Head-driven Phrase Structure Grammar – II
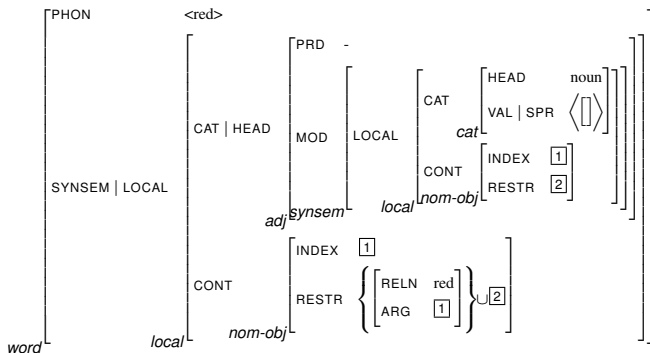## Grammatikformalismen (SS 2013)

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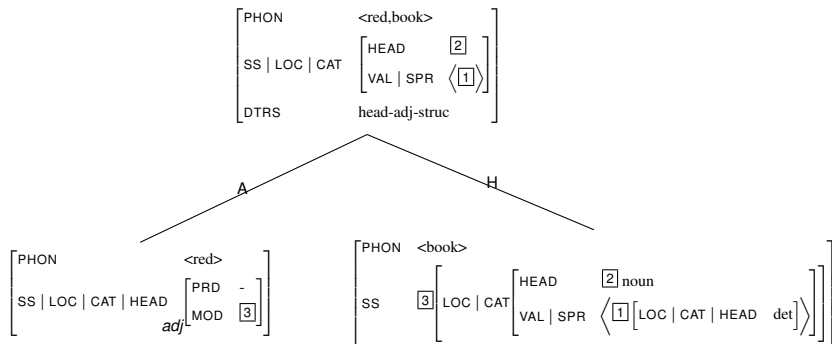Saarland University

June 25th, 2013

Towards Head Adjunct Structures

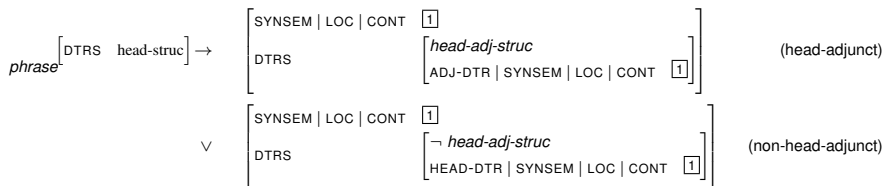An attributive adjective lexical entry

$$
\begin{bmatrix}
\text{PHON} & \langle red \rangle \\[2pt]
\text{SYNSEM} \mid \text{LOCAL} &
\begin{bmatrix}
\text{CAT} \mid \text{HEAD} &
\begin{bmatrix}
\text{PRD} & - \\
\text{MOD} &
\begin{bmatrix}
\text{LOCAL} &
\begin{bmatrix}
\text{CAT} &
\begin{bmatrix}
\text{HEAD} & noun \\
\text{VAL} \mid \text{SPR} & \langle\,[\,]\,\rangle
\end{bmatrix}_{cat} \\
\text{CONT} &
\begin{bmatrix}
\text{INDEX} & \boxed{1} \\
\text{RESTR} & \boxed{2}
\end{bmatrix}_{nom\text{-}obj}
\end{bmatrix}_{local}
\end{bmatrix}
\end{bmatrix}_{adj}\,{}_{synsem} \\[2pt]
\text{CONT} &
\begin{bmatrix}
\text{INDEX} & \boxed{1} \\
\text{RESTR} & \left\{ \begin{bmatrix} \text{RELN} & red \\ \text{ARG} & \boxed{1} \end{bmatrix} \right\} \cup \boxed{2}
\end{bmatrix}_{nom\text{-}obj}
\end{bmatrix}_{local}
\end{bmatrix}_{word}
$$

A Sketch of Head-Adjunct Structure

$$
\begin{bmatrix}
\text{PHON} & \langle \text{red,book} \rangle \\
\text{SS | LOC | CAT} & \begin{bmatrix} \text{HEAD} & \boxed{2} \\ \text{VAL | SPR} & \langle \boxed{1} \rangle \end{bmatrix} \\
\text{DTRS} & \text{head-adj-struc}
\end{bmatrix}
$$

A   H

$$
\begin{bmatrix}
\text{PHON} & \langle \text{red} \rangle \\
\text{SS | LOC | CAT | HEAD} & \underset{adj}{\begin{bmatrix} \text{PRD} & - \\ \text{MOD} & \boxed{3} \end{bmatrix}}
\end{bmatrix}
$$

$$
\begin{bmatrix}
\text{PHON} & \langle \text{book} \rangle \\
\text{SS} & \boxed{3} \begin{bmatrix} \text{LOC | CAT} & \begin{bmatrix} \text{HEAD} & \boxed{2}\,\text{noun} \\ \text{VAL | SPR} & \langle \boxed{1}\begin{bmatrix} \text{LOC | CAT | HEAD} & \text{det} \end{bmatrix} \rangle \end{bmatrix} \end{bmatrix}
\end{bmatrix}
$$

Semantic Principle

Semantic principle

- The CONTENT value of a headed phrase is token identical to the CONTENT value of the semantic head daughter
- The semantic head daughter is identified as
  - The ADJ-DTR in a head-adjunct phrase
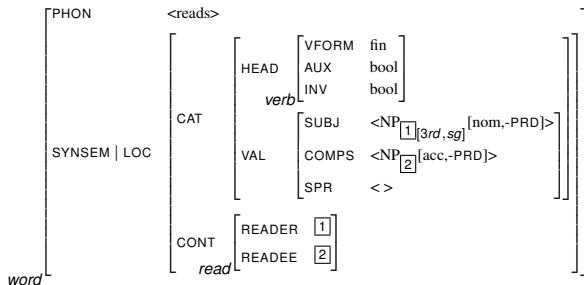 - The HEAD-DTR in other headed phrases

$$
phrase\begin{bmatrix} \text{DTRS} & \text{head-struc} \end{bmatrix} \rightarrow
\begin{bmatrix}
\text{SYNSEM | LOC | CONT} & \boxed{1} \\
\text{DTRS} & \begin{bmatrix} head\text{-}adj\text{-}struc \\ \text{ADJ-DTR | SYNSEM | LOC | CONT} & \boxed{1} \end{bmatrix}
\end{bmatrix} \quad \text{(head-adjunct)}
$$

$$
\vee
\begin{bmatrix}
\text{SYNSEM | LOC | CONT} & \boxed{1} \\
\text{DTRS} & \begin{bmatrix} \neg\ head\text{-}adj\text{-}struc \\ \text{HEAD-DTR | SYNSEM | LOC | CONT} & \boxed{1} \end{bmatrix}
\end{bmatrix} \quad \text{(non-head-adjunct)}
$$

SPEC Principle

SPEC principle

In a headed phrase whose non-head daughter (either the MARK-DTR or COMP-DTR|FIRST) has a SYNSEM|LOCAL|CATEGORY|HEAD value of type *functional*, the *spec* value of that value must be token-identical with the phrase's DTRS|HEAD-DTR|SYNSEM value

$$
\textit{phrase} \left[\text{DTRS} \begin{bmatrix} \textit{head-struc} \\ \text{NONHEAD-DTR | SYNSEM | LOCAL | CAT | HEAD} \quad \textit{functional} \end{bmatrix} \right]
$$
$$
\rightarrow \left[\text{DTRS} \begin{bmatrix} \text{HEAD-DTR | SYNSEM} & \boxed{1} \\ \text{NONHEAD-DTR | SYNSEM | LOCAL | CAT | HEAD | SPEC} & \boxed{1} \end{bmatrix} \right]
$$

Constraint Interaction - An Example

(1)   John reads a new book.
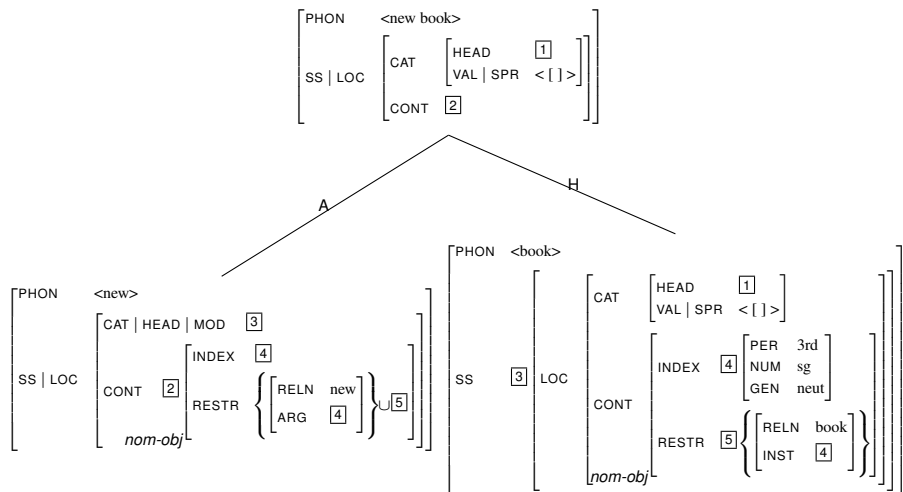
The lexical entry for "reads" looks like the following

$$
\begin{bmatrix}
\text{PHON} & \text{<reads>} \\
\text{SYNSEM} \mid \text{LOC} & \begin{bmatrix}
\text{CAT} & \begin{bmatrix}
\text{HEAD} & \begin{bmatrix} \text{VFORM} & \text{fin} \\ \text{AUX} & \text{bool} \\ \text{INV} & \text{bool} \end{bmatrix}_{verb} \\
\text{VAL} & \begin{bmatrix} \text{SUBJ} & <\text{NP}_{\boxed{1}}[3rd,sg] [\text{nom,-PRD}]> \\ \text{COMPS} & <\text{NP}_{\boxed{2}}[\text{acc,-PRD}]> \\ \text{SPR} & <\,> \end{bmatrix}
\end{bmatrix} \\
\text{CONT} & \begin{bmatrix} \text{READER} & \boxed{1} \\ \text{READEE} & \boxed{2} \end{bmatrix}_{read}
\end{bmatrix}
\end{bmatrix}_{word}
$$

Constraint Interaction - An Example

The lexical entry for "new" looks like the following

$$
\begin{bmatrix}
\text{PHON} & \langle \text{new} \rangle \\
\text{SYNSEM} \mid \text{LOCAL} & \begin{bmatrix}
\text{CAT} \mid \text{HEAD} & \begin{bmatrix}
\text{PRD} & - \\
\text{MOD} & \begin{bmatrix}
\text{LOCAL} & \begin{bmatrix}
\text{CAT} & \begin{bmatrix} \text{HEAD} & \text{noun} \\ \text{VAL} \mid \text{SPR} & \langle [\ ] \rangle \end{bmatrix}_{cat} \\
\text{CONT} & \begin{bmatrix} \text{INDEX} & \boxed{1} \\ \text{RESTR} & \boxed{2} \end{bmatrix}_{nom\text{-}obj}
\end{bmatrix}_{local}
\end{bmatrix}_{synsem}
\end{bmatrix}_{adj} \\
\text{CONT} & \begin{bmatrix}
\text{INDEX} & \boxed{1} \\
\text{RESTR} & \left\{ \begin{bmatrix} \text{RELN} & \text{new} \\ \text{ARG} & \boxed{1} \end{bmatrix} \right\} \cup \boxed{2}
\end{bmatrix}_{nom\text{-}obj}
\end{bmatrix}_{local}
\end{bmatrix}_{word}
$$
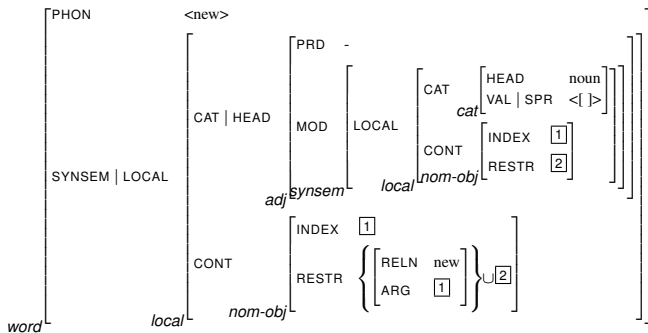
Constraint Interaction - An Example

For *"new book"*, *head-adjunct* schema is applied

$$
\begin{bmatrix}
\text{PHON} & <\text{new book}> \\
\text{SS | LOC} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{VAL | SPR} & <\ [\ ]\ > \end{bmatrix} \\ \text{CONT} & \boxed{2} \end{bmatrix}
\end{bmatrix}
$$

A

H

$$
\begin{bmatrix}
\text{PHON} & <\text{new}> \\
\text{SS | LOC} & \begin{bmatrix} \text{CAT | HEAD | MOD} & \boxed{3} \\ \text{CONT} & \boxed{2} \begin{bmatrix} \text{INDEX} & \boxed{4} \\ \text{RESTR} & \left\{ \begin{bmatrix} \text{RELN} & \text{new} \\ \text{ARG} & \boxed{4} \end{bmatrix} \right\} \cup \boxed{5} \\ \textit{nom-obj} \end{bmatrix} \end{bmatrix}
\end{bmatrix}
$$

$$
\begin{bmatrix}
\text{PHON} & <\text{book}> \\
\text{SS} & \boxed{3} \ \text{LOC} \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{VAL | SPR} & <\ [\ ]\ > \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{INDEX} & \boxed{4} \begin{bmatrix} \text{PER} & \text{3rd} \\ \text{NUM} & \text{sg} \\ \text{GEN} & \text{neut} \end{bmatrix} \\ \text{RESTR} & \boxed{5} \left\{ \begin{bmatrix} \text{RELN} & \text{book} \\ \text{INST} & \boxed{4} \end{bmatrix} \right\} \end{bmatrix} \\ \textit{nom-obj} \end{bmatrix}
\end{bmatrix}
$$

For *"a [new book]"*, *head-specifier* schema is applied

$$\begin{bmatrix} \text{PHON} & \text{<a new book>} \\ \text{SS | LOC} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{VAL | SPR} & <> \end{bmatrix} \\ \text{CONT} & \boxed{2} \end{bmatrix} \end{bmatrix}$$

SPR ⟋ ⟍ H

$$\begin{bmatrix} \text{PHON} & \text{<a>} \\ \text{SS} & \boxed{6}\begin{bmatrix} \text{LOC | CAT | HEAD} & \begin{bmatrix} det \\ \text{SPEC} & \boxed{7} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

$$\begin{bmatrix} \text{PHON} & \text{<new book>} \\ \text{SS} & \boxed{7}\begin{bmatrix} \text{LOC} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{VAL | SPR} & <\boxed{6}> \end{bmatrix} \\ \text{CONT} & \boxed{2} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$
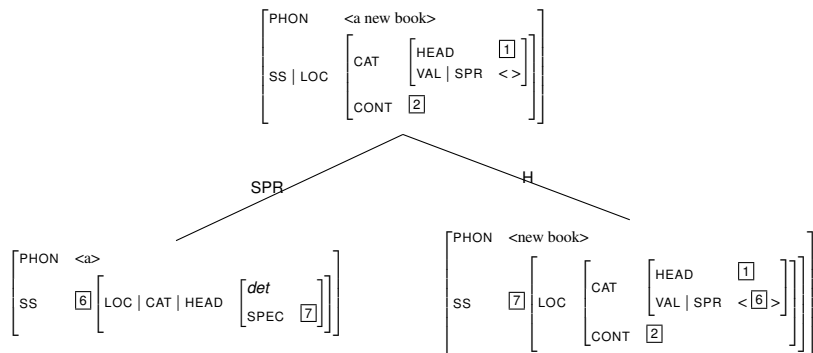
Constraint Interaction - An Example

For *"reads [a new book]"*, *head-complement* schema is applied
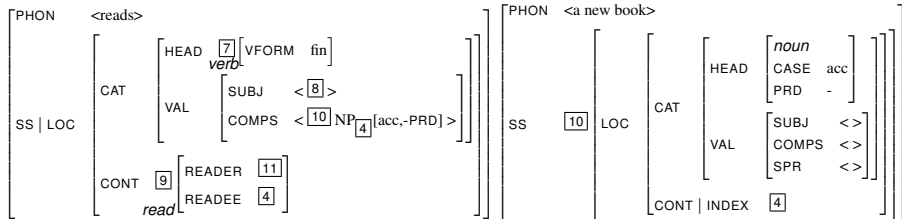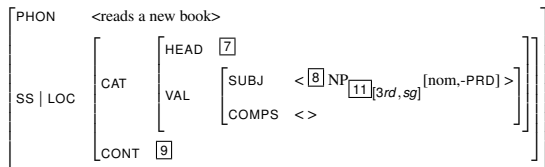
Constraint Interaction - An Example

For *"John [reads a new book]"*, *head-subject* schema is applied
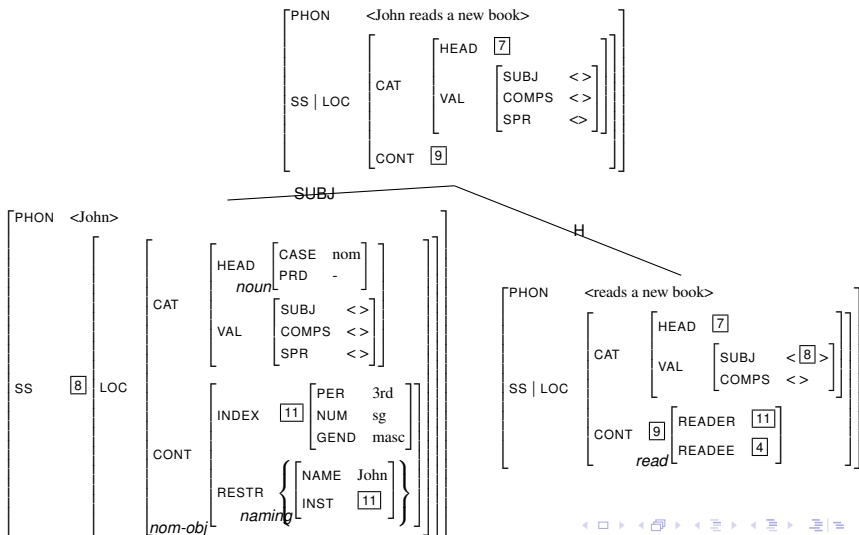
Marking Principle

Marking principle

In a headed phrase, the MARKING value is token-identical with that of the MARK-DTR if any, and with that of the HEAD-DTR otherwise

$$
\text{phrase}\begin{bmatrix} \text{DTRS} & \text{head-struc} \end{bmatrix} \rightarrow
\begin{bmatrix}
\text{SYNSEM | LOC | CAT | MARKING} & \boxed{1} \\
\text{DTRS} & \begin{bmatrix} \text{head-mark-struc} \\ \text{MARK-DTR | SYNSEM | LOC | CAT | MARKING} & \boxed{1} \end{bmatrix}
\end{bmatrix}
$$

$$
\vee
\begin{bmatrix}
\text{SYNSEM | LOC | CAT | MARKING} & \boxed{1} \\
\text{DTRS} & \begin{bmatrix} \neg\text{head-mark-struc} \\ \text{HEAD-DTR | SYNSEM | LOC | CAT | MARKING} & \boxed{1} \end{bmatrix}
\end{bmatrix}
$$

Lexical Entry for the *Marker "that"*

$$\begin{bmatrix} \text{PHON} & \langle \text{that} \rangle \\ \text{SYNSEM} \mid \text{LOC} \mid \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{SPEC} \mid \text{LOC} \mid \text{CAT} & \begin{bmatrix} \text{HEAD} & verb\begin{bmatrix} \text{VFORM} & \text{fin} \vee \text{bse} \end{bmatrix} \\ \text{MARKING} & \text{unmarked} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle \rangle \\ \text{COMPS} & \langle \rangle \\ \text{SPR} & \langle \rangle \end{bmatrix} \end{bmatrix} \\ marker \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle \rangle \\ \text{COMPS} & \langle \rangle \\ \text{SPR} & \langle \rangle \end{bmatrix} \\ \text{MARKING} & \text{that} \end{bmatrix} \end{bmatrix}_{word}$$
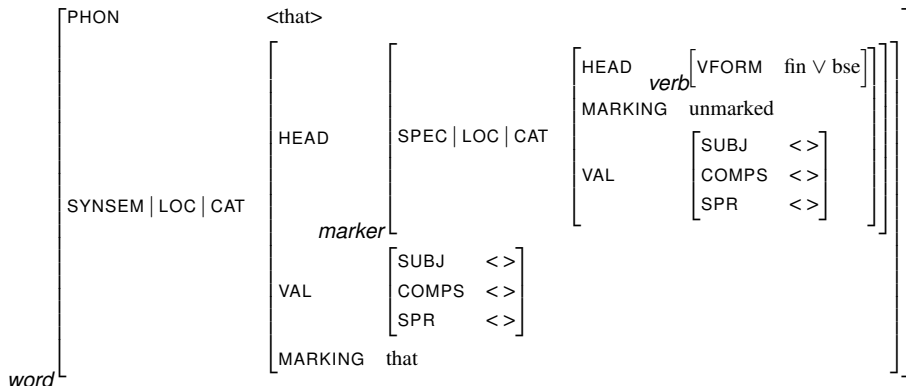
- The combination of *head-marker* schema and the marking principle will combine the head with the marker and set the value of MARKING features properly

A Sketched Example of a Head-Marker Structure
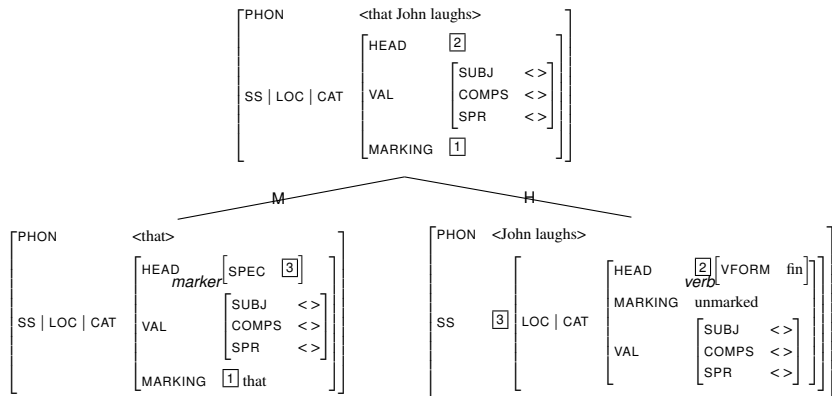
Lexical Rules

- So far we have been using surface forms of the words in the lexical entries
- In practice, lexical rules can be used to automatically derive the variations of the lexical entries, e.g. pluralization, passivization, dative alternation, etc.

Example (Pluralization lexical rule)

$$
\begin{bmatrix}
\text{PHON} & \langle \boxed{1} \rangle \\
\text{SS} & \begin{bmatrix}
\text{CAT} & \boxed{2} \\
\text{CONT} & \begin{bmatrix}
\text{INDEX} & \boxed{3}\begin{bmatrix} \text{PER} & \text{3rd} \\ \text{NUM} & \text{sg} \end{bmatrix} \\
\text{RESTR} & \left\{ \begin{bmatrix} \text{RELN} & \boxed{1} \\ \text{INST} & \boxed{3} \end{bmatrix} \right\}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
\rightarrow
\begin{bmatrix}
\text{PHON} & \langle F_{pl}(\boxed{1}) \rangle \\
\text{SS} & \begin{bmatrix}
\text{CAT} & \boxed{2} \\
\text{CONT} & \begin{bmatrix}
\text{INDEX} & \boxed{4}\begin{bmatrix} \text{PER} & \text{3rd} \\ \text{NUM} & \text{pl} \end{bmatrix} \\
\text{RESTR} & \left\{ \begin{bmatrix} \text{RELN} & \boxed{1} \\ \text{INST} & \boxed{4} \end{bmatrix} \right\}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$
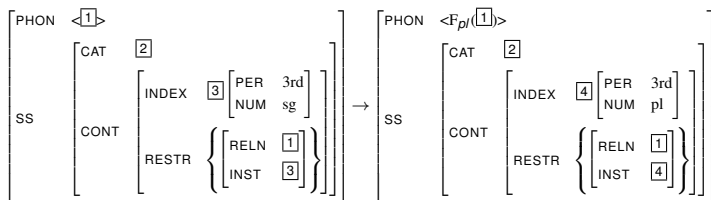
Lexical Rules

Example (Passivization lexical rule)

$$
\begin{bmatrix}
\text{PHON} & \langle \boxed{1} \rangle \\
\text{SS | LOC | CAT} & \begin{bmatrix}
\text{HEAD} & \begin{bmatrix} \text{VFORM} & \text{bse} \end{bmatrix} \\
& \textit{verb} \\
\text{VAL} & \begin{bmatrix}
\text{SUBJ} & \langle \text{NP}_{\boxed{2}} \rangle \\
\text{COMPS} & \langle \boxed{3} \mid \boxed{4} \rangle
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
\rightarrow
\begin{bmatrix}
\text{PHON} & \langle \text{F}_{psp}(\boxed{1}) \rangle \\
\text{SS | LOC | CAT} & \begin{bmatrix}
\text{HEAD | VFORM} & \textit{passive} \\
\text{VAL} & \begin{bmatrix}
\text{SUBJ} & \langle \boxed{3} \rangle \\
\text{COMPS} & \langle \boxed{4} \rangle \oplus \langle \text{PP}[by]_{\boxed{2}} \rangle
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$
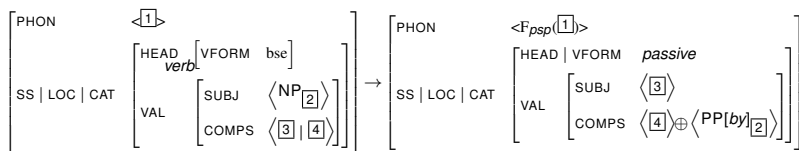
- Although lexical rules are *"neutral between the declarative and procedural interpretations . . . we lack as yet any satisfactory declarative formalization."* [Pollard and Sag, 1994]
- Many of the generalizations captured by lexical rules can also be represented directly in the lexical hierarchy

Equi and Raising

There are reasons for drawing a careful distinction between these two classes of complement-taking expressions. The key difference is that

- Equi verbs (and adjectives) systematically assign one more semantic role than their raising counterparts

Subject Equi/Raising Verbs

1. - They try to run.
   - $\begin{bmatrix} \text{TRYER} & \boxed{1} \\ \text{SOA-ARG} & run\begin{bmatrix} \text{RUNNER} & \boxed{1}\,\text{ref} \end{bmatrix} \end{bmatrix}$

2. - They tend to run.
   - $tend\begin{bmatrix} \text{SOA-ARG} & run\begin{bmatrix} \text{RUNNER} & \text{ref} \end{bmatrix} \end{bmatrix}$
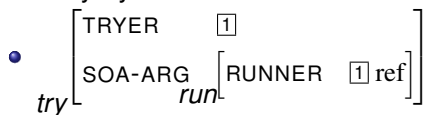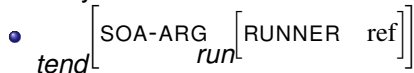
- The subjects of subject-raising verbs are assigned no role in the matrix psoa

Object Equi/Raising Verbs

1. - They persuade him to be happy.
   -
   $$persuade\begin{bmatrix} \text{PERSUADER} & \text{ref} \\ \text{PERSUADEE} & \boxed{1}\,\text{ref} \\ \text{SOA-ARG} & happy\begin{bmatrix} \text{INST} & \boxed{1} \end{bmatrix} \end{bmatrix}$$
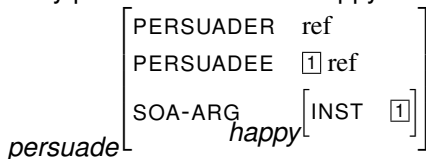
2. - They believe him to be happy.
   -
   $$believe\begin{bmatrix} \text{BELIEVER} & \text{ref} \\ \text{SOA-ARG} & happy\begin{bmatrix} \text{INST} & \text{ref} \end{bmatrix} \end{bmatrix}$$
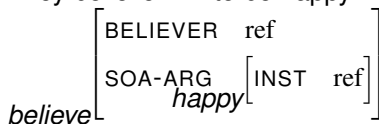
- The objects of object-raising verbs are assigned no role in the matrix psoa

Key Property of Subject-Raising Verbs

The subject plays no semantic role in the predication introuced by the SRV itself. Its semantic role (if any) is only in the predication introduced in the complement.

Lexical entry for SRV "tend"

$$
\begin{bmatrix}
\text{PHON} & \left\langle \textit{tend} \right\rangle \\
\text{SYNSEM} \mid \text{LOC} & \begin{bmatrix}
\text{CAT} \mid \text{VAL} & \begin{bmatrix}
\text{SUBJ} & \left\langle \boxed{1}\text{NP} \right\rangle \\
\text{COMPS} & \left\langle \text{VP}[\textit{inf}]{<}\boxed{1}{>}{:}\boxed{2} \right\rangle
\end{bmatrix} \\
\text{CONT} & \textit{tend}\begin{bmatrix} \text{SOA-ARG} & \boxed{2} \end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$

Constraints on the Subject of Subject-Raising Verbs

- SRVs take dummy subjects when and only when their complements do
  - There continue to be seats available.
  - It continues to matter that we lost.
  - *It continues to be seats available.
  - *There continues to matter that we lost.
- Passivizing the complement of an SRV does not change the truth conditions of the whole sentence:
  - Skeptics continue to question your hypothesis.
  - Your hypothesis continues to be questioned by skeptics.
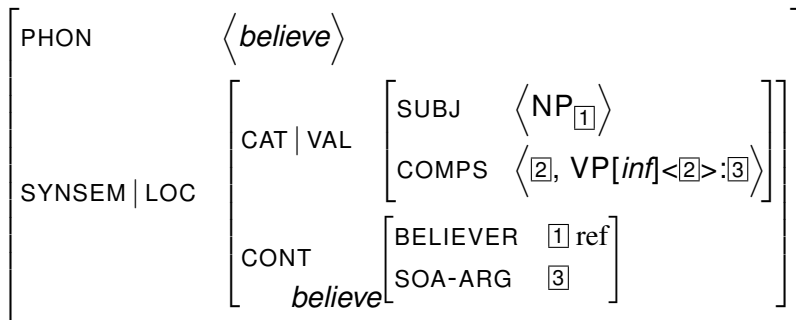
Subject-Equi Verbs

Lexical entry for SEV "try"

$$
\begin{bmatrix}
\text{PHON} & \left\langle \textit{try} \right\rangle \\
\\
\text{SYNSEM} \mid \text{LOC} &
\begin{bmatrix}
\text{CAT} \mid \text{VAL} &
\begin{bmatrix}
\text{SUBJ} & \left\langle \text{NP}_{\boxed{1}} \right\rangle \\
\text{COMPS} & \left\langle \text{VP}[\textit{inf}]\text{<NP}_{\boxed{1}}\text{>:}\boxed{3} \right\rangle
\end{bmatrix} \\
\\
\text{CONT} & \textit{try}\begin{bmatrix} \text{TRYER} & \boxed{1}\,\text{ref} \\ \text{SOA-ARG} & \boxed{3} \end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$
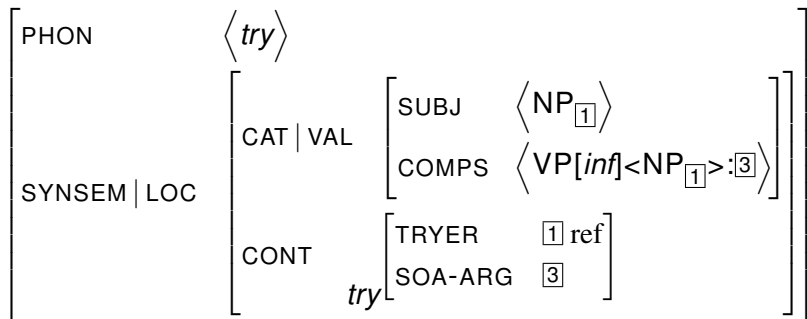
Note that:

- $\boxed{1}$ is a semantic argument in the *"try"* relation
- The subject NP is coindexed with the VP complements' subject

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Object-Raising-Verbs

Lexical entry for ORV "believe"

$$
\begin{bmatrix}
\text{PHON} & \left\langle \textit{believe} \right\rangle \\[2em]
\text{SYNSEM} \mid \text{LOC} &
\begin{bmatrix}
\text{CAT} \mid \text{VAL} &
\begin{bmatrix}
\text{SUBJ} & \left\langle \text{NP}_{\boxed{1}} \right\rangle \\[1em]
\text{COMPS} & \left\langle \boxed{2},\ \text{VP}[\textit{inf}]{<}\boxed{2}{>}{:}\boxed{3} \right\rangle
\end{bmatrix} \\[3em]
\text{CONT} \quad \textit{believe} &
\begin{bmatrix}
\text{BELIEVER} & \boxed{1}\ \text{ref} \\
\text{SOA-ARG} & \boxed{3}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$

Object-Equi Verbs

Lexical entry for OEV "persuade"

$$
\begin{bmatrix}
\text{PHON} & \left\langle \textit{persuade} \right\rangle \\
\text{SYNSEM} \mid \text{LOC} &
\begin{bmatrix}
\text{CAT} \mid \text{VAL} &
\begin{bmatrix}
\text{SUBJ} & \left\langle \text{NP}_{\boxed{1}} \right\rangle \\
\text{COMPS} & \left\langle \text{NP}_{\boxed{2}},\ \text{VP}[\textit{inf}]{<}\text{NP}_{\boxed{2}}{>}{:}\boxed{3} \right\rangle
\end{bmatrix} \\
\text{CONT} &
\textit{persuade}
\begin{bmatrix}
\text{PERSUADER} & \boxed{1}\ \text{ref} \\
\text{PERSUADEE} & \boxed{2}\ \text{ref} \\
\text{SOA-ARG} & \boxed{3}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$

Extra Difference Between Equi and Raising Verbs

- For equi verbs, the VP complement's unexpressed subject is coindexed with one of the other syntactic dependents (the subject for the subject-equi verbs, the object for the object-equi verbs); For raising verbs, the entire SYNSEM of the subject of the VP complement is structure-shared with one of the other syntactic dependents

- Only raising expressions allow expletive "there" — as subject of SRVs, as an object of ORVs
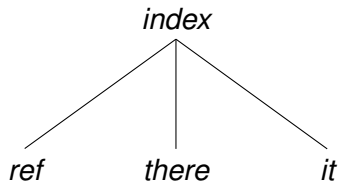
An Example

(On the whiteboard)

- They tend to run.
- Kim_i, John persuaded Mary to trust $\_i$.

Summary

- We have shown the differences between Equi and Raising verbs
- Lexical entries for handling subject/object equi/raising verbs are introduced and compared
- The generalization of raising can be captured with a principle which states that any unassigned argument must be raising controllers (not to be discussed in this lecture)

References I

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