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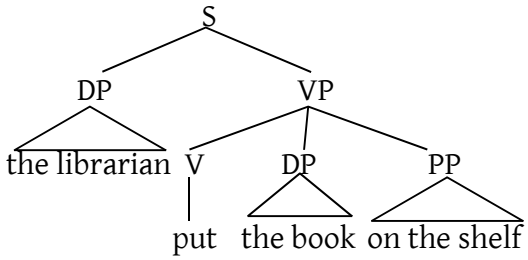
Some LFG Basics

Consider the sentence *The librarian put a book on the shelf*.

(1) constituent structure (c-structure):



functional structure (f-structure):

$$\begin{bmatrix} \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'librarian'} \\ \text{DEF} & + \end{bmatrix} \\ \text{TENSE} & \text{PAST} \\ \text{PRED} & \text{'put } \langle (\uparrow \text{SUBJ})(\uparrow \text{OBJ})(\uparrow \text{OBL}_{\text{Loc}}) \rangle \text{'} \\ \text{OBJ} & \begin{bmatrix} \text{DEF} & + \\ \text{PRED} & \text{'book'} \\ \text{NUM} & \text{SG} \end{bmatrix} \\ \text{OBL}_{\text{Loc}} & \begin{bmatrix} \text{PRED} & \text{'on } \langle (\uparrow \text{OBJ}) \rangle \text{'} \\ \text{OBJ} & \begin{bmatrix} \text{DEF} & + \\ \text{PRED} & \text{'shelf'} \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

In LFG, the two levels of representation, the structural and the functional, are in a relation of correspondence with each other. For example, the S, VP, and V nodes in the c-structure correspond to the outermost layer of f-structure, the DP node *the librarian* and all its daughter nodes correspond to the f-structure $\begin{bmatrix} \text{PRED} & \text{'librarian'} \\ \text{DEF} & + \end{bmatrix}$, etc.

The '↑' on the arguments in the specification of argument-taking predicates restricts the argument to a local one. For example, the OBJ argument of *put* is filled by *the book* and not *the table*, even though both bear the function OBJ. They bear the function in different local f-structures. (↑ OBJ) represents a path through the f-structure: '↑' means 'the local f-structure'.

(2)

$$\begin{bmatrix} \vdots & \vdots \\ \text{PRED} & \text{'put } \langle \ldots (\uparrow \text{OBJ}) \ldots \rangle \text{'} \\ \uparrow\text{:} \ \text{OBJ} & \begin{bmatrix} \text{DEF} & + \\ \text{PRED} & \text{'shelf'} \\ \text{NUM} & \text{SG} \end{bmatrix} \\ \text{OBL}_{\text{Loc}} & [\ \vdots\ ] \end{bmatrix}$$

Similarly, the OBJ which fills the argument position of *on* is in its local f-structure.

(3)

$$\begin{bmatrix} \vdots & \vdots \\ \text{OBL}_{\text{Loc}} & \uparrow\text{:} \begin{bmatrix} \text{PRED} & \text{'on } \langle (\uparrow \text{OBJ}) \rangle \text{'} \\ \text{OBJ} & \begin{bmatrix} \text{DEF} & + \\ \text{PRED} & \text{'shelf'} \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

If we wanted to refer to the OBJ of *on* from the perspective of *put*, we would have to specify a two-step path: (↑ OBL_{Loc} OBJ).

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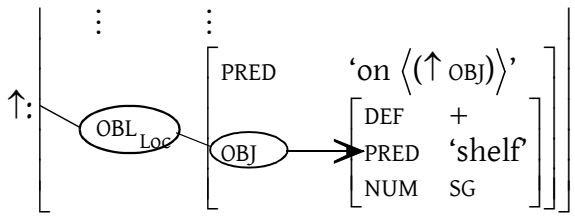
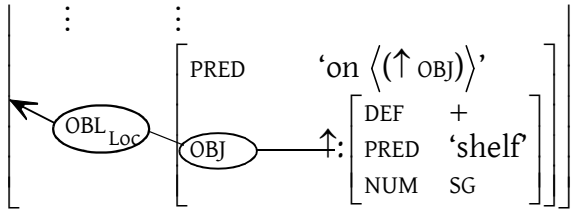
(4)



These are inward paths through the f-structure (called "outside-in"). We can also designate an outward ("inside-out") path. If we start at the f-structure corresponding to the OBJ of *on* (the one headed by 'table'), an inside-out path to the outermost f-structure would be: (OBL_{Loc} OBJ ↑).

(5)



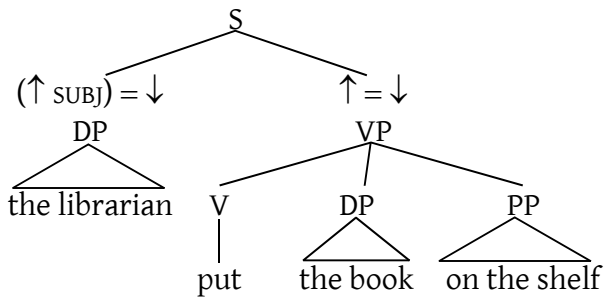
In addition to '↑', there is a '↓'. They both appear in annotations to phrase structure rules defining the c-structure–f-structure mapping.

(6) $S \rightarrow \underset{(\uparrow SUBJ)=\downarrow}{NP} \quad \underset{\uparrow=\downarrow}{VP}$

The annotation on the NP means "the f-structure you get to by starting at the f-structure corresponding to S and going through the attribute SUBJ is the f-structure corresponding to NP", and the annotation on the VP means "the f-structure corresponding to the S is identical to the f-structure corresponding to the VP". For our purposes, we need not go into the formal details of the correspondence, but we will need to use the arrow notation. Technically, the arrows are called **metavariables**.

To make the structure-function mapping in a particular situation clear, we can annotate these equations to positions in the c-structure:

(7)



This is not a distinct level of representation in LFG; it is simply a notational convenience (like drawing an arrow representing movement in transformational theory). In this handout, we will do this only where necessary for the point.

For a textbook-level introduction to LFG, see Falk (2001). More advanced references/textbooks are Bresnan (2001) and Dalrymple (2001).

The representation of *wh*-type constructions

A direct representation of the multifunctionality of the *wh* element:

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$$\begin{bmatrix}
\text{OPER} & f \\
\text{FRONT} & f \\
\text{SUBJ} & [\text{“the student”}] \\
\text{TENSE} & \text{PRES} \\
\text{PRED} & \text{‘think } \langle(\uparrow \text{SUBJ})(\uparrow \text{COMP})\rangle\text{’} \\
 & \begin{bmatrix}
\text{SUBJ} & [\text{“the teacher”}] \\
\text{TENSE} & \text{PAST} \\
\text{PRED} & \text{‘say } \langle(\uparrow \text{SUBJ})(\uparrow \text{COMP})\rangle\text{’} \\
\text{COMP} & \begin{bmatrix}
\text{SUBJ} & [\text{“the librarian”}] \\
\text{TENSE} & \text{PAST} \\
\text{COMP} & \begin{bmatrix}
\text{PRED} & \text{‘put } \langle(\uparrow \text{SUBJ})(\uparrow \text{OBJ})(\uparrow \text{OBL})\rangle\text{’} \\
\text{OBJ} & f \\
\text{OBL} & [\text{“on the shelf”}]
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}$$

$f = [\text{“what”}]$

$$\begin{bmatrix}
\text{OPER} & f \\
\text{FRONT} & g \\
\text{SUBJ} & [\text{“the student”}] \\
\text{TENSE} & \text{PRES} \\
\text{PRED} & \text{‘think } \langle(\uparrow \text{SUBJ})(\uparrow \text{COMP})\rangle\text{’} \\
 & \begin{bmatrix}
\text{SUBJ} & [\text{“the teacher”}] \\
\text{TENSE} & \text{PAST} \\
\text{PRED} & \text{‘say } \langle(\uparrow \text{SUBJ})(\uparrow \text{COMP})\rangle\text{’} \\
\text{COMP} & \begin{bmatrix}
\text{SUBJ} & [\text{“the librarian”}] \\
\text{TENSE} & \text{PAST} \\
\text{COMP} & \begin{bmatrix}
\text{PRED} & \text{‘put } \langle(\uparrow \text{SUBJ})(\uparrow \text{OBJ})(\uparrow \text{OBL})\rangle\text{’} \\
\text{OBJ} & g \\
\text{OBL} & [\text{“on the shelf”}]
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}$$

$f = [\text{“whose”}]$

$$g = \begin{bmatrix} \text{POSS} & f \\ \text{PRED} & \text{‘book’} \end{bmatrix}$$

Relation between c-structure and f-structure

The various levels of representation envisioned by LFG (f-structure, c-structure, i-structure, etc.) exist in parallel, representing different aspects of the linguistic expression. As such, no level comes before another, or is derived from another. Sometimes, it is useful to conceptualize a directional relationship, but there is no inherent directionality.

The relation between c-structure and f-structure is generally formalized as a mapping from c-structure to f-structure, as we have already seen. This is done for formal convenience: the mapping from c-structure to f-structure (ϕ) is a function, while the mapping from f-structure to c-structure (ϕ^{-1}) is not. Conceptually, this direction can be thought of as the c-structure licensing features and grammatical functions in the f-structure.

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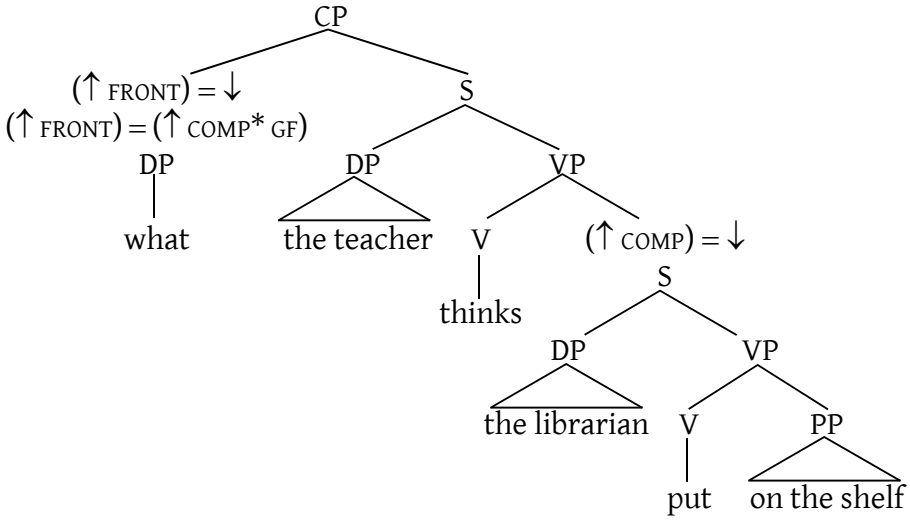
However, conceptually it is sometimes useful to look at the relation in the other direction: starting from the f-structure. This is similar to the "realizational" approach to morphology. The question is what structural configuration expresses (realizes) an f-structure in which, for example, one element has two grammatical functions. This is a useful way, for example, to think about "in-situ" *wh* questions, for example: they simply differ from the more familiar "movement" construction in the realization of the multifunctional element: they realize it in the position of the local clause-internal function instead of the OPER (or FRONT) position.

Licensing *wh*-type constructions

The LFG system for licensing the multifunctionality of *wh* elements was first outlined by Kaplan and Zaenen (1989). The basic idea is that one element gets two functions by specifying the f-structure path between them. This can be done either by starting at the discourse function and working inward ("outside-in") to the argument function, or by starting at the argument function and working outward ("inside-out") to the discourse function. The c-structures look different in the two cases: going outside-in there is no need for an empty category in the position of the gap, but going inside-out there is one.

This can be illustrated by showing the c-structures of the sample sentence, including partial functional annotation. (For convenience, the trees are not full $\bar{X}$ trees. We will deal with the OPER function later.)

(8) a. outside-in licensing



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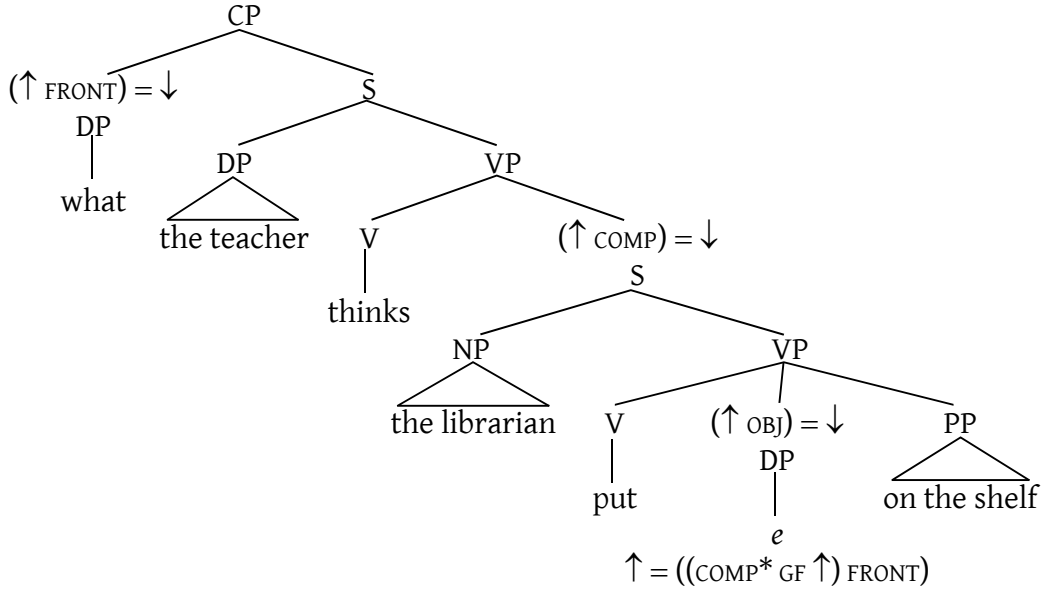
b. inside-out licensing (with empty category)



The outside-in licensing approach (without empty category) is the one taken in the original Kaplan and Zaenen article, and, in this century, by Dalrymple, Kaplan, and King (2001) and Dalrymple (2001). The alternative inside-out licensing approach (with empty categories) has been argued for by Bresnan (1995, 2001).

Whether outside-in or inside-out, the path between the two grammatical functions is expressed in terms of a sequence of f-structure attributes (COMP in this example) of unspecified length (this is the meaning of the Kleene star operator on COMP). Because of the fact that the path is not unique (due to the unspecified length of the sequence of COMPs) this kind of specification is called **functional uncertainty**. One of the advantages of this approach to *wh*-type constructions is that the "long-distance" relationship is licensed locally, one layer of f-structure at a time.

Constructional properties of *wh*-type constructions can be linked to an f-structure feature specifying (CLAUSE)TYPE. Limiting ourselves to the values DECL, REL, and Q, since the complementizer *that* can occur in declaratives and relative clauses, it will have the lexical specification:

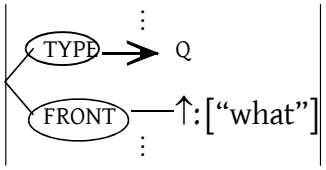
(9) (↑ TYPE) = DECL | REL

On the other hand, clause type is not always expressed by the complementizer; a clause introduced by *what* in [SPEC, CP] has to be a question, for example. The lexical entry of *what* includes the following lexical specification:

(10) ((FRONT ↑) TYPE) = Q

The path here is a combination of inside-out and outside-in specification:

(11)



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Pied-piping constructions are analyzed by treating the relationship between the actual operator and the entire filler as another funtional uncertainty construction. The f-structure of *Whose book did the librarian put on the shelf?* is:

(14) a.

$$\begin{bmatrix} \text{OPER} & [\text{“whose”}] \\ \text{FRONT} & \begin{bmatrix} \text{PRED} & \text{‘book’} \\ \text{POSS} & \end{bmatrix} \\ \text{TENSE} & \text{PAST} \\ \text{SUBJ} & [\text{“the librarian”}] \\ \text{PRED} & \text{‘put } \langle (\uparrow \text{SUBJ})(\uparrow \text{OBJ})(\uparrow \text{OBL}_{\text{Loc}}) \rangle\text{’} \\ \text{OBJ} & \\ \text{OBL}_{\text{Loc}} & [\text{“on the shelf”}] \end{bmatrix}$$

b.

$$\begin{bmatrix} \text{OPER} & g \\ \text{FRONT} & f \\ \text{TENSE} & \text{PAST} \\ \text{SUBJ} & [\text{“the librarian”}] \\ \text{PRED} & \text{‘put } \langle (\uparrow \text{SUBJ})(\uparrow \text{OBJ})(\uparrow \text{OBL}_{\text{Loc}}) \rangle\text{’} \\ \text{OBJ} & f \\ \text{OBL}_{\text{Loc}} & [\text{“on the shelf”}] \end{bmatrix}$$

$$f = \begin{bmatrix} \text{PRED} & \text{‘book’} \\ \text{POSS} & g \end{bmatrix}$$

$$g = [\text{“whose”}]$$

This is licensed by associating the following functional specification with the [SPEC, CP] node:

(15) $(\uparrow \text{OPER}) = (\uparrow \text{GF}^*)$

(This specific implementation is based on Falk 2001; see also Kaplan and Bresnan 1982 and Dalrymple 2001).

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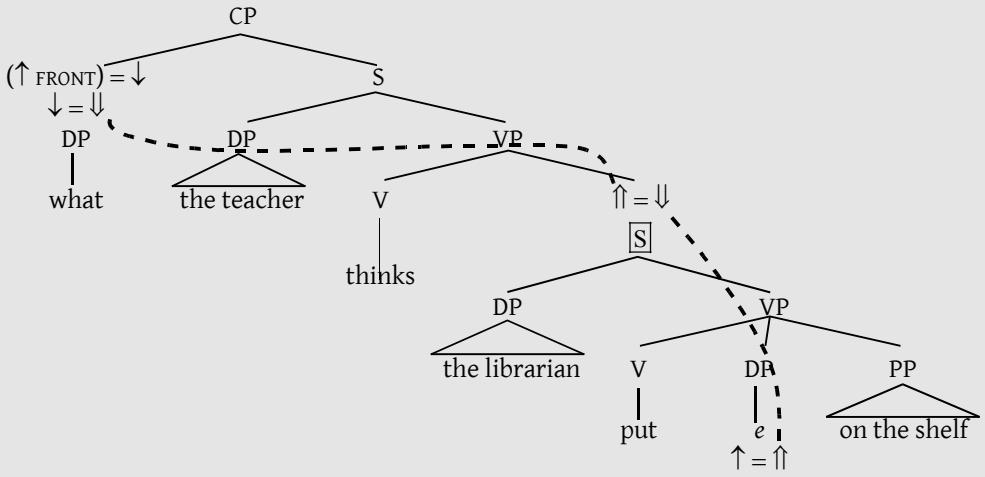
Of Historical Interest Only

Early LFG (e.g. Kaplan and Bresnan 1982) licensed multifunctionality in *wh*-type constructions not directly at the level of f-structure but rather indirectly through c-structure. In this system, the filler constituent is associated with a ⇓ metavariable and an empty category in the gap position is associated (nonlocally!) with a matching ⇑ metavariable. Bounding nodes, à la Subjacency, block the matching of ⇓ and ⇑. (The boxed node is a bounding node, and the dotted lines show how the long-distance metavariables are matched up.)

(16)



Within this framework, Falk (1983) argued (following (Gazdar 1981) in GPSG) that subject *wh*-type constructions are different, and do not have an empty category (or trace). Zaenen (1983) used this framework as well.

Direction of licensing

As we saw above, a formal issue that arises in LFG is the direction of the licencing: outside-in vs. inside-out. Like esoteric formal questions in other theoretical frameworks, the direction of licensing has interesting empirical consequences. More specifically, the issue of empty categories is related to the direction of licencing.

There are various reasons one might prefer one direction of licensing or the other. In Falk (2006), the claim is made (in the context of a theory of the nature of the grammatical function SUBJ), that SUBJ is the unmarked lower function for a *wh* element. For this reason, SUBJs are linked to FRONT by outside-in licensing (which does not involve an empty element) while other functions are linked to FRONT by inside-out licensing (which **does** involve an empty element). We will see later that there is independent evidence that this is correct.

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