

LG521 Introduction to HPSG: Some Constructions

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1 Review

- Principles, Grammar, Lexicon: grammaticality;
- Top level structure of signs;
- Abbreviations (tree notation).

2 Introduction

In this lecture, we flesh out the ideas of the first lecture by looking at some principles and some English constructions, and lots of examples.

- Subcat and Head Feature Principles;
- ID-principles (“Rules”);
- Overview some constructions.

The main idea is to get a bit more familiarity with the notation and the way of thinking, without bothering too much with motivation at this stage.

3 Abbreviations

Writing (and reading) Feature Matrices can be hard work, so we use a number of standard abbreviations.

- Paths can be written as follows: LOC|CAT|HEAD.
- NP is an abbreviation for a saturated, i.e. ([SUBCAT <>], nominal:

$$\left[\text{LOC} \left[\text{CAT} \left[\begin{array}{ll} \text{HEAD} & \text{noun} \\ \text{SUBCAT} & \langle \rangle \end{array} \right] \right] \right]$$

- S is an abbreviation for a saturated verb:

$$\left[\text{LOC} \left[\text{CAT} \left[\begin{array}{ll} \text{HEAD} & \text{verb} \\ \text{SUBCAT} & \langle \rangle \end{array} \right] \right] \right]$$

- VP is an abbreviation for an almost saturated verb:

$$\left[\text{LOC} \left[\text{CAT} \left[\begin{array}{ll} \text{HEAD} & \text{verb} \\ \text{SUBCAT} & \langle \square \rangle \end{array} \right] \right] \right]$$

- Subscripting gives the *index* of a phrase: NP_[i] abbreviates:

$$\left[\text{LOC} \left[\begin{array}{l} \text{CAT} \left[\begin{array}{ll} \text{HEAD} & \text{noun} \\ \text{SUBCAT} & \langle \rangle \end{array} \right] \\ \text{CONTENT|INDEX} & \boxed{i} \end{array} \right] \right]$$

- X:[i] abbreviates a structure of category X, with content [i], for example:

S:[i] abbreviates

$$\left[\text{LOC} \left[\text{CAT} \left[\text{HEAD} \quad \text{verb} \right] \right] \right]$$

$$\left[\text{SUBCAT} \quad \langle \rangle \right]$$

$$\left[\text{CONT} \quad \boxed{2} \right]$$

VP:[i] abbreviates

$$\left[\text{LOC} \left[\text{CAT} \left[\text{HEAD} \quad \text{verb} \right] \right] \right]$$

$$\left[\text{SUBCAT} \quad \langle \boxed{i} \rangle \right]$$

$$\left[\text{CONT} \quad \boxed{2} \right]$$

- Feature specifications can also be given after abbreviations:
NP[nom] is an NP which contains a nom value, i.e.

$$\left[\text{LOC} \left[\text{CAT} \left[\text{HEAD} \quad \text{noun} \right] \right] \right]$$

$$\left[\text{SUBCAT} \quad \langle \rangle \right]$$

$$\left[\text{CASE} \quad \text{nom} \right]$$

- Abbreviations can be combined. NP_{[1][3rd,sing,fem]} is an NP, whose index is [1], and whose index contains values 3rd, sing, and fem (cf. *she*).

4 Principles

Immediate Dominance (ID) Principles: See below.

Head Feature Principle (HFP): The HEAD value of any headed phrase is structure-shared with the HEAD value of the head daughter.

Subcategorization (Subcat) Principle : In a headed phrase (i.e. a phrasal sign whose DTRS value is of sort *head-struct*), the SUBCAT value of the head daughter is the concatenation of the phrases SUBCAT list with the list (in order of increasing obliqueness) of the SYNSEM values of the complement daughters.

SPEC principle : If a non-head daughter in a headed structure bears a SPEC value, it is token identical to the SYNSEM value of the head daughter.

Semantics Principle : In a headed phrase, the CONTENT value is token identical to that of the adjunct daughter if the DTRS value is of sort *head-adj-struct*, and with that of the head daughter otherwise.

Quantifier Inheritance Principle : ...

4.1 The Head Feature Principle (HFP)

- The notion "head of a phrase";
- In headed constructions, phrases share certain properties with their heads:
 - category (part of speech): NP are headed by Ns, VPs by Vs (and Ss by VPs).
 - finiteness: finite Ss are headed by finite VPs; finite VPs are headed by finite Vs; similarly for other vforms.
 - (1) They believe that she *be/is on time.
 - pform: the form of preposition is a property of PP, which it shares with its head:
 - (2) a. They relied [_{PP_{on}} on Sam]
 - b. They spoke [_{PP_{to}} to Sam]
- Not all constructions are headed (coordinate structures).

The Head Feature Principle (HFP)

The HEAD value of any headed phrase is structure-shared with the HEAD value of the head daughter.

4.2 Subcategorization Principle

The SUBCAT list records the complements of a head:

- as a list of SYNSEM values;
- in order of increasing obliqueness;
- including the subject.
- Combining complements with a head ‘cancels’ them from the SUBCAT list of the phrase (cf. CG).

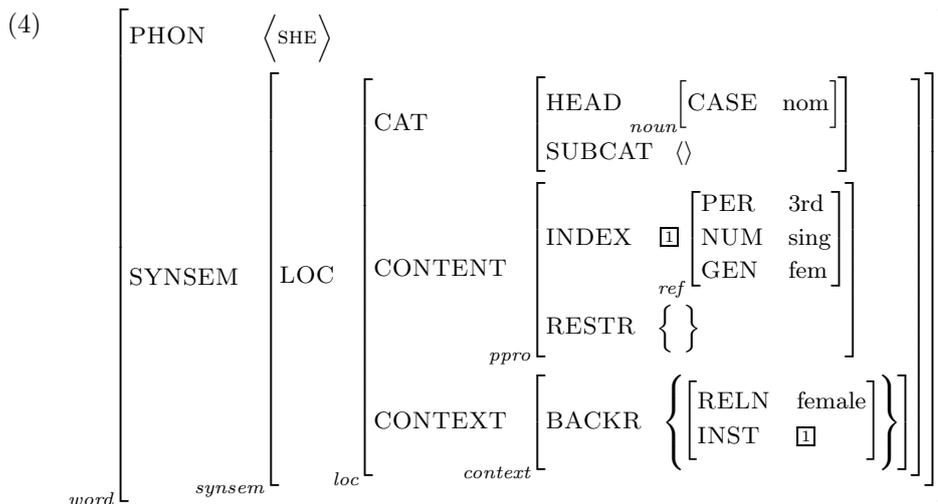
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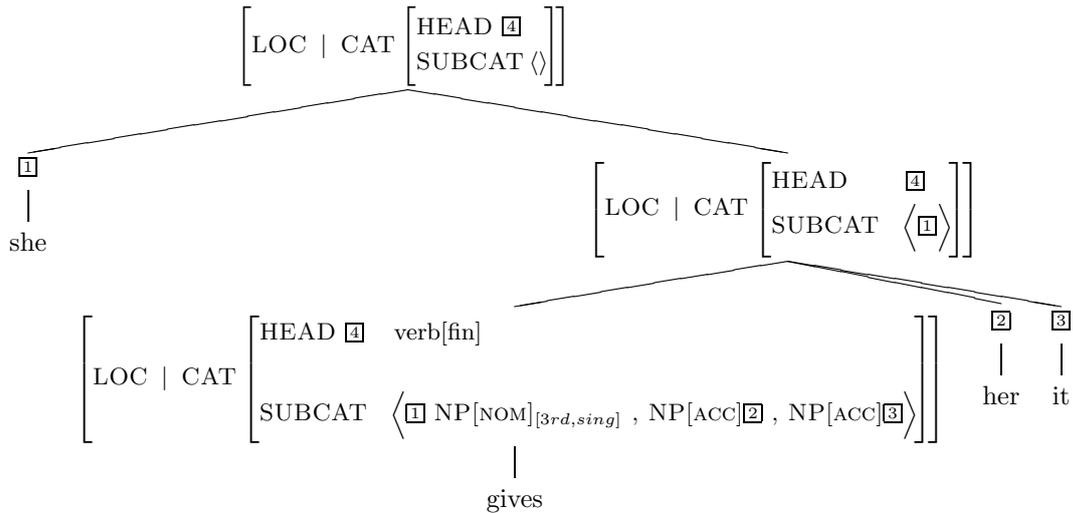
5 Example

Consider the lexical entries for *she* (*her*, and *it*), and the verb *gives*, and the structure that might be assigned to *She gives her it*, assuming a fairly conventional phrase structure.

(3) *she*:



(5) She gives her it.



6 ID Principles

Instead of rules, HPSG employs a small number of very general *Immediate Dominance (ID) Schemas*.

- A ‘schema’ is a generalization over a set of rules, e.g.
 - (6) a. $XP \rightarrow X YP$
 - b. $XP \rightarrow XP YP$
- Immediate Dominance Schemas deal only with immediate dominance relation (as opposed to precedence relations — i.e. they say what dominates what, but not what comes before what).

6.1 Summary

The following are brief/outline descriptions of the ID principles of standard HPSG:

ID1 Head Complement Structures:

$$(7) X_{\langle \rangle} \rightarrow X_{\langle _ \rangle} \dots$$

$$(8) \text{ a. } S \rightarrow NP VP$$

$$\text{ b. } NP \rightarrow DET N$$

ID2 Almost Saturated Head-Complement Structures:

$$(9) X_{\langle _ \rangle} \rightarrow X_{\langle \dots \rangle} \dots$$

$$(10) \text{ a. } VP \rightarrow V NP$$

$$\text{ b. } N' \rightarrow N PP \text{ (e.g. } teacher \text{ of } English)$$

ID3 ‘Flat’ Almost Saturated Head-Complement Structures:

$$(11) X_{\langle \rangle} \rightarrow X_{\langle \dots \rangle} \dots$$

$$(12) S \rightarrow AUX NP VP$$

ID4 Head-Marker Structures:

$$(13) \text{ a. } that \text{ } [_S \text{ he left }]$$

$$\text{ b. } for \text{ } [_S \text{ him to go }]$$

ID5 Head-Adjunct Structures:

$$(14) XP \rightarrow XP YP$$

ID6 Filler-Head Structures:

$$(15) Who_i \text{ } [_S \text{ does Sam say she likes } t_i \text{ }]$$

With this small number of schemas and a similar number of principles, it is possible to describe a very wide range of structures in English and other languages. Here we will just focus on the first

three schemas.

6.2 ID1

Schema 1 (ID1: Head Complement Structures): a saturated (SUBCAT $\langle \rangle$) phrase with DTRS value of sort *head-comp-struct* in which the HEAD-DTR value is a phrasal sign and the COMP-DTRS value is a list of length one.

$$(16) \left[\begin{array}{l} \text{SYNSEM} | \text{LOC} | \text{SUBCAT } \langle \rangle \\ \text{DTRS} \left[\begin{array}{l} \text{HEAD-DTR} \left[\begin{array}{l} \text{SYNSEMS} | \text{LOC} | \text{SUBCAT } \langle [i] \rangle \\ \text{phrase} \end{array} \right] \\ \text{COMP-DTRS } \langle [i] \text{ phrase} \rangle \end{array} \right] \\ \text{h-c-struct} \end{array} \right] \\ \text{phrase} [\text{SUBCAT } \langle \rangle]$$

$$(17) \begin{array}{ccc} & \text{H} & \text{C} \\ & \swarrow & \searrow \\ \text{[SUBCAT } \langle [j] \rangle] & & \text{phrase } [i] \end{array}$$

(the SUBCAT principle means that $i = j$).

Examples:

$$(18) \begin{array}{ll} \text{a. } S \rightarrow NP VP \\ \text{b. } NP \rightarrow DETP N \end{array}$$

6.3 ID2

Schema 2 (ID2: Almost Saturated HEAD-COMP-STRUCTURES): an almost saturated (SUBCAT $\langle [] \rangle$) phrase with DTRS value of sort *head-comp-struct* in which the HEAD-DTR value is a lexical sign.

$$(19) \left[\begin{array}{l} \text{SYNSEM} | \text{LOC} \left[\begin{array}{l} \text{HEAD } [3] \\ \text{SUBCAT } \langle [1] \rangle \end{array} \right] \\ \text{DTRS} \left[\begin{array}{l} \text{HEAD-DTR} \left[\begin{array}{l} \text{SYNSEM} | \text{LOC} | \text{SUBCAT } \langle [1], [2], \dots, [n] \rangle \\ \text{lexical} \end{array} \right] \\ \text{COMP-DTRS } \langle \text{phrase } [2], \dots, \text{phrase } [n] \rangle \end{array} \right] \\ \text{h-c-struct} \end{array} \right] \\ \text{[SUBCAT } \langle [1] \rangle]$$

$$(20) \begin{array}{ccccccc} & \text{H} & & \text{C}_1 & & & \text{C}_n \\ & \swarrow & & \searrow & & & \searrow \\ \text{lex [SUBCAT } \langle [1], [2], \dots, [n] \rangle] & & & \text{phrase } [2] & & \dots & \text{phrase } [n] \end{array}$$

(The SUBCAT principle requires that $[1]$ appears in the mother's SUBCAT list).

Examples:

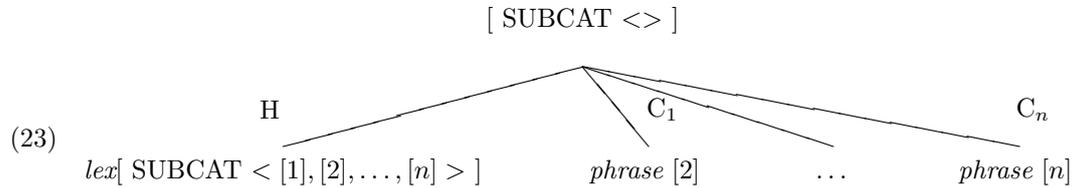
$$(21) \text{ a. } VP \rightarrow V NP$$

- b. $VP \rightarrow NP PP$
- c. $N' \rightarrow N PP$ (*teacher of English*)
- d. $A' \rightarrow A PP$ (*fond of children*)

6.4 ID3

Schema 3 (ID3: ‘Flat’ saturated HEAD-COMP-STRUCTURES): a saturated (SUBCAT $\langle \rangle$) phrase with DTRS value of sort *head-comp-struct* in which the HEAD-DTR value is a lexical sign.

$$(22) \left[\begin{array}{l} \text{SYNSEM} | \text{LOC} \left[\begin{array}{l} \text{HEAD} \quad \boxed{3} \\ \text{SUBCAT} \quad \langle \rangle \end{array} \right] \\ \text{DTRS} \left[\begin{array}{l} \text{HEAD-D} \quad \left[\begin{array}{l} \text{SYNSEM} | \text{LOC} | \text{SUBCAT} \quad \langle \boxed{1}, \boxed{2}, \dots, \boxed{n} \rangle \\ \text{COMP-DS} \quad \langle \textit{phrase} \boxed{1}, \textit{phrase} \boxed{2}, \dots, \textit{phrase} \boxed{n} \rangle \end{array} \right] \\ \textit{h-c-struct} \end{array} \right] \end{array} \right]$$



Used for ‘Flat’ structures, SOV structures, Inversion, etc. Examples:

- (24) a. Did Sam kiss Sandy?
- b. $S \rightarrow Aux NP VP$

7 Examples

The aim in this section is to look at a few lexical entries, and think about how structures are built up according to HPSG.

Look at the following entries, try to paraphrase (in English) what they say. Where there are abbreviations, say what they mean.

7.1 Some Verb Entries

- (25) She walks.

walks:
$$\left[\begin{array}{l} \text{CAT} \quad \left[\begin{array}{l} \text{HEAD} \quad \text{verb}[\text{fin}] \\ \text{SUBCAT} \quad \langle \text{NP} [\text{nom}] \boxed{1} [\text{3rd, sing}] \rangle \end{array} \right] \\ \text{CONTENT} \quad \left[\begin{array}{l} \text{RELN} \quad \text{walk} \\ \text{AGENT} \quad \boxed{1} \end{array} \right] \end{array} \right]$$

- (26) She sees her.

sees:
$$\left[\begin{array}{l} \text{CAT} \\ \text{CONTENT} \end{array} \left[\begin{array}{l} \text{HEAD} \quad \text{verb}[\text{fin}] \\ \text{SUBCAT} \quad \langle \text{NP}[\text{nom}]_{\boxed{1}[\text{3rd}, \text{sing}]} , \text{NP}[\text{acc}]_{\boxed{2}} \rangle \\ \text{RELN} \quad \text{see} \\ \text{AGENT} \quad \boxed{1} \\ \text{THEME} \quad \boxed{2} \end{array} \right] \right]$$

(27) She gives her it.

(28) gives:
$$\left[\begin{array}{l} \text{CAT} \\ \text{CONTENT} \end{array} \left[\begin{array}{l} \text{HEAD} \quad \text{verb}[\text{fin}] \\ \text{SUBCAT} \quad \langle \text{NP}[\text{nom}]_{\boxed{1}[\text{3rd}, \text{sing}]} , \text{NP}[\text{acc}]_{\boxed{2}} , \text{NP}[\text{acc}]_{\boxed{3}} \rangle \\ \text{RELN} \quad \text{give} \\ \text{AGENT} \quad \boxed{1} \\ \text{GOAL} \quad \boxed{2} \\ \text{THEME} \quad \boxed{3} \end{array} \right] \right]$$

(29) I think she sees it:

(30) think:
$$\left[\begin{array}{l} \text{CAT} \\ \text{CONTENT} \end{array} \left[\begin{array}{l} \text{HEAD} \quad \text{verb}[\text{fin}] \\ \text{SUBCAT} \quad \langle \text{NP}[\text{nom}]_{\boxed{1}[\text{1st}, \text{sing}]} , \text{S}[\text{fin}]_{\boxed{2}} \rangle \\ \text{RELN} \quad \text{see} \\ \text{AGENT} \quad \boxed{1} \\ \text{THEME} \quad \boxed{2} \end{array} \right] \right]$$

(31) *she*:

(32)
$$\left[\begin{array}{l} \text{CAT} \\ \text{CONTENT} \\ \text{CONTEXT} \end{array} \left[\begin{array}{l} \text{HEAD} \quad \left[\begin{array}{l} \text{noun} \\ \text{CASE} \quad \text{nom} \end{array} \right] \\ \text{SUBCAT} \quad \langle \rangle \\ \text{INDEX} \quad \boxed{1} \left[\begin{array}{l} \text{PER} \quad \text{3rd} \\ \text{NUM} \quad \text{sing} \\ \text{GEN} \quad \text{fem} \end{array} \right] \\ \text{RESTR} \quad \left\{ \begin{array}{l} \text{ref} \\ \} \end{array} \right\} \\ \text{BACKR} \quad \left\{ \left[\begin{array}{l} \text{RELN} \quad \text{female} \\ \text{INST} \quad \boxed{1} \end{array} \right] \right\} \end{array} \right] \right]$$

pro

loc *context*

(33) every:
$$\left[\begin{array}{l} \text{PHON} \quad \langle \text{every} \rangle \\ \text{SYNSEM} | \text{LOC} \end{array} \left[\begin{array}{l} \text{CAT} \left[\begin{array}{l} \text{HEAD} \quad \text{det} \left[\text{SPEC} \quad \text{N}':\boxed{2} \right] \\ \text{SUBCAT} \quad \langle \rangle \end{array} \right] \\ \text{CONT} \quad \boxed{5} \end{array} \right] \right]$$

(This ignores QSTORE and CONTENT).

(34) book: $\left[\begin{array}{l} \text{PHON } \langle \textit{book} \rangle \\ \text{SYNSEM} | \text{LOC} \\ \left[\begin{array}{l} \text{CAT} \\ \text{CONT} \end{array} \right] \left[\begin{array}{l} \left[\begin{array}{l} \text{HEAD } \textit{noun} \\ \text{SUBCAT } \langle \text{DETP} \rangle \end{array} \right] \\ \left[\begin{array}{l} \text{INDEX } \boxed{1} \\ \text{RESTR } \left\{ \begin{array}{l} \left[\begin{array}{l} \text{INDEX PER } 3\text{rd} \\ \text{NUM } \textit{sing} \\ \text{GEND } \textit{neut} \end{array} \right] \\ \left[\begin{array}{l} \text{PSOA RELN } \textit{book} \\ \text{INST } \boxed{1} \end{array} \right] \end{array} \right\} \end{array} \right] \end{array} \right]$

(35) They gave a book *to* her.

(36) *to*: $\left[\begin{array}{l} \text{CAT} \\ \text{CONTENT } \boxed{1} \end{array} \right] \left[\begin{array}{l} \text{HEAD } \left[\begin{array}{l} \text{PREP PFORM } \textit{TO} \\ \text{PRED } - \end{array} \right] \\ \text{SUBCAT } \langle \text{NP}[\text{ACC}]:\boxed{1} \rangle \end{array} \right]$

Given these entries, and the principles so far discussed, what structures would be assigned to the following examples?

- (37) a. She walks.
 b. Every book
 c. She sees every book.
 d. *to* her (as in *They gave every book to her*)
 e. Every book walks.
 f. *Walks she?
 g. *Walks every book?

Discuss what structures might be considered for the following, and what principles they violate.

- (38) a. *She walks the book.
 b. *Her walks.
 c. *I think walks.

The following is slightly more difficult. Try to work out what sort of structure *can* will appear in, and hence what the HPSG analysis of the following will be.

- (39) a. She can walk.
 b. Can she walk?

(40) *can*: $\left[\begin{array}{l} \text{CAT} \\ \text{CONTENT } \left[\begin{array}{l} \text{RELN } \textit{possible} \\ \text{SOA } \boxed{2} \end{array} \right] \end{array} \right] \left[\begin{array}{l} \text{HEAD } \textit{verb} [\text{fin}, +\text{AUX}] \\ \text{SUBCAT } \langle \boxed{1} \text{ NP}[\text{nom}], \text{ VP}[\text{bse}, \text{SUBCAT } \langle \boxed{1} \rangle]:\boxed{2} \rangle \end{array} \right]$

Given the lexical entries above, what should the lexical entry for *give* in the following use be:

- (41) Sam gave a book to Sandy.

The lexical entry for the preposition *to* above is reasonable enough if we think that its sole function is some kind of ‘case marking’ (cf. *of* in *teacher of English*). But if we think it expresses a relation, then the following might be a better structure.

$$(42) \text{ to: } \left[\begin{array}{l} \text{CAT} \\ \text{CONTENT} \end{array} \left[\begin{array}{l} \text{HEAD} \left[\begin{array}{l} \text{PREP PFORM TO} \\ \text{PRED +} \end{array} \right] \\ \text{SUBCAT} \left\langle \text{NP}:\boxed{1}, \text{NP}[\text{ACC}]:\boxed{2} \right\rangle \\ \text{REL ON} \\ \text{ARG1 } \boxed{1} \\ \text{ARG2 } \boxed{2} \end{array} \right] \right]$$

What would the representation of (41) be on this analysis?

8 Reading

See Pollard and Sag (1994, Ch1), and the references given in the first lecture.

References

Carl J. Pollard and Ivan A. Sag. *Head-Driven Phrase Structure Grammar*. University of Chicago Press, Chicago, 1994.