# Syntactic Theory

## Lecture 7 (06-08.01.2009)

PD Dr.Valia Kordoni

Email: kordoni@coli.uni-sb.de

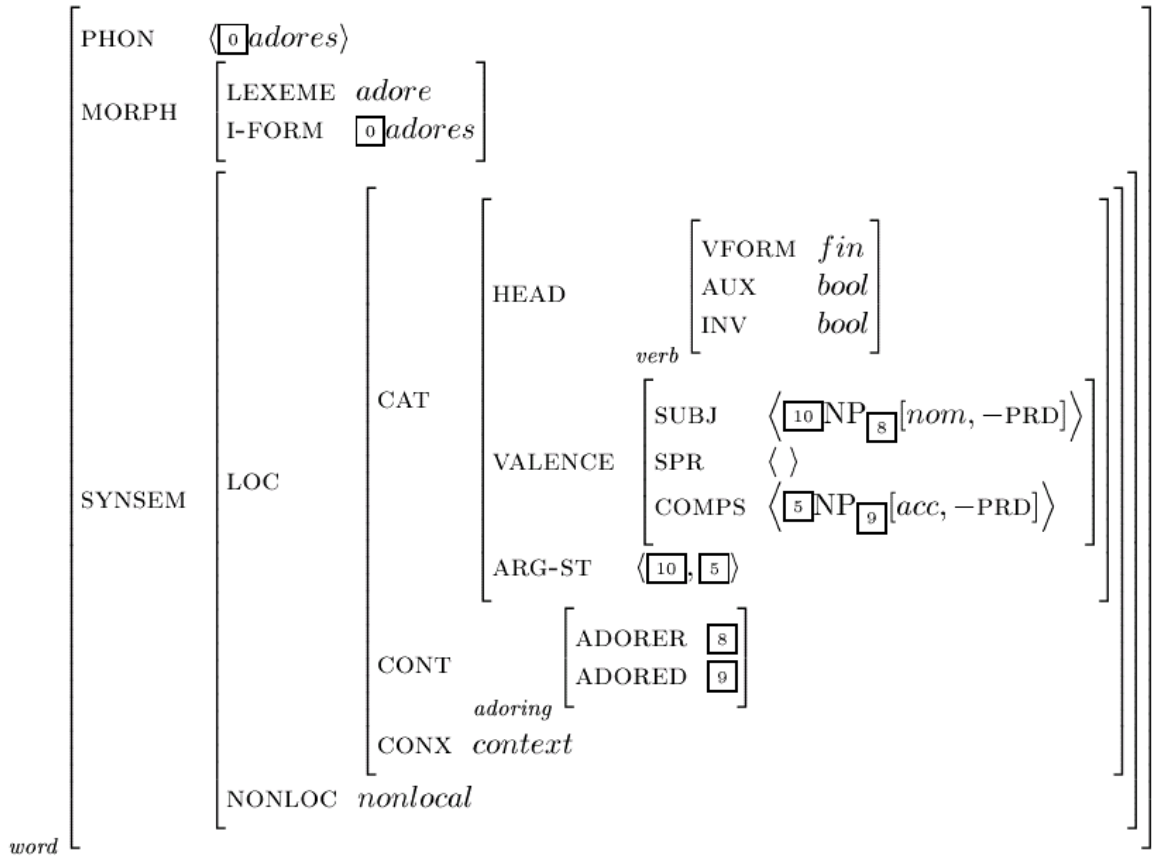
http://www.coli.uni-saarland.de/courses/syntactic-theory-08/

# Head-Driven Phrase Structure Grammar (HPSG)

## Introduction – Part IV -

# Sample lexical entries - verb

(1)



# Sample lexical entries – verb (cont.)

Notation:

(2)

$$\boxed{5}\mathrm{NP}_{\boxed{9}} = \left[\begin{array}{l} \text{SYNSEM } \boxed{5} \mid \text{LOC} \left[\begin{array}{ll} \text{CAT} & \left[\begin{array}{ll} \text{HEAD} & \textit{noun} \\ \text{VAL} & \left[\begin{array}{ll} \text{SUBJ} & \langle\,\rangle \\ \text{SPR} & \langle\,\rangle \\ \text{COMPS} & \langle\,\rangle \end{array}\right] \end{array}\right] \\ \text{CONT} \mid \text{INDEX} & \boxed{9} \end{array}\right] \end{array}\right]$$

# Sample lexical entries – verb (cont.)

Changes from HPSG2—

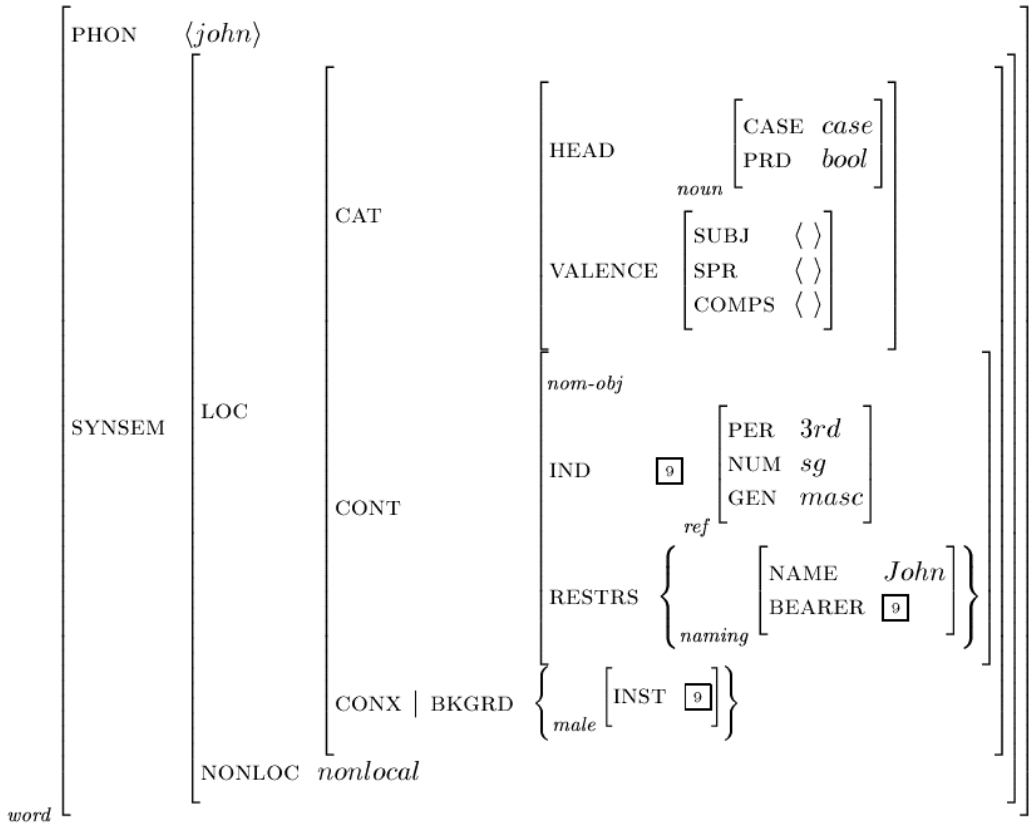
- VALENCE features:
  SUBCAT list divided into three separate lists for subject, specifier, and complements.

- ARG-ST list (argument structure):
  Defined for lexical signs, takes over many of the functions of the SUBCAT list. In canonical cases, equal to the concatenation of SUBJ, SPR, and COMPS (in that order).[1]

- CONTENT value:
  Verbal relations are encoded as a subsorts of *psoa* so they can select appropriate semantic role attributes.

# Sample lexical entries – noun

(3)



# ID Rules: Head-Complement Schema – PS rules

Classical phrase structure rules for verbal complementation:

(4)

| | |
|---|---|
| $VP \rightarrow V$ | $(V \in \{vanish,\ appear,\ die\})$ |
| $VP \rightarrow V\ NP$ | $(V \in \{like,\ eat,\ kiss\})$ |
| $VP \rightarrow V\ NP\ NP$ | $(V \in \{give,\ cost\})$ |
| $VP \rightarrow V\ PP$ | $(V \in \{stay,\ depend,\ approve\})$ |
| $VP \rightarrow V\ \overline{S}$ | $(V \in \{know,\ think,\ say\})$ |
| $VP \rightarrow V\ NP\ PP$ | $(V \in \{put,\ give,\ blame\})$ |
| $VP \rightarrow V\ NP\ \overline{S}$ | $(V \in \{tell,\ ask\})$ |
| $VP \rightarrow V\ VP$ | $(V \in \{will,\ must,\ have\})$ |

Generalizations:

- A verb and its complements combine to form a VP.
- A lexical verb precedes all its complements.

# ID Rules: Head-Complement Schema – PS rules (cont.)

Other head-complement combinations:

(5)

| | | |
|---|---|---|
| a. | NP → N PP | (N ∈ {*king, surface, student*}) |
| | NP → N $\overline{\text{S}}$ | (N ∈ {*claim, belief, assumption*}) |
| b. | AP → A PP | (A ∈ {*similar, fond, rife*}) |
| | AP → A $\overline{\text{S}}$ | (A ∈ {*certain, unsure, angry*}) |
| c. | PP → P NP | (P ∈ {*of, with, to*}) |
| | PP → P PP | (P ∈ {*off, away, instead*}) |
| | PP → P NP PP | (P ∈ {*across, down*}) |
| | PP → P S | (P ∈ {*because, while*}) |

Further generalizations:

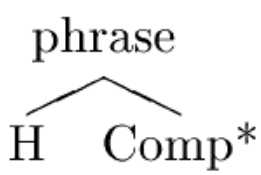
- A lexical head combines with its complements to form a phrase. (⟶ ID rule/schema)
- A lexical head precedes all its complements. (⟶ LP rule)

# Head-Complement Schema

A general rule for complementation:

(6) a. *phrase* → H, Comp*
(Kleene star * = zero or more repetitions)

b.




c.

$$\textit{phrase}\left[\begin{array}{ll}\text{DTRS} & \left[\begin{array}{ll}\textit{head-comp-struc} & \\ \text{HD-DTR} & \textit{sign} \\ \text{COMP-DTRS} & \textit{list}(\textit{sign})\end{array}\right]\end{array}\right]$$

# Principles

Three further constraints:

- The head determines the syntactic category of the mother phrase.
- The complements must be exactly the ones specified in the head's COMPS list. The head's other valency requirements (if any) must be passed on to the mother.
- The head determines the semantic content of the mother.

# Head Feature Principle

In a headed phrase, the HEAD value (i.e., the HEAD value of the mother) and the head daughter's head value are token identical.

(7)

$$\textit{phrase}\left[\begin{array}{l}\text{SYNSEM} \mid \text{LOC} \mid \text{CAT} \mid \text{HEAD} \quad \boxed{1} \\ \text{DTRS} \mid \text{HD-DTR} \mid \text{SYNSEM} \mid \text{LOC} \mid \text{CAT} \mid \text{HEAD} \quad \boxed{1}\end{array}\right]$$

# Head Feature Principle (cont.)

This includes information about syntactic category and other appropriate features.

- Verbs:
  - VFORM: finite, infinitive, base, participles (past, present, passive)
  - AUX: whether or not the verb is an auxiliary (*be*, *have*, *do*, modals)
  - INV: whether or not the verb appears in an inverted construction (e.g., yes/no question, matrix *wh*-question)
- Nouns:
  - CASE: nominative, accusative, dative, genitive, ...
  - PRD: whether or not the noun appears in a predicative position (i.e., taking an external argument)

# Head Feature Principle (cont.)

- Prepositions:
  - PFORM: to, of, from, with, by, ...
  - PRD: see Nouns
- Adjectives:
  - MOD: the *synsem* of the sign that the adjective modifies
  - PRD: see Nouns
- Determiners and markers (complementizers):
  - SPEC: the *synsem* value of the sign "specified" by the functional catgeory (i.e., $\overline{\text{N}}$ in Det-$\overline{\text{N}}$, S in Comp-S)

# Valence Principle

In a headed phrase, VALENCE feature values are shared with the head daughter, except for any subject/specifier/complements that appear(s) in that phrase.

More explicitly:
For every valency feature F (F ∈ {SUBJ, COMPS, SPR}), the head daughter's specification for F is equal to the append of the mother's value for F and the SYNSEM values of the members of corresponding DTRS list.

(8)

$$\textit{phrase}\left[\begin{array}{l}\text{SYNSEM} \mid \text{LOC} \mid \text{CAT} \mid \text{VAL} \mid \text{F} \quad \boxed{1}\ \textit{list}(\textit{synsem}) \\ \text{DTRS} \left[\begin{array}{l}\text{HD-DTR} \mid \text{SYNSEM} \mid \text{LOC} \mid \text{CAT} \mid \text{VAL} \mid \text{F} \quad \text{append}(\boxed{1}, \langle \boxed{2}, \boxed{3}, \ldots \rangle) \\ \text{“F-DTRS”} \qquad\qquad \left\langle \left[\text{SYNSEM} \quad \boxed{2}\right], \left[\text{SYNSEM} \quad \boxed{3}\right], \ldots \right\rangle \end{array}\right] \end{array}\right]$$

Some of the head daughter's valency requirements are "discharged" when it combines with other signs; the remaining valency specifications are passed on to the mother.

# Semantics Principle

In a headed phrase, the CONTENT value is token identical to the CONTENT value of the **semantic head daughter**. The semantic head daughter is identified as

- the ADJUNCT-DTR in a head-adjunct phrase
- the HD-DTR in other headed phrases

(9)

$$\textit{phrase}\left[\begin{array}{ll}\text{SYNSEM} \mid \text{LOC} \mid \text{CONT} & \boxed{1} \\ \text{DTRS} & \left[\begin{array}{l}\textit{head-nonadj-struc} \\ \text{HD-DTR} \mid \text{SYNSEM} \mid \text{LOC} \mid \text{CONT} \quad \boxed{1}\end{array}\right]\end{array}\right]$$

In non-headed phrases, the CONTENT value must be specified by other means.

Note: This principle is changed in recent formulations of HPSG CONTENT, where the notion of semantic head is discarded (Copestake, Flickinger, & Sag, 1997).

# Constraint Interaction

Recall (6c):

(6c)

$$\textit{phrase}\left[\begin{array}{ll}\text{DTRS} & \left[\begin{array}{ll}\textit{head-comp-struc} & \\ \text{HD-DTR} & \textit{sign} \\ \text{COMP-DTRS} & \textit{list}(\textit{sign})\end{array}\right]\end{array}\right]$$

Plus the HFP:

(10)

$$\textit{phrase}\left[\begin{array}{ll}\text{SYNSEM} \mid \text{LOC} \mid \text{CAT} \mid \text{HEAD} & \boxed{1} \\ \text{DTRS} & \left[\begin{array}{ll}\textit{head-comp-struc} & \\ \text{HD-DTR} \mid \text{SYNSEM} \mid \text{LOC} \mid \text{CAT} \mid \text{HEAD} & \boxed{1} \\ \text{COMP-DTRS} & \textit{list}(\textit{sign})\end{array}\right]\end{array}\right]$$

# Constraint Interaction (cont.)

Plus the ValP:

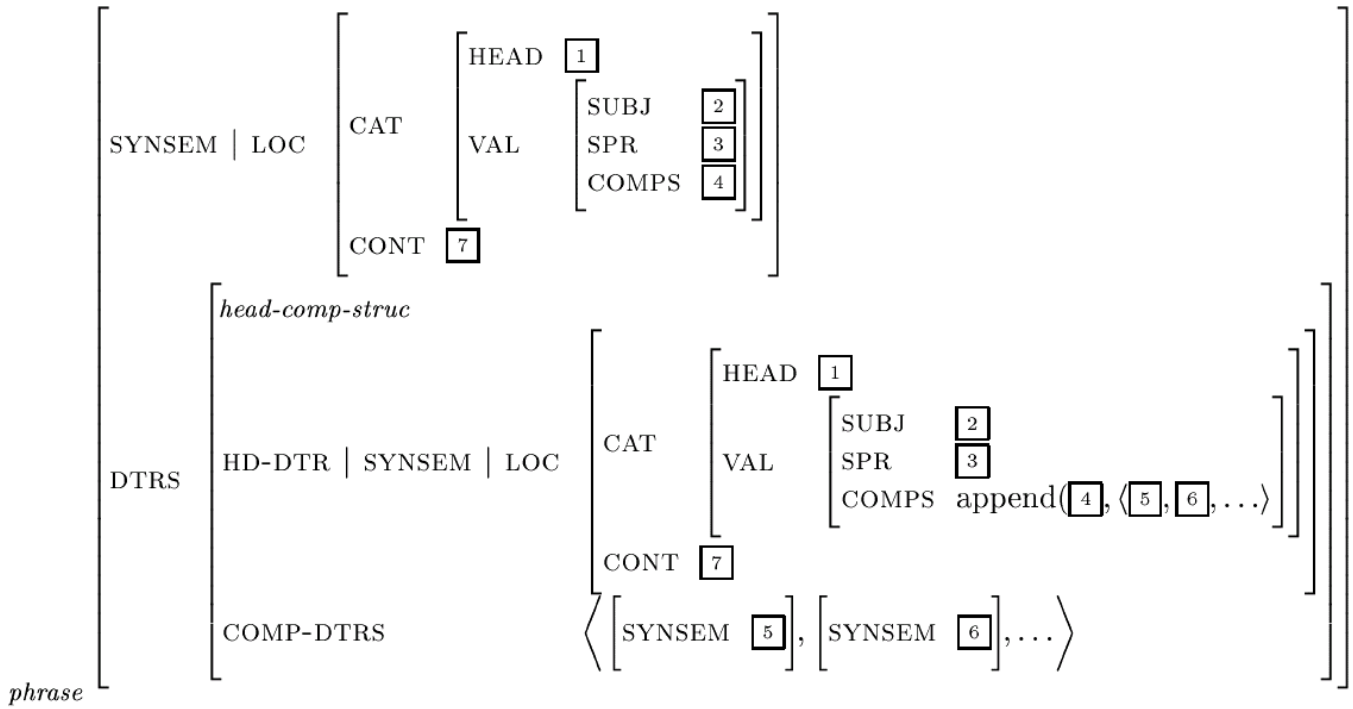
(11)

$$
\textit{phrase}\left[\begin{array}{l}
\text{SYNSEM} \mid \text{LOC} \mid \text{CAT}\left[\begin{array}{ll}\text{HEAD} & \boxed{1}\\ \text{VAL} & \left[\begin{array}{ll}\text{SUBJ} & \boxed{2}\\ \text{SPR} & \boxed{3}\\ \text{COMPS} & \boxed{4}\end{array}\right]\end{array}\right]\\
\text{DTRS}\left[\begin{array}{ll}\textit{head-comp-struc} & \\ \text{HD-DTR} \mid \text{SYNSEM} \mid \text{LOC} \mid \text{CAT} & \left[\begin{array}{ll}\text{HEAD} & \boxed{1}\\ \text{VAL} & \left[\begin{array}{ll}\text{SUBJ} & \boxed{2}\\ \text{SPR} & \boxed{3}\\ \text{COMPS} & \text{append}(\boxed{4}, \langle \boxed{5}, \boxed{6}, \ldots \rangle)\end{array}\right]\end{array}\right]\\ \text{COMP-DTRS} & \left\langle \left[\text{SYNSEM}\ \boxed{5}\right], \left[\text{SYNSEM}\ \boxed{6}\right], \ldots \right\rangle\end{array}\right]
\end{array}\right]
$$

# Constraint Interaction (cont.)

Plus the SemP:

(12)




Note: The order in which the constraints apply is unimportant. All constraints must be satisfied simultaneously.

# Constraint Interaction - example

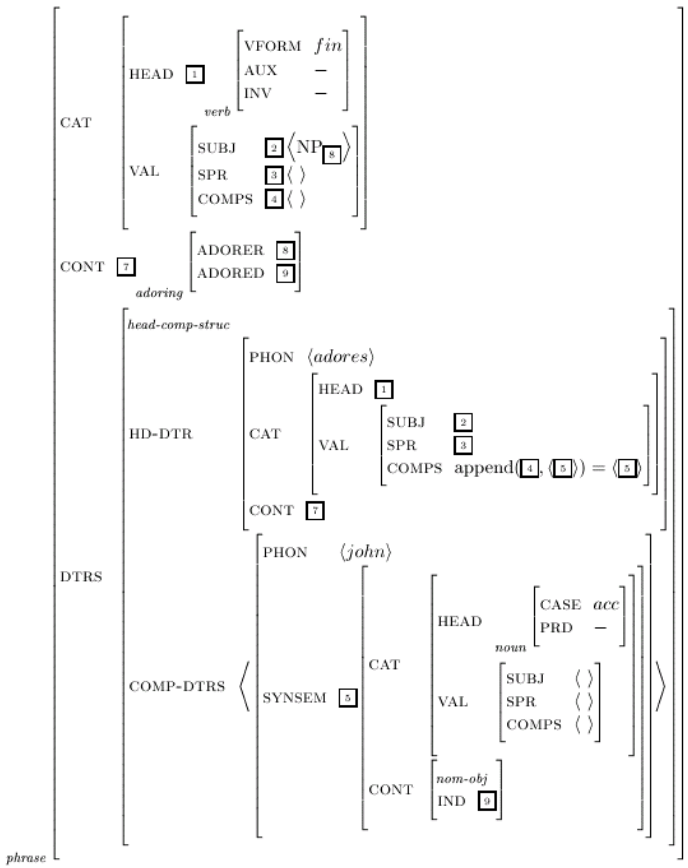
Consider the VP *likes John* in the following sentence:

(13) Mary [adores John].

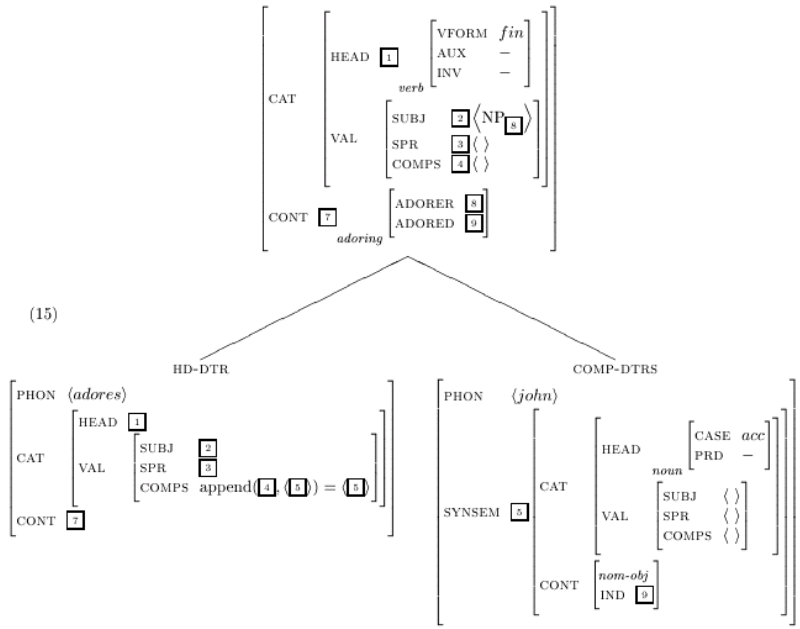
# Constraint Interaction - example

The verb *adores* and the noun *John* combine via the Head-Complement Schema:

(14)




Often represented as a tree:




Note: The PHONOLOGY feature for the head-complement phrase is not determined by any of the principles we have seen. The Constituent Ordering Principle (i.e., all the LP Rules) is responsible for mapping the daughters' PHON elements onto the mother's PHON list.

# Head-Subject Schema

A COMPS-saturated phrase combines with another sign to form a head-subject structure:

(16)

$$\textit{phrase}\left[\begin{array}{l}\text{DTRS}\ \left[\begin{array}{l}\textit{head-subj-struc}\\ \text{HD-DTR} \mid \text{SYNSEM} \mid \text{LOC} \mid \text{CAT} \mid \text{VAL} \mid \text{COMPS}\ \langle\ \rangle\\ \text{SUBJ-DTR}\ \langle \textit{sign} \rangle\end{array}\right]\end{array}\right]$$

# Head-Subject Schema (cont.)

Plus SemP:

(17)

$$\textit{phrase}\left[\begin{array}{ll}\text{SYNSEM} \mid \text{LOC} \mid \text{CONT} & \boxed{7} \\ \text{DTRS} & \left[\begin{array}{ll}\textit{head-subj-struc} & \\ \text{HD-DTR} \mid \text{SYNSEM} \mid \text{LOC} & \left[\begin{array}{ll}\text{CAT} \mid \text{VAL} \mid \text{COMPS} & \langle\,\rangle \\ \text{CONT} & \boxed{7}\end{array}\right] \\ \text{SUBJ-DTR} & \langle \textit{sign} \rangle\end{array}\right]\end{array}\right]$$

# Head-Subject Schema (cont.)

Plus HFP:

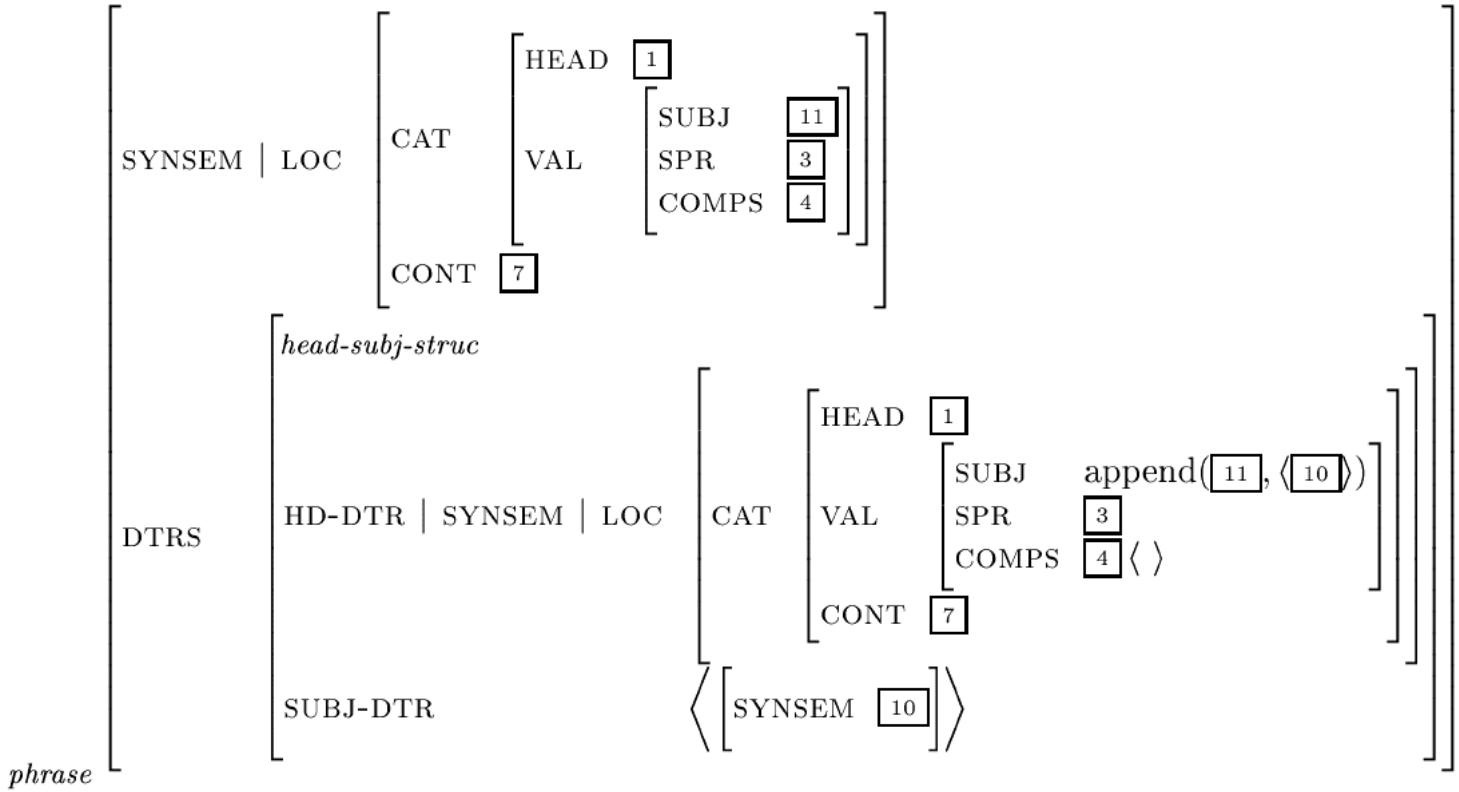
(18)

$$\textit{phrase}\left[\begin{array}{ll}\text{SYNSEM} \mid \text{LOC} & \left[\begin{array}{ll}\text{CAT} \mid \text{HEAD} & \boxed{1} \\ \text{CONT} & \boxed{7}\end{array}\right] \\ \text{DTRS} & \left[\begin{array}{ll}\textit{head-subj-struc} & \\ \text{HD-DTR} \mid \text{SYNSEM} \mid \text{LOC} & \left[\begin{array}{ll}\text{CAT} & \left[\begin{array}{ll}\text{HEAD} & \boxed{1} \\ \text{VAL} \mid \text{COMPS} & \langle\ \rangle\end{array}\right] \\ \text{CONT} & \boxed{7}\end{array}\right] \\ \text{SUBJ-DTR} & \langle \textit{sign} \rangle\end{array}\right]\end{array}\right]$$

# Head-Subject Schema (cont.)

Plus ValP:

(19)

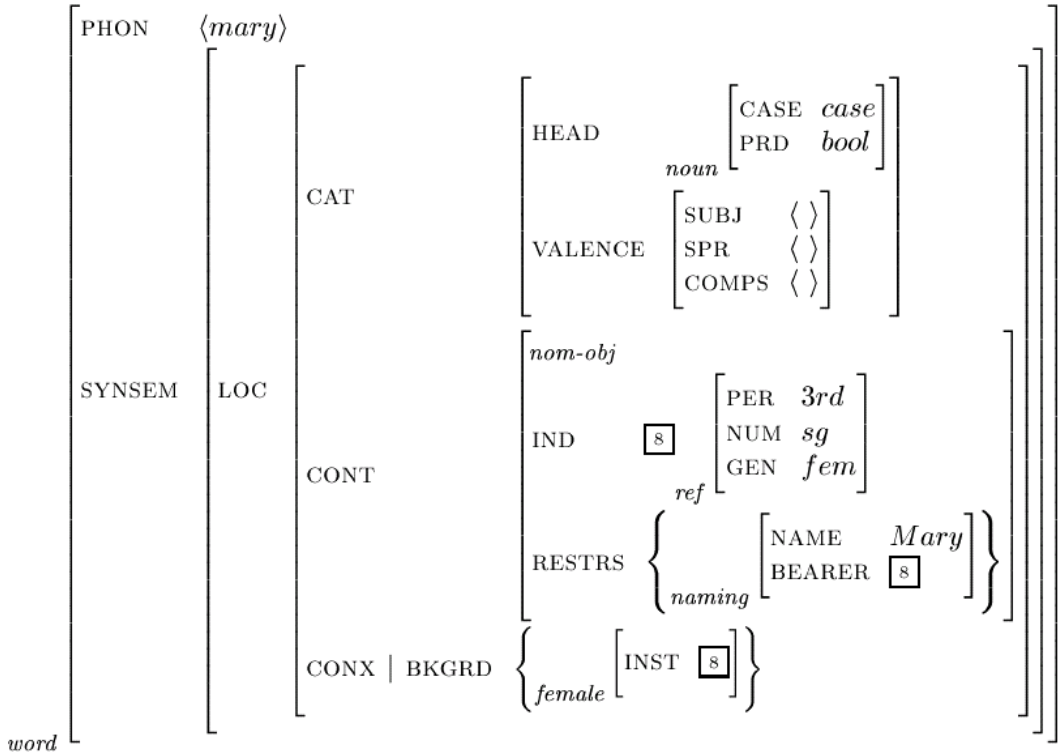


# Head-Subject Schema - examples

Recall example (13): *Mary adores John.*

Lexical entry for *Mary*:

(20)



# Head-Subject Schema - examples

Abbreviated sign for the VP *adores John* (above in (14), PHON value added):

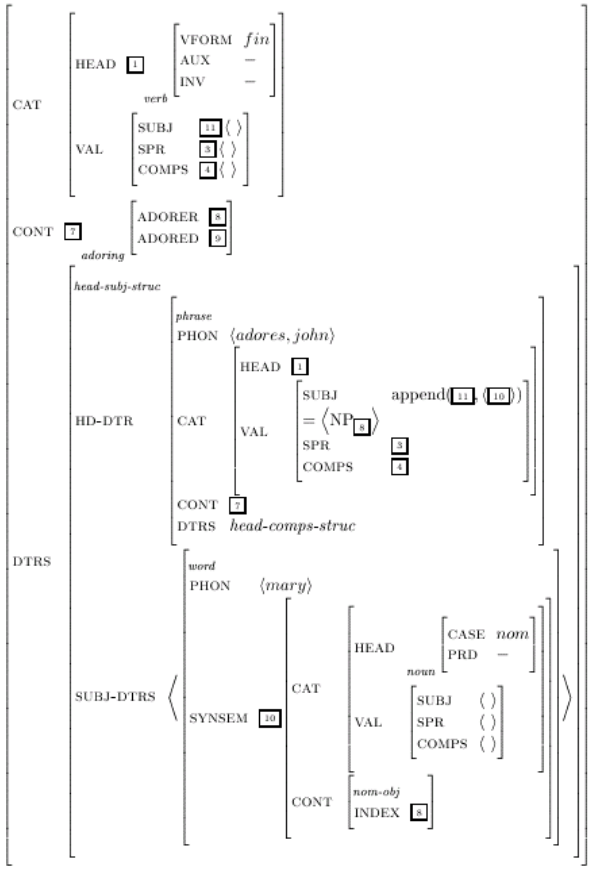
(21)

$$
\begin{bmatrix}
\textit{phrase} \\
\text{PHON} & \langle \textit{adores}, \textit{john} \rangle \\
\text{CAT} & \begin{bmatrix}
\text{HEAD} & \begin{bmatrix} \textit{verb} \\ \text{VFORM} & \textit{fin} \\ \text{AUX} & - \\ \text{INV} & - \end{bmatrix} \\
\text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle \text{NP}\boxed{8} \rangle \\ \text{SPR} & \langle\,\rangle \\ \text{COMPS} & \langle\,\rangle \end{bmatrix}
\end{bmatrix} \\
\text{CONT} & \begin{bmatrix} \textit{adoring} \\ \text{ADORER} & \boxed{8} \\ \text{ADORED} & \boxed{9} \end{bmatrix} \\
\text{DTRS} & \textit{head-comps-struc}
\end{bmatrix}
$$

# Head-Subject Schema - examples

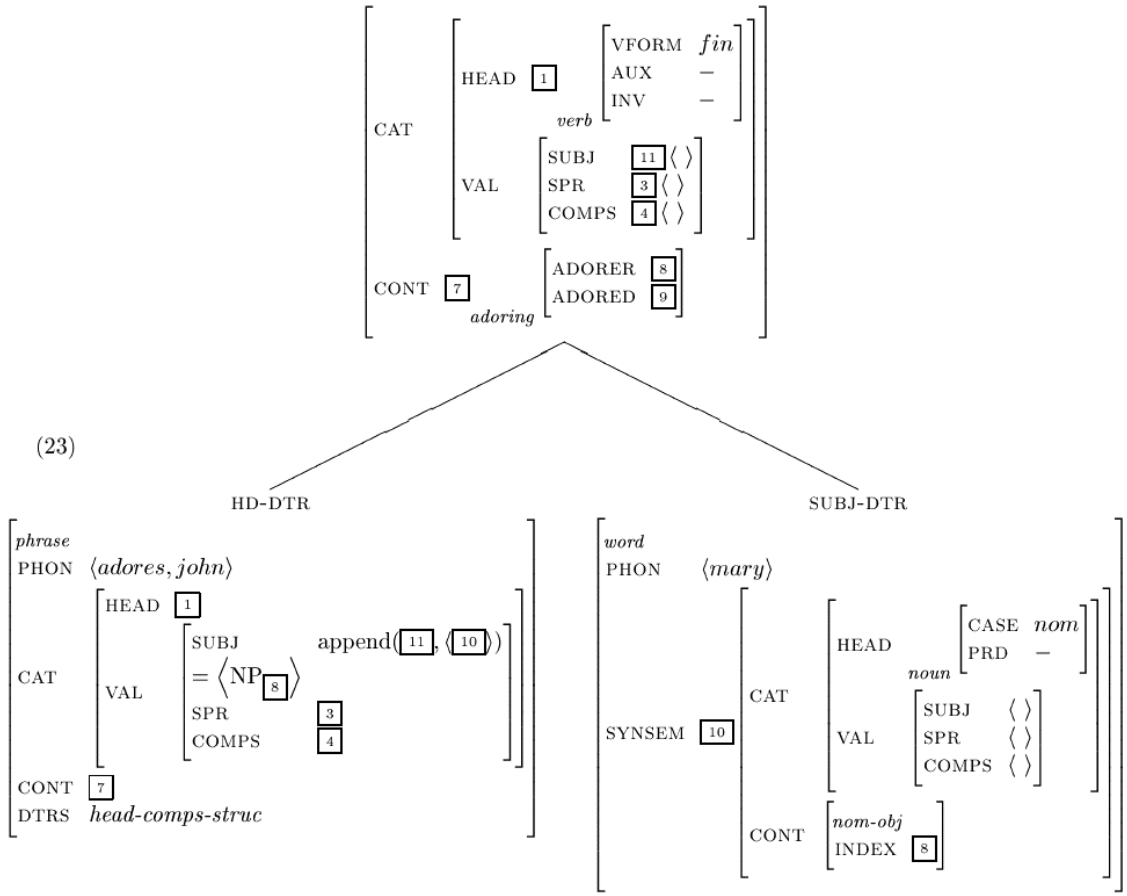
Head-Subject Phrase:

(22)



# Head-Subject Schema - examples

Tree notation:



# References

Copestake, A., Flickinger, D., & Sag, I. A. (1997). *Minimal Recursion Semantics: An introduction.*

Manning, C. D., & Sag, I. A. (1999). Dissociations between argument structure and grammatical relations. In G. Webelhuth, J.-P. Koenig, & A. Kathol (Eds.), *Lexical and constructional aspects of linguistic explanation.* Stanford: CSLI Publications.