What levels of linguistic representation determine or constrain the semantic level?

• We believe that the f-structure is the primary level that constrains semantic interpretation.

Of course, information from other levels, such as c-structure, may also be relevant. The relation between the semantic structure and these other levels may be encoded directly by a projection function, or indirectly as a composition of projection functions between other levels.

• Even if other levels (e.g. c-structure) constrain scope, we needn’t have a level of representation at which information from both levels is encoded.

We can talk about the relation between two levels in addition to relations within a level.

Do we need a linguistic representation of semantic information?

• Yes, for purposes of talking about semantics.

• Is the representation “dispensable”? Perhaps – depends on choice of semantic theory. Semantic structures can be related to a level of representation of meaning (Discourse Representation Structures, Situation-Theoretic Infons, formulas of intensional logic) or directly to a model.
Building up a quantifier: “Every person”

\[ g : \left[ \begin{array}{c}
\text{SPEC} & \text{‘every’} \\
\text{PRED} & \text{‘person’}
\end{array} \right] \]

\[ \sigma : \left[ \begin{array}{c}
\text{VAR} & [ ] \\
\text{RESTR} & [ ]
\end{array} \right] \]

\[ g \sigma : \left[ \begin{array}{c}
\text{VAR} & [ ] \\
\text{RESTR} & [ ]
\end{array} \right] \]

\[
\text{every}: \forall R, P, S.[\forall Y.(g \sigma \text{ VAR}) \sim Y \Rightarrow (g \sigma \text{ RESTR}) \sim R(Y)] \otimes \\
[\forall X.g \sigma \sim X \sim S \sim P(X)] \\
\sim S \sim \text{every}(\text{person},P)
\]

\[
\text{person}: \forall X.(g \sigma \text{ VAR}) \sim X \sim (g \sigma \text{ RESTR}) \sim \text{person}(X)
\]

\[
\text{every person}: \forall P, S.[\forall X.g \sigma \sim X \sim S \sim P(X)] \sim S \sim \text{every}(\text{person},P)
\]

What kind of information needs to be represented in a grammar?

- **F-structure**: represents syntactic argument structure

- **Semantic structure**: represents semantic type structure with no syntactic argument structure reflex

- **Glue language**: constrains how linguistic structures determine the assembly of meanings (issues about relative scope, scope islands, type raising, . . .) – “grammatical semantics”

- **Meaning language**: Meanings
"John walks."

\[
\begin{aligned}
&f : \left[ \begin{array}{c}
PRED \quad \text{'walk}' \\
\text{SUBJ} & g : \left[ \begin{array}{c}
PRED \quad \text{'John'}
\end{array} \right]
\end{array} \right] \\
\sigma & \rightarrow \ f_\sigma : [] \\
\sigma & \rightarrow \ g_\sigma : []
\end{aligned}
\]

g_\sigma \sim joh

\forall X. (f \ \text{SUBJ}_\sigma \sim X \rightarrow f_\sigma \sim \text{walk}(X))

\[
\begin{aligned}
f_\sigma & \sim \text{walk}(\text{john})
\end{aligned}
\]

Quantification: "Everyone walks."

\[
\begin{aligned}
&f : \left[ \begin{array}{c}
PRED \quad \text{'walk}' \\
\text{SUBJ} & g : \left[ \begin{array}{c}
PRED \quad \text{'everyone'}
\end{array} \right]
\end{array} \right] \\
\sigma & \rightarrow \ f_\sigma : [] \\
\sigma & \rightarrow \ g_\sigma : []
\end{aligned}
\]

everyone : \forall P, S. (\forall X. g_\sigma \sim X \rightarrow S \sim P(X)) \rightarrow S \sim \text{every(person, P)}

walks : \forall X. (f \ \text{SUBJ}_\sigma \sim X \rightarrow f_\sigma \sim \text{walk}(X))

\[
\begin{aligned}
everyone \ \text{walks} & : f_\sigma \sim \text{every(person, walk)}
\end{aligned}
\]
An architecture for the syntax-semantics interface:
Assemble meanings with instructions in a logical language

- Use "glue language", linear logic, to specify how to put meanings together

- Meaning language: your choice; we use higher-order intensional logic

"John"

\[
g : \text{PRED} \quad \text{`John'}
\]

\[
g_\sigma : [\] \leadsto john
\]
Problems with variable binding:

Problems with function application:

\[ \lambda X. P(X) \quad (Y) \implies P(Y) \]
Halvorsen and Kaplan (1988),
Projections and semantic description in LFG:

- Form of meaning: attribute-value structure

- Meaning determined by projection from c-structure, indirectly related to f-structure

- Meaning assembled by accumulation of constraints on attribute-value pairs

Commonalities:

- Separate representation of syntactic and semantic information

- Form of meaning: attribute-value structure; gives (more or less) underspecified representation of semantic information

- Meaning related directly to c-structure or f-structure

- Meaning assembly by analysis of f-structure or accumulation of constraints
Fenstad et al. (1987), Situations, Language, and Logic:

- Form of meaning: attribute-value structure, the sitschema, representing a formula in Situation Semantics

- Meaning determined (in principle) by phonology, morphology, syntax, context

- Meaning assembled by accumulation of constraints on attribute-value pairs

Halvorsen and Kaplan (1988), Projections and semantic description in LFG:
Halvorsen (1983), Semantics for LFG:

- Form of meaning representation: attribute-value structure
  - F-structure and formula of intensional logic are dispensible
  - Different meaning language is possible

- Meaning determined by f-structure

- Meaning assembled by analysis of f-structure

Fenstad et al. (1987), Situations, Language, and Logic:

\[
\begin{align*}
\text{FSTRUCT} & \quad \begin{cases}
\text{PRED} & \text{'walk}(\uparrow \text{SUBJ})', \\
\text{SUBJ} & \begin{cases}
\text{PRED} & \text{'John'}
\end{cases}
\end{cases} \\
\text{SITSHEMA} & \quad \begin{cases}
\text{REL} & \text{walk}, \\
\text{ARG1} & \begin{cases}
\text{IND} & \text{john}
\end{cases}, \\
\text{LOC} & \begin{cases}
\text{IND} & \text{IND.1}, \\
\text{COND} & \begin{cases}
\text{REL} & \circ, \\
\text{ARG1} & [1], \\
\text{ARG2} & l_d
\end{cases}
\end{cases}
\end{cases}
\end{align*}
\]
Halvorsen (1983), Semantics for LFG:

PRED-ARG configuration

If $f_k$ is an f-structure of the form $\begin{bmatrix} s_1 & v_1 \\ s_2 & v_2 \\ \vdots & \vdots \\ s_n & v_n \end{bmatrix}$ containing some $v_i$ that has an argument list, then

$$(M_k \text{ PREDICATE}) = M_{s_i}$$

and for $0 < j \leq m$,

$$(M_k \text{ ARG}_j) = M_l$$

where $m$ is the number of thematic arguments of the semantic form in $s_i$, and $M_l$ is the semantic structure associated with the f-structure designator in the $j$th argument position.

"John walks."

$$f_k = \begin{bmatrix} \text{PRED} & \text{walk}<[1 \text{ SUBJ}>'] \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'John'} \end{bmatrix} \end{bmatrix}$$

$$M_k = \begin{bmatrix} \text{PREDICATE} & \text{walk} \\ \text{ARG1} & \begin{bmatrix} \text{CM} & \lambda P. P(john) \\ \text{MODE} & \text{CM} \\ \text{PM} & \lambda P. P(john) \end{bmatrix} \end{bmatrix}$$

Formula of intensional logic: $\text{walk}^*(\text{john})$
Levels of semantic representation in LFG
Mary Dalrymple, John Lamping, and Vijay Saraswat

Semantics Workshop at the LFG Colloquium and Workshops
Grenoble, France
August 26, 1996

- What is the form of the meaning representation?
- What is the relation of the meaning representation to other levels?
- How are meanings put together?