# Modeling Quantification with Polysemous Nouns

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## 1. Polysemous nouns and the "quantification puzzle"

Inherently polysemous noun such as 'book' provide referential access to both a physical and an informational object.

(1) a. John read the book.
b. John took the book from the shelf.

We assume 'book' to refer to entities of type *phys(ical)-obj(ect)* which have an attribute CONTENT whose value is of type *information*.

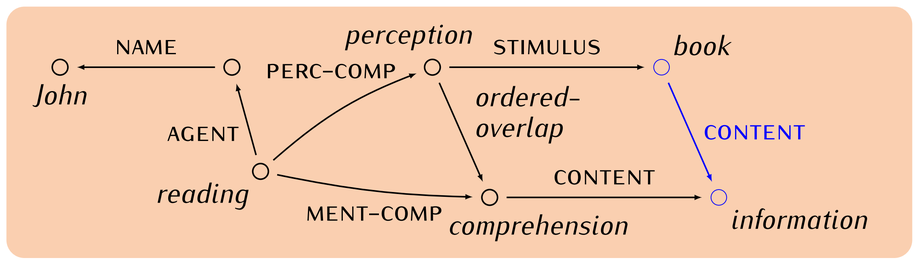
The **quantification puzzle** (Asher & Pustejovsky, 2006):

(2) a. John carried off every book in the library.
b. John read every book in the library.

While (2a) poses no problem since the domain of quantification consists of physical entities, it not obvious how to cope with (2b), which is naturally interpreted as quantifying over all contents of the books in the library.

## 2. Basic analysis: Frame for *John read the book*

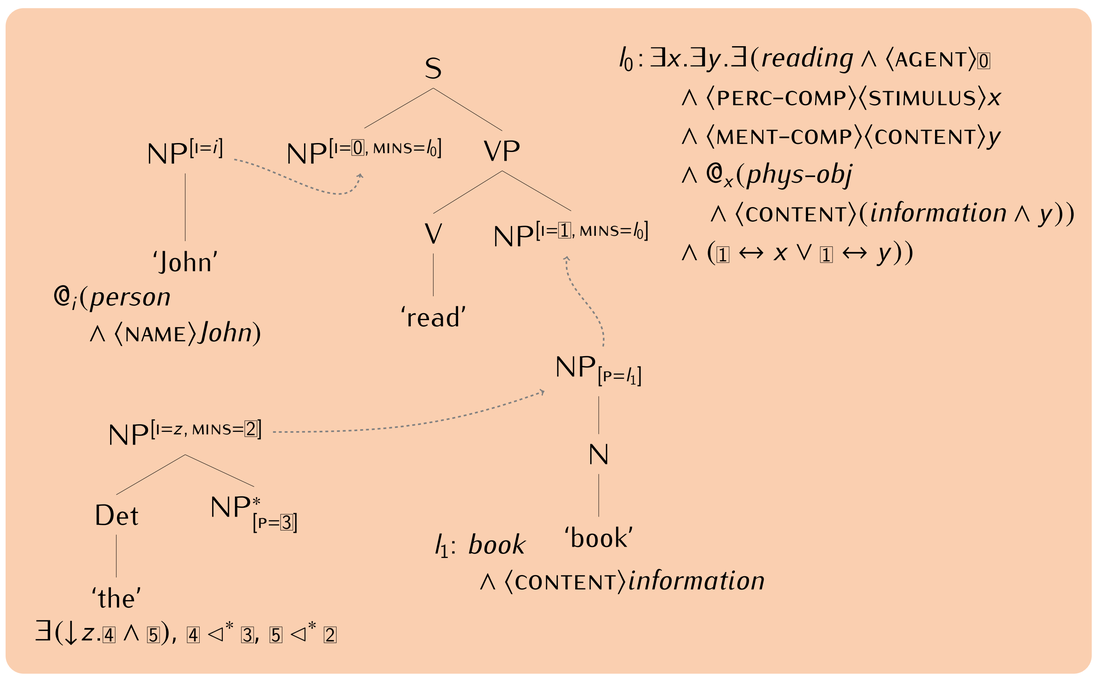
Semantic frame for (1a) according to Babonnaud et al. (2016), contribution of *book* in blue:




We use hybrid logic to describe frames:

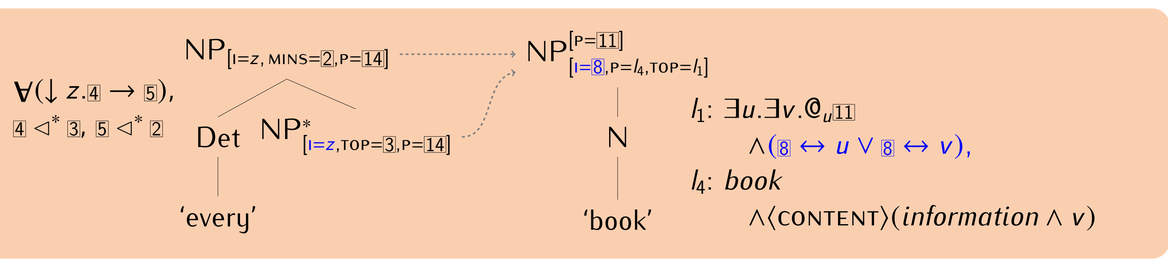
$$\begin{aligned}\exists x.\exists y.\ (&\exists(x \wedge \mathit{book}\\ &\wedge \langle\text{CONTENT}\rangle(y \wedge \mathit{information})\\ &\wedge\exists(\mathit{reading}\\ &\wedge \langle\text{AGENT}\rangle(\mathit{person} \wedge \langle\text{NAME}\rangle \mathit{John})\\ &\wedge \langle\text{PERC-COMP}\rangle\langle\text{STIMULUS}\rangle x\\ &\wedge \langle\text{MENT-COMP}\rangle\langle\text{CONTENT}\rangle y))\end{aligned}$$

## 2. Basic analysis: Combine LTAG with frame semantics



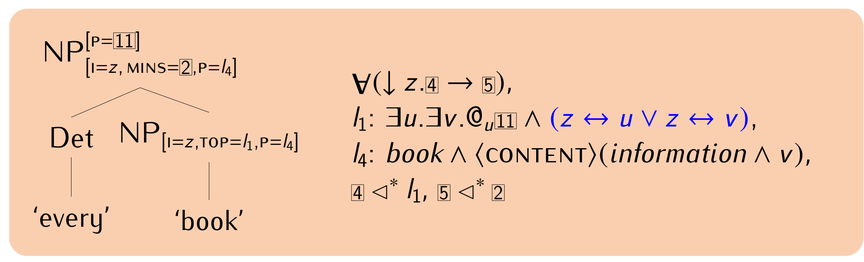

- 'book' provides a description of the *phys-obj* node of its frame (label $l_1$)
- This is passed into the restriction of the determiner: unification of 3 with $l_1$ and scope constraint 4 ◁* 3 ("3 is subformula of 4") lead to 4 → $l_1$
- the *information* node is only accessible via the CONTENT feature
- problematic for (2b) where we want to quantify over informational contents

## 3. Revised analysis: underspecification of the interface



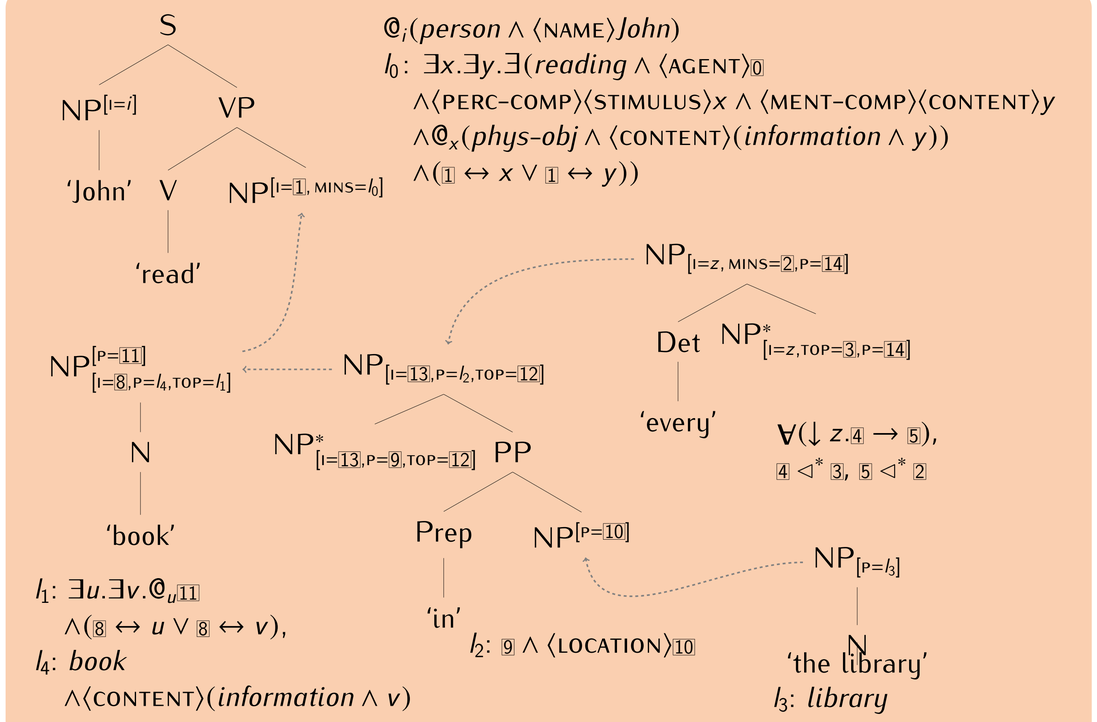

- the *book* frame is still the same as before
- 'book' explicitly provides an underspecified I feature at the syntax-semantics interface
- the quantifier can therefore pick either of the two nodes from the *book* frame and identify it with its variable
- the variable of the quantifier is passed as argument to 'read'

Result:




- 11 will be mapped to $l_4$ by final top-bottom unficiation.
- $u$ denotes then the physical object node while $v$ denotes the information node.
- $z$ can denote either of the two.

## 3. Revised analysis: Putting things together

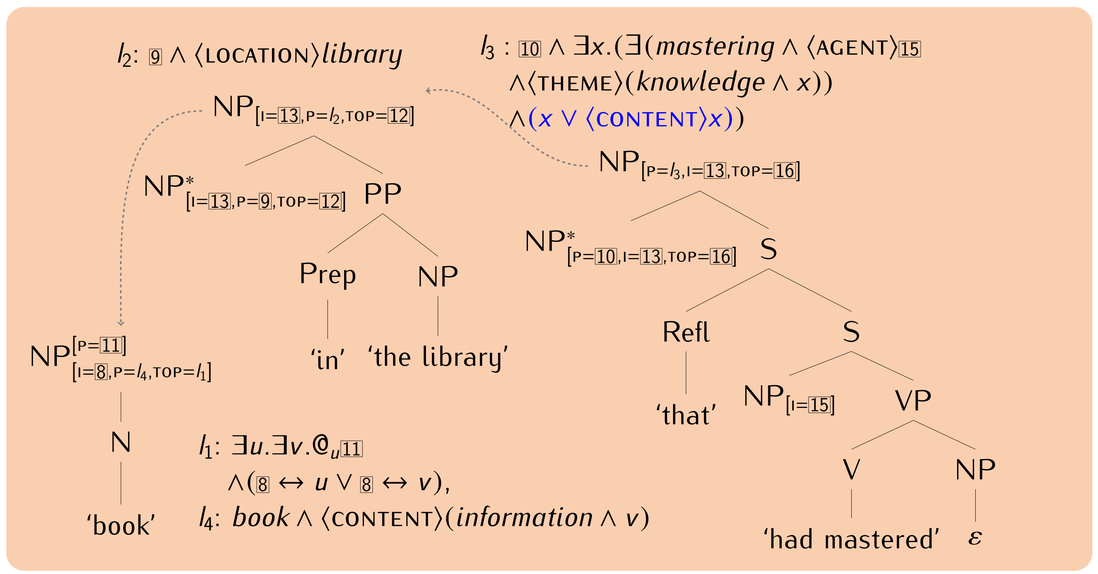



- the 'in' tree extends the *book* description $l_4$ with a further conjunct (unification of P = 9 and P = $l_4$)
- here, 11 unifies with $l_2$ and the frame $u$ becomes
  $book \wedge \langle\text{CONTENT}\rangle(information \wedge v) \wedge \langle\text{LOCATION}\rangle library$
- as before, the quantifier's variable $z$ can be equivalent with either $u$ or $v$

## 4. Copredication and quantification

(3) John destroyed every book in the library that Mary had mastered.

- 'destroy' requires quantification over physical objects
- 'in the library' modifies the physical object
- 'had mastered' predicates over information components




- 'mastered' adds to the description of the physical object but predicates either over this or over its CONTENT value. Due to type constraints, the latter is chosen.
- a quantifier can still pick either $u$ or $v$.

## 5. Further issues

- Functionality of the relation from books (phys. obj.) to inform. contents (Asher, 2011)
- Interaction of copredication and counting (Gotham, 2017)
- Flexibility of copredication (Retoré, 2014)

**References:**

• Asher (2011). *Lexical Meaning in Context. A Web of Words.* Cambridge: Cambridge University Press. • Asher & Pustejovsky (2006). A type composition logic for generative lexicon. *Journal of Cognitive Science 6*, 1–38. • Babonnaud, Kallmeyer & Osswald (2016). Polysemy and coercion – a frame-based approach using LTAG and Hybrid Logic. In M. Amblard, P. de Groote, S. Pogodalla, and C. Retoré (Eds.), *Logical Aspects of Computational Linguistics, 9th International Conference*, Lecture Notes in Artificial Intelligence 10054, 18–33. Berlin: Springer. • Gotham (2017). Composing criteria of individuation in copredication. *Journal of Semantics 34*, 333–371. • Kallmeyer & Osswald (2013). Syntax-Driven Semantic Frame Composition in Lexicalized Tree Adjoining Grammars. *Journal of Language Modelling*. • Retoré (2014). The Montagovian Generative Lexicon $\Lambda Ty_n$: a type theoretical framework for natural language semantics. In *TYPES: International Workshop on Types and Proofs for Programs, April 2013, Toulouse, France*, pp. 202–229.