Word Order in HPSG

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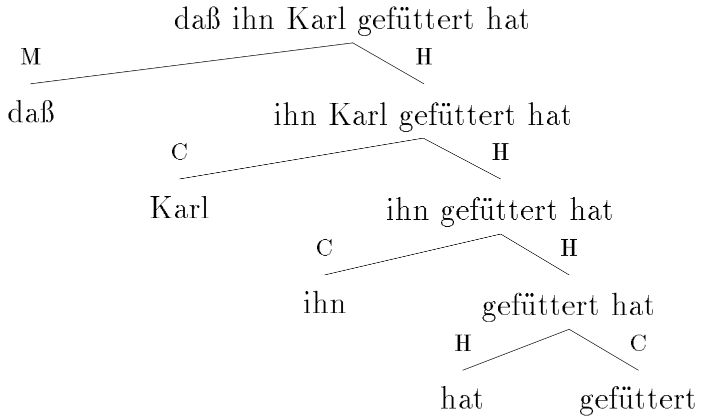
1 Prerequisites

(1.1) *HPSG vs. classical phrase structure grammars*

daß ihn Karl gefüttert hat
(that Karl fed him)



List of wishes for a word order theory in HPSG:

1. *Mathematical precision*
   The theory of word order should be fully formalized in a logic for HPSG. Ideally, the word order component should not require any extra devices that are not independently motivated. To comply with this demand, we formalize our word order module entirely within the classical logic for HPSG of King (1989).

2. *Flexibility*
   Existing theories of word order diverge widely in their presuppositions as to which information is necessary for an adequate theory. Moreover, they often focus on a narrow empirical domain. In order to coherently accomodate such diverse and eclectic approaches, our word order component must be extremely flexible. It must not prescribe specific syntactic analyses.

3. *Straightforwardness*
   Despite its mathematical precision, the word order component should allow for a straightforward integration of both informal word order rules as discussed in the literature and formal word order rules as they have been formulated in other formalisms (e.g. the LP statements of GPSG).

4. *Modularity*
   Modularity should allow us to achieve the envisioned flexibility and straightforwardness. The main characteristics can be summarized as follows:

   (a) The independence of the word order principles proper from the rest of the linguistic analysis is ensured by the definition of clean interfaces. The word order principles vary with different linguistic analyses in other parts of the grammar as little as the head feature principle.

   (b) The word order module itself allows for modularly adding more word order principles. This is particularly useful for developing large systems by incrementally extending the empirical domain.

   (c) The set of word order principles we provide contains the building blocks out of which more word order principles can easily be constructed. By and large, the really difficult work has only to be done once.

To show that such requirements indeed do have strong consequences for the development of a framework for word order theories, we show at which points the ID/LP approach of GPSG does not comply with them.
The most important properties of LP statements in GPSG are the following:

1. The LP statements only affect sisters in local trees. Constituents that are not sisters in local trees can not directly be ordered with respect to each other.

2. The LP statements indiscriminately apply to all local trees in a sentence (technically, this is known as the ECPO property).

3. The LP statements can only refer to features and feature values of the objects that have to be ordered. This means, they can only refer to inherent properties of these objects.

2 Two empirical generalizations for German

2.1 On the order of NPs in the mittelfeld

In our treatment of focus projections and their impact on the grammaticality of sentences we follow Höhle (1982).
We assume that in an utterance of a sentence S the focus of S, Fk(S), is that part of S which is not given by the relevant context. We write Fk(S) as a set of constituents of S.

(2.1) *Empirical Generalization*

if two nominal arguments A and B of a verb are in Fk(S)
and A precedes B on the COMPS list of the verb,
then B must be stressed
and A phonologically precedes B.

(2.2) *The verb* geben*:* COMPS < *dat, acc* >

1. weil Karl dem Kind das *Buch* gab
(because Karl gave the child-DAT the book-ACC)
2. *weil Karl das *Buch* dem Kind gab
3. *weil Karl dem *Kind* das Buch gab
4. *weil Karl das Buch dem *Kind* gab

Fk(S) = {dem Kind, das Buch, gab}

(2.3) *The verb* überlassen*:* COMPS < *acc, dat* >

1. *weil Karl dem Kind das *Buch* überließ
(because Karl let the child-DAT have the book-ACC)
2. *weil Karl das *Buch* dem Kind überließ
3. *weil Karl dem *Kind* das Buch überließ
4. weil Karl das Buch dem *Kind* überließ

Fk(S) = {dem Kind, das Buch, überließ}

2.2 Interaction of scope and word order

(2.4) *Empirical Generalization*

if there are unstressed complements A and B,
and A and B are quantified nominals,
and A precedes B on the COMPS list of the verb,
and B has scope over A,
then B must phonologically precede A.

Crucially, (2.4) refers to the scope inclusion relation among constituents.

(2.5) *Quantified arguments:*

1. es heißt, daß jede Theorie manchen Linguisten ge*fall*en hat
   (it is said that every theory pleased some linguists)
2. es heißt, daß manchen Linguisten jede Theorie ge*fall*en hat

3 A Sketch of the Word Order Module

For the following sketch of the word order module it might be useful to recall how the subcategorization principle of (Pollard and Sag 1994) can be formalized without a relational extension of the underlying description language. The AVM in (3.1) indicates how a recursive sort definition for a sort *sub-append* ensures the desired working of the subcategorization principle in a phrase.

(3.1) *Illustration of the subcategorization principle*

$$\left[\begin{array}{ll} \multicolumn{2}{l}{\textit{phrase}} \\ \text{SYNSEM} & \left[\text{LOC CAT SUBCAT } \boxed{1}\ \textit{list-of-synsems}\right] \\ \text{DTRS} & \left[\begin{array}{ll} \multicolumn{2}{l}{\textit{headed-struc}} \\ \text{HEAD-DTR} & \left[\begin{array}{l} \textit{sign} \\ \text{SYNSEM LOC CAT SUBCAT } \boxed{3}\ \textit{list-of-synsems} \end{array}\right] \\ \multicolumn{2}{l}{\text{COMP-DTRS } \boxed{2}\ \textit{list-of-signs}} \\ \text{APPEND} & \left[\begin{array}{ll} \multicolumn{2}{l}{\textit{sub-append}} \\ \text{LEFT} & \boxed{1}\ \textit{list-of-synsems} \\ \text{RIGHT} & \boxed{2}\ \textit{list-of-signs} \\ \text{RES} & \boxed{3}\ \textit{list-of-synsems} \end{array}\right] \end{array}\right] \end{array}\right]$$

(3.2) *The word order module*

$$
\begin{bmatrix}
\textit{phrase} & \\
\textsc{phon} & \boxed{1}\ \textit{list-of-phons} \\
\textsc{synsem} & \textit{synsem} \\
\textsc{dtrs} & \begin{bmatrix} \textit{head-comp-struc} & \\ \textsc{head-dtr} & \textit{sign} \\ \textsc{comp-dtrs} & \textit{list-of-signs} \\ \textsc{all-dtrs} & \boxed{2}\ \textit{list-of-signs} \end{bmatrix} \\
\textsc{build-phon} & \begin{bmatrix} \textsc{perm}\ \ldots & \boxed{2}\ \textit{list-of-signs} \\ \textsc{signphon}\ \ldots & \boxed{1}\ \textit{list-of-phons} \end{bmatrix} \\
\textsc{lp} & \begin{bmatrix} \textit{lp-hc} & \\ \textsc{build-aux1} & \begin{bmatrix} \textit{build-aux1} & \\ \textsc{input} & \boxed{2} \\ \textsc{output} & \boxed{3}\ \textit{object} \end{bmatrix} \\ \ldots & \\ \textsc{lpp1} & \begin{bmatrix} \textit{lpp1} & \\ \textsc{phon} & \boxed{1} \\ \textsc{scope} & \boxed{3}\ \textit{object} \\ \ldots & \end{bmatrix} \\ \ldots & \end{bmatrix}
\end{bmatrix}
$$

Advantages of the suggested architecture:

1. It is largely independent of a given linguistic analysis. This means, no modifications to the linguist's prefered set of appropriateness conditions are necessary as long as the required information can somehow be derived.

2. Any given set of word order principles can be modularly augmented.

3. All generalizations known to us from the literature can be expressed. Therefore they can be fully formalized.

4. There seem to be two choices:

   (a) The word order module can be fully formalized in a logic implicitly underlying the HPSG of (Pollard and Sag 1994) without using relations.

   (b) In ongoing work we augmented the logic of King (1994) with the syntax and semantics of relational expressions which, contrary to common usage, do not introduce free variables into the logic. It can be shown that all parts of our word order theory can directly be translated into this kind of relational expressions. As a consequence, there are no additional attributes and sorts in this version of our theory. Also, the corresponding models do not contain any additional objects. From this perspective, the present approach is superior to those which use a special DOM attribute.

References

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