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 "dispensible"? 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"

$$g: \begin{bmatrix} \text{SPEC} & \text{'every'} \\ \text{PRED} & \text{'person'} \end{bmatrix}$$

$$\sigma \searrow$$

$$g_\sigma: \begin{bmatrix} \text{VAR} & [\,] \\ \text{RESTR} & [\,] \end{bmatrix}$$

every : $\forall R, P, S.[\forall Y.(g_\sigma\ \text{VAR}) \rightsquigarrow Y \multimap (g_\sigma\ \text{RESTR}) \rightsquigarrow R(Y)] \otimes$
$[\forall X.g_\sigma \rightsquigarrow X \multimap S \rightsquigarrow P(X)]$
$\multimap S \rightsquigarrow every(person, P)$

person : $\forall X.(g_\sigma\ \text{VAR}) \rightsquigarrow X \multimap (g_\sigma\ \text{RESTR}) \rightsquigarrow person(X)$

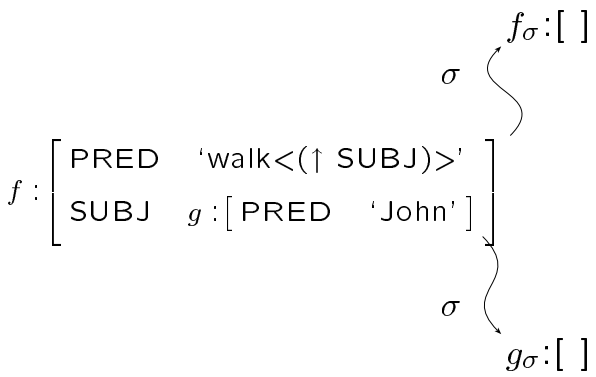
---

every person : $\forall P, S.[\forall X.g_\sigma \rightsquigarrow X \multimap S \rightsquigarrow P(X)] \multimap S \rightsquigarrow every(person, P)$

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."

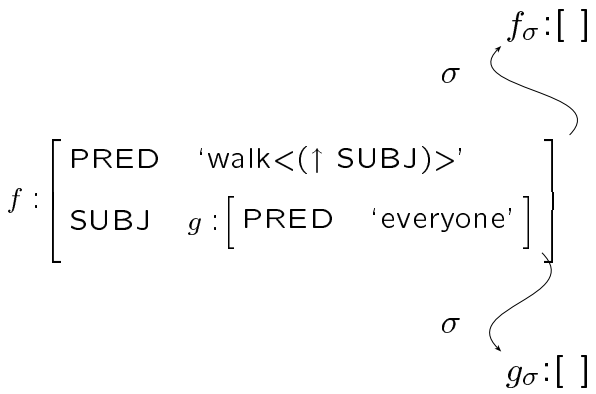


$g_\sigma \rightsquigarrow john$

$\forall X.(f\ \mathsf{SUBJ})_\sigma \rightsquigarrow X \multimap f_\sigma \rightsquigarrow walk(X)$

$f_\sigma \rightsquigarrow walk(john)$

Quantification: "Everyone walks."



everyone : $\forall P, S.[\forall X.g_\sigma \rightsquigarrow X \multimap S \rightsquigarrow P(X)] \multimap S \rightsquigarrow every(person, P)$

walks : $\forall X.(f\ \mathsf{SUBJ})_\sigma \rightsquigarrow X \multimap f_\sigma \rightsquigarrow walk(X)$

---

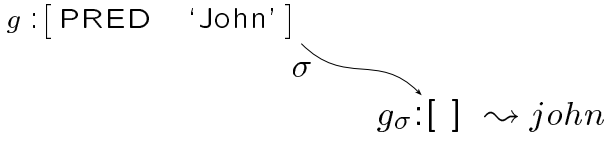
everyone walks : $f_\sigma \rightsquigarrow every(person, walk)$

An architecture for the syntax-semantics interface:
Assemble meanings with instructions in a logical language

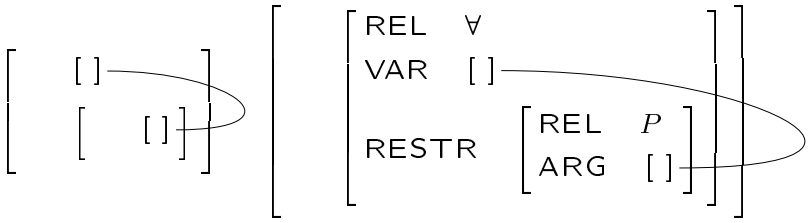
- Use "glue language", linear logic, to specify how to put meanings together

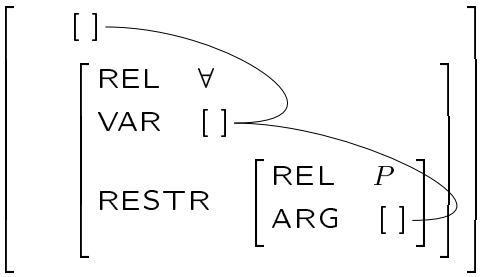
- Meaning language: your choice; we use higher-order intensional logic

"John"

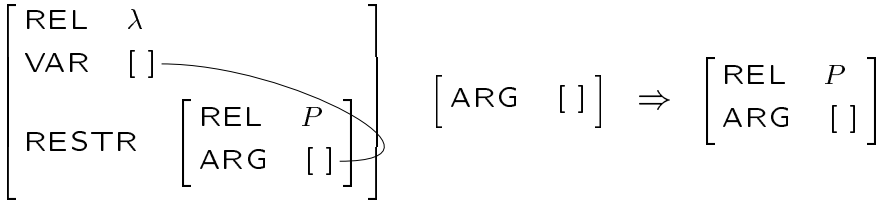


Problems with variable binding:





Problems with function application:



$$\lambda X.P(X) \qquad (Y) \qquad \Rightarrow P(Y)$$

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

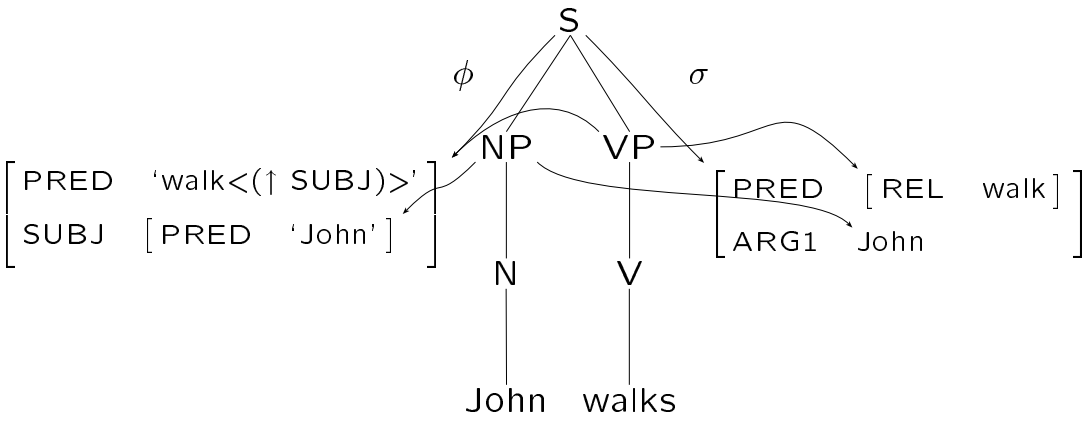
Commonalities:

- 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:

$$\left[\begin{array}{ll} \text{FSTRUCT} & \left[\begin{array}{ll} \text{PRED} & \text{`walk<(}\uparrow \text{ SUBJ)>'} \\ \text{SUBJ} & \left[\text{PRED} \quad \text{`John'}\right] \end{array}\right] \\ \text{SITSCHEMA} & \left[\begin{array}{ll} \text{REL} & walk \\ \text{ARG1} & \left[\text{IND} \quad john\right] \\ \text{LOC} & \left[\begin{array}{ll} \text{IND} & IND.1 \\ \text{COND} & \left[\begin{array}{ll} \text{REL} & \circ \\ \text{ARG.1} & [\,]_1 \\ \text{ARG.2} & l_d \end{array}\right] \end{array}\right] \end{array}\right] \end{array}\right]$$

Halvorsen (1983), Semantics for LFG:

PRED-ARG configuration

If f_k is an f-structure of the form $\begin{bmatrix} s_1 & v_1 \\ & \vdots \\ s_n & v_n \end{bmatrix}$ 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 jth argument position.

"John walks."

$$f_k = \begin{bmatrix} \text{PRED} & \text{'walk<(}\uparrow \text{ SUBJ)>'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'John'} \end{bmatrix} \end{bmatrix}$$

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

Formula of intensional logic: $walk^*(john)$

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?