Discontinuity Continued: LRS 3.0 α

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1 Grammar Architecture

1.1 The Formal Framework

Grammars and their denotation:

- A grammar consists of a **signature** and a **theory**
  - Signature: sort hierarchy, set of attributes, set of relation symbols, arity of relations, appropriateness conditions (sometimes called *feature declarations*)
  - Theory: a set of descriptions (the *principles* of grammar)
- A **model** of a grammar is a collection of objects whose components are configured in accordance with the signature; and all objects satisfy each description in the theory.
- Currently, there are essentially two explanations of the meaning of an HPSG 94 grammar:
  - An **exhaustive model** contains "instances" of all objects that are licensed by the theory. One of the exhaustive models of the class of exhaustive models of a grammar is understood as containing the **possible tokens** of the natural language under consideration (King, 1999).
  - A collection of structures that can be construed in various ways is understood as the **types** of the natural language under consideration. The types are taken to be (a certain kind of) feature structures in Pollard and Sag (1994), but not in Pollard (1999), which takes a slightly different (more agnostic) ontological perspective.
- Our view: We take *Relational Speciate Re-entrant Language* (RSRL, Richter et al. (1999); Richter (2000)) as the description language for HPSG grammars.

1.2 The Structure of Signs

Expressed within the formal framework, we find universal assumptions about the structure of linguistic signs. The structure of signs is best visualized with a sketch of a description of all possible signs:

$$\begin{bmatrix} \textit{sign} & \\ \textsc{phonology} & \textbf{phonological structure} \\ \textsc{synsem} & \begin{bmatrix} \textsc{local} & \begin{bmatrix} \textsc{category} & \textbf{syntactic structure} \\ \textsc{content} & \textbf{semantic structure} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

1.3 Underspecification

The most natural notion of "*underspecification*" in HPSG is *underspecification at the description level.*

- *Underspecification in the lexicon*: a lexical entry is a description. A lexical entry is underspecified if there is some attribute whose value is not fully determined by the lexical entry. For example, for auxiliary verbs in English, the grammar in Pollard and Sag (1994) leaves the value of the INVERTED attribute underspecified. In every sentence, however, the value of this attribute is either *plus* or *minus*.
- Typical semantic instances of that kind of underspecification in the lexicon of Pollard and Sag (1994) are "CONTENT raisers" like the verbs *to* and *be*.
- In the grammar of Pollard and Sag (1994) sentence (2) receives a single syntactic analysis. The SEMANTICS PRINCIPLE leaves some freedom as to the place where quantifiers are inserted into the CONTENT value of a sign. In this sense, the SEMANTICS PRINCIPLE is underspecified.

1.4 Semantic Representations

- We assume that the CONTENT value of a sign is a **logical form**. In particular, we assume the language Ty2 of (Gallin, 1975), which is similar to Intensional Logic (Montague, 1974) but has technical advantages.
- Furthermore, we take it as given that we can express a grammar of Ty2 in RSRL. For the necessary proofs, see Sailer (2000).

(1) A description that denotes the term $\lambda x_e.\mathsf{student}'_{et}(x_e)$:

$$\left[\begin{array}{ll} \multicolumn{2}{l}{\textit{abstraction}} \\ \text{TYPE} & \boxed{0}\left[\begin{array}{ll} \multicolumn{2}{l}{\textit{c-type}} \\ \text{IN} & \boxed{1}\ \textit{entity} \\ \text{OUT} & \boxed{2}\ \textit{truth} \end{array}\right] \\ \text{VAR} & \boxed{3}\left[\begin{array}{ll} \multicolumn{2}{l}{\textit{var}} \\ \text{TYPE} & \boxed{1} \end{array}\right] \\ \text{ARG} & \left[\begin{array}{ll} \multicolumn{2}{l}{\textit{application}} \\ \text{FUNC} & \left[\begin{array}{ll} \multicolumn{2}{l}{\textit{student}} \\ \text{TYPE} & \boxed{0}\left[\begin{array}{ll} \multicolumn{2}{l}{\textit{c-type}} \\ \text{IN} & \boxed{1} \\ \text{OUT} & \boxed{2} \end{array}\right] \end{array}\right] \\ \text{ARG} & \boxed{3} \end{array}\right] \end{array}\right]$$

(2) a. Every student reads some book.

b. $\forall x[\mathsf{student}'(x) \rightarrow \exists y[\mathsf{book}'(y) \wedge \mathsf{read}'(x,y)]]$

c. $\exists y[\mathsf{book}'(y) \wedge \forall x[\mathsf{student}'(x) \rightarrow \mathsf{read}'(x,y)]]$

2 The Main Ideas

2.1 The Big Picture

What's the ontological status of underspecified representations? Do they belong to language itself, or to some level of the description of language and to language processing? The main objectives are

- to establish standard semantic representations in HPSG,
- to understand the possible ontologies of underspecification and their linguistic and empirical significance in a constraint-based architecture, and
- to build an architecture that takes the theoretical concerns of underspecified semantics into consideration.

In its fundamental assumptions, LRS is close to CLLS.

2.2 Old and New Arguments

- At least for some phenomena that are ideal candidates for underspecification, it can be shown that underspecification cannot be a property of the linguistic entities in question.
- However, there are good reasons to ascribe some sort of reality to underspecification:
  - spoken language understanding
  - improved efficiency in processing (monotonically extended constraint sets)
  - incremental architecture (speech recognition, syntax, semantic analysis, reasoning)
  - robust processing
  - humans seem to be able to make use of underspecified output of the semantic analysis as witnessed by inferences on an underspecified understanding of highly ambiguous sentences

- truth-conditionally irrelevant layer of information that might be indespensable for discourse-semantics
- distinction between a language-oriented level of semantic representation and a non-linguistic processing level

- previous work in LRS: provides a more natural analysis of negative concord in Polish than alternative accounts
- new: separation of local semantics and semantic structure

3 A Brief Introduction to LRS 3.0

LRS enables us to

1. use identities to account for concord phenomena (negative concord, multiple interrogatives).
2. get a more local theory of selection.
3. give a natural account of discontinuity phenomena in logical forms.

3.1 Ontology

(3) Appropriateness conditions for the sort *sign*:

sign	PHON	*phonology*
	SYNSEM	*synsem*
	LF	*lrs*

(4) Appropriateness conditions for the sort *lrs*:

lrs	TOP	*me*
	BOTTOM	*me*
	PARTS	*list(me)*

Intuitions:

- TOP: the term that is associated with the logical form of a complete phrase.
- BOTTOM: the scopally lowest element in a phrase.
- PARTS: all nodes of the term tree of the overall logical form that are contributed by this sign.

For ease of readability, we use a shorthand such that:

$\overline{\phi}$ gives the TOP value

$\underline{\phi}$ gives the BOTTOM value

$\phi[\psi_1, \ldots, \psi_n]$: the terms $\psi_1, \ldots, \psi_n$ are subterms of the term ϕ.

(5) *book*: $\underline{\mathsf{book}'x}$ and TOP $= Qx[\phi]$ $\left[\begin{array}{ll} \text{TOP} & \left[\begin{array}{l} \textit{quantifier} \\ \text{VAR } x \end{array}\right] \\ \text{BOTTOM} & \mathsf{book}'x \\ \text{PARTS} & \left\langle x, \mathsf{book}'x,\ \mathsf{book}' \right\rangle \end{array}\right]$

(6) *some*: $\underline{\exists x}[\alpha \wedge \beta]$ $\left[\begin{array}{ll} \text{TOP} & \textit{me} \\ \text{BOTTOM} & \exists x[\alpha \wedge \beta] \\ \text{PARTS} & \left\langle x,\ \exists x[\alpha \wedge \beta],\ [\alpha \wedge \beta] \right\rangle \end{array}\right]$

(7) *everyone*: $\overline{\forall x}[\alpha[\underline{\mathsf{human}'(x)}] \rightarrow \beta]$

$$\left[\begin{array}{ll} \textit{lrs} & \\ \text{TOP} & \boxed{1}\ \forall x[\alpha \rightarrow \beta] \\ \text{BOT} & \boxed{2}\ \mathsf{human}'(x) \\ \text{PARTS} & \left\langle x,\ \boxed{1},\ \boxed{2},\ \mathsf{human}' \right\rangle \end{array}\right] \ \&\ \boxed{2} \triangleleft \alpha$$

(8) *read*: $\exists e[\phi[\underline{((\mathsf{read}'e)y)x}]$ and $\exists e.\phi \triangleleft$ TOP

$$\begin{bmatrix} lrs & \\ \text{TOP} & \boxed{1}\ me \\ \text{BOTTOM} & ((\mathsf{read}'e)y)x \\ \text{PARTS} & \langle e, x, y, \exists e\phi, ((\mathsf{read}'e)y)x, (\mathsf{read}'e)y, \mathsf{read}'e, \mathsf{read}' \rangle \end{bmatrix} \begin{array}{l} \&\ ((\mathsf{read}'e)y)x \triangleleft \phi \\ \&\ \exists e\phi \triangleleft \boxed{1} \end{array}$$

3.2 Principles

(9) The Bottom Principle (BP):
In each *lrs*, the BOTTOM value is an element of the PARTS list and a component of the TOP value.

(10) The Top Principle (TP):

1. In every phrase, the TOP value of the non-head daughter is an element of its PARTS list.
2. In every utterance, every subterm of the TOP value of the utterance is an element of its PARTS list, and every element of the utterance's PARTS list is a subterm of the TOP value.

(11) Semantics Principle

In each *headed-phrase*,

1. the TOP value of the head and the mother are identical,
2. the BOTTOM value of the head and the mother are identical,[1]
3. the PARTS value contains exactly all elements of the PARTS values of the daughters,
4. the following conditions hold:
   (a) if the nonhead is a quantifier then its TOP value is of the form $Qx[\rho \circ \nu]$[2], the BOTTOM value of the head is a component of ρ, and the TOP values of both daughters are identical,
   (b) if the non-head is a quantified NP with a TOP value of the form $Qx[\rho \circ \nu]$, then the BOTTOM value of the head is a component of ν,
   (c) in a *head-marker-phrase*, the TOP value of the non-head is identical to the TOP value of the mother.
   (d) in a *head-adjunct-phrase*, the TOP value of the non-head is a component of the TOP value of the head, and
      i. if the non-head is an intersective modifier, then its TOP value is of the form $\alpha \wedge \beta$ and the BOTTOM value of the head is a component of β.
      ii. if the nonhead is a non-intersective modifier, then it is of the form $\alpha(\beta)$ and the BOTTOM value of the head is a component of β.
   (e) In a *head-filler-phrase*, the TOP value of the filler is a component of the TOP value of the head.

3.3 An Extensional Fragment

Quantifier Scope

(12) Every student read some book.

a. $\exists e \forall x[\mathsf{student}'(x) \rightarrow \exists y[\mathsf{book}'(y) \wedge \mathsf{read}'(e, x, y)]]$

b. $\forall x[\mathsf{student}'(x) \rightarrow \exists e \exists y[\mathsf{book}'(y) \wedge \mathsf{read}'(e, x, y)]]$

c. $\forall x[\mathsf{student}'(x) \rightarrow \exists y[\mathsf{book}'(y) \wedge \exists e[\mathsf{read}'(e, x, y)]]]$

d. $\exists e \exists y[\mathsf{book}'(y) \wedge \forall x[\mathsf{student}'(x) \rightarrow \mathsf{read}'(e, x, y)]]$

e. $\exists y[\mathsf{book}'(y) \wedge \exists e \forall x[\mathsf{student}'(x) \rightarrow \mathsf{read}'(e, x, y)]]$

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[1] We take the noun to be the head of a quantified NP.

[2] $Qx[\rho \circ \nu]$ is shorthand for the description $\begin{bmatrix} quantifier & \\ \text{VAR} & var \\ \text{SCOPE} & \begin{bmatrix} l\text{-}const & \\ \text{ARG1} & \rho \\ \text{ARG2} & \nu \end{bmatrix} \end{bmatrix}$.

f. $\exists y[\mathsf{book}'(y) \wedge \forall x[\mathsf{student}'(x) \rightarrow \exists e[\mathsf{read}'(e,x,y)]]]$

(13)

S
$\underline{\mathsf{read}'(e,x,y)} \lhd \delta$

COMP — HEAD

NP
$\overline{\forall x[\underline{\mathsf{student}'(x)} \rightarrow \delta]}$

HEAD

Det
$\underline{\forall x}[\gamma \rightarrow \delta]$
Every

N
$\mathsf{student}'(x)$
student

VP
$\underline{\mathsf{read}'(e,x,y)} \lhd \beta$

HEAD — COMP

V
$\exists e[\phi[\underline{\mathsf{read}'(e,x,y)}]$
read

NP
$\overline{\exists y[\underline{\mathsf{book}'(y)} \wedge \beta]}$

HEAD

Det
$\underline{\exists y}[\alpha \wedge \beta]$
some

N
$\mathsf{book}'(y)$
book

Recursive Modification

(14) (an) apparently simple example
$\mathsf{apparently}'(\mathsf{simple}'(x)) \wedge \mathsf{example}'(x)$

(15) Derivation:

N'
$[\mathsf{apparently}'(\mathsf{simple}'(x)) \wedge \underline{\mathsf{example}'(x)}]$

ADJ — HEAD

AP
$\overline{[\mathsf{apparently}'(\underline{\mathsf{simple}'(x)}) \wedge \beta]}$

ADJ — HEAD

Adv
$\overline{\mathsf{apparently}'(\gamma)}$
apparently

Adj
$[\alpha[\underline{\mathsf{simple}'(x)}]\overline{\wedge}\beta]$
simple

N
$\mathsf{example}'(x)$
example

3.4 An Intensional Fragment

Opaque verbs

(16)

dass eine Schraube fehlt.
that a screw is missing

$\lambda @.\exists e \exists x[\mathsf{screw}'(@,x) \wedge \mathsf{is\text{-}missing}'(@,e,\lambda @ \lambda P.P(@,x))]$

$\lambda @.\exists x[\mathsf{screw}'(@,x) \wedge \exists e[\mathsf{is\text{-}missing}'(@,e,\lambda @ \lambda P.P(@,x))]]$

$\lambda @.\exists e[\mathsf{is\text{-}missing}'(@,e,\lambda @ \lambda P.\exists x[\mathsf{screw}'(@,x) \wedge P(@,x))]]$

(17) Derivation:

S
$P(@,x) \lhd \beta$

COMP — HEAD

NP
$\overline{\exists x[\underline{\mathsf{screw}'(@,x)} \wedge \beta]}$

HEAD

Det
$\underline{\exists x}[\alpha \wedge \beta]$
eine

N
$\mathsf{screw}'(@,x)$
Schraube

V
$\lambda @.\psi[\exists e[\phi[\mathsf{is\text{-}missing}'(@,e,\lambda @ \lambda P.\chi[\underline{P(@,x)}])]]]$
$\lambda @.\psi \lhd$ TOP
fehlt

Modals We follow the treatment of modals of Penka and Stechow (2001).

(18) John may read a book.

a. $\lambda @.\exists e'\exists x[\mathsf{book}'(x) \wedge \mathsf{may}'(@, e', j, \lambda @.\exists e[\mathsf{read}'(@, e, j, x)])]$

b. $\lambda @.\exists x[\mathsf{book}'(x) \wedge \exists e'[\mathsf{may}'(@, e', j, \lambda @.\exists e[\mathsf{read}'(@, e, j, x)])]]$

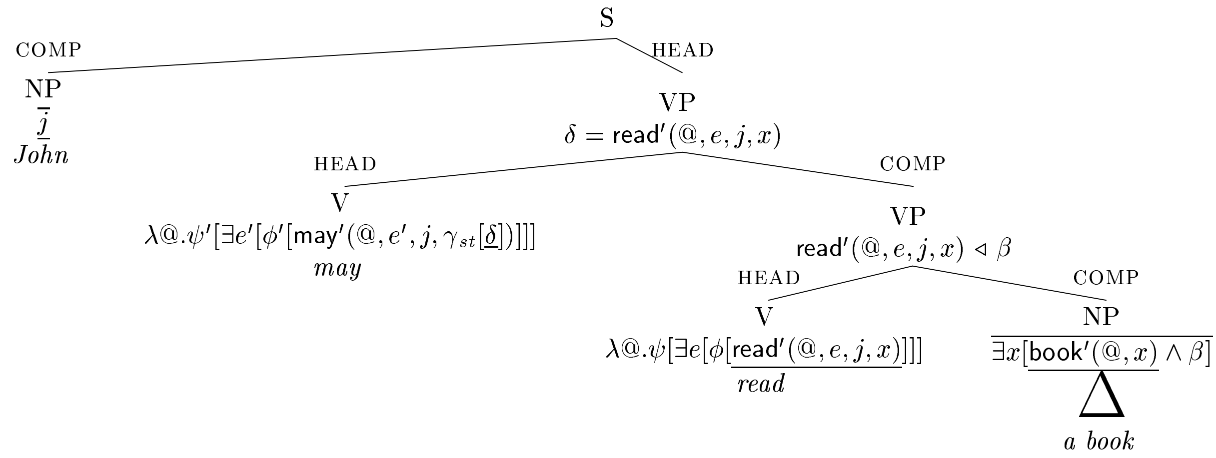
c. $\lambda @.\exists e'[\mathsf{may}'(@, e', j, \lambda @.\exists e\exists x[\mathsf{book}'(x) \wedge \mathsf{read}'(@, e, j, x)])]$

d. $\lambda @.\exists e'[\mathsf{may}'(@, e', j, \lambda @.\exists x[\mathsf{book}'(x) \wedge \exists e[\mathsf{read}'(@, e, j, x)]])]$

(19) Content Raiser Principle (informal version):

If a phrase has a modal verb as its head daughter, then $\begin{bmatrix} \textit{phrase} & \\ \text{LF} & \begin{bmatrix}\text{BOT } \boxed{1}\end{bmatrix} \\ \text{N-DTR} & \begin{bmatrix}\text{LF } \begin{bmatrix}\text{BOT } \boxed{1}\end{bmatrix}\end{bmatrix} \end{bmatrix}$

(20) Derivation



4 Locality of Semantic Selection

Summary
The CONTENT value is used for Binding Theory, linking and semantic selection, but not for combinatorial semantics. (Just as in the distinction between CAT and DTRS in Pollard and Sag (1994).)

4.1 Encoding

(21) a. Appropriateness conditions of the sort *content*:

content INDEX *index*
MAIN *term*

b. Sort hierarchy and appropriateness conditions of the sort *index*:

index
PERSON *person*
NUMBER *number*
GENDER *gender*

referential *there* *it*
TERM *term*

Remark: In our shorthand notation, if a term ϕ should be indicated as MAIN value, we write $\boxed{\phi}$.

(22) The CONTENT-LF-INTERFACE (CLFI):
In each *sign*, the SYNSEM LOC CONTENT MAIN value and the SYNSEM LOC CONTENT INDEX TERM value are elements of the LF PARTS list and components of the LF TOP value.

(23) The CONTENT PRINCIPLE (CP):
In each *phrase*, the SYNSEM LOC CONTENT value of the phrase and the head daughter are identical.

(24) Sketch of the lexical entry of *Peter*:

$$\begin{bmatrix} \textit{word} & \\ \text{PHON} & \langle \textit{Peter} \rangle \\ \text{SYNSEM} & \begin{bmatrix} \text{LOC CONTENT} & \begin{bmatrix} \textit{content} & \\ \text{INDEX} & \begin{bmatrix} \textit{referential} & \\ \text{PERSON} & \textit{third} \\ \text{NUMBER} & \textit{singular} \\ \text{GENDER} & \textit{masculin} \\ \text{TERM} & \boxed{1}\ p \end{bmatrix} \\ \text{MAIN} & \boxed{1} \end{bmatrix} \end{bmatrix} \\ \text{LF} & \begin{bmatrix} \textit{lrs} & \\ \text{TOP} & \textit{me} \\ \text{BOTTOM} & \boxed{1} \\ \text{PARTS} & \left\langle \boxed{1} \right\rangle \end{bmatrix} \end{bmatrix}$$

(25) Sketch of the lexical entry of *student*:

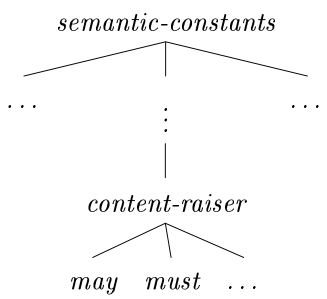
$$\begin{bmatrix} \textit{word} & \\ \text{PHON} & \langle \textit{student} \rangle \\ \text{SYNSEM} & \begin{bmatrix} \text{LOC CONTENT} & \begin{bmatrix} \textit{content} & \\ \text{INDEX} & \begin{bmatrix} \text{PERS} & \textit{3rd} \\ \text{NUM} & \textit{sing} \\ \text{GEN} & \textit{masc} \\ \text{TERM} & \boxed{1}\ x \end{bmatrix} \\ \text{MAIN} & \boxed{2}\ \mathsf{student}'(x) \end{bmatrix} \end{bmatrix} \\ \text{LF} & \begin{bmatrix} \textit{lrs} & \\ \text{TOP} & \textit{me} \\ \text{BOTTOM} & \boxed{2} \\ \text{PARTS} & \left\langle \boxed{1}, \mathsf{student}', \boxed{2} \right\rangle \end{bmatrix} \end{bmatrix}$$

(26) Sketch of the lexical entry of *read*:

$$\begin{bmatrix} \textit{word} & \\ \text{PHON} & \langle \textit{read} \rangle \\ \text{SYNS} & \begin{bmatrix} \text{LOC} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SUBCAT} & \left\langle \text{NP}\left[\text{IND TERM}\ x\right], \text{NP}\left[\text{IND TERM}\ y\right] \right\rangle \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{INDEX} & \left[\text{TERM}\ e\right] \\ \text{MAIN} & \boxed{2}\ \mathsf{read}'(e,x,y) \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{LF} & \begin{bmatrix} \text{TOP} & \boxed{1} \\ \text{BOT} & \boxed{2} \\ \text{PARTS} & \left\langle e,\ x,\ y,\ \exists e.\phi,\ ((\mathsf{read}'\,e)y)x,\ (\mathsf{read}'\,e)y,\ \mathsf{read}'\,e,\ \mathsf{read}' \right\rangle \end{bmatrix} \end{bmatrix} \begin{array}{l} \&\ \exists e.\phi \triangleleft \boxed{1} \\ \&\ \mathsf{read}'(e,x,y) \triangleleft \phi \end{array}$$

4.2 Semantic Hierarchies

(27)



(28) Content Raiser Principle:

$$\left(\begin{bmatrix} \textit{phrase} \\ \textsc{h-dtr} \begin{bmatrix} \textsc{syns loc cont main} \boxed{1} \end{bmatrix} \end{bmatrix} \begin{array}{l} \& \ \texttt{semantic-functor}(\boxed{1},\boxed{2}) \\ \& \ \boxed{2}\begin{bmatrix}\textit{content-raiser}\end{bmatrix} \end{array} \right) \Rightarrow \begin{bmatrix} \textit{phrase} \\ \textsc{lf} & \begin{bmatrix} \textsc{bot} \ \boxed{1} \end{bmatrix} \\ \textsc{n-dtr} & \begin{bmatrix} \textsc{lf} \begin{bmatrix} \textsc{bot} \ \boxed{1} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

where read' is the semantic functor of $\mathsf{read}'(@, e, x, y)$.

4.3 Selection

(29) a. the subject of *talk*, *think*, . . . must be human.

b. the object of *drink* must be liquid.

c. the subject of *pretty* must be human and female.

(30) a. green ideas sleep furiously

b. The girl is pretty.
The child is pretty. ⇒ the child is feminine
The man is pretty. ⇒ ???

4.4 Semantic types of arguments

(31) Ich frage mich, . . .
I ask myself . . .

a. ob Peter noch kommt.
if Peter still comes

$\lambda @.\exists e[\mathsf{wonder}'(@, e, \mathsf{I}, \lambda p.p = \lambda @.\exists e[\mathsf{come}'(@, e, \mathsf{peter})])]$

b. wer noch kommt.
who still comes

$\mathsf{wonder}'_{@}(\mathsf{I}, \lambda p.\exists x[\mathsf{human}'(x) \wedge p = \lambda @.\mathsf{come}'_{@}(x)])$

c. * dass Peter noch kommt.
that Peter still comes

4.5 Linking: Davis and Koenig (2000); Koenig and Davis (2001); Koenig (2001)

(32) a. Burns gave/ sent/ offered/ owed/ promised/ charged/ denied Smithers $10 for the dinner.

b. Bill had/ received/ lost/ lacked/ needed many books.

c. Sue perceived/ noticed/ overlooked/ missed him.

d. Bill managed/ tried/ failed/ neglected to read the book.

e. Sue forced/ urged/ defied/ forbade Bill to go.

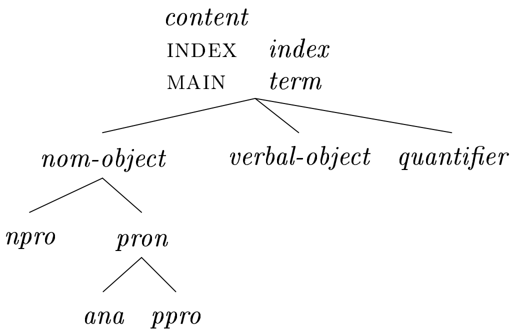
(33) a. Bill promised Sue $10.

b. (simplified) description of the content of *promise* following Koenig and Davis (2001):

$$\begin{bmatrix} \textit{content} \\ \textsc{nucleus} & \begin{bmatrix} \textit{promise-sem} \\ \textsc{sit-core} & \boxed{3} \begin{bmatrix} \textit{cause-possess-rel} \\ \textsc{actor} & \boxed{1} \\ \textsc{undergoer} & \boxed{2} \\ \textsc{soa} & \begin{bmatrix} \textsc{sit-core} & \begin{bmatrix} \textit{have-rel} \\ \textsc{actor} & \boxed{2} \\ \textsc{undergoer} & \boxed{4} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \textsc{modal-base} & \left\langle \begin{bmatrix} \textit{deontic-mb} \\ \textsc{soa} \ \boxed{3} \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

4.6 Binding Theory

(34) Sort hierarchy below *content*:



4.7 Quantifiers in CONTENT?

(35) a. A unicorn appears to be approaching.

b. Sandy believes each painting to be fraudulent.

c. Five books, I believe John read.

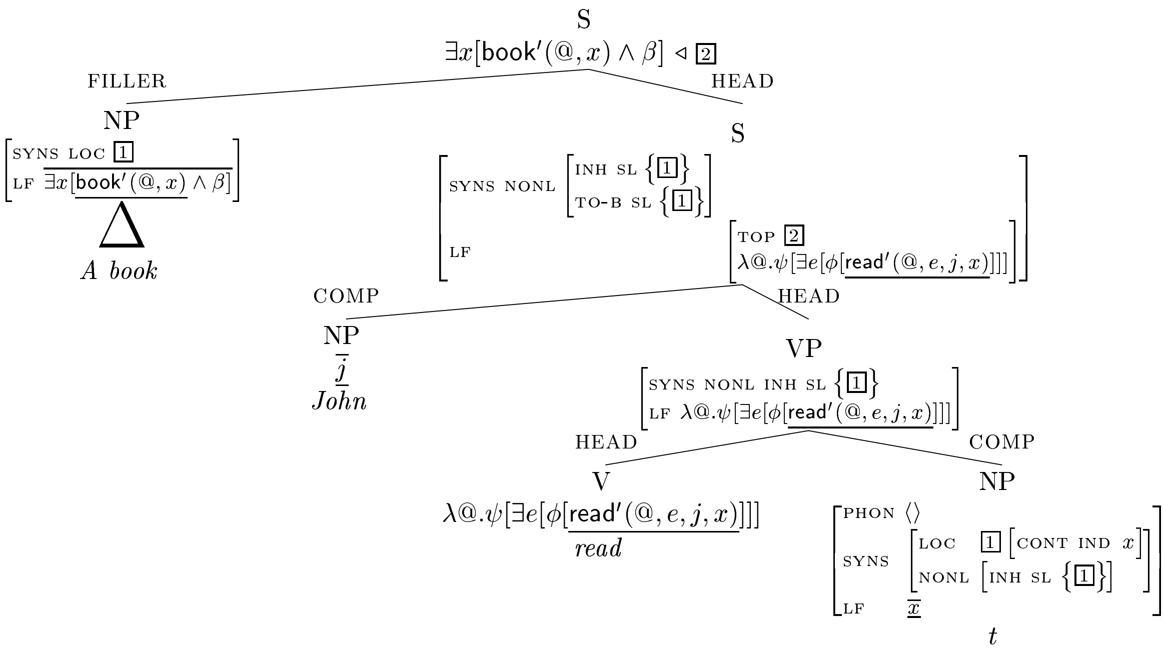
(36) A book, John read.

(37) Lexical entry of the trace:

$$\begin{bmatrix} \textit{word} & \\ \textsc{phon} & \textit{elist} \\ \textsc{syns} & \begin{bmatrix} \textsc{loc} & \boxed{1}\begin{bmatrix}\textsc{cat cont index term } \boxed{2}\end{bmatrix} \\ \textsc{nonloc} & \begin{bmatrix}\textsc{inh slash } \{\boxed{1}\}\end{bmatrix}\end{bmatrix} \\ \textsc{lf} & \begin{bmatrix}\textsc{top} & \textit{me} \\ \textsc{bot} & \boxed{2} \\ \textsc{parts} & \langle\boxed{2}\rangle\end{bmatrix}\end{bmatrix}$$

(38) A book John read.
$\lambda @.\exists e \exists x[\mathsf{book}'(@,x) \wedge \mathsf{read}'(@,e,j,x)]$

(39) Derivation:



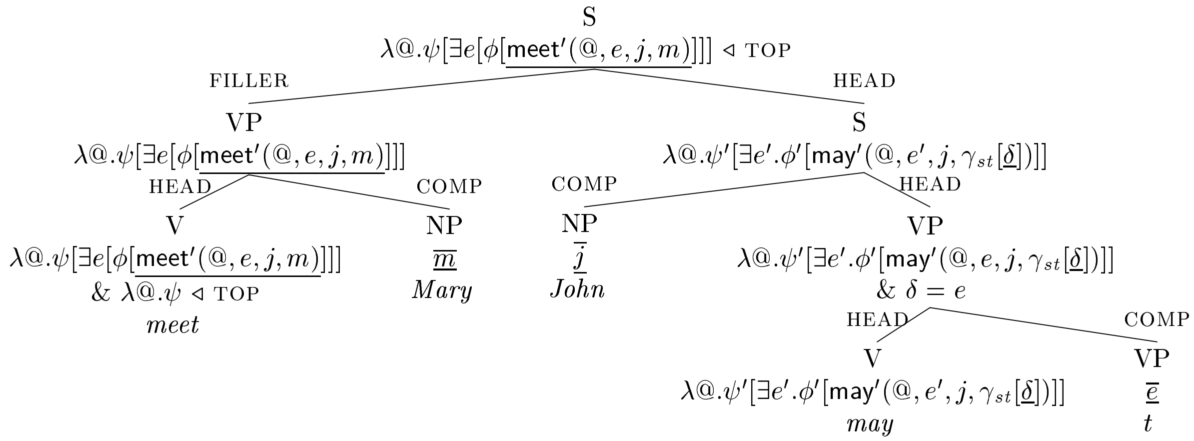
(40) Some book John believes Mary knows.

a. $\lambda @.\exists e \exists x[\mathsf{book}'(@,x) \wedge \mathsf{believe}'(@,e,j,\lambda @.\exists e[\mathsf{know}'(@,e,m,x)])]$

b. $\lambda @.\exists e[\mathsf{believe}'(@,e,j,\lambda @.\exists e \exists x[\mathsf{book}'(@,x) \wedge \mathsf{know}'(@,e,m,x)])]$

(41) a. Meet Mary John may.
$\lambda @.\exists e'[\mathsf{may}'(@,e',j,\lambda @.\exists e[\mathsf{meet}'(@,e,j,x)])]$

b. Derivation:



(42) Sandy believes each student to be asleep.
$\lambda @.\exists e'[\mathsf{believe}'(@,e',\mathsf{sandy},\lambda @.\exists e \forall x[\mathsf{student}'(@,x) \rightarrow \mathsf{be\text{-}asleep}'(@,e,x)])]$

(43) Every student believes Sandy to be asleep.

5 Identity

Summary
We can use the HPSG mechanism of identities to account for cases of multiple expression of the same semantic contribution.

5.1 Polish Negation — Basic Facts

(44) Janek nie pomaga ojcu.
Janek.NOM NM helps father.DAT 'Janek doesn't help his father.'

(45) a. Janek *(nie) pomaga nikomu.
J.NOM (NM) helps nobody.DAT 'Janek doesn't help anybody.'

b. Nikt *(nie) pomaga ojcu.
nobody.NOM (NM) helps father.DAT 'Nobody helps his father.'

c. Janek nigdy *(nie) pomaga ojcu.
Janek.NOM never (NM) helps father.DAT 'Janek never helps his father.'

(46) a. Nic nikomu *(nie) powiedziałem.
nothing.GEN nobody.DAT (NM) I-told 'I didn't tell anybody anything.'

b. Nikt nigdy nikogo niczym *(nie) uszczęśliwił.
'Nobody has ever made anybody happy with anything.'

(47) Tomek nie może nie znać Marii.
Tomek.NOM NM may NM know Maria.GEN
'It is not the case that it is possible that Tomek does not know Maria.'

5.2 Polish N-Words are Inherently Negative

N-Words as the only overt negative element:

(48) Kogo widziałeś? Nikogo.
Who have you seen? Nobody.GEN/ACC.

(49) Ile przeczytałeś książek?
How many you read books ‘How many books have you read?’

a. Żadnej./ Żadną.
None.GEN./ None.ACC.

b. Nie przeczytałem [żadnej kziążki]/ *[żadną książkę].
NM I read [no book].GEN/ [no book].ACC.

(50) Powiedział coś? *Słowo./ Słowa./ Słowa nie powiedział.
he said something? Word.ACC/ Word.GEN/ Word.GEN NM he said

‘Did he say something/anything? Not even a word./ He did not say even a word.’

(51) a. Był tam ktoś?
Was there someone? ‘Was there anybody?’

b. Błaszczak (1999): *?Nikt./ *?Nikogo./ Nie, nie było tam nikogo.
Nobody.NOM/ Nobody.GEN/ No NM was there nobody.GEN

‘Was there anybody? Nobody/ No, there was nobody.’

c. our informants: ?Nikt./ *Nikogo./ Nie, nie było tam nikogo.
Nobody.NOM/ Nobody.GEN/ No NM was there nobody.GEN

(52) a. Chcę poślubić albo ją, albo nikogo/ [żadnej innej]/ [żadną inną].
I want marry either her or nobody/ [no other].GEN/ [no other].ACC

b. Chcę poślubić albo ją, albo [żadnej innej]/ *[żadną inną] nie chcę poślubić.
I want marry either her or [no other].GEN/ [no other].ACC NM I want marry

(53) a. Kocham ją jak [żadną inną]/ ?[żadnej innej].
I love her.ACC as [no other].ACC/ [no other].GEN

‘I love her more than (I love) any other (girl).’

b. Kocham ją jak *[żadną inną]/ [żadnej innej]/ nie kocham.
I love her.ACC as [no other].ACC/ [no other].GEN NM I love

N-Words are excluded with expletive negation:

(54) a. Zostaniesz w domu, dopóki nie napiszesz wypracowania/ *niczego/ czegoś.
you will stay at home until NM you will write essay.GEN/ nothing.GEN/ something.GEN

‘You will stay at home until you write (have written) the essay/ something.’

b. Zrobię to, zanim Maria/ *nikt/ ktoś (nie) przyjdzie.
I will do this before Maria/ nobody/ somebody NM will come

‘I will do it before Maria/ somebody comes.’

Non-negative uses?

(55) a. Błaszczak (1999): Boję się, żeby on/ *nikt/ ktoś nie przyszedł.
I fear REFL that he/ nobody/ somebody NM came
'I am afraid that he/ somebody will/might come.'

b. other informants:[3] Boję się, żeby on/ nikt/ ktoś nie przyszedł.

c. Ana Kupść (p.c.): Boję się, żeby teraz ktoś/ ktokolwiek/ ?nikt nie wszedł.
I fear REFL that now somebody/ anybody/ nobody NM entered
'I'm afraid that somebody might/will enter now.'

5.3 "Evidence" for the Non-negative Character of N-words (1)

- *Nie* is obligatory in verbal contexts
- Negative Concord is obligatory

5.4 Account

Assumptions:

- The prefix *nie* adds the following to the LF value of the verb:
  - a term $\neg\alpha$ is added to the PARTS list,
  - the MAIN value of the verb is a component of α,
  - $\neg\alpha$ is a component of the TOP value.

(56) Discription of the verb *nie przyszedł* (*NM came*):

$$\lambda @.\psi[\exists e \phi[\,\boxed{\mathsf{come}'(@,e,x)}\,]]$$

$$\left[\begin{array}{ll} \textit{word} & \\ \textsc{phon} & \langle \textit{nie przyszedł} \rangle \\ \textsc{syns} & \left[\textsc{loc cont} \left[\begin{array}{ll} \textsc{index} & \left[\textsc{term}\ e\right] \\ \textsc{main} & \boxed{1}\ \mathsf{come}'(@,e,x) \end{array}\right]\right] \\ \textsc{lf} & \left[\begin{array}{ll} \textit{lrs} & \\ \textsc{top} & \textit{me} \\ \textsc{bottom} & \boxed{1}\ \mathsf{come}'(@,e,x) \\ \textsc{parts} & \left\langle @, e, x, \boxed{1}, \boxed{1a}\mathsf{come}'@, \boxed{1b}(\mathsf{come}'@)e, \boxed{1c}((\mathsf{come}'@)e)x, \exists e[\phi], \lambda @.\psi, \boxed{2}\neg\alpha, \right\rangle \end{array}\right] \end{array}\right] \begin{array}{l} \&\ \phi \triangleleft \psi \\ \&\ \alpha \triangleleft \psi \\ \&\ \boxed{1} \triangleleft \alpha \end{array}$$

- N-words are analyzed as existential quantifier, i.e. analogously *żaden* (*no*) analogously to *some* in (6), and *nikt* (*nobody*) analogously to *somebody* (see (7) for a quantified NP), but
  - they contain a term of the form $\neg\beta$ in their PARTS list,
  - the TOP value of the n-word is a component of β,
  - no logical operator except for other existential quantifiers may intervene between the quantifier and its nuclear scope (i.e., the n-word always has narrow scope).

(57) Relevant parts of the lexical entry of *nikt* (*nobody*):

$$\neg\beta[\exists x[\gamma[\,\boxed{\mathsf{human}'(@,x)}\,] \wedge \delta]]$$

$$\left[\begin{array}{ll} \textit{word} & \\ \textsc{phon} & \langle \textit{nikt} \rangle \\ \textsc{syns} & \left[\textsc{loc cont} \left[\begin{array}{ll} \textsc{index term} & x \\ \textsc{main} & \mathsf{human}'(@,x) \end{array}\right]\right] \\ \textsc{lf} & \left[\begin{array}{ll} \textit{lrs} & \\ \textsc{top} & \boxed{5}\ \exists x[\gamma \wedge \delta] \\ \textsc{bottom} & \boxed{3}\ \mathsf{human}'_{@}(x_{@}) \\ \textsc{parts} & \left\langle @, x, x_{@}, \boxed{3}, \boxed{3a}\mathsf{human}'_{@}, \boxed{3b}\mathsf{human}', \boxed{4}\neg\beta, \boxed{5}, \boxed{5a}[\gamma \wedge \delta] \right\rangle \end{array}\right] \end{array}\right] \begin{array}{l} \&\ \boxed{5} \triangleleft \beta \\ \&\ \boxed{3} \triangleleft \gamma \end{array}$$

$$\&\ \mathbf{A}\boxed{7}\ \left(\left(\boxed{7}\left[\textsc{var}\ \textit{variable}\right]\ \&\ \boxed{7} \triangleleft \delta\ \&\ \texttt{is-free}(x,\boxed{7})\right) \Rightarrow \boxed{7}\left[\textit{existential}\right]\right)$$

[3] We are grateful to Anna Mlynarczyk for pointing us to this judgement pattern.

(58) The Negation Complexity Constraint (NCC):

For each sign, there may be at most one negation that is a component of the top value and has the main value as its component.

(59)

S
$\lambda@.\neg\exists e\exists x[\mathsf{human}'(@,x) \wedge \mathsf{come}'(@,e,x)]$
$\mathsf{come}'(@,e,x) \triangleleft \delta$

COMP: NP
$\neg\beta[\exists x[\gamma[\boxed{\mathsf{human}'(@,x)}] \wedge \delta]]$
Nikt

HEAD: V
$\lambda@.\psi[\exists e\phi[\boxed{\mathsf{come}'(@,e,x)}]]$
nie przyszedł

(60) The Neg Criterion (NegC):

For every verb, if there is a negation in the top value of the verb that has scope over the verb's main value, then that negation must be an element of the verb's parts list.

6 Discontinuity

Summary
The interaction of negation and intensionality in Polish receives a natural account in LRS, which would not be possible in continous semantic frameworks such as LF-Ty2.

6.1 "Evidence" for the Non-negative Character of N-words (2)

Intervening semantic material

(61) a. Janek nie szuka żadnego jednorożca.
Janek NM seeks no unicorn
$\lambda@.\neg\exists e[\mathsf{seek}'(@,e,\mathsf{j},\lambda@\lambda P.\exists x[\mathsf{unicorn}'(@,x) \wedge P(@,x)])]$

b. Janek nie może nic czytać.
Janek NM can nothing read 'Janek is not allowed to read anything.'
$\lambda@.\neg\exists e'[\mathsf{may}'(@,e',\mathsf{j},\lambda@.\exists e\exists x[\mathsf{read}'(@,e,\mathsf{j},x)])]$

6.2 Account

(62) Janek nie szuka żadnego jednorożca.
Janek NM seeks no unicorn

a. *de dicto*: $\lambda@.\neg\exists e[\mathsf{seek}'(@,e,\mathsf{j},\lambda@\lambda P.\exists x[\mathsf{unicorn}'(@,x) \wedge P(@,x)])]$

b. *de re*: $\$\lambda@.\neg\exists e\exists x[\mathsf{unicorn}'(@,x) \wedge \mathsf{seek}'(@,e,\mathsf{j},\lambda@\lambda P.P(@,x)])]$

(63) Derivation:

S

COMP: NP
$\underline{\mathsf{jan}}$
Janek

HEAD: VP
$P(@,e,x) \triangleleft \gamma$

HEAD: V
$\lambda@.\phi[\neg\delta[\exists e[\psi[\boxed{\mathsf{seek}'(@,e,\mathsf{jan},\lambda@.\exists e[\epsilon[\underline{P(@,e,x)}]])}]]]]$
nie szuka

COMP: NP
$\mathsf{unicorn}'(@,x) \triangleleft \beta$

Det
$\neg\alpha[\underline{\exists x}[\beta \wedge \gamma]]$
żadnego

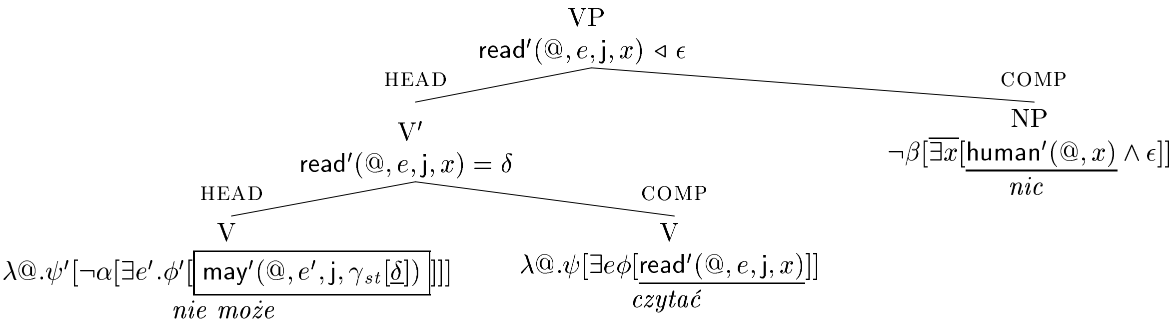
HEAD: N
$\underline{\mathsf{unic}'}(@,x)$
jednorożca

(64) a. Janek nie może nic czytać.
Janek NM can nothing read
'Janek is not allowed to read anything.'

b. Narrow scope reading: $\lambda @.\neg\exists e'[\mathsf{may}'(@, e', \mathsf{j}, \lambda @.\exists e\exists x[\mathsf{read}'(@, e, \mathsf{j}, x)])]$

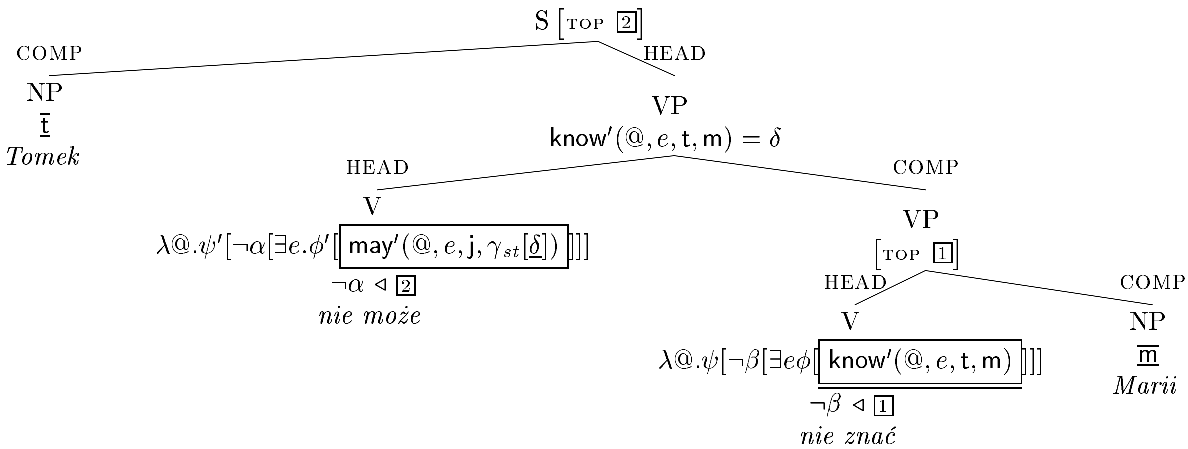
c. Wide scope reading: \$ $\lambda @.\neg\exists e'\exists x[\mathsf{may}'(@, e', \mathsf{j}, \lambda @.\exists e[\mathsf{read}'(@, e, \mathsf{j}, x)])]$

(65) Derivation:



(66) Tomek nie może nie znać Marii.
Tomek NM may NM know Maria
'It is not the case that it is possible that Tomek does not know Maria.'
$\lambda @.\neg\exists e'[\mathsf{may}'(@, e', \mathsf{t}, \lambda @.\neg\exists e[\mathsf{know}'(@, e, \mathsf{t}, \mathsf{m})])]$

(67) Derivation:



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