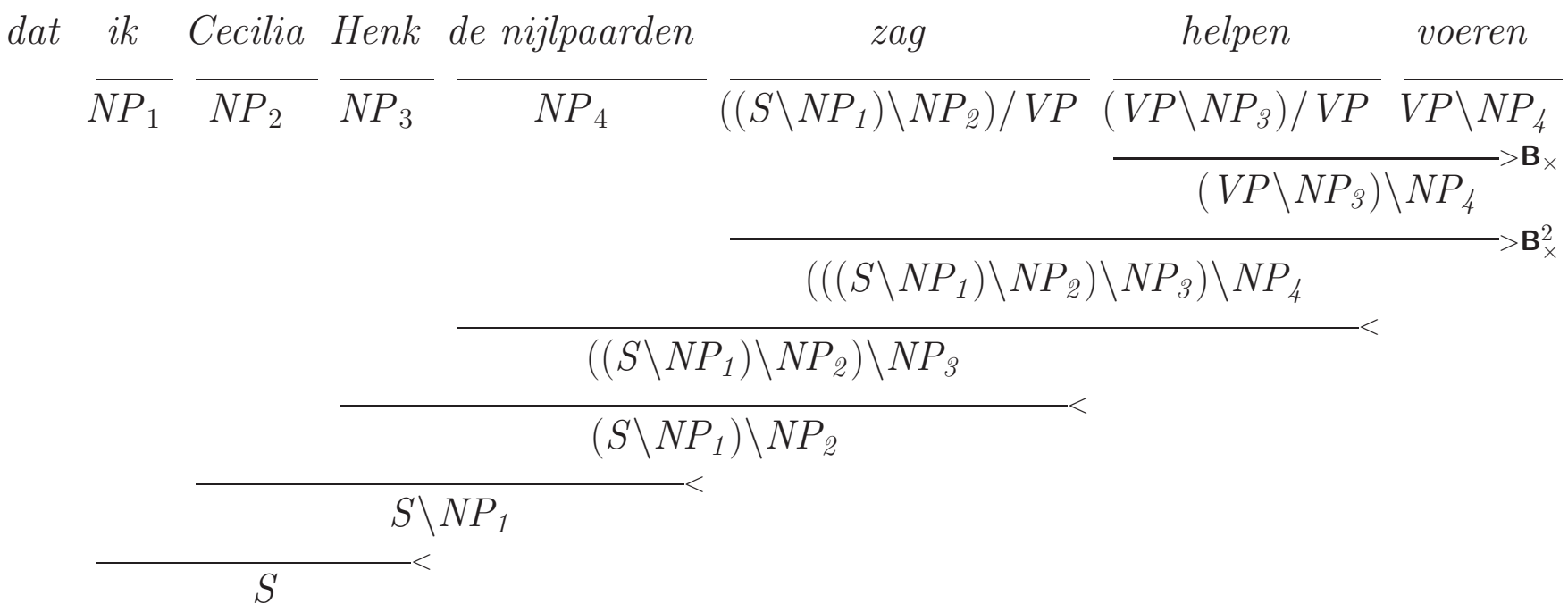
$$X/Y \;\; Y\backslash Z \Rightarrow_{\mathbf{B_x}} X\backslash Z$$

- Generalised Foward-Crossed Composition:

$$X/Y \;\; (\ldots(Y\backslash Z)\backslash W)\backslash\ldots \Rightarrow_{\mathbf{B}^n_{\mathbf{x}}} (\ldots(X\backslash Z)\backslash W)\backslash\ldots$$

- Generalised case needed for the next derivation
- These rules not part of the English grammar

CCG Derivation 2



Mild Context Sensitivity

- It is the generalised composition rules which lead to greater-than-context free power
- A CCG with generalised composition and certain rule restrictions has the same generative power as Tree Adjoining Grammar (TAG) (“mildly context-sensitive”)
- Interestingly, Kuhlman et al. show that *relaxing* some of the rule restrictions can provide a CCG with greater-than-context-free power, but with strictly less power than TAG

References

- Mark Steedman. The Syntactic Process, Chapter 6, MIT Press, 2000
- Stuart M. Shieber. Evidence against the context-freeness of natural language. Linguistics and Philosophy, 8:333-343, 1985
- Marco Kuhlmann, Alexander Koller, and Giorgio Satta. The importance of rule restrictions in CCG. Proceedings of the 48th ACL, Uppsala.
- Fowler, Timothy A. D. and Penn, Gerald (2010). Accurate Context-Free Parsing with Combinatory Categorial Grammar . In Proceedings of the 48th Annual Meeting of the Association for Computational Linguistics